



INTERNATIONAL CONFERENCE on Diet and Activity Methods

**Methodological Challenges
for Measuring the Achievements of International Policies**



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INDEX

<i>KEYNOTE SPEAKERS</i>	<i>p. 4</i>
<i>INVITED SPEAKERS / ORAL PRESENTATIONS</i>	<i>p. 6</i>
<i>POSTER PRESENTATIONS (001 - 416)</i>	<i>p. 77</i>



KEYNOTE SPEAKERS

MEASURING UPSTREAM: INDICATORS OF ACTION AND IMPACTS ON FOOD ENVIRONMENTS

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To date, most of the monitoring focus in relation to diet and physical activity has been ‘downstream’ on behaviours, anthropometry and disease outcomes. A similar concerted effort is needed more ‘upstream’ to monitor the food and physical activity environments and the actions on them taken by the major public and private sector actors. An International Network for Food and Obesity/NCD research, Monitoring and Advocacy for Action (INFORMAA) will be launched in late 2012 as part of public-interest civil society’s action to monitor and advocate for action to reduce obesity and non-communicable diseases (NCDs). It aims to create a set of standard indicators of government and food industry actions and their impacts on the food environment – food composition, marketing to children, labeling, price and policy implementation. Countries will collect the data and contribute it to a global database which will be managed through a network of universities with expertise in each of the areas. The communication and feedback of benchmarking data and good practice exemplars to public health advocates, politicians and the food industries aims to stimulate: advocacy and research efforts among civil society actors; policies and program funding by governments, and; changes in the production and promotion of foods and beverages by the food industries towards healthier products.

RESEARCH AND ACTION TO IMPROVE DIET

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Ideally research provides an understanding as to what causes nutrition related health problems. The evidence, synthesised in a systematic and appropriate way should inform decisions as to which actions are likely to be most effective in achieving improvements in diet. Broadly there is agreement as to what constitutes a healthy diet, but less agreement as to the best way to achieve this, particularly from the point of view of reducing global, national and local inequalities in nutrition related health. What may be seen to work in theory (efficacy studies) may not work in practice (effectiveness) because of the many constraining factors that influence uptake and compliance. It may also be that the models, and political ideology (values) for asking research questions are too narrow for usefully guiding actions or understanding the deeper underlying factors that constrain populations from implementing known efficacious actions. Actions that operate at the society or governmental level and that operate to prevent the development of health problems have the potential to reach and affect more people than individual level interventions applied to people once they already have developed symptoms.

When systematically reviewing the evidence the terms of reference of the review and the inclusion and exclusion criteria applied shape the conclusions that can be drawn from the review. If certain sorts of data are excluded, and this then excludes data from many countries, the generalizability of the findings of the review may be severely limited. This reductionist approach may lead to inappropriate generalisation from North American or European studies to populations in low and middle income countries where the determinants of risk may be quite different. On the other hand poor quality data are never useful for guiding actions, so what do governments do where there are no sound data to guide actions? Policy makers have to make decisions now with the information available; if no data equates to no decision, which equate to no change, is that really the best course of (in)action? We need to apply frameworks for action based on sound public health principles that support judgements which are more likely to lead to making things better than waiting ten years and doing nothing in the mean time.

Many academics do not like engaging in the messy world of applying their findings to solving problems. Vested interests are much less reticent to support policies that protect their interests, even though the evidence may be incomplete. If academics are to be useful to guide effective actions and support policy they must understand and engage in this messy world.

CHANGING PHYSICAL ACTIVITY POLICIES AND PRACTICE: MEASUREMENT THAT MAKES A DIFFERENCE

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At a recent high level meeting of the UN General Assembly on the Prevention and Control of Non-Communicable Disease, the global burden and threat of non-communicable diseases was acknowledged as a major challenge for the twenty-first century: NCDs have the potential to undermine global social and economic development and are a threat to the economies of many member states. An emergency whole-of-society response is required, with prevention front and centre of the solution. As physical activity (and behavioral nutrition) researchers we are ideally placed to help meet this global challenge. The question is: are we ready, and are we equipped to respond? There is no question that high quality measurement is essential to produce the high quality evidence required to change physical activity policies and practice. High quality evidence equips academics with the fuel to generate debate; provides policy-makers with the levers required to inform, and advocate for, policy reform; and offers practitioners insights to inform practice. Yet as we explore innovative measurement at this conference, another lens that might be applied to discussions and debate, is does what we measuring have the potential to make a difference? Measurement that makes a difference is policy-relevant and is disseminated beyond academic circles: It involves active partnerships between researchers, policy-makers and practitioners, the measurement of things that policy-makers and practitioners can act upon, and the active dissemination of findings well beyond academic conferences and journals. It also involves working with knowledge brokers: e.g., non-government agencies and advocates who have the ability to amplify researchers' findings well beyond what would be possible if researchers alone were responsible for disseminating findings. Drawing on Australian examples, the focus of this talk will be on providing suggestions that have the potential to take researchers beyond simply 'good measurement', to 'good measurement that makes a difference'.

MEASUREMENT ERROR IN NUTRITIONAL EPIDEMIOLOGY – IN MEMORY OF ARTHUR SCHATZKIN

Laurence S. Freedman

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Arthur Schatzkin (1948 - 2011) devoted a large part of his working life to the study of relationships between diet and disease. One major issue in his research with which he grappled was the problem of measurement error in self-reported dietary intakes. He employed a variety of approaches to try to overcome the effects of measurement error or to address head-on the sources of such errors. These approaches included the use of randomized comparisons (NCI Polyp Prevention Trial), very large cohorts with widely varying intakes (NCI-AARP Diet and Health Study), examining the magnitude and statistical nature of reporting error (Observing Protein and Energy Nutrition Study), and the promotion of new dietary questionnaires (the Automated Self-Administered 24-hour recalls and others). Throughout his working life he was a dynamic and positive force for questioning current practice and continually looked towards influencing future methodology and research.

This talk will focus on three later initiatives that Arthur started to improve the quality and strength of studies to detect diet-health outcome relationships, initiatives that we have continued to develop since his death: (i) developing guidelines for dealing with measurement error in nutritional cohort studies; (ii) combining results for several large validation studies that use recovery biomarkers; and (iii) combining different dietary intake instruments (different types of self-report, or self-reports and biomarkers).

BIOMARKERS AND BIOMONITORING -IN MEMORY OF SHEILA BINGHAM

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Biomarkers are an important component of the range of methods available for assessing nutrient intake and nutritional status in epidemiological studies and population monitoring. Biomarkers such as serum concentrations of nutrients provide a specific measure which has the advantage that, unlike assessment of intake by questionnaire, there is no error or bias due to limitations of recording or recall by the people being studied. However, biomarkers are affected by random measurement error and systematic errors in assay performance, as well as by confounding by other nutritional factors and by non-nutritional factors such as smoking. Biomarkers can also be affected by "reverse causality", in which the presence of disease causes changes in levels of the biomarker. The advantages and disadvantages of several nutritional biomarkers will be discussed, mainly using recent examples from the European Prospective Investigation into Cancer and Nutrition. Particular attention will be given to the need for standardization of quality control in assay laboratories, for more information on the long-term reliability of biomarkers, and for better understanding of reverse causality, all of which are essential for the correct interpretation of findings from nutritional studies.

INVITED SPEAKERS

ORAL PRESENTATIONS



A-1 ASSESSMENT OF FOOD ENVIRONMENTS

INFORMING FOOD ENVIRONMENT ACCESS POLICIES AND PRACTICE: THE NEXT GENERATION OF RESEARCH

Angela D. Liese

Improving spatial access to healthy food retailers has emerged as a novel public policy approach to curbing the obesity epidemic. Most policies have focused exclusively on improving spatial access to food retailers offering healthy food choices, such as supermarkets and large grocery stores. However, research in the social sciences suggests that multiple dimensions of access exist and influence food shopping and dietary behaviors. These access dimensions fall under the broad headings of economic access, service delivery, spatial, social, temporal, and personal dimensions. The objective of this presentation is to provide a brief overview of current research on the assessment of the food environment with respect to multiple extant dimensions of food access. In that process, gaps in the current research landscape, opportunities and challenges will be identified, with the goal of informing policy and practice related to changing the food retail environment and the behavior patterns of consumers.

Oral Presentations:

OC 01

ASSESSING THE CONSTRUCT VALIDITY OF FOOD ENVIRONMENT MEASURES: A MULTITRAIT MULTIMETHOD MATRIX APPROACH

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Background: Over 500 food environment (FE) assessment methods have been published to date. Objective methods can be categorized as checklists, shelf-space, and geographic access measures. Subjective measures include residents' perceptions of their FEs. In part because of the inconsistencies in assessment methods, the literature is unclear on how, where, and why FEs affect residents' diet-related health outcomes. The current study aimed to assess construct validity of different types of FE measures and to examine how geographic scale affects construct validity. Methods: FE data were collected from three cities in Ontario, Canada, using four assessment methods (the NEMS-S checklist, shelf-space measures, the Retail Food Environment Index, and residents' perceptions). FE variables were created for study households at 250m, 500m, 1000m and 1500m buffer zones to reflect the constructs of food availability, affordability, and quality as measured by each tool. A multitrait-multimethod (MTMM) matrix was constructed at each buffer zone size to assess construct validity. Two sets of MTMM matrices were constructed: one set included all data; one included only data where food outlets were found within buffer zones. Spearman correlations were computed since the metrics of the assessment methods differed. Results: For the first set of MTMM matrices, FE measures reliably predicted the presence or absence of food outlets, indicated by high convergent validity coefficients. For the second set, convergent validity coefficients were lower, indicating that in environments where food outlets exist, measures do not necessarily rank constructs in the same order. Each measure showed very good to excellent reliability and/or internal consistency for most constructs. Discriminant validity coefficients between food availability and food quality were higher than expected, for both objective and subjective measures. Objective measures showed no correlation with subjective measures. In general, for objective measures, increasing geographic scale resulted in lower construct validity. Interestingly, however, correlations between subjective and objective measures increased with geographic size, indicating that participants may accurately conceptualize geographic scale, if not objective characteristics. Conclusion: Low convergent validity among different measures of the same construct indicates that assessment methods purportedly measuring the same constructs may in fact be measuring different constructs. High discriminant validity coefficients between food availability and quality implies that these constructs may not actually be separate or distinct. Smaller geographic scales seem to be more reliable, perhaps because the data more closely approximate independent data. This study emphasizes the importance of selecting appropriate FE assessment methods and geographic scales for future research.

OC 02

ASSESSMENT OF DIETARY OUTCOMES IN FOOD ENVIRONMENT RESEARCH: A BARRIER TO INFORMING POLICY AND PROGRAMS TO SUPPORT HEALTHY EATING?

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Introduction: There is a growing body of literature focused on elucidating relationships between features of food environments and health behaviors or outcomes, most often diet and body weight. However, it is difficult to draw conclusions from this research due to methodologic differences among studies, including heterogeneity in measures. The purpose of this study is to examine measures used to characterize dietary intakes in food environment studies.

Methods: An initial review of studies published between January 2007 and May 2011 was conducted through examination of literature compiled on the U.S. National Cancer Institute's Measures of the Food Environment website. The compilation is updated continually via PubMed searches using 'food environment' and 'food access' as search terms. From among the articles identified, those that include examination of relationships between food environments and diet were selected. To ensure comprehensive coverage, a systematic review using the search engines PubMed, Scopus, Web of Knowledge, and PsycINFO and a broader array of search terms is underway.

Results: From the initial review, 187 studies that assessed relationships between food environment features and a health behavior or outcome were identified, 71 of which included a measure of dietary intake. Researchers often focused on indicator foods, such as fruits and vegetables and salty or sugary snacks, as a marker of healthfulness of the diet. 24-hour recalls, which are thought to provide the most accurate intake data, were used in about one in ten studies and about a quarter of studies made use of a food frequency questionnaire. Almost one in three studies made use of a brief instrument such as a screener and 15% used only 1 or 2 questions to assess dietary intakes. The existence of extensive measurement error in self-reported intake data was rarely discussed.

Conclusions: There is a tendency toward dietary assessment instruments with low cost and respondent burden at the expense of precision. Measurement error in intake data may be substantial, particularly if estimates are based on brief instruments or only one or two questions, and may lead to spurious findings and reduced statistical power to detect relationships. The application of automated and mobile assessment tools that can be implemented at low cost has the potential to contribute to food environment research by making it feasible to collect higher-quality dietary data. Food environment research may also benefit by borrowing strategies for reducing and dealing with measurement error from the fields of nutrition surveillance and epidemiology.

OC 03

APPLYING A DIET QUALITY INDEX TO ASSESS THE HEALTHFULNESS OF FOOD BALANCE SHEETS

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The United States Department of Agriculture has maintained data on the aggregate food supply in the US for over a hundred years. For much of that time, the Food and Agriculture Organization of the United Nations has compiled food balance sheets reflecting the supplies of food in dozens of countries around the world. Such data are typically used to monitor the potential of a country's food supply to meet the nutritional needs of its people, to examine trends in supplies, and to guide food policy. They can also be used to assess the healthfulness of the overall food supply using a diet quality index. The Healthy Eating Index-2010 (HEI-2010) is a measure of diet quality that can be used for this purpose. It is a multi-dimensional index designed to assess conformance with US federal dietary guidance, reflecting 12 separate components of diet quality (Total Vegetables, Greens and Beans, Total Fruit, Whole Fruit, Whole Grains, Dairy, Total Protein Foods, Seafood and Plant Proteins, Fatty Acids Ratio, Sodium, Refined Grains, and Empty Calories). It is density based, meaning that scores are assigned in relation to food and nutrient amounts per energy or per some other nutrient. The advantage of the density approach is that the HEI-2010 can be used to assess the quality of any mix of foods, including individual-level diets, the offerings of food stores or restaurants, or a country's aggregate food supply for a year. To illustrate its usefulness for the latter purpose, the HEI-2010 will be applied to nearly 40 years of US food supply data to examine trends in overall diet quality as well as quality that is specific to each individual component. Researchers in other countries may be interested in examining the diet quality of their country's food supply with the HEI-2010 or a similar measure. The HEI-2010 captures conformance with the Dietary Guidelines for Americans, 2010; nonetheless, many countries have similar dietary recommendations, and applying a single metric to data from a range of countries would facilitate comparisons. Such cross-country studies could compare and contrast overall diet quality, as well as the quality reflected in each of the HEI-2010 components.

OC 04

ASSESSING THE FOOD POLICY ENVIRONMENT – PARTICIPATORY APPROACHES

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The food environment has a significant impact on diets, and can limit the effectiveness of health promotion interventions. Efforts to create health-promoting environments are urgently needed, however understanding of the factors contributing to the food environment is limited, and in turn targeting interventions is hampered. In particular, policies are key drivers of the food environment, and therefore mapping policies is an important aspect of increasing understanding.

Two multi-sectoral approaches which have been used in the Pacific Islands to map policies impacting on food supply are considered. The first used a problem and solution tree-based approach to map policies impacting on supply of problem foods. The second utilised a sector by sector approach, combined with food supply chain process to identify where and how policies might have an impact. There are advantages of both methods, in particular the sectoral approach provides a format which can be useful in monitoring changes over time, whereas the trees provide a detailed item-specific map. Both are also valuable in highlighting to different sectors how they have an impact on the food environment, and can be an important advocacy tool for multi-sectoral action.

There are difficulties attached to the processes. Both methods are reliant on a participatory approach involving multiple sectors, and this can be difficult to achieve. Without full representation, the maps produced are likely to be incomplete and this was experienced for particular sectors, during the use of the above methods.

Food environments are constantly changing, as policies and governments change, and it is therefore important to have low-cost and practical tools to be able to map the policy changes. These two methods offer the potential to map environments and also gain stakeholder commitment to contributing to a healthier food environment. They are a relatively low cost approach to understanding food environments, and can therefore be useful in resource-poor settings.

OC 05

FOOD PURCHASING: HOW IMPORTANT IS THE LOCAL NEIGHBOURHOOD?

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Food environments create opportunities to purchase both healthy and unhealthy food items. In recent years there has been a growing emphasis on neighbourhood food environments and their independent influence on food purchasing behaviours however findings remain inconsistent. Measures of food access vary greatly between studies and may not accurately reflect a person's true contextual exposure to the full range of food vendors throughout the course of the day. To better understand environmental determinants, the next phase of research needs to move beyond place-based measures towards people-based measures. In this instance, an individual's exposure to food stores will not only consider food stores nearby to where they live, but also nearby to where they work or socialise as well as factors related to their mobility (e.g. vehicle ownership, age). Such data will help to better determine the relative importance of the neighbourhood food environment on purchasing behaviours. We are currently pilot testing the use of a food purchasing diary in two contrasting neighbourhoods (one with few food stores and one with many food stores) to determine the location of all food purchases made over a two-week period. These diaries include data on a number of factors including the type of food stores visited, food items purchased, mode of travel, and whether the purchaser was alone or with others. The diary allows us to map food purchases relative to home locations however a sub-sample are also wearing a GPS unit which allows us to examine food purchases relative to all daily travels. Demographic and socioeconomic data on the individuals are also reported. Combined, these data allow us to better determine the contribution of the local neighbourhood environment to food purchasing decisions as well as assess other influences on where people are buying food. This data can be used to inform planning decisions and is particularly important for populations that more heavily rely on their local neighbourhood for their food purchases (e.g. the elderly or those without access to a motor vehicle). Preliminary results have demonstrated the ability of the approach to detect noticeable differences across individuals and their interactions with the food environment (median distance from household's to stores where food was purchased ranged from 0.2km – 7.8km). Further analysis will be undertaken to explore patterns between an individual's interactions with the food environment and how this impacts on the healthiness of food purchasing patterns.

B-1 NUTRITION AND FOOD SECURITY ANALYSES USING HOUSEHOLD SURVEYS

USING HOUSEHOLD CONSUMPTION AND EXPENDITURES SURVEYS TO ESTIMATE THE COVERAGE AND IMPACT OF INTRODUCING FORTIFIED WHEAT FLOUR INTO SOCIAL SAFETY NET PROGRAMS: A CASE STUDY OF GUJARAT, INDIA

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Micronutrient deficiencies exact an enormous health burden on India. According to the 2005/06 National Family Health Survey, the state of Gujarat—with one of India's best performing state economies—has deficiency levels that exceed the national averages. The release of the NFHS data spurred Gujarat government officials to action: starting in 2008, Gujarat began phasing in the substitution of fortified wheat flour for wheat grain in the state's three Social Safety Net Programs (SSNPs): the Public Distribution System (PDS), the Integrated Child Development Scheme (ICDS) and the Mid-Day Meal (MDM) Program. The objective of this presentation is to present an HCES-based assessment of the coverage and impact of Gujarat's introduction of fortified wheat flour into its SSNPs.

India's HCES, the 2004-05 National Sample Survey (NSS), was designed to provide statistically representative samples for each of India's 35 states and union territories. The Gujarat sample included 4,275 households comprised of 20,677 individuals. We used the NSS data in two ways. First, we used its food acquisition and consumption data (in combination with India's Food Composition Tables) to estimate average daily caloric consumption and usual intake levels of vitamin A, iron and zinc. Second, we used responses to questions about whether or not the household was a PDS ration cardholder and whether or not anyone in the household had participated in the ICDS or the MDM Programs in the previous 365 days to identify the beneficiaries of each of these programs. No information was available in the NSS on whether or not the beneficiaries actually participated in the programs. We adopted what is referred to in program evaluation literature as the "intention to treat" approach, and assumed that households and persons who were eligible to participate in each of the programs did so. 27% of the Gujarat population participated in one or more of the programs. We analyzed the HCES to identify which individuals and households were not beneficiaries of any of the programs and among those who were, we identified the number and patterns of multiple program participation, and its fortification level implications.

Comparing age- and gender-specific usual intakes to Estimated Average Requirements (EARs), we estimated the proportion of the population with inadequate intakes. Using NSS data together with the Social Safety Net Programs' (SSNP) fortification parameters, we modeled the post-fortification intake of these micronutrients and calculated reductions in inadequate intake. Inadequate vitamin A intakes were reduced by 35% and 76% among MDM and ICDS beneficiaries, respectively. Both programs effectively eliminated inadequate intakes of both iron and zinc. Among PDS beneficiaries, inadequate iron intakes were reduced by 94% among beneficiaries. Gujarat's substitution of fortified wheat flour for wheat grain is dramatically increasing the intake of micronutrients among the beneficiaries of its SSNPs. The introduction of similar reforms throughout India would largely eliminate the prevalence of inadequate iron intake among persons reached by any of the three SSNPs, and would have a significant impact on the global prevalence rate as well.

USING HCES TO INFORM NUTRITION POLICY: THE ZAMBIA MICRONUTRIENT PORTFOLIO STUDY

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Designing successful national nutrition programs requires valid and accurate national-level information on food consumption and dietary intake. Weighed food records or 24-recall surveys are considered the methods of choice, yet they are too costly to routinely implement on a large scale. There is growing evidence, however, that nationally representative Household Consumption and Expenditure Surveys (HCES) can offer useful information for informing nutrition-related policy. In this study, the Zambia Living Conditions Monitoring Survey V 2006 (LCMS V 2006) was used to simulate the impact of fortification, biofortification and supplementation programs under various scenarios. Data from three key modules were used: 1) Agricultural Production; 2) Household Expenditure; and 3) Child Health and Nutrition. Here, the methodological approaches to processing and using these data will be discussed. Focus will be placed on: data cleaning; dealing with

outliers; combining data with a food composition table (FCT); creating variables for nutrition-related analyses and fortification simulations; and using agricultural information to estimate the impact of a biofortification program. Challenges and decision points will be highlighted and select results will be demonstrated. Critical policy-related information was generated with this analysis, including the suitability of particular food fortification vehicles, appropriate levels of fortificants required, conditions required to achieve impact from biofortification, geographic and demographic variability in outcomes, and the degree to which multiple interventions are needed and the degree of overlap. This study demonstrates the strength and flexibility of HCES data for the purpose of informing national-level nutrition programming. HCES provide a means to identify and rank potential fortification vehicles, to estimate the impact and cost-effectiveness of fortifying one or a combination of candidates, to link agricultural production to nutrition-related impacts of biofortification, to identify gaps and areas of overlap in coverage, and to identify the optimal implementation of these large-scale micronutrient interventions.

ESTIMATING INDIVIDUAL CONSUMPTION FROM NATIONAL HOUSEHOLD CONSUMPTION AND EXPENDITURE SURVEY DATA FOR NUTRITION PROGRAMMING DECISIONS

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Nationally representative, secondary household consumption and expenditure data are useful for many types of nutrition programming decisions, but must often rest on assumptions about intra-household allocation of foods and nutrients to individuals in target subgroups. This study assessed the relative validity of two approaches to estimating individual consumption. We compared assumed/predicted individual consumption to directly measured values using household-level consumption and expenditure data, household-level 24-hour recall data, and data on the food preparer's report of the distribution of food to individual household members collected from 600 households in rural Bangladesh. The first approach generated individual consumption estimates from household level data based on the assumption that food and nutrients are distributed equitably with respect to adult male equivalent (AME) caloric and micronutrient needs. The second approach employed econometric modeling using household demographic composition to predict which specific foods, considered potential vehicles for fortification programs, are disproportionately consumed by particular age/sex categories of members. Finally, the AME and modeling results generated from the household data were compared to directly measured values derived from the food preparer's report. Household and individual-level factors associated with deviation from the equitability hypothesis were explored. The results of these analyses can be used to improve the accuracy of estimates of individual consumption of fortified or potentially fortifiable foods, or of foods rich in a particular micronutrient, that may be consumed differentially by children, women, or other groups, when only household level data are available.

EVOLUTION OF BRAZILIAN DIETARY PATTERNS BASED ON HOUSEHOLD BUDGET SURVEY: SIMILARITIES AND DIFFERENCES BETWEEN 2002/2003 AND 2008/2009

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Understanding the main population dietary patterns can be useful to cope with increasing rates in obesity, cardiovascular disease, diabetes mellitus and cancer, which are diseases related to food intake. Using data from a national population-based Household Budget Survey (HBS) conducted in 2002/2003 and 2008/2009, we identified food acquisition patterns in Brazil. In 2002/3, the sample comprised 48,470 households, allocated in 443 sample strata and, in 2008/9, 55,970 households and 550 strata. The analysis comprised the households in each of these strata, as study units.

Factor analysis (principal component) was used to derive food patterns based on food groups. In 2002/3, two patterns of food acquisitions were identified: the first, "dual", was characterized by dairy, fruits, fruit juice, and vegetables but also by processed meat, soda, sweets, bread and butter, and by inverse correlations with Brazilian staple foods. In contrast, the second pattern, "traditional", was characterized by rice, beans, manioc, flour, milk and sugar. Four factors were extracted in 2008/9. The first factor was similar to the first retained in 2002/3, with high loadings in the same food groups, meaning that this duality persisted across these six years of time interval. The traditional, with Brazilian staple foods (rice and beans), turned to third position. The 2nd was formed by food

groups that usually are employed as culinary ingredients. In the 4th, emerged food groups that weren't represented in 2002/3.

In 2002/3, the "dual" pattern was associated with higher household educational level, income and adult's average age, while the "traditional" presented higher loadings in less educated households and in the rural setting. For 2008/9, these associations are still being analyzed. As HBS is being conducted periodically in the country, this data can be used to monitor and support food and nutrition policies aiming to alleviate the burden of disease related with inadequate food intake.

Oral Presentations:

OC 06

THE CHALLENGING INCLUSION OF THE FIRST BRAZILIAN INDIVIDUAL DIETARY SURVEY IN THE 2008-2009 HOUSEHOLD CONSUMER EXPENDITURES SURVEY

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Since the decade of 1970, the Brazilian Institute for Geography and Statistics (IBGE) has regularly developed Household Consumer Expenditures Surveys (HCES), which provide strategic data to economic planning and have been widely used in food consumption monitoring. However, in Brazil, the growing of out-of-home eating might affect the estimations of dietary intake based on household food availability. In this country, the increasing prevalence of nutritional disorders, especially obesity, prompted for the realization of a nationwide dietary survey in order to more accurately picture the variation in food intake at the individual level. To reduce costs the Brazilian Individual Dietary Survey (IDS) was attached to the 2008-2009 HCES. The Brazilian IDS was conceived with the participation of experts from all the Brazilian regions. The planning and preparations for the survey lasted four years. The instruments were pre-tested, a pilot study was developed, and an analysis plan incorporating the newest proposals for estimating usual intake was prepared. Data on food intake were obtained by means of two non-consecutive food diaries completed by 34,003 10 years old and over subjects residing in 13,569 households selected for the study, corresponding to approximately ¼ of the households (n=55,970) sampled for the HCES by a two-stage cluster sampling design. It was assured that all census tracts selected for main sample were represented in the IDS sample; therefore, urban and rural areas from all 26 states and the Federal District were included. The subjects reported all foods and drinks consumed during the two pre-determined days, specifying the time, place (at or out-of-home) and amount of intake, and the foods' preparation mode. Information on water drinking and use of nutritional supplements was not collected. Subjects were probed on usually forgotten foods and on periods longer than three hours without any reported food intake. This method was validated against doubly labeled water estimation of energy expenditure and the results indicated that mean energy underreport was 17%. A variety of procedures were applied to check the data quality during the field work. This experience actually taught us various lessons and the remedies for the minor flaws we have detected in the survey methods can be implemented in the next IDS. The successful planning, coordination, development, and analysis of the first Brazilian IDS were only possible due the politically and technically committed dynamic environment brought up by the partnership between the research team, the IBGE, and the Ministry of Health.

OC 07

HOW DO HOUSEHOLD CONSUMPTION AND EXPENDITURE SURVEYS COMPARE TO 24-HOUR RECALLS IN TERMS OF NUTRIENT INTAKES? EVIDENCE FROM UGANDA AND MOZAMBIQUE

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In developing countries, nationally representative high quality dietary surveys remain rare despite efforts to promote them. Household Consumption and Expenditure Surveys (HCES) are increasingly used to fill in the gap. These surveys are generally readily available and already paid for by other agencies. However, they present several shortcomings that can limit their usefulness to inform food policy. In this study, we compare dietary intake results in women from 24-hour recall surveys (24-HR) and HCES data collected from the same households in Uganda and Mozambique. We also attempt to identify factors that explain differences between methods. HCES and 24-HR data was collected as part of Reaching End Users (REU) project. We used the baseline data. Per capita intake of energy, vitamin A, iron, and zinc was computed from HCES data using the same food composition data as 24-HR and using adult equivalency. Women dietary intake was collected using an interactive multiple pass 24-hour recall. Food portions were estimated using standardized measures, food models and photos. Differences in distribution of macro and micronutrient intakes were assessed using t-test and

Kolmogorov-Smirnov test of distributional shape equality. In Uganda, the shape of energy intake distribution differed significantly between HCES and 24-HR data ($p < 0.001$). Mean energy intake using HCES was underestimated compared to 24-HR (-781 kcal; $p < 0.001$). Similar patterns were observed for vitamin A (-193 μg RAE; $p < 0.001$), iron (-0.84 mg; $p < 0.001$), and zinc (-2.21 mg; $p < 0.001$). In Mozambique, results were more contrasted. Energy ($p = 0.02$) and vitamin A ($p < 0.001$) intake distribution differed between HCES and 24-HR data but the statistical evidence for differences was weak for iron ($p = 0.04$) and non-existent for zinc ($p = 0.18$). Generally, HCES data overestimated energy intake from staple foods and underestimated energy intake from (i) nuts and legumes, (ii) fruits and vegetables, and (iii) animal source foods. Among the household socio-demographic and economic characteristics examined, only household size was correlated with differences between HCES and 24-HR. In Mozambique for instance, an additional household member meant that energy intake measured from HCES will be 220 kcal/day higher than measured intake from 24-HR. This finding can be explained by economies of scale. In these particular countries and surveys, HCES produce different results from 24-hour recall surveys. In order for them to be useful, we need to address their tendency to underestimate intake of certain food groups and to better establish consumption especially among larger households.

OC 08

ASSESSING CHANGE IN HOUSEHOLD FOOD INSECURITY

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The Household Food Security Survey Module (HFSSM) is an 18-item severity scale widely used in research and population monitoring. Households are classified as food secure or food insecure based on their number of affirmative responses relative to a threshold. Food insecure households are further dichotomized based on a threshold of severity. These thresholds are relatively arbitrary and their impact on the characterization of changes in household food security status has been the subject of little study. This study sought to explore how choice of threshold for classification of food insecurity affects the assessment of change and to evaluate the potential significance of changes in number of affirmative responses within food security categories.

We used data from a study of 361 low income, predominantly food insecure families recruited by door-to-door sampling in high poverty neighbourhoods in Toronto. A structured interview, which included the HFSSM, was conducted with the household member in charge of food expenditure, and was repeated one year later. The significance of changes in scale score was evaluated by examining use of resource augmentation strategies (e.g. delayed payment of bills or rent, selling personal possessions, using charitable food assistance, sending children to a friend's home for a meal), and inability to purchase milk, vegetables or fruit, in relation to increasing number of affirmatives within food security categories by logistic regression.

The prevalence of transient and persistent food insecurity was found to be highly sensitive to the threshold used to designate households as food insecure: 49% of households were classified as persistently food insecure when a threshold of 3 or more affirmatives was used, while 69% were classified as persistently food insecure when a threshold of 1 or more affirmatives was used, and fewer households were classified as experiencing transient food insecurity.

The use of conventional food security classifications to describe change masked important differences in the severity of households' food insecurity. Although the food security status of most households did not change between baseline and follow-up, most had experienced a change in severity indicated by a change in number of affirmative responses. Households with a greater number of affirmatives within categorical classifications of food insecurity were more likely to have used resource augmentation strategies and have been unable to purchase milk, vegetables, and fruit.

These findings raise questions about what constitutes meaningful change in household food insecurity and how it should be classified.

C-1 EVALUATING PHYSICAL ACTIVITY ENVIRONMENTS

CREATING INTERNATIONALLY-COMPARABLE BUILT ENVIRONMENT VARIABLES IN GIS FOR THE IPEN STUDY.

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The World Health Organization and the United Nations now recommend strategies for preventing non-communicable diseases including policies to improve urban design, public transportation, and recreation facilities that can encourage large portions of the world population to be physically active. Yet, most supporting evidence for environment and policy change comes from regions within single countries, particularly the U.S., Australia, and a few European nations. Each country represents a limited range of features and variability. The

ongoing International Physical Activity and Environment Network (IPEN) study aims to examine the full range of variation in the built environment (BE) across 12 countries and relate those features to physical activity and other outcomes. This presentation will describe the methods employed and tools developed to create comparable GIS-(geographic information system)derived BE features across countries. IPEN is an epidemiologic cross-sectional study among adults using a coordinated study approach to manage investigative teams in Australia, Belgium, Brazil, Colombia, the Czech Republic, Denmark, Hong Kong, Mexico, New Zealand, Spain, the United Kingdom, and the United States of America. BE features and physical activity will be assessed by both self-report and objective measures. Countries differed on their access to specific spatial datasets, the availability of details (i.e., attributes) within datasets, definitions for operationalizing features, and to a lesser extent countries differed on technical procedures for creating variables. The need for a comprehensive GIS protocol was identified and a 100 page document completed to guide investigators on using similar definitions and procedures. Objective measures of walkability (i.e. residential density, street connectivity, mix of land uses, enumeration of retail destinations), access to public transit, parks, trails, and private recreational facilities around each participant's residential address using 1000m and 500m street network buffers were prioritized. Eleven of 12 countries will have objective data on environment features. For some features, spatial datasets were lacking details to produce variables representing the "state-of-the-science". A conceptual hierarchy was therefore envisioned with two categories of variables. Required variables were defined as those variables that could be completed by almost all countries with access to data for a specific feature (i.e. "least common denominator"). Desired variables could be created only by those countries with exceptional GIS datasets. Preliminary data will be presented to show the range of variation in built environment features across a subset of countries. This outcome represents a first attempt to design a process and find solutions to these challenges to creating internationally-comparable GIS variables. Future built environment research can benefit from our process and recommendations for standardizing objective built environment measures.

Oral Presentations:

OC 09

ASSESSMENT OF NEIGHBOURHOOD PARK CHARACTERISTICS FOR PHYSICAL ACTIVITY AMONG YOUTH

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Objectives: Urban parks are an important aspect of the built environment for physical activity (PA) among youth. Yet there are currently no measures that specifically assess park characteristics that may be attractive for youth. Our aims were to: 1) describe the development and estimate the reliability of an observation tool designed to assess the presence and condition of park characteristics hypothesized to be attractive for youth PA, and; 2) generate meaningful park-related factors based on the Bedimo-Rung conceptual model (2005). Data were gathered in the neighbourhoods of the QUALITY Cohort families, an ongoing study on the natural history of obesity among youth considered at high risk due to parental obesity.

Methods: The three closest parks (n=584) within a 1000 m buffer zone of study participants' residence in the greater Montreal area were independently audited by one of five observer pairs using a 90-item park observation tool adapted from the Public Open Space Tool (POST) and the Bedimo-Rung Assessment Tool – Direct Observation, and extensively pre-tested. Data were gathered between April and December, 2008-2010. Inter-rater and intra-rater reliability was estimated using % agreement and Cohen's kappa, and test-retest, respectively. Exploratory principal component analysis (PCA) was used to investigate the correlations between variables using an orthogonal rotation to maximize variance (varimax).

Results: 85.5% of items had $\geq 75\%$ agreement between the two observers. Kappa coefficients indicated that 82.5% of items were between moderate to almost perfect agreement (0.41 – 1). Subjective items (e.g. Safety) had the lowest inter-rater reliability. Correlations and kappa statistics were generally high for 41 test-retest occurrences, in which the same observer audited a given park twice. Inter-rater kappa results for items shared with the POST were compared and found to be in the same direction and magnitude, strongly supporting reliability results. PCA yielded 10 factors (Team Sport Features, Safety, Pool Features, Play Area, Cycle Features, School Yard Features, Aesthetically Pleasing, Incivilities, Skate Park, and Walking Features) with

eigenvalues above 0.99, explaining almost 60% of the variation in the data. Some factors can be explained using the conceptual model domains (Condition/Incivilities, Safety and Aesthetically Pleasing).

Conclusions: The park observation tool demonstrated high overall reliability and can be used to measure park features that may be found to be targets for PA among youth. Park features such as Incivilities, Safety and Aesthetically Pleasing may be conceptualized as independent entities. Future research should test the influence of park characteristics on youth PA outcomes.

OC 010

OBJECTIVE ASSESSMENT OF OBESOGENIC ENVIRONMENTS IN YOUTH: GIS METHODS TO EVALUATE PHYSICAL ACTIVITY AND FOOD ENVIRONMENTS FOR THE NEIGHBORHOOD IMPACT ON KIDS (NIK) STUDY

Lawrence D. Frank, University of British Columbia (corresponding / presenting author); Brian E. Saelens, University of Washington; James Chapman, Urban Design 4 health, Inc; James F. Sallis, University of California at San Diego; Jacqueline Kerr, University of California at San Diego; Karen Glanz, University of Pennsylvania; Sarah C. Couch, University of Cincinnati; Vincent Learnihan, Urban Design 4 Health, Inc; Chuan Zhou, University of Washington; Trina Colburn, University of Washington; Kelli Cain, University of California at San Diego

Background: GIS-based walkability measures designed to explain active travel fail to capture “playability” and proximity to healthy food. These constructs should be considered when measuring potential child obesogenic environments. Sampling participants from combinations of high and low levels of support for active living and healthy eating will help to understand each aspects unique impact on obesity.

Purpose: To describe the systematic development of GIS-based multi-component physical activity and nutrition environment indicators of child obesogenic environments in the San Diego and Seattle regions.

Methods: Census block group level walkability using parcel land use data (street connectivity, residential density, land use mix, and retail floor area ratio) measures were constructed for each region. Multiple data sources were used to enumerate parks (~1,000 per region) and food establishments (~10,000 per region). Physical activity environments (PAE) were evaluated based on walkability and presence and quality of parks. Nutrition environments (NE) were evaluated based on presence and density of fast food restaurants (FFR) and distance to supermarkets for each block group. Four neighborhood types were defined using region-specific high/low cut points for PAE and NE through an iterative process which considered variable distributions and a sufficient pool of potential youth and parent participants and applied to the recruitment of youth.

Results: To have sufficient ability to recruit 6-11 year old children, high PAE block groups had at least one high-quality park within a quarter mile and were above median walkability, whereas low PAE had no parks and were below median walkability. High NE block groups had a supermarket within .5 miles, and fewer than 16 (Seattle) and 31 (San Diego) FFR within .5 miles. Low NE had either no supermarket, or a supermarket and more than 16 (Seattle) and 31 (San Diego) FFR within .5 miles. Income and educational attainment varied considerably across PAE / NE environments while less variation was observed across ethnicity. Spatial distribution of the resulting block groups for three of the four neighborhood types is systematic. Low PAE/NE block groups are the newest whereas high PAE/NE block groups the oldest.

Conclusions: These definitions of neighborhood environments can be used to study physical activity, nutrition, and obesity outcomes. A substantial proportion of neighborhoods in large metropolitan areas can be classified using these methods. Strong policies are required to reverse the observed trend in both regions showing that newer communities are more obesogenic from both a physical activity and food environment perspective.

OC 011

NATURAL EXPERIMENTS – AN EFFECTIVE METHOD FOR ASSESSING BUILT ENVIRONMENT POLICY IMPACT

Dr R Quigg, Dr AI Reeder, A Gray

Natural experiments have been promoted as an effective tool in public health research¹⁻⁴, but little has been written about how to ensure the best chance of implementing a successful project. Petticrew et al.⁵ suggested benefits and drawbacks, but no direct advice about how to proceed. Other researchers, such as Sallis et al.,^{1,3,4,6} have indicated that more natural experiments need to be undertaken, but little attention appears to have been paid to consideration of which are the key features of a natural experiment and the best way to proceed.

A natural experiment was used in a New Zealand study that assessed the impact of the implementation of a segment of the Dunedin City Council (DCC) Play Policy. The planned and funded up-grade of playgrounds at public parks in a spatially-defined community provided the opportunity to undertake ‘before and after’ physical activity assessments. The Location of Children's Activity in Their Environment (LOCATE) study results have

been reported separately⁷; this presentation identifies the successful features of the natural experiment study design.

Both Cockx and Brasseur⁸ and Layte⁹ indicate that natural experiments provide an opportunity to take advantage of an event or naturally occurring incident. The LOCATE study took advantage of the programmed up-grade of playgrounds associated with the implementation of council policy. The intervention was carefully chosen by the research team to have a high likelihood of implementation, since it was programmed and funded by local government. Furthermore, baseline measurements of physical activity fitted into the implementation timeframe, and the community-by-community approach of the policy enabled a spatially-defined control community to be selected. Another key feature of the successful LOCATE study was its use of global positioning system (GPS) units and accelerometers to objectively measure both activity intensity and its location. These measures were replicated at the one-year follow-up.

A number of drawbacks of natural experiments have been proposed⁵, but the LOCATE study aimed to mitigate these by using a meticulous process to select a control community and scrupulous recruitment which achieved very good response rates for the completion and return of the parental questionnaire. The results from the LOCATE study suggest that the use of a natural experiment study design was a risk well worth taking in order to be able to better understand the effects of implementing policy. For the DCC, the next policy review may be more focused on physical activity outcomes, alongside outcomes associated with play generally.

A-2 DIETARY SURVEYS AND INDICATORS FOR FORMULATING POLICIES

DIETARY SURVEYS AND INDICATORS FOR INFORMING POLICY

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Indicators, or proxy measures, with agreed cut offs, are used to identify populations most at risk, to monitor trends and to evaluate the impact of interventions. To be fit for purpose the indicators must be: valid, routinely or periodically collected or available, capable of providing comparable data across different collection centres, sensitive to change, collected at the required level of the population to identify and assess risk in sub-groups, affordable and practical.

In low and middle income countries (LMICs) with over and undernutrition now co-existing, and with the continued presence of specific micronutrient deficiencies, the requirements for dietary indicators to inform policy provide a considerable challenge to governments. Indicators are required to assess the various aspects of food security, as well as indicators of fat, salt and sugar intakes linked to chronic disease risk. Recent surveys of available information on diet in LMICs suggest that few currently collect sufficient or appropriate, or timely information for monitoring risk for chronic diseases. Food security related data are most often provided from routinely collected data such as Food Balance Sheets, or income and expenditure data. Many countries have household level data collected as part of Demographic Health Surveys, but these are not collected on a regular basis, are nationally but not locally representative, and are very often not well integrated into the local countries health information system so do not provide helpful information to inform policy. There has been less agreement and consistency in the indicators used for monitoring diet (in terms of fat, salt, and sugar) for risk of chronic diseases, as outlined for example in the global strategy for diet, physical activity and health and highlighted in the UNGA declaration on the prevention and control of NCDs. There are few indicators of the basic and underlying determinants of poor diet in LMICs, and this lack of information may lead to policies and actions that are not directed at the most critical constraints to reducing risk and improving health.

Oral Presentations:

OC 012

DIETARY PATTERNS ASSOCIATED WITH DEMOGRAPHIC AND SOCIOECONOMIC GROUPS IN THE REGARDS STUDY

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Introduction: Examining diet as a whole with dietary patterns may be more informative than single food or nutrient exposures when studying associations of diet and disease. The REasons for Geographic And Racial Differences in Stroke (REGARDS) study provides an opportunity to empirically derive dietary patterns in a geographically and racially diverse cohort. **Methods:** The REGARDS study is a cohort of 30,239 Blacks and Whites age 45 and older, half of whom reside in the Southeastern United States (known as the “stroke belt”), and

half from the remaining 48 contiguous states. The present analysis included 21,636 participants who completed the Block98 food frequency questionnaire. Principal Component Analysis (PCA) with varimax rotation was used on a split sample to determine dietary patterns based on 56 food groups. Differences in factor score means were evaluated after adjustment for age, gender, race, region, education, and income in analysis of covariance (ANCOVA) models with and without interactions. **Results:** Five dietary patterns emerged: the “traditional” pattern was characterized by mixed dishes; the “plant-based” pattern by fruits and vegetables; the “sweets” pattern by sweet snacks and desserts; the “Western” pattern by fried food, organ meat, and sweetened beverages; and the “alcohol” pattern by beer, wine, liquor, and salads. Associations across age were strongest for the traditional diet pattern with each ten-year increment of age corresponding to a lower pattern score (mean factor score decreased by 0.24 [95% CI:0.22-0.25]). This reduction over time was somewhat accelerated in Whites, males, and those with a college education. Gender, racial, regional, and education differences were most pronounced in the Western pattern with men having a higher score than women (difference of 0.47 [0.45-0.49]), Blacks having a higher score than Whites (difference of 0.82 [0.79-0.85]), the Southeastern US “stroke buckle” having the highest score (difference with areas outside the stroke belt=0.28 [0.25-0.31]), and those with less than a high school education having the highest score (difference with college graduates=0.45 [0.40-0.49]). Strong interactions were evident between education and race (sweets pattern, $p<0.0001$), and education and age (alcohol pattern, $p=0.003$). Lower income individuals (<\$20k annually) had a lower score from the alcohol pattern (difference with \$75k+ earners=0.44 [0.39-0.49]). **Discussion:** Clear and meaningful dietary patterns were associated with age, gender, race, region, education, and income in this large cohort of Black and White Americans. Understanding variability in dietary intake and interactions with demographic factors can provide insight into the relationship between diet and chronic disease.

OC 013

DEVELOPMENT OF UK EATING CHOICES INDEX

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Background: The use of diet quality measures to study diet-health relationships has increased rapidly over the past two decades. Diet quality is often measured by scoring food intakes in terms of how closely they align with national dietary guidelines. The most commonly used diet quality indices have been developed in the US and so far no diet quality score has been specifically developed for the UK..

Objective: To develop a UK based score that can be applied to dietary assessments of various types, including diet diaries, 24H recalls and food frequency questionnaires (FFQs), that discriminates between healthy and unhealthy dietary behaviours, and can also be used as a short questionnaire to categorise individuals in large surveys.

Methods: The Eating Choices Index (ECI) includes four elements: (i) consumption of breakfast, (ii) type of milk consumed (iii) type of bread consumed, and (iv) portions of fruit intake. These four elements were included based on current dietary recommendations, previous findings in the literature and the ease and accuracy of obtaining correct responses from study participants. Since eating behaviours and choices may be equally important as amounts of food eaten, the ECI therefore focuses on these, rather than on amounts consumed. ECI was tested using 5-d food records collected in 1989 (n=2256) in the National Health and Development Survey (NSHD), the 1946 British Birth Cohort. **Results:** Preliminary results showed that scores for the ECI were significantly negatively correlated with fat as per cent total energy ($r=-0.2$, $p<0.001$) and positively correlated with protein as per cent total energy ($r=0.2$, $p<0.001$), carbohydrate as per cent total energy ($r=0.3$, $p<0.001$), dietary fibre (as NSP, $r=0.5$, $p<0.001$), vitamin C ($r=0.4$, $p<0.001$), iron ($r=0.3$, $p<0.001$), calcium ($r=0.2$, $p<0.001$), and folate ($r=0.2$, $p<0.001$). ECI scores explained 3% (protein) to 23% (NSP) of the variation in these indicator nutrients.

Conclusion: The ECI correlated with nutrient profiles that are consistent with a healthy diet and may provide a method to rank diet quality in epidemiological studies but further development is required.

OC 014

IS A HEALTHY DIET THE MOST EXPENSIVE TYPE OF DIET?; USING DIETARY DATA FROM THE UK WOMEN'S COHORT STUDY

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Introduction: Cost of food can influence food choice ([Drewnowski et al., 2007](#)) and therefore the budget which an individual or family have for food could affect their dietary patterns. A healthy diet has been shown to be an expensive one ([Cade et al., 1999](#), [Darmon et al., 2004](#)). As diet is a risk factor in development of cancers ([Key et](#)

al., 2002) (Danaei et al., 2005) and other chronic diseases (Foresight, 2007), hindering pursuit of a healthy diet due to economic restrictions introduces inequalities in health. **Methods:** Using the Diet and Nutrition Tool for Evaluation (DANTE) cost database a daily diet cost was assigned to the diets of ~35000 in the UK Women's Cohort study, using dietary data recorded through a food frequency questionnaire. Seven dietary patterns, derived through a cluster analysis (Greenwood et al., 2000) had this diet cost assigned to them. **Results:** Results show that the health conscious dietary pattern is the most expensive, with mean cost £6.74 (SD £2.40). The cheapest dietary pattern is that of a low quality monotonous omnivore, costing as little as £3.29 (SD £0.96) per day. Diversity in one's diet appears to come at a cost with the high diversity vegetarian having a more expensive diet, £5.02 (SD £1.27), compared to the lower diversity vegetarian dietary pattern, £3.93 (SD £1.01). The higher diversity traditional omnivore dietary pattern costs £5.54 (SD £1.33) with a conservative omnivore diet costing only £4.14 (SD £1.02). **Conclusion:** This study adds novel information on the cost of dietary patterns in the UK. Results support existing claims that a healthy diet is an expensive one. In the current economic climate this could have ever increasing importance in public health policy. Promotion of a healthy diet to reduce cancer and chronic disease risk will be a challenge when considering the financial burden this will place on individuals.

OC 015

COMPARABILITY OF DIETARY PATTERNS DERIVED FROM FOOD FREQUENCY QUESTIONNAIRE AND FOOD DIARY APPROACHES IN THE UK WOMEN'S COHORT STUDY (UKWCS)

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The application of dietary patterns within nutritional epidemiology has increased over the past decade and patterns research is thought to have potential advantages over the single food or nutrient-based approach in terms of describing the relationship with disease occurrence. However, some of the variations in diet:disease association that have been observed may be due to the methodological approach used to define the dietary pattern. In particular, it is possible that the source of dietary data used may have an impact on the nature of the pattern observed. Using participant data from the UKWCS, this study sought to compare whether women would be similarly categorised when using food frequency questionnaire (FFQ) –derived patterns or food diary-based patterns.

The UKWCS consists of 35,372 middle-aged women selected to represent a wide range of dietary habits. Between 1995 and 1998, these women completed a 217 item FFQ. Approximately 4 years after baseline, women were requested to complete a four-day semi-weighed food diary. Three dietary pattern derivation approaches were employed. Women were categorised into four commonly occurring diets (meat, poultry and fish-eaters and vegetarians) on the basis of their meat and fish eating habits as reported in the FFQ. Two dietary indices were also applied to the FFQ data: the World Health Organisation Healthy Diet Indicator (WHO HDI) and the Mediterranean Diet Index. These latter approaches generated a score for each woman which described the 'healthiness' and extent of adherence to a Mediterranean diet respectively. Dietary patterns were then also generated using the food diary data of 994 cohort participants. The agreement of the patterns formed from the FFQ and the diary data in 994 women was assessed using weighted Kappa tests. When derived using the two different datasets, the common diets pattern had very good agreement of 94%, giving a Kappa statistic of 0.83. Categorisation of the women using the WHO HDI and Mediterranean diet score did not agree as strongly. The WHO HDI although having agreement of 88% had a Kappa statistic of 0.37 indicating fair agreement. The Mediterranean diet had worse agreement between the FFQ and diary patterns with a Kappa statistic of 0.26. This however, is still described as being fair agreement. These results indicate that grouping of women by meat and fish-eating habits was similar regardless of the dietary assessment method used, but some variation in categorisation may be anticipated when dietary indices are applied depending on whether FFQ or food diary data are employed.

B-2 INTERNATIONAL DIETARY DATA HARMONISATION FOR MONITORING AND EXPOSURE ASSESSMENT-SYNERGIES AND CHALLENGES

EUROPEAN ACTIVITIES IN HARMONISING DIETARY DATA

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Since 2005, the European Food Safety Authority (EFSA) has worked towards harmonising dietary survey methodology and building of a common European Union (EU) food consumption database. Harmonised food consumption data are the basis for improving accuracy of EU wide exposure assessments. Improved risk assessments can assure more targeted risk management and permit more accurate risk communication resulting in increased consumer confidence. Harmonised and detailed food consumption data can also assist in serving the needs of nutrition surveillance and of further studies on diet and health related conditions causing high financial burden in Europe.

Food consumption information has been collected by EFSA over the last years at an increasing level of detail. In particular, the EFSA Comprehensive European Food Consumption Database¹ is a compilation of existing national dietary information and currently includes food consumption data for each individual from a total of 32 different dietary surveys carried out in 22 different Member States. A new food classification and description system, called FoodEx, has been developed and recently updated with the aim of providing a common link to all the diverse food databases in different domains, e.g. food consumption, chemical occurrence and nutrients. Since different methodologies have been used within the dietary surveys that can influence the outcome, direct country-to-country comparisons of the data is not advisable.

In 2007, EFSA created the “Expert group on food consumption data” (EGFCD), a network with representatives from all EU Member States. The Expert Group coordinates the efforts to harmonise the collection and collation of food consumption data. The EFSA “Guidance document on dietary surveys in EU” was published by EFSA in 2009, after endorsement by the EGFCD. By early 2010 a pan-European food consumption survey project proposal called “What’s on the menu in Europe” (EU Menu) was launched and pilot and supporting projects were initiated with the aim of developing and testing harmonised tools and procedures. The project “Pilot study for the Assessment of Nutrient intake and food Consumption Among Kids in Europe” (PANCAKE), coordinated by RIVM (The Netherlands), is focusing on infants and children up to 10 years of age, whereas different adult population groups are considered by the project “Pilot study in the view of a Pan-European dietary survey – Adolescents, adults and elderly” (PILOT-PANEU), coordinated by the Hungarian Food Safety Office. As part of the EU Menu, EFSA also supported the International Agency for Research on Cancer (IARC) to further develop EPIC-SOFT, a software for dietary surveys.

EFSA’s first support to Member States to collect national data according to the EU Menu survey requirements were granted in 2011 to France and Estonia and new calls will be launched by EFSA in the following years. Reference: European Food Safety Authority; General Principles for the Collection of National Food Consumption Data in the View of a Pan-European Dietary Survey. EFSA Journal 2009;1435 (51 pp.). DOI:10.2903/J.Efsa.2009.1435. Available online: www.efsa.europa.eu

INTERNATIONAL HARMONISATION OF DIETARY MONITORING – DIETARY ASSESSMENT AND BEYOND

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Dietary monitoring data are essential for the development and evaluation of food and nutrition policies and for dietary exposure assessment and subsequent risk management. Food consumption surveys are usually organised at the national level. Due to differences in methodologies, dietary intake data from the various national food consumption surveys have limited comparability. International initiatives including monitoring are needed in the context of the large global burden of nutrition. Furthermore, dietary risk assessment is increasingly done at the international level. For these reasons, international harmonisation of dietary monitoring is of major importance.

For all food consumption surveys, it is required that 1) the methodologies are applicable to and feasible for the study populations involved and for conducting organisations; 2) the collected data are valid; and 3) the study population is representative for the target population. In the case of international harmonisation in dietary monitoring, these three requirements are even greater challenges as compared to national surveys. In addition, there is a fourth requirement, tools and methodologies should be standardised.

For reliable and comparable dietary assessment, the 'European Food Consumption Survey Method' (EFCOSUM) group advised the use of at least two non-consecutive 24-h dietary recalls for adults. EPIC-Soft software©, developed by IARC, was preferred to standardise the 24-h recalls. In the 'European Food Consumption and Validation' (EFCOVAL) project (www.efcoval.eu), EPIC-Soft was validated and further developed to estimate the intake of foods, nutrients and chemicals in the context of pan-European food consumption surveys. For children a combination of a food diary with an EPIC-Soft 24-h recall was tested. This resulted in a standardised, sufficiently valid dietary assessment method that is applicable across the different population groups in Europe. Other aspects that need standardisation are sampling protocols, additional questionnaires, anthropological measurements, food classification, statistical models to estimate dietary exposure from the collected data, food composition tables, and biomarker measurements. From experience in Europe, it can be concluded that harmonisation of dietary monitoring is a major challenge; Standardisation implies that sometimes changes in existing procedures have to be made that are not optimal for the local situation. It requires sufficient time to come to consensus, develop, test, and validate all tools and materials, capacity building and training. Strong coordination and commitment from many stake holders is needed. Although for some aspects (e.g. sampling frames) strict standardisation seems impossible, major steps towards a harmonised pan-European food consumption survey have been made but the final hurdles need to be taken.

Oral Presentations:

OC 016

TRAIN-THE-TRAINERS IN CONDUCTING STANDARDIZED 24-H DIETARY RECALL INTERVIEWS IN INTERNATIONAL STUDY SETTINGS: REPORT FROM A REAL STUDY EXPERIENCE

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Background: Although the EPIC-Soft® 24-h recall programme, used as reference methodology in EPIC and recently recommended for pan-European dietary surveys, maximizes a structured and standardized recall approach, trained/experienced interviewers are needed to ensure good quality of open-ended interviews. In the context of international studies, the training of these interviewers should be standardized across countries, including country-specific aspects. Therefore the local trainers (who will train the local interviewers) need to be instructed and trained via a "train-the-trainer" course given in English by international/experienced trainers, before being able to organize local training of the fieldwork interviewers in their own language. **Aims:** To report on the experiences of training the trainers for conducting standardized repeated EPIC-Soft 24-h dietary recalls in the pilot study of the pan-European monitoring surveys (PILOT-PANEU-project) and to notify the importance of e-training tools to facilitate and support such trainings. **Methods:** PILOT-PANEU is the pilot phase of the EFSA-initiated "EU-MENU" study, a planned pan-European dietary survey. Staff members (in charge of the local EPIC-soft training) of 5 different countries (Bulgaria, Finland, Hungary, Poland and Portugal) attended the train-the-trainers course at IARC. The three-day train-the-trainers course in the PILOT-PANEU project was based upon pre-existing materials and knowledge obtained in different study contexts and settings. It was closed by an evaluation discussion that led to useful suggestions for future pan-European train-the-trainer courses. An e-training approach was pilot tested during this course using the GoToWebinar system, the method of choice derived from an inventory of more than 80 e-learning software tools. **Results:** Although three training days were the minimum requirement to train-the-trainers who need to organize their local EPIC-soft training in a standardized way, suggestions were made to decrease cost and burden for attendees and course organizers. The e-training system was evaluated positively by all attendees and recommended for future train-the-trainer courses. Via such e-learning tool attendees were able to access and follow the presentations and make exercises at their own convenience and place. However, to participate in discussions, it was necessary to attend the e-training via the GoToWebinar system following a fixed time schedule. More details on limitations and opportunities of the e-training module experienced during the train-the-trainer course will be presented during the presentation. **Conclusion:** The PILOT-PANEU EPIC-soft train-the-trainers course underlined the importance of the e-learning module for future pan-European monitoring surveys. Extra trials and evaluations will allow further optimizations of these e-training applications for use in pan-European dietary surveys. **Acknowledge:** We acknowledge the IARC training and IT groups for their support in organizing the train-the-trainer course at IARC and via the online GoToWebinar system. Ms. Nicole Suty, Ms. Susan Anthony and Dr SELEIRO, Eduardo are acknowledged for their assistance in the administrative tasks required for the train-the-

trainer course. Furthermore, Dr. Eric Lucas and Willem De Keyzer are acknowledged for their assistance in the development of the EPIC-soft step-by-step interview. The PILOT-PANEU project is funded by the European Food Safety Authority (EFSA).

OC 017

FEASIBILITY OF USE AND PERFORMANCE OF A EUROPEAN FOOD PROPENSITY QUESTIONNAIRE IN THE IDAMES PROJECT

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Introduction: There is a need for cultural-sensitive standardized dietary assessment methods that capture the dietary variation across European countries within reasonable timeframes, costs and respondent burden. **Objective:** To present the results on the feasibility and performance of a European Food Propensity Questionnaire (EFPQ) which was developed and tested within the “Innovative Dietary Assessment Methods in Epidemiological Studies and Public Health” (IDAMES) project. **Methods:** The non-quantitative EFPQ inquires the frequency of consumption of 116 food items during the last 12 months and was standardized across five cohorts in Estonia (Estonian Genome Centre/EGC), Italy (EPIC-Florence), Spain (EPIC-San Sebastian), Norway (Norwegian Women and Cancer Study/NOWAC) and Germany (EPIC-Potsdam). Between January and April 2009, 80 randomly selected participants (aged 19-75y) from each cohort were invited to complete either a web- or paper-based EFPQ in combination with three telephone-24-hour dietary recalls (24-HDRs) administered once per month by EPIC-Soft®. Descriptive analysis were performed to explore the feasibility of the administration mode (paper- vs. web-based) and the food item list, using data from 261 subjects with complete data. To evaluate the performance of the EFPQ in accurately ranking subjects with regard to food intake, two different portion sizes types (common portion sizes for all cohorts versus cohort-specific portion sizes) were determined from 241 subjects with at least two 24-HDRs. Food intakes derived from the EFPQ with both portion sizes types were compared to reference data estimated by statistical modelling for usual individual intake (Multiple Source method/MSM). The extent of agreement was expressed by non-parametric statistics for all cohorts and different European regions. **Results:** Response rates for the web-based EFPQ varied from 30% in EPIC-San Sebastian to 70% in NOWAC and 93% in EGC. For 67% of the included food items on the standardized food list, more than 65% of subjects reported daily consumption and 27 food items were consumed by 90% of all study participants. However, there were marked cohort-specific differences in consumer proportions for several food items, such as porridge, rye bread, butter (on bread) or specific dairy products. Taken the reference data, Spearman rank correlation coefficients of food item intake improved clearly by the inclusion of cohort-specific portion sizes, but the effect seemed to cancel out at food group level. Furthermore, the EFPQ with cohort-specific portion sizes classified fewer subjects correctly into the same quartile of intake of the food group (overall: 36.7%) compared to the EFPQ with common portion sizes (overall: 39.7%) and misclassified more (overall: 4.2% with cohort-specific portion sizes versus 3.3% with common portion sizes). **Conclusion:** This study supports the feasibility of using the EFPQ in a diverse European study population and motivates to further improve and explore its methodological concept. Furthermore, the moderate ability to correctly rank individuals according to their food intake calls into question the stand-alone application of long-term dietary assessment instruments in epidemiological studies.

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OC 018

DELIVERING FOOD INFORMATION AND OTHER TOOLS TO SUPPORT FOOD AND HEALTH PROFESSIONALS

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Food information is essential for measurement of diets. The food information available in food composition databases (FCDB) comprises the description and identification of foods, as well as their nutrient content and other constituents. This information is required for a range of purposes including dietary assessment, e.g. evaluation of food consumption surveys, nutritional and clinical management, consumer information and research. There have been differences within and beyond Europe in the way food information is expressed in FCDBs with respect to food description, definition of nutrients and other food constituents. One major goal of the EuroFIR Network of Excellence (NoE) (2005-10) was to provide tools to overcome existing differences with respect to documentation and interchange of food composition data. The establishment of the European

Committee for Standardisation's TC 387 project group on Food Data, led by the Swedish Standards Institute, and the preparation of the draft Food Data Standard, has addressed these deficiencies by enabling unambiguous identification and description of food data and their quality, as well as dissemination and electronic data interchange. Another major goal was to develop and disseminate a comprehensive and coherent "food information resource" that provides a single, authoritative source of food information for users in Europe. The non-profit association EuroFIR AISBL now continues the work of the EuroFIR Network providing a complete range of benefits comprising access to food information via innovative data interfaces including data on nutrients from almost all European countries and on bioactive compounds with putative health benefits. The information on the composition of foods (nutrients, energy values) is available for single foods, recipes and sometimes branded foods. EuroFIR AISBL represents a time-saving, centralised and standardised source of food information for users in Europe and beyond. Visit www.eurofir.org for more information. Funding acknowledgements: This work was completed on behalf of the EuroFIR NoE consortium and funded under the European Community's 6th Framework Programme: 'Food Quality and Safety Theme' (FOOD-CT-2005-513944), and is being further refined and extended under the current EuroFIR Nexus project ("The EuroFIR Food Platform: further integration, refinement and exploitation for its long-term self-sustainability"), funded under the European Community's 7th Framework Programme (KBBE.2010.4.01) by Grant Agreement No 265967.

OC 019

CHALLENGES IN MONITORING BIOMARKERS OF FOLATE, VITAMIN D AND SODIUM OVER TIME: THE NHANES EXPERIENCE

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The National Health and Nutrition Examination Survey (NHANES) has been collecting biomarkers and direct physical measures on the U.S. population for over 50 years. An important use of biomarkers from NHANES has been to examine trends in the nutritional status of the population over time. Biomarkers are assumed to have less error than other measures of nutritional status (e.g. diet and physical activity). This is not always the case. In this presentation, three important nutritional biomarkers (serum folate, serum vitamin D and urinary sodium) will be used to demonstrate numerous methodological challenges and sources of error that impact the monitoring of these important public health issues over time. The importance of implementing blind quality control procedures and cross-over studies and using internationally accepted lab reference methods and materials will be demonstrated using various methodological studies conducted in recent years within the NHANES survey. For example, laboratory drift in serum Vitamin D that was within acceptable lab quality control limits resulted in significant differences in population distributions over time that were not real population changes. Four well known international labs using the same folate microbiologic assay method produced significantly different findings on the same blood samples. These and other similar studies have led to increased (and coordinated) international laboratory standardization efforts that will also be described in this presentation.

C-2 PHYSICAL ACTIVITY ASSESSMENT IN INTERNATIONAL SURVEILLANCE SYSTEMS

INTERNATIONAL AND NATIONAL-LEVEL PHYSICAL ACTIVITY SURVEILLANCE SYSTEMS – COULD ACCELEROMETRY AND OBJECTIVE MEASUREMENT BE A BARRIER TO OPTIMAL GLOBAL PHYSICAL ACTIVITY SURVEILLANCE?

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The principles of optimal physical activity surveillance involve the development of a surveillance 'system', comprised of all the elements that a country or region might need to assess and monitor progress towards meeting physical activity recommendations. The first step is a national physical activity survey, providing population-representative information on physical activity patterns, especially among adults, using an established surveillance instrument, such as those used in the World Health Organisation STEPS framework. Next, the surveillance system needs indicators of progress, monitoring of policies, institutions and stakeholders, to assess programmatic progress towards physical activity goals. The central focus of this talk is to identify the measurement and monitoring issues in setting up such a physical activity surveillance system, and provide examples of such national systems in current use. In this context, objective assessment is an addendum to the measurement armamentarium, and could distract attention and resources away from the development of national surveillance systems, and come to dominate discussion and debate. Specifically, accelerometry, the current

measurement fad for objective assessment of physical activity, is far from stable, as new measurement techniques, including inclinometers, are added to the suite of assessment methods, making such investment difficult for backwards comparability in population surveillance. Thus, although objective assessment is a *sine qua non* in every physical activity intervention as a criterion measurement, it may distract from emerging efforts to focus on building national PA surveillance systems.

Oral Presentations:

OC 020

LEVERAGING DISTRIBUTED SENSOR NETWORKS TO DEVELOP A SCALABLE SYSTEM FOR BEHAVIORAL HEALTH SURVEILLANCE AND HEALTH OUTCOMES RESEARCH

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PURPOSE: To enhance capacity for population scale behavioral health surveillance and health outcomes research through development of a scalable architecture for research data collection from distributed sensor networks.

METHODS: Monitoring of lifestyle behaviors, including physical activity, dietary intake, and sleep, for the purpose of health research or surveillance has historically relied on highly centralized systems of data collection within government or academic institutions. Data collection methods have utilized a combination of in-person or telephone administered questionnaires and recalls, physical examinations, and remote monitoring using wearable sensors including accelerometers and GPS. Our current systems and methods for health research and surveillance are optimized for standardization, maximizing control over the population sampled and both the type and quality of information gathered from respondents. Advances in personal consumer technology (e.g., wireless monitoring devices and smartphones) have generated a nationally distributed sensor network that could be leveraged to increase research capacity for behavioral monitoring and interventions. In contrast to centralized systems that have relatively high cost per person and limits to population coverage, data captured from a distributed sensor networks would be optimized to scale vertically (increasing sample sizes) and scale horizontally (increasing geographic or sociodemographic coverage of the sample). Distributed methods of data collection may reduce researchers control over standardization of data collection methods. However, the system could utilize a standardized recruitment system for enrollment of potential participants with a wireless network connection (e.g., cell phone).

Facilitation of strategic and efficient public, private and nonprofit partnerships will be required to develop necessary data management architecture for capture, storage, analysis and reporting of behavioral measures from distributed sensor networks.

A proposed approach to support development, promotion, and system deployment as a behavioral research resource will be illustrated. The proposed design is modular and would serve as the behavioral assessment and monitoring core, allowing for additional research data collection modules to be developed and deployed using wireless biometric monitoring technology and online or mobile survey and recall instruments.

CONCLUSION: Proliferation of sensor technology for behavioral health monitoring and assessment provides an opportunity to explore complementary approaches to enhance our national, state, and local surveillance and research capacity.

OC 021

DAILY PATTERNS OF PHYSICAL ACTIVITY PARTICIPATION IN CANADIANS

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INTRODUCTION: As interest in the link between movement and health increases, the need for accurate measurement of physical activity becomes a central research need. Population-level surveillance typically reports adherence to physical activity recommendations and time spent being moderately active and/or sedentary. Accelerometry data have the potential to provide more comprehensive profiles of physical activity behaviour. Such analyses would allow for further insight to be gleaned about when physical activity is accumulated both within the day and across the week. This type of information would be particularly relevant to informing policy and programming efforts designed to increase physical activity at the population level.

METHODS: Data are from the 2007-2009 Canadian Health Measures Survey (CHMS), the most comprehensive direct health measures survey ever conducted on a nationally representative sample of Canadians (n = 4,440). Moderate-to-vigorous physical activity (MVPA) was measured using the Actical accelerometer which was worn by survey respondents for 7 consecutive days during waking hours. MVPA was defined as the sum of minutes above 1,535 counts per minute (cpm) for children and above 1,500 cpm for adults. MVPA was assessed for 7 time-periods of 2 hours between 7am and 9pm. Patterns were derived by age, sex, week-end, weekdays, body-mass index (BMI)

categories and least (bottom tertile for MVPA) and most active (top tertile for MVPA) in the population. **RESULTS:** According to the CHMS, half of the active minutes in a day are accumulated between 11am and 5pm. The most active period for children is at lunch time (11am to 1pm) and moves toward the after-school period (3pm to 5pm) for teenagers aged 15 to 19 years old. Children and youth are more active on weekdays compared to week-end days. The most active children and youth accumulate more minutes of MVPA after school (3 to 5 pm) while the most active adults do so at lunch time (11am to pm). **CONCLUSIONS:** The within-day timing and pattern of MVPA accumulation is useful to further our understanding of why overall levels of physical activity are what they are. The results obtained from this type of analytical approach provide evidence for policy and programming efforts aimed at targeting critical periods of the day and/or week when physical activity levels should be increased. By extension, this type of analysis will allow for robust evaluation of future policies and interventions.

OC 022

OBJECTIVE MEASUREMENT OF PHYSICAL ACTIVITY, SLEEP, AND STRENGTH IN THE US NATIONAL HEALTH AND NUTRITION EXAMINATION SURVEY 2011-2014

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The first large-scale study to include accelerometer-based physical activity assessment was the National Health and Nutrition Examination Survey (NHANES) 2003-2006. Participants (ages 6 years and older) were asked to wear an Actigraph 7164 on a waist belt for 7 days while awake, removing the device for bathing and other wet activities. The ActiGraph 7164 logged a propriety acceleration measure (activity counts) in a single (vertical) axis, recording one integrated measure of activity per minute. The resulting data were the basis of more than 45 publications as of August 2011, including several analyses that focused attention on health effects of sedentary time. NHANES 2011-2014 includes an accelerometer component with three substantial modifications. First, monitor technology was updated to the ActiGraph GT3X+ platform. The GT3X+ monitor logs 80 Hz raw acceleration data (milli-g) in three axes and ambient light for 8 days and has a water-resistant case. Second, the sensor location was changed from the waist to the non-dominant wrist. Finally, the monitoring period was changed from waking hours to continuous (24hr/day) wear. These protocol modifications were selected to 1) enhance wear compliance, 2) enable simultaneous monitoring of physical activity and sleep, and 3) allow data processing flexibility as methods evolve. Preliminary data demonstrate excellent compliance with the accelerometer component. Participation is approximately 96%, and wear compliance is much higher than in the earlier cycles. The 25th percentile of mean accelerometer wear time per day is about 20 hours and the median is about 22 hours. In 2003-2004, the proportion of participants meeting the criterion of 10 h wear/d on 6 or more days ranged from about 40% (for younger ages) to 70% (for older adults). Currently, nearly 70% to more than 80% of participants of all ages are providing 6 or more days with at least 18 h wear/d. In addition to the accelerometer for activity and sleep measures, body strength is being measured by hand-grip dynamometer with 3 trials for each hand. The strength component also has high acceptance with 94% participation. Anecdotally, kids really enjoy the component. Preliminary results show that 96% of the 2nd and 3rd trials on each hand differ by 20% or less, indicating good test performance. Wrist wear of a water-resistant accelerometer in NHANES 2011-2014 has improved component compliance and allowed sleep monitoring. The survey will provide researchers with valuable nationally representative objective data on physical activity, sleep, and body strength.

OC 023

EVALUATION OF WEIGHT MANAGEMENT, DIET AND PHYSICAL ACTIVITY INTERVENTIONS: A STANDARDISED APPROACH

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Background : A key challenge for obesity prevention and treatment is the identification of interventions that are effective in reducing body weight and changing diet and physical activity behaviour. It is critical that we build up a strong knowledge base of effective interventions, and that we encourage the discontinuation of ineffective interventions that waste public resources. As well as good quality academic intervention research, there is an urgent need for systematically conducted evaluations of public health programmes. However, this is hampered by a lack of consistency in measurement. Research among public health practitioners in the UK indicates that while healthy weight related interventions are being commissioned by a variety of organisations, they are often poorly evaluated, with inconsistent data being collected on outputs, impacts and outcomes.

Objectives: The UK's National Obesity Observatory set out to support high quality, consistent evaluations of weight management interventions, through the development of a standard evaluation framework (SEF) for

weight management interventions and subsequently, specific SEFs for diet and physical activity interventions. The SEFs are intended to support the collection of data and facilitate future comparisons across public health programmes.

Methods: The three frameworks include a theoretical framework for evaluation, key data collection criteria and guidance on assessment methods. These were developed in conjunction with leading academics and public health practitioners in the areas of obesity, diet and physical activity, to ensure that the document was evidence-based, robust and suitable for application in a public health setting.

Results: The Standard Evaluation Framework (SEF) for weight management interventions was published in 2009. Training workshops and a user survey have shown the SEF to be widely used, including being a mandatory requirement for commissioning in some regions. The Diet and Physical Activity SEFs have recently been published and feedback has been positive. An online tool has been developed to enable details of evaluations that have been conducted using the SEFs to be collated and compared. This work sets standards for key criteria for data collection when evaluating interventions relating to obesity or its behavioural determinants.

Conclusions: While the SEFs appear to have contributed to more systematic evaluation of healthy weight related interventions, some significant challenges remain, including the lack of validated tools to measure diet and physical activity; a lack of resources being allocated for evaluation; and an ongoing need for practical evaluation support.

A-3 ASSESSMENT OF DIETARY SUPPLEMENT INTAKES

Oral Presentations:

OC 024

ASSESSMENT OF DIETARY SUPPLEMENT USE IN NEW ZEALAND: METHODOLOGY AND REGULATORY CHALLENGES

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Introduction: The frequency of use of dietary supplements in New Zealand appears to be markedly lower among adults than in the United States. Nevertheless the regulatory environment also differs, is deemed to be in urgent need of updating, and currently allows the use of a wide range of products sourced from within and outside the country. Recent data from the 2008/09 Adult Nutrition Survey provide knowledge of the breadth of supplements available for consumption, allow comparisons of prevalence of use over time (between 1997 and 2008/09), and lay bare the challenge of documenting supplement composition (nutrients and other components).

Methods: Data on 4721 free-living adults 15+ years were collected in the homes of participants. The 24 hour diet recall included foods, beverages and dietary supplements; a Dietary Habits Questionnaire assessed regular and occasional use of supplements (by type) over the previous year.

Data allowing supplement categorisation (as to type) and composition were obtained by viewing supplement containers in the home and recording label data. Post survey, further information was obtained from product websites and manufacturers. Nutrient composition data for supplements enabled calculation of nutrient intake of participants from all sources.

Results: In 2008/09 'any' supplement use in the last year was reported as 47.6% of New Zealanders, whereas in 1997 59% of adults reported consuming at least one supplement over the previous year. Adult females reported such use more often than males. Consumption in the previous 24 hours of 'any' supplement was reported by 24.2% of adults in 1997 and 8.8% in 2008/09. In both time periods 'occasional' (2008/09) or 'episodic' (1997) use of supplements was higher among older New Zealanders. Whereas in 1997 multivitamins/multiminerals were the type of supplement most frequently consumed, in 2008/09 it was the group 'oils', which includes fish oils, omega 3/6 products and Evening Primrose Oil.

Assigning nutrient lines to supplements presented challenges: extravagant claims about nutrient presence were made without any quantitative data; nutrients naturally present in a plant-based product were not included with 'added/fortified' nutrients'; website and label data were not always congruent.

Conclusions: Categorisation of supplements is increasingly difficult given the burgeoning range available to New Zealand consumers. Nutrient composition is difficult to determine and non-nutrient components are of an undocumented nature. The need for appropriate regulation of supplements available to New Zealand consumers is imperative to enable informed and safe consumption.

Source of funding: Ministry of Health, New Zealand

OC 025

A THREE-PART, MIXED EFFECT MODEL TO ESTIMATE HABITUAL TOTAL NUTRIENT INTAKE DISTRIBUTIONS FROM FOOD AND DIETARY SUPPLEMENTS IN DUTCH YOUNG CHILDREN

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Introduction: In the estimation of habitual nutrient intake distributions and the estimation of proportions of the population with inadequate or excessive intakes it is vital to take into account intake from all sources, including dietary supplements.

Statistical modeling of habitual nutrient intake from food and dietary supplements using short-term measurements is hampered by heterogeneous variances and multimodal and/or skewed distributions in the original data.

Summation of the intake from food and dietary supplements from short-term measures prior to correction for within-person variation (first add then shrink) may produce biased estimates of habitual total intake. In some cases the estimate for habitual total intake is smaller than the estimate for habitual intake from food sources only. A three-part model using a first shrink then add approach is proposed.

Methods: With this approach habitual nutrient intake is estimated separately for 1) amounts from food for non-users of dietary supplements, 2) amounts from food for users of dietary supplements, and 3) dietary supplements for users only. For dietary supplements the habitual frequency of consumption was estimated and combined with the mean recorded amount (or imputed amount) from dietary supplements.

This was done because for most subjects there was no day-to-day difference between dosage, and the distribution of recorded dosages was not smooth, but showed spikes at some specific dosages. The population habitual total nutrient intake distribution is estimated by combining these three habitual intake distributions, accounting for possible interdependence between 2) and 3). Also several covariates are accounted for. The new model is an extension of a model developed by the USA National Cancer Institute.

Results and conclusion: Habitual total vitamin D and C intake among Dutch young children (2-6 yr) were estimated using the proposed model and data from the Dutch food consumption survey among young children (n=1279). Application of the new model resulted in habitual total vitamin D or C intakes that were always similar to or greater than the estimates for intake from food sources only. In addition, the multimodal shape of the observed total vitamin D intake distribution was preserved. Comparison of the first shrink then add approach with the more simple first add then shrink approach showed that prevalence of intakes below a cut-off value could deviate substantially (>10 percent points).

This methodology could be useful for other complex cases, e.g., where high nutrient concentrations appear in episodically consumed foods.

OC 026

DIETARY SUPPLEMENT USE IN THE NETHERLANDS

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Background: There is an expanding supply of dietary supplements in the shops and on the internet and the number of people taking supplements increases. Do dietary supplements effectively contribute to a healthy diet?

Objective: To get more insight in the importance of dietary supplements for the habitual micronutrient intake in the Dutch population. **Methods** Consumption data of food and dietary supplements of 3819 children and adults in the Netherlands, aged 7 to 69 years, have been collected (DNFCS 2007-2010), using two 24-hour dietary recalls and a food frequency questionnaire per participant. Nutrient intake was calculated using the Dutch food composition database (NEVO) and the Dutch Supplement Database (NES). Habitual intake distributions were estimated using SPADE. **Results:** 34% of the study population reported to use one or more dietary supplements per day. Overall dietary supplement use increased during winter time and by age. Most commonly used dietary supplements in all age groups were multivitamins/minerals and vitamin C. Dietary supplements with fish oil were also frequently used, mostly by older adults (about 13%). Vitamin D supplementation is recommended by the Dutch Health Council for women above 50 years of age. Only 37% of them mentioned taking vitamin D containing dietary supplements in winter time, 28% during the rest of the year. Overall, the average contribution of dietary supplements to the intake of micronutrients of the Dutch population was highest for folate equivalents and vitamin C (both 10%). No exceeding of upper limits seemed to appear. The intake of most B-vitamins appeared sufficient already without supplements. 19-41% of the adult females had total folate equivalent intakes from foods only, below the EAR of 200 µg/day. Folic acid contribution by dietary supplements improved the intake to 14-28% below the EAR, still being highest in women of childbearing age. Besides for folate and

vitamin D, percentages of low intakes hardly differed when taking dietary supplements into account. Conclusion: Dietary supplement use data collected with a combination of FFQ and repeated 24-hr recalls gives insight in the contribution of dietary supplements to the micronutrient intake. The use of dietary supplements is common in the Netherlands; however, compliance with the supplementation recommendation for vitamin D in seniors is low. The current consumption of dietary supplements does not lead to excess intakes nor does it change the percentages of low intakes for most micronutrients.

OC 027

PITFALLS WHEN ACCOUNTING FOR SUPPLEMENT USE IN VALIDATION STUDIES: EXPERIENCES FROM THE EUROPEAN FOOD CONSUMPTION VALIDATION (EFCOVAL) STUDY

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Background: Whether the use of supplements could be appropriately accounted for and would influence the results of the EFCOVAL study was questioned.

Aim: Report on the EFCOVAL experiences, especially pitfalls, when accounting for supplement use in the validation of 24-h dietary recalls (24-HDR) in European centres.

Methods: We collected data from 600 adults in five centres in Belgium (BE), the Czech Republic (CZ), France (FR), the Netherlands (NL) and Norway (NO). Dietary intakes were estimated via two independent 24-HDR using EPIC-Soft. Two 24-h urine samples were collected to measure protein (Prot) and potassium (K) intake based on the recovery of urinary nitrogen and K, respectively. In addition, fatty acids in serum phospholipids (FA) - EPA and DHA expressed as % - and serum carotenoids were used as concentration biomarkers of intake for fish, and fruit plus vegetable (FV) consumption, respectively. Consumers of supplements containing FA, carotenoids, Prot and K were identified from 24-HDRs and from a questionnaire on supplement use. To identify the nutrient content of the supplements, we searched: (1) companies' websites, (2) drugstores, and (3) national databases. For each centre, we compared the mean bias in Prot and K intake with and without supplement use. Given that we could not simply add the supplement amounts to the intakes of fish and FV, a different approach was used for the analysis with concentration biomarkers, that is the comparison of biomarker between groups of supplement user and non-users.

Results and discussion: Supplements containing Prot, K and carotenoids were less often consumed (<12% of subjects each) than those with FA (21% of subjects). In particular, supplements containing Prot was only reported in BE (1%) and in FR (12%). The % of consumers of supplements with FA was especially high in NO (63% vs <14% in other centres). Comparison of bias in Prot and K intake with and without the inclusion of supplement use were not statistically different across centres. Only in NO, the percentage of FA (i.e. biomarker) of the subjects who reported not taking any supplement was substantially lower (5.9%) than of the users (7.9%) and the total group (7.2%) whereas no obvious differences were observed for serum carotenoids across groups of supplement users and non-users in each centre. Overall, the validity assessment considering supplement intake in EFCOVAL was not straightforward and was hampered by a number of issues, including the difficulty to quantify the content of supplements; the user's ability to report detailed information about the supplements (e.g. brandname); the complexity to handle the information from countries with different markets and languages; the difficulty to consider the supplement intake in the validation of foods with concentration biomarkers, among others.

Conclusion: A degree of uncertainty remains in the evaluation of supplement use in the EFCOVAL study. Future evaluations should aim to collect precise data on the usual intake of dietary supplements and then account for differences in their use between the countries.

B-3 MEASUREMENT ERROR IN NUTRITIONAL EPIDEMIOLOGY

MULTIVARIATE MODELING OF REPEAT SHORT-TERM UNBIASED MEASUREMENTS OF DIETARY INTAKES WITH APPLICATION TO NUTRITIONAL SURVEILLANCE AND EPIDEMIOLOGY

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The more precise short-term instruments such as 24-hour dietary recalls or multiple-day food diaries have been traditionally used by national surveys but until recently their application as the primary assessment instrument

has been prohibited by the high cost of their administration or processing in nutritional epidemiology. With the advantage of automated web-based versions of such instruments, it has become practical to apply them, alone or together with dietary questionnaires, in large epidemiological studies as well. Yet, modeling short-term reported intakes is associated with numerous statistical challenges. First, short-term measurements represent a snapshot of intakes on a given day or several days. Thus, even if they are assumed unbiased, due to large day-to-day variation, usual (i.e., long-term average) dietary intake is assessed with considerable random measurement error that has to be accounted for. Second, diet represents numerous foods, nutrients and other components, consumption of which varies widely. Some are consumed daily by almost everyone (e.g., total fat or grains), while others are episodically consumed (e.g., fish, whole grains), so that short-term data are often zero-inflated. Third, models in nutritional epidemiology usually contain several dietary components. In surveillance, there is also increasing interest in exploring dietary intakes collectively to assess the totality of diet or dietary patterns. While dealing with multiple dietary components, it is important to take into account that they are usually interrelated. Finally, it is often preferable to analyze intakes of dietary components relative to total energy intake to address dietary composition. In this talk, extending the previously proposed NCI method for modeling univariate episodically consumed dietary components, I will present a novel multivariate measurement error model for such short-term repeat dietary measurements that meets the above challenges. I will then discuss the application of this model in both nutritional epidemiology and surveillance. The former application uses the model to correct diet-health associations for covariate measurement error using regression calibration. The latter application is illustrated by using the model to estimate the population distribution of the Healthy Eating Index, a multi-component dietary quality index involving ratios of interrelated dietary components to energy.

MEASUREMENT ERROR CORRECTION FOR TIME-VARYING EXPOSURES IN PROSPECTIVE COHORT STUDIES, WITH APPLICATION TO NUTRITIONAL EPIDEMIOLOGY

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Healthy diet and moderate physical activity have consistently been associated with reduced risks of chronic diseases, including cancer, cardiovascular disease and diabetes. Most studies rely on the assessment of diet using a food frequency questionnaire, and assess activity questions about the usual frequency of common activities. However, the impact of measurement error has typically not been incorporated into the estimates of risk, in part due to the inavailability of methods and corresponding software for adjusting point and interval estimates of relative risk for the bias from time-varying exposures such as cumulative or current diet or activity. By recalibrating the measurement error model within each risk set of the standard survival data analysis used for prospective cohort studies, we have developed a risk set regression calibration (RRC) method for this setting (Liao X-M, Zucker DM, Li Y, Spiegelman D. "Survival Analysis with Error-Prone Time-Varying Covariates: A Risk Set Calibration Approach". *Biometrics*, 2011;1:50-8) An algorithm for a bias-corrected point estimate of the relative risk using an RRC approach is given, followed by the derivation of an estimator of its variance. Emphasis is on methods applicable to the main study/external validation study design, which is standard in nutritional and environmental epidemiology. Limitations of current validation studies are discussed, and methods are given to assess the sensitivity of results to assumptions for which the data permit incomplete empirical verification. The method is applied to a study of the effect of long-term healthy diet scores in relation to Type II diabetes incidence in Harvard's Health Professionals Follow-up Study (de Koning L, Fung TT, Liao XM, Chiuve S, Rimm EB, Willett WC, Spiegelman D, Hu FB. "Low-carbohydrate diet scores and risk of type 2 diabetes mellitus among men" *American Journal of Clinical Nutrition*, 2011 Apr;93(4):844-50). A user-friendly publicly-available SAS macro (%RRC) has been developed and its use will be illustrated in this talk.

Oral Presentations:

OC 028

VARIATION OF BIAS IN PROTEIN AND POTASSIUM INTAKE COLLECTED WITH 24-H RECALLS ACROSS EUROPEAN POPULATIONS USING MULTILEVEL ANALYSIS

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¹IARC, ²WUR, ³RIVM, ⁴UO, ⁵NIPH, ⁶GU, ⁷ANSES, ⁸CAM, ⁹HUGE, ¹⁰CRC, ¹¹IRCCS, ¹²DKFZ, ¹³INSERM, ¹⁴UOA, ¹⁵OX, ¹⁶Dife

Background: The accuracy of protein (Prot) and potassium (K) intakes as estimated by 24-h recalls (24-HDR) using EPIC-Soft® has been investigated in the EPIC and EFCOVAL studies, suggesting differences across European populations. However, those analyses did not allow for simultaneous separation of within- and between-group variances. **Aim:** To further investigate whether mean bias of Prot and K intake estimated by a single 24-HDR varied across European centers and whether the characteristics of individuals or centers influenced the mean bias. **Methods:** Data from EFCOVAL and EPIC were combined, including 14 centers from 9 countries (n=1841). A computerized 24-HDR (EPIC-Soft) was used to collect the dietary data and country-specific food composition tables were used to estimate the nutrient intakes. Urinary nitrogen and K in 24-h collections were used as reference method. Differences in nutrient calculations (e.g., conversion factors) and design aspects of the 24-HDR collection (e.g., mode of administration) were harmonized or considered during the data analysis. To harmonize the biomarker data between studies, a study was conducted among the laboratories that performed the analyses. However, the calibration of data between studies was judged unnecessary. Multilevel linear regression analysis was performed, including individual-level (e.g., BMI and educational level) and center-level (e.g., food pattern index) variables. **Results:** We observed that bias in Prot intake did not vary significantly across centers in men, but varied modestly among women (CV: 5.7%) in the crude model. Conversely, bias in K intake differed between centers in men (CV: 8.9%), but not in women. Explanatory variables at the individual level predicting the between-center variation of bias in Prot and K intake were identified. BMI was the most important factor influencing the biases across centers ($p < 0.01$ in all analysis). In addition, mode of administration ($p = 0.06$ in women) and day of the week ($p = 0.03$ in men and $p = 0.06$ in women) may have influenced the bias in Prot intake across centers. After inclusion of these individual variables in the model, between-center variation in bias in Prot intake disappeared for women, whereas for K it increased slightly in men (to 9.5%). Selected center-level variables did not influence the between-center variations in bias in our assessment. **Conclusion:** The results suggest that bias in Prot and, for women, in K collected with 24-HDR does not vary across centers while it varies to a certain extent for K in men. BMI and study design aspects, rather than center-level characteristics, affected the biases across centers.

OC 029

A BIVARIATE MEASUREMENT ERROR MODEL FOR AN EPISODICALLY-CONSUMED DIETARY COMPONENT AND ENERGY: APPLICATION TO NUTRITIONAL EPIDEMIOLOGY

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Measurement error models are used to adjust estimated diet-health associations for bias due to measurement error in reported intake. Fitting such a model requires an unbiased reference measure, in practice usually a repeat application of a short-term instrument such as a 24-hour dietary recall or food record. Modeling episodically-consumed dietary components such as dark green vegetables or fish is challenging, since short-term instruments may have a substantial proportion of subjects reporting zero intakes, leading to “semicontinuous” observations with excess zeros, in addition to within-person measurement error.

A two-part measurement error model was recently proposed for a single episodically-consumed dietary component and used to adjust estimated diet-health associations. For analyzing energy-adjusted diet-health associations, we extend the univariate measurement error model to a bivariate model for an episodically-consumed dietary component and energy. The model allows energy consumption on a given day to depend on: 1) whether or not the episodically-consumed component was consumed that day; and 2) the amount consumed that day (if greater than zero). After fitting the model, we use the estimated parameters to compute the expected value of true intake given reported intake and other covariates in the risk model, and then apply regression calibration to estimate diet-health associations.

We illustrate the methodology using data from the NIH-AARP Diet and Health study, a prospective cohort of 567,169 men and women that uses a FFQ to assess diet and includes a calibration sub-study of 2055 men and women with two nonconsecutive 24-hour dietary recalls as reference measures. We estimate the hazard ratio of lung cancer in men for red meat density between 10 and 60 g/1000 kcal, and, separately, for orange vegetable density between 0.2 and 1 cups/1000 kcal, adjusting for energy intake, age and smoking status. For red meat density, the estimated hazard ratio (95% confidence interval) adjusted for measurement error was 1.51 (1.30, 1.74), compared to the unadjusted estimate 1.28 (1.17, 1.40). For orange vegetable density, the estimated hazard ratio adjusted for measurement error was 0.69 (0.59, 0.81), compared to the unadjusted estimate 0.84 (0.79, 0.89).

Using simulations, we compare our methodology to linear regression calibration, a method often used for daily-consumed dietary components. We demonstrate that the proposed methodology may perform substantially better than linear regression calibration for episodically-consumed dietary components.

OC 030

DIET-OBESITY RELATIONSHIPS IN CHILDREN: APPROACHES TO HANDLE IMPLAUSIBLE DIETARY RECORDS

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Introduction: It has been repeatedly shown that measurement errors in dietary data lead to attenuated estimates of associations between dietary exposure and health outcomes. In young children this may even be more pronounced as data mainly rely on proxy-reports. Problems emerge in particular from (intentional) misreporting resulting in differential measurement errors. Different procedures have been proposed to screen out implausible dietary reports but the question how to handle reports identified as implausible is still open. This study aims to compare and evaluate different approaches of handling implausible reports. For this purpose, the relationship between reported dietary intakes (total energy, fruits/vegetables, softdrinks) and BMI z-scores in children aged 2- 9 years is investigated. **Material/ methods:** The analysis was conducted within the framework of the multi-center IDEFICS-study and is based on 5357 children aged 2-9 years with 24-hour dietary recall (24-HDR) and complete covariate information. After estimating the basal metabolic rate using the Schofield equations, the 24-HDR were classified in „over-report“, „plausible report“ or „under-report“ according to adapted Goldberg cut-offs. The association between BMI z-scores and dietary intakes was tested using a basic mixed regression model adjusting for age and sex and with study center as random effect. Results were compared with findings obtained from models excluding implausible reports, adding the reporting status (dummy variables) and/or adding a propensity score as adjustment variable for misreporting. The propensity score was constructed based on variables previously found to be related to misreporting. **Results:** In our basic model none of our three considered dietary exposures showed a significant association with BMI z-scores (effect estimates: energy intake: 0.000938 (p= 0.7922), fruits/vegetables: 0.003215 (p= 0.1414), softdrinks: 0.002878 (p= 0.3876)). Exclusion of “under-reports” led to an increase in the effect estimate for the association between energy intake and BMI z-scores (0.01479 (p= 0.0002)). Adjustment for the reporting status and the propensity score yielded in significant effect estimates for all associations (energy intake: 0.0394 (p<0.0001), fruits/vegetables: -0.02251 (p<0.0001), softdrinks: 0.0242 (p<0.0001)). In this case, the effect estimate for the association between fruit/vegetable intake and BMI z-scores even changed its sign (compared to the basic model) and pointed to the expected negative direction. **Conclusion:** Associations between dietary exposure and health outcomes are strongly affected or even masked by measurement errors. In our analysis consideration of the reporting status as well as inclusion of a propensity score for misreporting turned out to be useful tools to counteract attenuation of effect estimates.

OC 031

IMPROVING ETHNIC-SPECIFIC FOOD FREQUENCY QUESTIONNAIRES BY DIFFERENT QUALITATIVE APPROACHES

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Background: Population based studies of dietary intake often exclude immigrant origin groups due to a lack of validated instruments to estimate the habitual diet of immigrants. We developed Food Frequency Questionnaires (FFQ) to assess the habitual dietary intake of Surinamese, Turkish and Moroccan ethnic groups within the HELIUS study, a multi-ethnic longitudinal study in Amsterdam, the Netherlands. In the present study we aimed to improve data quality and ease of administration of the self-administered ethnic-specific FFQ by using different qualitative approaches. **Methods:** Several methods were applied to select negatively rated, incomplete or difficult questions from the FFQs. These methods were (1) plus-minus interviews; (2) expert judgement by dietitians; and (3) focus group discussions. After applying these methods, we selected questions that needed additional evaluations by cognitive interviewing. This intensive interviewing procedure for improving questionnaires was applied only in testing questions from the Moroccan FFQ as we expected this group to best represent potential difficulties in filling out the questionnaire. Techniques used in cognitive interviewing were the think-aloud method and conditional, context-based probing. Information on comprehension of the questions, portion sizes, food products, frequency of intake, order of food groups, composed meals, and residual categories was collected.

Results: Results from the plus-minus interviews (n=30) indicated that subjects were not always able to correctly understand questions of the FFQ and that further in-depth testing of the ethnic-specific FFQs was necessary. Expert judgement (n=13) and focus group discussions (n=9) gave additional insight in problems like missing portion sizes, and missing commonly eating food items. Twenty-five questions from the Moroccan FFQ were selected to test by cognitive interviewing. Seven one-on-one interviews were performed according to a standardized cognitive interview protocol. Based on these interviews, the most occurring problems were terms that subjects were not familiar with and with phrases that were too long. Participants also had difficulties in their description of portions sizes for couscous, potatoes and Turkish or Moroccan bread. These findings led to cognitive refinement, which included: inclusion of descriptions of unknown food items or groups; formatting long sentences; inclusion of different portion size ranges (including photos); and ordering of food groups. Results of the cognitive interviews were applied to all ethnic-specific FFQs as it was hypothesized that the cognitive difficulties experienced by the Moroccan participants were representative for the other populations. Conclusion: Qualitative approaches are an important step in pinpointing (cognitive) problems in the development of ethnic-specific FFQs and thereby improving the quality.

C-3 NEW TECHNOLOGIES FOR OBJECTIVE MONITORING OF PHYSICAL ACTIVITY

EXPERIENCES BUILDING A SYSTEM FOR REAL-TIME, CONTINUOUS ACTIVITY MEASUREMENT AND REMOTE MONITORING USING MOBILE PHONES

Stephen Intille, Fahd Albinali, Selene Mota, Mary Rosenberger, William Haskell

Mobile phones are increasingly capable of measuring behavior using sophisticated, real-time information processing using internal sensors in the phone, such as accelerometers and GPS, and external sensors that communicate with phones using wireless networks. We have developed a system for continuous remote measurement of physical activity using portable wireless accelerometers and common mobile phones. The system permits not only data collection, but also automatically-detected, event-triggered prompts to encourage compliance. The system can support the development of prototype interventions that respond to physical activity or sedentary behavior immediately after it is measured by the mobile phone system. In this talk, challenges encountered when developing the system will be described, as well as the steps we have taken to overcome them. These challenges include dealing with noisy sensors to automatically detect certain types of physical behaviors, interface design considerations when developing for long-term wearability, power-management issues on mobile devices, and effective remote management and interpretation of data and subject behavior as a study is running.

Oral Presentations:

OC 032

UP TO HALF OF STEPS PERFORMED IS NOT MEASURED BY ACCELEROMETERS IN OBESE INDIVIDUALS

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OBJECTIVE: Accelerometers increase in popularity because they provide an objective measure to assess physical activity level. However, human movements are difficult to measure and many limitations have to be considered in health studies. Many investigators have assessed the accuracy and reliability of pedometers and accelerometers under walking conditions. However, no study looked at the accuracy of accelerometers to provide valid step counts in individuals with excess body weight, despite the fact that these devices are commonly used in studies with individuals from various body weight status. The present study evaluates the accuracy of the step count function under walking conditions in obese individuals.

DESIGN: Seventeen obese participants (59% men) with a mean age of 41,2 years and a mean body mass index of 36,8 kg/m² took part in the experiment. They walked on a treadmill at three different speeds (2.5 km/h, 3.5 km/h and 4.8 km/h) for 5 minutes per stage with an accelerometer (ActiGraph, Fort Walton Beach, FL) worn at the waist. A camera also captured the number of steps actually performed. The difference between the step counts detected by the accelerometer and the camera were computed for the last three minutes of every stage.

RESULTS: The present study showed that accelerometers underestimate step counts by 56% at 2,5km/h, 32% at 3.5km/h and <1% at 4.8 km/h. These differences are clinically and statistically significant.

CONCLUSION: At slower speed, accelerometers underestimate step counts in obese population. Because walk is the most basic form of human locomotion and an important component of many daily physical activities, the use of pedometer counts at speed slower than 5 km/h may be not appropriate for obese individuals. This study also supports the relevance to develop new algorithms for step counts or of device more sensible to steps performed by obese individuals when they walk at low speed.

OC 033

COMPARISON OF OLDER AND NEWER GENERATIONS OF ACTIGRAPH ACCELEROMETERS WITH AND WITHOUT THE LOW FREQUENCY EXTENSION

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Background: Accelerometers are the gold standard for objective physical activity (PA) measurement. Many studies have used the older generation ActiGraph (7164) but this model has been replaced with newer generation models (e.g., GT3X+). Laboratory studies show that the models are generally comparable for moderate-to-vigorous physical activity (MVPA) but likely different at lower intensity levels. With growing interest in measuring PA across the intensity spectrum, these differences are an important concern. A recent study questioned the assumption that newer models are more accurate PA measurement devices than older ones. Recently, Actigraph introduced a low-frequency extension (LFE) that increases the low-intensity sensitivity of newer models, but it has not been tested for comparability with older models.

Purpose: This study compared data collected with 7164 and GT3X+ models, with and without the LFE.

Methods: Twenty-five adults (mean age=32.8; SD=11.3) wore 3 accelerometers (7164, GT3X+, GT3X+ with LFE) on the same belt, in randomized position order, for 3 days and were instructed to engage in typical behaviors. Days with at least 8 wearing hours (non-wear defined as ≥ 60 minutes of consecutive zeroes) were scored with Freedson adult cut points and sedentary was defined as ≤ 100 counts per minute. Average minutes per day in sedentary, light, moderate, vigorous, and MVPA were calculated. Repeated measures ANOVA with post-hoc pairwise comparisons was used to compare mean values for activity categories across the three models.

Results: Means for the GT3X+ and 7164 were significantly different in 4 of 5 categories ($p < .05$), with non-significant differences only for vigorous activity. The largest differences were in sedentary and light activity categories with the GT3X+ showing more sedentary and less light than the 7164 (+25.6 and -31.2 mins/day, respectively); GT3X+ also detected 2.7 fewer MVPA mins/day ($p = .013$). Similar significant differences were seen in 4 of 5 categories when comparing the GT3X+ with and without the LFE ($p < .001$). However, GT3X+ with LFE showed non-significant differences with 7164 in all 5 intensity categories (e.g., <1 min/day differences in MVPA and <4.5 mins/day in sedentary and light intensities).

Conclusion: Significant differences between older and newer generation models were found in almost all intensity categories; however, differences were significantly reduced when using the low frequency extension with the GT3X+. Studies using the newer generation ActiGraphs should employ the low frequency extension for more comparable results to studies using the older models and greater sensitivity to lower intensity activity.

OC 034

VALIDATION OF A MULTISENSOR ARMBANDS' CAPACITY TO ESTIMATE ENERGY EXPENDITURE IN OVERWEIGHT AND OBESE LACTATING WOMEN USING DOUBLY LABELED WATER

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Reproduction is a risk factor for excessive weight gain and postpartum weight retention, especially in women who are already overweight or obese. Valid, affordable and easy-to use methods for measuring physical activity during the reproductive cycle are needed to tailor appropriate treatment. The aim was to validate Total Energy Expenditure (TEE) from the portable armband SenseWear SWA Pro 2 (Inner View software versions SWA 5.1 and SWA 6.1) against TEE from Doubly Labeled Water (TEE_{DLW}) in overweight and obese lactating women at 10 weeks postpartum. TEE was measured using doubly labeled water during 2 weeks and the SWA Pro 2 armband was worn simultaneously during the first seven 24-hour periods. Resting Energy Expenditure (REE) was measured by indirect calorimetry. Physical Activity Level (PAL) was calculated as TEE_{DLW}/REE. Sixty-two healthy, non-smoking women with a BMI > 25 kg/m² and a percent "on body time" for SWA of $> 90\%$ were included in the analysis. All were breastfeeding and had singleton, term deliveries with a birth weight > 2500 g and were able to perform physical activity. TEE (mean of seven 24 hour periods) as provided by the Inner View programs (TEE_{SWA5.1} and TEE_{SWA6.1}) were used for comparisons to TEE_{DLW}. Mean TEE_{SWA5.1} was overestimated

with 85 kcal compared to TEE_{DLW} ($p=0.040$), while mean $TEE_{SWA 6.1}$ was underestimated with 241 kcal compared to TEE_{DLW} ($p<0.001$). Forty-four percent (27 of 62) were within a predefined level of agreement of $\pm 10\%$ (277 kcal) using SWA 5.1 and 52% (32 of 62) were within this level of agreement using SWA 6.1. There was a significant association between the differences ($TEE_{DLW} - TEE_{SWA6.1}$) and TEE_{DLW} ($R=0.64$, $p<0.001$) indicating underestimation of $TEE_{SWA 6.1}$ at higher levels of TEE. These differences were also significantly associated with PAL ($R=0.629$ $p<0.001$) and BMI ($R=0.391$ $p=0.002$). This validation study shows that the SenseWear armband Pro 2 combined with the InnerView software version 5.1 can be used to estimate TEE within 3% of TEE_{DLW} at group level in overweight and obese lactating women. The Inner View software version 6.1, however, underestimates TEE with about 9% with a systematic underestimation at higher levels of TEE, PAL and BMI.

OC 035

MAKING COUNTS, COUNT MORE? USING WEARABLE CAMERAS TO CONTEXTUALISE ACCELEROMETER DATA

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To investigate the feasibility of wearable image capture to objectively measure the type and context of participants' accelerometry-identified bouts of moderate to vigorous physical activity (MVPA).

Methods: 52 adults were given an Actical hip-mounted accelerometer and a SenseCam image capturing device (worn via lanyard). The onboard clocks on both devices time-synchronised. Participants engaged in free-living activities for 3 days. Accelerometer data were cleaned and bouts of MVPA identified, using standard approaches. Using associated SenseCam images, each MVPA bout was categorised according to its type and context.

Results: There were 117 valid days of accelerometer data from 49 participants for whom 452,445 SenseCam images were also captured. Using a cut-point of 1,535 counts per minute, 71 MVPA bouts were identified from 25 participants totalling 1,218 minutes. Of those bouts, 21% ($n=15$, 267min) could not be categorized. The remaining 79% ($n=56$, 951min) of MPVA bouts were categorised as follows: 75% ($n=42$, 622min) walking; 7% ($n=4$, 119min) sports; 7% ($n=4$, 59min) bicycling; 7% ($n=4$, 46min) conditioning exercise; and 4% ($n=2$, 105min) running. With regard to context, 93% ($n=52$, 905min) of MVPA bouts were outdoors versus 7% ($n=4$, 46min) indoors; and 57% ($n=32$, 560min) of MVPA bouts were carried out in companionship versus 43% ($n=24$, 391min) alone.

Conclusion: Images captured from the perspective of the participant offer a method to capture the type and context of over 79% of accelerometer-defined MVPA bouts. Wearable image capture represents the best objective method currently available to measure the type and context of accelerometer-defined MVPA episodes.

A-4 DIETARY PATTERNS: METHODOLOGICAL ADVANCES AND NEW RESEARCH DIRECTIONS

Oral Presentations:

OC 036

A COMPARISON OF FOUR DIET QUALITY INDEXES WITH ALL-CAUSE AND CAUSE-SPECIFIC MORTALITY

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Background: Index-based scoring systems may be used to evaluate dietary patterns and health outcomes.

Objective: To investigate and compare the relationships between four diet quality indexes—Alternate Healthy Eating Index (AHEI), Alternate Mediterranean Diet Score (aMED), Dietary Approaches to Stop Hypertension (DASH), and Healthy Eating Index-2005 (HEI-2005)—and all-cause, cancer, and cardiovascular disease (CVD) mortality in the National Institutes of Health-AARP Diet and Health Study.

Design: We used data from a 124-item food frequency questionnaire administered at baseline to calculate scores for each index for men and women ($n=492,823$). Deaths were ascertained during 10 years of follow-up and adjusted relative risks and 95% confidence intervals (CI) were estimated.

Results: Higher index scores were associated with a decreased risk of all-cause mortality (comparing the highest quintile scores with the lowest, data shown for men only): AHEI RR: 0.70 (95% CI: 0.68, 0.73), aMED RR: 0.78 (95% CI: 0.75, 0.81), DASH RR: 0.86 (95% CI: 0.83, 0.89), and HEI-2005 RR: 0.92 (95% CI: 0.89, 0.96). Similarly, all indexes showed a reduced risk of cancer mortality: AHEI RR: 0.71 (95% CI: 0.66, 0.76), aMED RR: 0.78 (95% CI: 0.73, 0.82), DASH RR: 0.81 (95% CI: 0.75, 0.88), and HEI-2005 RR: 0.74 (95% CI: 0.69, 0.79). Three indexes showed a reduced risk of CVD mortality: AHEI RR: 0.75 (95% CI: 0.70, 0.79), aMED RR: 0.82 (95% CI: 0.78, 0.87), and DASH RR: 0.90 (95% CI: 0.85, 0.96); and alcohol emerged as an effect modifier for HEI-2005, with increased risk for low levels of alcohol intake and decreased risk for moderate and high levels. Additional analyses explored which components contributed most to the observed associations. Conclusions: Our comparison of four indexes indicated a relatively consistent and protective association between diet quality and all-cause and cancer mortality. This pattern was similar for CVD mortality, with the exception of the HEI-2005, confirming previous evidence that moderate alcohol intake contributes to a reduced CVD mortality risk. The findings illustrate some key differences in the indexes related to how alcohol intake is scored: AHEI and aMED count alcohol as a component contributing to optimal diet quality; HEI-2005 considers alcohol an "empty" source of calories to be limited along with solid fats and added sugars; and in DASH, alcohol is not included as part of the index score. AHEI, aMED, and DASH were readily applied to all health outcomes, and HEI-2005 required additional considerations to develop an appropriate model.

OC 037

DIETARY PATTERNS AND COLORECTAL CANCER INCIDENCE: A CLASSIFICATION TREE ANALYSIS

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Background: Classification and regression tree analysis (CART) is a nonparametric statistical technique used to explore data, assess hierarchical patterns, identify high-risk subgroups, determine key predictors or risk factors, and examine multilevel interactions. CART can handle continuous, dichotomous, ordinal, and nominal variables and does not require the theoretical or distributional assumptions necessary with more commonly used dietary pattern identification methods. Although it is used with increasing frequency in clinical research and epidemiology, to date this novel analytical method has not been applied to examine the complex relationship between diet and colorectal cancer.

Objective: To model the relationship between diet and colorectal cancer incidence using CART.

Design: Participants (n = 491,817) aged 50-71 years from the National Institutes of Health-AARP Diet and Health Study were followed for 10 years, during which time 6,746 incident colorectal cancer cases were ascertained. Dietary intake data were generated from a 124-item food frequency questionnaire administered at baseline. CART analysis was performed on 28 candidate socio-demographic, dietary, and health-related variables separately for men and women. Results from CART analyses are presented in the form of inverted trees; the root node comprises the entire sample, which is subsequently partitioned into binary subgroups (nodes) based on shared characteristics. The procedure continues until all subgroups can no longer be subdivided.

Results: Ten terminal nodes determined the tree structure among women; relevant variables included age, added sugar, red meat, saturated fat, whole grains, and empty calories (i.e., solid fat, alcohol, and added sugar). The two highest-risk subgroups were defined by 1) age (60-67 years) and empty calories (greater than 50 percent of total calories) and 2) age (greater than 67 years) and higher red meat intake. In contrast, the lowest-risk subgroup was younger (less than 58 years) and had lower intakes of added sugar. Among men, the tree structure had eight terminal nodes; relevant variables included age, empty calories, diabetes, and body mass index. The highest-risk subgroup was defined by older age (greater than 61 years) and greater intake of empty calories, whereas the lowest-risk subgroup was younger (less than 58 years), with fewer empty calories. Age had multiple splits in both men and women, suggesting interactions between age and diet.

Conclusions: These findings indicate that CART may be a useful method to identify dietary components most relevant for given health outcomes. The multiple splits on age suggest CART may facilitate identification of key interactions among different variables.

OC 038

DEVELOPMENT AND EVALUATION OF THE HEALTHY EATING INDEX-2010

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The Healthy Eating Index (HEI) is a measure of diet quality that can be used to assess the food available in various environments as well as individual-level diets. The index is based on US federal dietary guidance, which was recently revised with the publication of the *Dietary Guidelines for Americans, 2010* and the accompanying

US Department of Agriculture's Food Patterns. These revisions prompted an update of the HEI-2005. The HEI-2010 retains several features of the previous index: it includes a total of 12 components; it is based on nutrient- and food group-density (using ratios to assign scores); and it employs "least restrictive" standards (those that are easiest to achieve among recommendations that vary by energy level or subpopulation). Many of the components are the same or similar; these include Total Vegetables, Total Fruit, Whole Fruit, Whole Grains, Dairy (formerly "Milk"), Total Protein Foods (formerly "Meat & Beans"), Sodium, and Empty Calories (formerly "Calories from Solid Fats, Alcoholic Beverages, and Added Sugars"). The revision also introduces some important refinements. The former adequacy component, Total Grains, is replaced by a moderation component, Refined Grains, to assess over-consumption; Seafood and Plant Proteins has been added to capture specific choices from the Protein group; Fatty Acids (a ratio of poly- and mono-unsaturated to saturated fatty acids) replaces the Oils and Saturated Fat components to better assess the fatty acid profile; and Beans and Greens replaces Dark Green and Orange Vegetables and Legumes to capture those vegetable subgroups that are the most under-consumed. Validity is being assessed by determining whether the HEI-2010 gives maximum scores to menus that are well-established as having high diet quality, distinguishes between population subgroups with known differences in diet quality, and measures diet quality independently of energy intake. The underlying structure and internal consistency of the index are also being evaluated. The HEI-2010 will be used for a range of purposes, including monitoring the diet quality of the US population and subpopulations and assessing the healthfulness of various food environments.

OC 039

APPLICATIONS AND MODIFICATIONS OF THE MEDITERRANEAN DIET INDEX FOR A MORE PRECISE ESTIMATE OF THE ASSOCIATION WITH LONGEVITY AND MORBIDITY

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Aim: The Mediterranean diet is one of the most cited examples of a priori pattern and has repeatedly been shown to be positively associated with health status. Relative adherence to this pattern has often been evaluated through the Mediterranean Diet Score (MDS), established by Trichopoulou et al. and recently modified in the HALE study to include fish intake. The aim of this work was to compare different refinements and adaptations of the score intended, on one hand, to tailor the score to the Nordic population healthy habits and, on the other hand to more accurately capture a truly healthy pattern in relation to morbidity and mortality reduction. **Methods:** Four refinement variations were applied: the replacement of total cereals with wholegrain cereals, the inclusion of eggs as a further indicator of western diet, the inclusion of alcohol intake and the ascertainment of single ingredients included in mixed dishes and their classification into food groups. Variations intended to tailor the score to the Nordic population habits included: the inclusion of polyunsaturated fats to consider fish contribution and the inclusion of wine instead of alcohol, less likely to be associated with unhealthy drinking. A sensitivity analysis, based on the exclusion of each component of the score (one at a time) helps to assess the score independence from any single component. Analyses were based on three Scandinavian cohorts: the Gerontological and Geriatric study in Gothenburg (Sweden) (H70, N = 1,037, diet history) and Västerbotten Intervention Programme in Umeå (Sweden) (VIP, N = 77,151, food frequency questionnaire), and the MONICA population study in Copenhagen (Denmark) (N = 1,849, 7-day food records). Cox Proportional Hazard Model adjusted for potential confounders (age, BMI, smoking status, physical activity) was used in all studies. **Results and conclusions:** In the H70 elderly study after substituting cereals with wholegrain cereals and including eggs, alcohol and polyunsaturated fatty acids, the resulting pattern was inversely and significantly associated with total mortality (HR = 0.93, 95% CI: 0.89; 0.98). In the MONICA cohort, after including ingredients ascertained from mixed dishes an association both with total mortality (HR = 0.95, 95% CI: 0.89; 1.00) and cardiovascular disease mortality (HR = 0.89, 95% CI: 0.80; 0.98) was found. In the VIP study, the largest cohort but the one where diet was assessed with the least detailed method, we demonstrated an association with both morbidity and mortality without any further refinement of the score. This approach can apply to evaluation of different patterns such as western (unhealthy) diet and Nordic healthy diet in relation to health status. For Mediterranean diet we were able to show an inverse association with both morbidity and mortality, consistently replicated in three Scandinavian cohorts. In smaller studies, highly detailed dietary assessment methods may be required to identify the healthiest and most population-specific patterns.

OC 040

ASSOCIATION BETWEEN DIETARY SCORES AND 13-Y WEIGHT CHANGE AND OBESITY RISK IN A FRENCH PROSPECTIVE COHORT: COMPARISON OF THEIR PREDICTIVE VALUE

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Background/Objectives: The relationship between diet quality and development of obesity is complex and unresolved. The aim of this study was to assess and compare the predictive value of six different dietary scores on both relative weight change and the risk of obesity after 13 years of follow-up in adults aged 45 years and older.

Subjects/Methods: Six scores reflecting adherence to different nutritional recommendations (the French Programme National Nutrition Santé Guideline Score (PNNS-GS), the Dietary Guidelines for Americans Index (DGAI), the Diet Quality Index-International (DQI-I), the Mediterranean Diet Scale (MDS), the relative Mediterranean Diet Score (rMED) and the Mediterranean Style Dietary Pattern Score (MSDPS) were estimated in 3 151 participants in the French SU.VI.MAX study. Associations of dietary scores with 13-year weight change were assessed through multivariate linear regression models, and obesity risk was analyzed with logistic regression, providing odds ratios (OR) and 95% confidence intervals (CI).

Results: Except for the MSDPS, higher scores, i.e. better adherence to nutritional guidelines or to a Mediterranean diet, were associated with lower weight gain in men (all $P < 0.05$). In addition, among men, ORs for becoming obese after 13 years associated with a 1 SD increase in dietary scores ranged from 0.63, 95%CI: 0.51, 0.78 for DGAI to 0.72, 95% CI: 0.59, 0.88 for MDS. Comparison with AUC showed overall no significant improvement to replace one score by another for predicting obesity risk, except for the MSDPS. These associations were weaker or not statistically significant in women.

Conclusions: Overall, the five dietary scores predicted obesity risk equally well. Among French adults, strong adherence to dietary guidelines appears to be protective regarding weight gain and obesity, especially in men.

B-4 ADVANCED STATISTICAL METHODS FOR OBJECTIVE MONITOR DATA

ESTIMATING PHYSICAL ACTIVITY WITH AN ACCELEROMETER: WHAT'S SO HARD?

John Staudenmayer

This talk reviews methods to estimate aspects of physical activity from accelerometers. We will review recent results and progress on feature selection, estimation algorithms, estimate post-processing, and performance evaluation. In addition, we will review different methods of data collection and illustrate the influence that those study designs can have on the success of a method in practical situations. The talk will demonstrate its points with data from Patty Freedson's laboratory at UMass-Amherst and the kinesiology and computational science literature.

Oral Presentations:

OC 041

VALIDATION OF A NOVEL METHOD TO ESTIMATE METS FROM FREE-LIVING ACCELEROMETER DATA: THE SOJOURN METHOD

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¹Kinesiology, ²Math and Statistics

The sojourn method is a three-step data processing technique for estimating METs from free-living accelerometer data. Using simple parameters from the acceleration signal the sojourn method 1) identifies bouts of activity and inactivity, 2) applies non-physical activity MET values to inactivity bouts and 3) applies a neural network to estimate METs for activity bouts.

Purpose: To validate the sojourn method for estimating METs in free-living settings and to evaluate its sensitivity to change in habitual activity.

Methods: Participants (4 males, 9 females) wore an ActiGraph GT3X accelerometer for two, 7-day conditions: inactive and active. Participants were directly observed (DO) once during each condition (mean \pm SD observation period = 9.6 \pm 0.4 hours). A trained observer used a personal-digital-assistant with focal sampling and duration coding to record activity mode, intensity and duration. The sojourn algorithm was developed using

accelerometer and DO data from six participants. Data from the remaining seven participants were used to compare Sojourn MET estimates to DO. Linear mixed effects models were used to assess the average difference between sojourn and DO MET estimates. To evaluate the sensitivity of the sojourn method to change, a linear mixed model with likelihood ratio testing was used to test for differences in mean MET-hours between conditions. Results: Compared to direct observation, the sojourn method accurately estimated MET-hours and time spent in sedentary, light, moderate and vigorous intensity activity (Table).

The sojourn method detected changes in MET-hours between the inactive (19.5 ± 4.1 mean \pm SD) and active conditions (22.5 ± 4.4 mean \pm SD) ($p < 0.001$).

Conclusion: The sojourn method produced accurate MET estimates and detected change in free-living habitual activity.

These results have particular importance for intervention studies where change in habitual physical activity is an outcome. Future work should refine the sojourn method to produce more detailed measures of behavior, including activity type, activity bout duration and breaks from sitting time. The sojourn method should also be compared to traditional approaches.

Support: NIH RC1HL099557

OC 042

EVALUATION OF NEURAL NETWORKS TO IDENTIFY TYPES OF ACTIVITY AMONG CHILDREN USING ACCELEROMETERS, GLOBAL POSITIONING SYSTEMS AND HEART RATE MONITORS

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Introduction: Accelerometers provide objective information about the frequency, intensity, and duration of physical activity. However, they do not provide information about the type of physical activity. Pattern-recognition-based approaches have shown to be successful in classifying a number of controlled physical activities among adults and elderly. Studies applying these approaches to accelerometer data from children are scarce. The purpose of this study was to identify types of physical activity among children using artificial neural network (ANN) models based on accelerometer data. Secondly, it was examined whether the accuracy of the model improved by including GPS or heart rate data.

Methods: Fifty-eight children (31 boys; 27 girls; age range: 9-12 years) performed the following activities in a field setting: sitting, standing, walking, running, rope skipping, playing soccer, and cycling. All children wore a three-axial ActiGraph accelerometer on the hip, a Qstarz Travel Recorder GPS device, and a Polar heart rate device. To classify the activity type, four ANN models were developed; a model based on: accelerometer data, accelerometer data and GPS data, accelerometer data and heart rate data, and accelerometer data, GPS data and heart rate data. The following accelerometer signal characteristics were used as input variables in the models: 10th, 25th, 75th, and 90th percentiles, absolute deviation, coefficient of variability, and lag-one autocorrelation computed over 10 second intervals. For the GPS signal, the mean and absolute deviation were included and for the heart rate signal, only the mean was included in the models. The accuracy of the models was evaluated by leave-one-subject-out cross-validation. Results: In general all models performed well ($>80\%$) in classifying the activities walking, standing still, rope skipping, running, and playing soccer. Cycling was best classified by models including GPS data.

Overall, the model based on accelerometer data correctly classified 82% of the activity types. When adding GPS data, the overall percentage of correctly classified activities improved to 89%. The improvement was lower when heart rate data were added. Finally, the overall percentage of correctly classified activities with the complete model including accelerometer, GPS and heart rate data was 90%. Discussion and conclusion: Applying ANN models to process sensor data from children is promising for classifying common physical activities. The performance of an accelerometer based ANN model improved by 2-8% when including other sensor data. The largest improvement was found when adding GPS data. Including GPS data seemed especially valuable for distinguishing between regular and brisk cycling.

OC 043

HOW MUCH ENERGY DO PRESCHOOLERS REALLY EXPEND? APPLICATION OF ADVANCE STATISTICAL METHODS TO PREDICT ENERGY EXPENDITURE AND PHYSICAL ACTIVITY LEVELS IN PRESCHOOLERS

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Novel approaches to assess physical activity (PA) and predict energy expenditure (EE) are essential for quantifying the characteristically sporadic PA patterns and variable rates of EE of preschool-aged children. In this study, we use fast-response room calorimetry and doubly labeled water (DLW) method to measure EE. We apply advanced technology (Actigraph GT3X and Actiheart accelerometers and miniaturized heart rate (HR) monitors) and sophisticated mathematical modeling techniques (cross-sectional time series, CSTS and multivariate adaptive regression splines, MARS) to develop and validate prediction models that capture the dynamic nature of PA and EE in preschool-aged children. CSTS and MARS models were developed in 69 boys and girls, ages 3 to 5 y, who performed a range of sedentary to vigorous activities while in a room respiration calorimeter.

Mean rates of EE measured by room calorimetry during sleep/awake periods and by DLW for 7-d free-living are summarized in Table 1. For model development, the Actigraph vertical, horizontal and diagonal vectors, as well as steps and position, contribute independently to the prediction of AEE during awake periods. Prediction errors for AEE were $2.1 \pm 16.9\%$ with a RMSE=0.074 kcal/min for CSTS and $0.9 \pm 10.4\%$ with a RMSE=0.048 kcal/min for MARS. Actigraph accelerometry is not applicable during sleep, but in combination with HR can be used to predict EE throughout the 24-h. For Actiheart, heart rate and physical activity counts contribute strongly to the prediction of EE. Actiheart prediction errors for EE were $-0.3 \pm 8.6\%$ with a RMSE=0.092 kcal/min for CSTS and $0.3 \pm 6.0\%$ with a RMSE=0.06 kcal/min for MARS. Actigraph+HR prediction errors for EE were $0.1 \pm 6.8\%$ with a RMSE=0.069 kcal/min for CSTS and $0.3 \pm 4.7\%$ with a RMSE=0.05 kcal/min for MARS.

In conclusion, accurate and precise CSTS and MARS models based on accelerometry and HR monitoring can be used for the quantitative assessment of AEE and EE preschool children.

	Age 3 y	Age 4 y	Age 5 y
n	23	23	23
Calorimeter: Sleep			
EE (kcal/min)	0.55 ± 0.07	0.59 ± 0.06	0.65 ± 0.08
EE (kcal/kg/min)	0.035 ± 0	0.032 ± 0.01	0.033 ± 0
PAR (EE/BMR)	0.95 ± 0.07	0.95 ± 0.08	1.03 ± 0.05
Calorimeter: Awake			
EE (kcal/min)	1 ± 0.17	1.15 ± 0.18	1.22 ± 0.14
EE(kcal/kg/min)	0.063 ± 0.008	0.062 ± 0.007	0.059 ± 0.008
Activity EE (kcal/min)	0.42 ± 0.14	0.53 ± 0.13	0.57 ± 0.11
PAR (EE/BMR)	1.73 ± 0.22	1.86 ± 0.16	1.87 ± 0.15
Doubly labeled Water			
TEE (kcal/d)	1088 ± 140	1258 ± 194	1385 ± 230
TEE (kcal/kg/d)	69 ± 6	69 ± 10	66 ± 13
PAL (TEE/BMR)	1.31 ± 0.13	1.42 ± 0.14	1.46 ± 0.22

*Mean \pm SD

C-4 ASSESSMENT OF PHYSICAL ACTIVITY IN CHILDREN AND YOUTH

Oral Presentations:

OC 044

STEP COUNT TARGET TO MEASURE ADHERENCE TO PHYSICAL ACTIVITY GUIDELINES IN CHILDREN

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Purpose: New physical activity guidelines state that children and youth should accumulate at least 60 minutes of moderate-to-vigorous physical activity (MVPA) every day. There is a lack of robust evidence to support a daily step count target that equates to current physical activity guidelines in children. This information would be useful to studies that are using pedometers to monitor physical activity. Methods: The data source for this analysis was the Canadian Health Measures Survey, a nationally-representative survey of Canadians aged 6-79 years which used accelerometers to collect objective measures of physical activity. All participants were asked to wear an Actical accelerometer for 7 consecutive days. Participants aged 6 to 19 years with 4 or more valid days of

accelerometer data were included in this analysis (number of participants = 1,613; number of valid days = 9,879). Regression analyses were completed on half of the sample to develop a prediction equation to derive a step count equivalent to 60 minutes of MVPA (Equation Development Sample: n = 837; 5,102 days). The other half of the data set was used to cross validate the cut-points obtained (Validation Sample: n = 776; 4,777 days). Sensitivity/specificity analyses were completed to compare the new cut-points to one currently used as a proxy estimate of 60 minutes of daily MVPA (13,500 steps per day). Results: Daily step counts were correlated with daily minutes of MVPA ($R = 0.81$, $p < .0001$). The step count equivalents to 60 minutes of MVPA were derived using linear regression (R^2 range = 0.59-0.74) and ranged between 11,290 steps per day and 12,512 steps per day. The new step count target led to mean overestimation (+2.8 percentage points) in the proportion of days meeting the physical activity target while the previously recommended step count target (13,500 steps per day) led to a mean underestimation in proportion meeting the target of 6.8 percentage points. The 12,000 steps per day target demonstrated improved balance between sensitivity and specificity when compared to a daily step count target of 13,500. Conclusion: The correlation between step counts and daily minutes of MVPA supports the use of pedometers in physical activity surveillance. Based on the results of this study, we propose that 12,000 steps per day be used as a target to determine whether children and youth aged 6-19 years are meeting the current physical activity guideline of 60 minutes of daily MVPA.

OC 045

COMPARING PARENT-REPORT AND DIRECTLY MEASURED PHYSICAL ACTIVITY, SEDENTARY BEHAVIOUR AND SLEEP IN CANADIAN CHILDREN AND THEIR ASSOCIATION WITH HEALTH

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Introduction: There are multiple instruments, procedures and analytical approaches to measure human movement. A clear understanding of how measurement methodology affects the associations between movement behaviours and health is lacking. This study compared parent-reported and directly measured (by accelerometer) physical activity, sedentary behaviour and sleep, and examined their associations, alone or in combination, with selected health outcomes in children aged 6-11 years.

Methods: This sample of children (n = 878) was from the 2007 to 2009 Canadian Health Measures Survey (CHMS), a nationally representative direct health measures survey. Moderate- to vigorous-intensity physical activity (MVPA), sedentary behaviour and sleep were assessed using both accelerometry and a questionnaire. Directly-measured MVPA, sedentary time and sleep were measured using the Actical accelerometer which was worn by survey respondents for 7 consecutive days during waking hours. MVPA was defined as the sum of minutes above 1,535 counts per minute (cpm); sedentary time was defined as the sum of wear time zeros and any observations between 1 and 100 cpm; sleep was defined as the longest non-wear time period on average in a day. Descriptive statistics were used to examine the difference between parent-reported and directly-measured variables. Regression analysis was used to assess the association between parent-reported and directly-measured MVPA, sedentary behaviour and sleep with selected health outcomes. Body mass index (BMI) was derived from directly measured height and weight ($\text{kg} \cdot \text{m}^{-2}$), waist circumference was measured by a trained examiner and blood pressure was measured using an automated monitor.

Results: According to parent-report, the children in this study had an average of 105 minutes of MVPA, 2.5 hours of screen time and 9.7 hours of sleep per day, in contrast to accelerometer measurements of 63 minutes of MVPA, 7.6 hours of sedentary time and 10.1 hours of sleep per day. MVPA, measured by parent-report or accelerometry, was significantly associated with BMI. In a full model (accounting for MVPA, screen time and sleep), directly-measured MVPA and sleep were significantly associated with BMI while directly-measured MVPA was significantly associated with waist circumference. In a univariate model, MVPA was also significantly associated with systolic blood pressure.

Conclusions: Both parent-reported and directly-measured movement variables are associated, to varying degrees, with health outcomes in children aged 6 to 11 years. The differences in estimates of MVPA, sedentary behaviour and sleep between measurement modalities are substantive and have implications with respect to understanding how these behaviours relate to health.

OC 046**SELF-REPORTED VERSUS OBJECTIVELY MEASURED PHYSICAL ACTIVITY & CARDIOMETABOLIC BIOMARKERS AMONG YOUTH IN NHANES**B. Belcher¹, R. Moser¹, K. Dodd¹, A. Atienza¹, R. Ballard-Barbash¹, D. Berrigan¹¹NCI

INTRODUCTION: Moderate to vigorous physical activity (MVPA) has positive effects on cardiometabolic biomarkers in adults. The relationship between biomarkers & MVPA in youth has not been examined in a nationally representative sample. **OBJECTIVE:** The purpose is to compare associations between MVPA measured by accelerometry versus self-report & biomarkers. **METHODS:** 2174 (1110 boys) youth ages 12-19 from the 2003-6 National Health and Nutrition Examination Survey (NHANES) combined cohorts answered a self-report questionnaire about MVPA in the past month & wore an Actigraph 7164 accelerometer (objective activity measure) for at least four 10-hour days. Participants with selected biomarkers & MVPA data were stratified by sex. The biomarkers were: body mass index (BMI, kg/m²), BMI percentile, height (cm), waist circumference (WC, cm), triceps & subscapular skinfolds (mm), high-density lipoprotein (HDL, mg/dl), total cholesterol (TC, mg/dl), systolic & diastolic blood pressure (SBP & DBP, mm/hg), triglycerides (mg/dl), glycohemoglobin (%), insulin (μ U/ml), & C-reactive protein (CRP, mg/dl). Each biomarker was independently regressed on each MVPA measure; models were stratified by sex. Covariates were age, race/ethnicity, SES, physical limitations, & asthma. Statistical significance was set at $\alpha=0.05$. All analyses were conducted using SAS v9.2 & accounted for the complex sampling procedures used in NHANES. **RESULTS:** Girls recorded fewer average min/day of accelerometer-measured MVPA [18.2 (0.9) vs. 33.6 (1.3) min/day; $p < 0.001$] & self-reported physical activity [160.0 (16.1) vs. 214.4 (12.2) min/week; $p=0.006$] than boys. Self-reported MVPA was significantly correlated with accelerometer-measured MVPA ($r=0.16$ for boys & $r=0.095$ for girls; $p < 0.002$). Among boys, accelerometer-measured MVPA was negatively associated with BMI, BMI percentile, height, WC, & triceps skinfold; & positively associated with HDL, & glycohemoglobin ($p < 0.05$ for all). Self-reported MVPA was inversely associated with DBP among boys ($p=0.001$). In girls, accelerometer-measured MVPA was negatively related to SBP levels ($p=0.046$) only. There were no significant associations between self-reported MVPA & biomarkers in girls. Subscapular skinfold thickness, TC, triglycerides, insulin, & CRP were not significantly associated with either measure.

CONCLUSIONS: Similar to adult studies, accelerometer-measured MVPA showed stronger associations with biomarkers than self-reported MVPA. The associations between biomarkers & both measures were stronger in boys. The lack of association in girls could reflect their low levels of MVPA.

OC 047**THE PATTERN AND TIMING OF SEDENTARY BEHAVIOUR ARE RELATED TO BODY MASS INDEX IN BOYS BUT NOT GIRLS**R. Colley¹, D. Garriguet², I. Janssen³, T. Saunders¹, V. Carson³, S. Wong², M. Tremblay¹¹Children's Hospital of Eastern Ontario Research Institute, ²Health Analysis Division, Statistics Canada,³Queen's University

Introduction: The pattern of how sedentary behaviour (SB) is accumulated (e.g., breaks, bouts) is associated with health risk in adults. However, little is known about these relationships in children and youth. The purpose of this study was to examine the impact of novel SB variables relating to the pattern and timing of SB accumulation on obesity in children and youth. **Methods:** The results are based on 1,608 children and youth aged 6 to 19 years from the 2007-2009 Canadian Health Measures Survey. SB was measured using the Actical accelerometer, and was defined as < 100 counts per minute (cpm). A break was considered as an interruption in SB (lasting a minimum of 1 minute) in which the accelerometer count was ≥ 100 cpm. SB time accumulated in prolonged bouts (i.e., 20, 40, 60, 80, 100 and 120 minutes) was also derived from the data. All SB variables were examined as minutes and % of the day. SB variables were examined on all days, on weekends only, and on weekdays after 3pm only. Overweight/obesity was defined using International Obesity Task Force cut-points. Data are presented as mean \pm standard error and significance was set at $p < 0.05$. **Results:** Total SB (min·d⁻¹), pattern of SB breaks (number or length) and weekend SB did not differ by BMI status in both boys and girls. Prolonged bouts of SB lasting at least 80 minutes, expressed as minutes per day and as a percentage of wear time, was significantly higher in overweight and obese boys compared to healthy weight boys (291 \pm 16 vs. 245 \pm 6 min·d⁻¹; 35% vs. 30% of wear time). SB accumulated during the after-school period was higher in overweight/obese versus healthy weight boys (281 \pm 7 vs. 259 \pm 4 min·d⁻¹); however this finding did not persist when wear time was accounted for. SB bouts lasting 20 minutes or more during the after-school period (weekdays after 3pm) were significantly higher in overweight and obese boys compared to healthy weight boys (20+min bouts: 246 \pm 9 vs. 219 \pm 5; 56% vs. 51% of after-school period). Pattern and timing of SB did not differ between healthy weight and overweight/obese girls. **Conclusion:** The findings of this study indicate that prolonged bouts of SB, particularly when accumulated during the after-school period, are associated with obesity in boys but not girls. Future studies using accelerometry to measure SB should examine the timing and duration of SB in addition to total daily sedentary time.

A-5 ASSESSMENT OF DIETARY PATTERNS FOR HEALTH

ASSESSMENT OF DIETARY PATTERNS FOR HEALTH: WHAT ARE THE CONNECTIONS?

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A number of studies published in 2011 and 2012 explore the relationship between dietary patterns and health outcomes. Alcohol and macronutrient intake patterns have been shown to be related to general and central adiposity by Swedish researchers. Also in Sweden, researchers from the Malmö diet and cancer cohort reported differences by sex due to dietary fiber and saturated fat intakes. Changes in dietary patterns among Chinese adults have been linked to hypertension. Korean school girls demonstrated changes in physical growth, particularly changes in body mass index, body fat, and bone mineral which resulted from distinctly different dietary patterns, while metabolic syndrome in Korean adults has been associated with breakfast patterns. In the US, researchers from the Coronary Artery Risk Development in Young Adults (CARDIA) Study suggested that both dietary patterns overall and diet beverage consumption in particular are related to a number of different metabolic outcomes. From the Women's Health Initiative Observational Study, US researchers reported associations between dietary patterns and risk of cardiovascular disease. In a short-term physical activity randomized trial, researchers from the Pennington Biomedical Research Center noted that active individuals had healthier dietary patterns than individuals who were sedentary or less active. As researchers focus on comparing health and disease risk with specific dietary components, it is clear that the whole concept of dietary patterns continues to define the populations of interest.

Oral Presentations:

OC 048

THE DIETARY APPROACHES TO STOP HYPERTENSION (DASH) DIET INDEX SCORES AND COLORECTAL CANCER RISK: A COMPARISON OF FOUR APPROACHES

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Background: The Dietary Approaches to Stop Hypertension (DASH) dietary pattern, which is rich in fruits, vegetables, whole grains, and low-fat dairy and low in total fat, saturated fat, sodium, and cholesterol, is similar to the largely plant-based dietary pattern recommended for cancer prevention. In previous studies, researchers have created DASH diet index scores using four different approaches to examine associations with health outcomes.

Objective: To calculate and compare DASH diet index scores according to the four methods identified in the literature and to examine the relationship between scores and colorectal cancer incidence.

Design: Participants (n = 491,817) aged 50-71 years from the National Institutes of Health-AARP Diet and Health Study were followed for 10 years, during which time 6,746 incident colorectal cancer cases were ascertained. DASH scores were generated from a 124-item food frequency questionnaire administered at baseline. The indexes were based on 1) seven food groups, saturated fat, and alcohol (Dixon's Method); 2) nine nutrient intakes (Mellen's Method); 3) seven food groups and sodium (Fung's Method); and 4) eight food groups (Günther's Method). Higher scores on all indexes indicate greater adherence to the DASH dietary pattern. Hazard ratios (HR) and 95% confidence intervals (CI) for colorectal cancer were generated with Cox proportional hazard models separately for each of the four DASH indexes, stratified by sex.

Results: After multivariable adjustment for known and suspected risk factors, DASH scores were inversely associated with colorectal cancer for each method among men, with the largest risk reduction observed with Dixon's Method (HR comparing the fifth to the first quintile = 0.67; 95% CI = 0.56, 0.80). Results were comparable for Mellen's (HR = 0.81; 95% CI = 0.73, 0.90), Fung's (HR = 0.75; 95% CI = 0.68, 0.83), and Günther's Methods (HR = 0.81; 95% CI = 0.73, 0.90). Among women, greater adherence to the DASH dietary pattern was associated with a lower risk of colorectal cancer with Mellen's (HR = 0.81; 95% CI = 0.71, 0.94) and Fung's (HR = 0.85; 95% CI = 0.74, 0.97) but not Dixon's or Günther's Methods.

Conclusions: The consistency of our findings across methods in men suggests that the key features of the DASH dietary pattern are captured with each approach and that greater compliance with a DASH dietary pattern is associated with reduced colorectal cancer incidence. Nevertheless, the method used to operationalize the DASH dietary pattern can have a differential impact on findings as shown in our results among women.

OC 049

MEDITERRANEAN DIET SCORE AND PROSTATE CANCER RISK IN SWEDEN

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Background: Several components of the traditional Mediterranean diet have been shown to reduce the risk of prostate cancer (PC). Also, the Mediterranean countries have lower PC incidence compared to the Nordic and North American countries, suggesting a potential protective effect of the Mediterranean lifestyle. To our knowledge, the present study is the first to investigate the association between the Mediterranean diet and PC risk. Moreover, we have used several variants of the Mediterranean Diet Score (MDS) to explore its usefulness in non-Mediterranean populations. **Methods:** Dietary intake was assessed using FFQ data from 1,482 incident PC patients and 1,108 population-based controls in the Cancer of the Prostate in Sweden (CAPS) study. We created four MDS variants with different cut-off values for high versus low intake of each score component: our main score used the study-specific median intake in grams/day (MDS-gram); a second variant used the median intake in servings/week (MDS-serv); a third variant used the 25th or 75th intake percentile in grams/day (MDS-cent); and a fourth variant used the median intake in grams/day in a Greek reference population (MDS-greek). Additionally, a fifth variant based on alternative dietary components was created using study-specific median intakes in grams/day as cut-off values (MDS-alt). Each summed MDS variant was categorized into low, medium, and high score. We used unconditional logistic regression to estimate the relative risk of PC for high and medium versus low score for each MDS variant separately. We also modeled the effect of each individual score component. Correlation between the five variants was estimated by Spearman correlation coefficients.

Results: No statistically significant association was found between either of the MDS variants and PC. However, a 15-30 % increased risk of total and advanced PC, comparing high to low score, was suggested for MDS-alt, MDS-greek, and MDS-cent. Among individual score components, a high ethanol intake was associated with a 31 % increased risk of advanced PC, and a high vegetable intake was associated with a 27 % and 43 % increased risk of total and advanced PC, respectively. Correlation between the MDS variants ranged from 0.43 to 0.79.

Conclusion: We found no support for an association between the Mediterranean diet and PC in this Swedish population. However, the results differ between the MDS variants. We propose that the original MDS with study-specific median intakes as cut-off values is suitable for assessing adherence to the Mediterranean diet in non-Mediterranean populations.

OC 050

HOW WELL DOES A TYPE 2 DIABETES PREVENTION INDEX SCORE (T2DPIS), PREDICT INCIDENCE OF THE DISEASE IN THE U.K WOMEN’S COHORT STUDY?

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Aims: This study aims to create a Type 2 Diabetes Prevention Index Score (T2DPIS) and assess the association of dietary patterns identified in relation to incidence of Type 2 diabetes (T2DM). **Method:** A T2DPIS was created based on information from a 217-item Food Frequency Questionnaire completed by 35,000 participants of the U.K Women’s Cohort Study (UKWCS) between 1995 and 1998. Ascertainment of T2DM was established 5 years subsequent to baseline measurements with around 14,000 respondents. Odds ratios (OR) for T2DM were calculated using logistic regression and adjusted for known diabetic risk factors. **Results:** A total of 114 incident cases of T2DM developed during 5 years of follow up. Women adhering to a healthy dietary pattern (quartile 5) were at decreased odds of T2DM when compared to quartile 1. The OR for the age adjusted model were 0.48 (95% CI; 0.27, 0.86, $p_{\text{trend}}=0.01$). Further adjustment for a range of covariates did not modify this association: 0.49 (95% CI 0.24, 0.98 $p_{\text{trend}}=0.02$). Results for the multivariate model plus body mass index and energy intake was not significant with OR; 0.51 (95% CI; 0.25, 1.07 $p_{\text{trend}}=0.03$). However quartile 4 shows a significant reduction in OR of T2DM; 0.47 (95% CI; 0.23, 0.96 $p_{\text{trend}}=0.03$). **Conclusion:** Consuming a healthy dietary pattern as characterized by the T2DPIS is associated with decreased odds of T2DM. Consequently the T2DPIS has potential for use in public health settings as a guide to preventing T2DM.

OC 051

DIETARY PATTERNS OF WOMEN, ABDOMINAL OBESITY, AND METABOLIC SYNDROME: THE FRAMINGHAM NUTRITION STUDIES

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Background: Metabolic syndrome (MetS) is associated with a 3-fold risk for cardiovascular disease and a 5- to 7-fold risk for diabetes in women. Diet is postulated to be a key etiological factor of MetS and MetS components. The dietary pattern approach may better inform the association of diet and the syndrome; however, data on the relationship between empirical dietary patterns and MetS and its components in prospective studies is limited. The effect of other MetS determinants such as age and smoking status on the association of dietary patterns and MetS is also not clear. **Objectives:** To evaluate the association between empirical patterns and MetS and its components in women as well as the effect of age and smoking status on these relationships.

Methods: We examined 1146 Framingham Offspring/Spouse Study women aged 25–77 years and without cardiovascular disease, diabetes, cancer, and MetS at baseline over a 7-year mean follow-up. Diet intake was collected using a 145-item food frequency questionnaire. Five dietary patterns: Heart Healthier, Lighter Eating, Wine and Moderate Eating, and Empty Calorie, were previously identified using cluster analysis. The relationships of dietary patterns and MetS and its components were assessed using logistic regression.

Results: Higher Fat (higher in oils, soft margarine, vegetable fats, and refined grains and lower in high-fat dairy and snack foods) and Wine and Moderate Eating (higher in wine and lower in sweetened beverages and desserts) dietary patterns were associated with lower odds for abdominal obesity (Higher Fat: OR 0.3, 95% CI 0.1–0.8; Wine and Moderate Eating: OR 0.2, 95% CI 0.1–0.7) compared to the Empty Calorie pattern (higher in sweetened beverages and desserts) after adjusting for baseline age, physical activity, smoking status, menopausal status, other MetS components (elevated blood pressure, elevated glucose, low HDL-cholesterol, elevated triglycerides), and energy intake. Additional adjustment for BMI somewhat attenuated these findings (Higher Fat: OR 0.4, 95% CI 0.2–1.0; Wine and Moderate Eating: OR 0.3, 95% CI 0.1–1.0). None of the clusters was associated with MetS and other MetS components. Age and smoking status did not modify the relationship between dietary patterns and MetS and its components.

Conclusions: We found an inverse association between empirical dietary patterns of women and measures of adiposity. However, because these reflect existing eating patterns, they do not necessarily represent optimal dietary patterns for disease prevention.

OC 052

ASSOCIATION BETWEEN DIET AND HIP FRACTURE RISK: COMPARISON BETWEEN A PRIORI (MEDI SCORE) AND A POSTERIORI DERIVED DIETARY PATTERNS IN ELDERLY PEOPLE.

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Introduction. Hip fractures are relatively common in elderly and lead to severe consequences, such as persistent pain and limited mobility. Nutrition may play a role in preventing hip fractures and the promotion of healthy diets could contribute to decreasing fracture risk in older persons. To identify healthy dietary patterns is therefore a major issue. **Objective.** To compare an *a priori* dietary pattern (the Mediterranean diet (MEDI) score) with an *a posteriori* (derived from a Principal Component Analysis - PCA) dietary pattern on the risk of occurrence of hip fractures in elderly community dwellers. **Methods.** The sample consisted of 1482 participants from Bordeaux, France (932 women, 550 men) aged 67 years and over included in the 3C study, a prospective cohort study of vascular risk factors of dementia. The participants had a dietary survey in 2001-2002 and were followed-up every two years for 8 years. Occurrence of hip fracture was self-reported at each wave. The *a priori* dietary pattern was based on the MEDI score already associated with lower risks of cardiovascular diseases, cancer and dementia. The score was divided into three classes corresponding to low (score 0 to 3), moderate (4 to 5) and high adherence (6 to 9). The *a posteriori* dietary pattern was developed using a PCA and individual scores on PCA components were used. Dietary pattern scores were used as explanatory variables in Cox regression models to estimate relative risk of occurrence of the first hip fracture, controlling for age, gender, education, marital status, body mass index, total energy intake, supplementation with calcium and/or vitamin D, self-reported osteoporosis, osteoporosis treatment and falling. **Results.** After eight years of follow-up, 57 incident hip fractures were recorded. The MEDI score was not associated with occurrence of hip fractures ($p=0.50$); however moderate ($HR=1.34$, $p=0.41$) and high adherence ($HR=1.57$, $p=0.24$) to the MEDI showed non significant higher risks of occurrence of hip fractures compared to the reference category (low adherence). In the PCA, three components

with eigenvalues greater than one explained 53% of the variance of dietary intake. The score on the third component, characterized by a high intake of calcium, phosphorus, vitamin D, proteins and lipids, and a low consumption of carotene, folate, fiber and vitamin C, was associated with a significantly decreased risk of hip fracture (HR=0.78, p=0.03). The other components were not associated with hip fracture risk. Conclusion. The *a priori* healthy MEDI score was not associated with a lower risk of occurrence of hip fractures but tended to show an increased risk as adherence increases. By contrast, the *a posteriori* pattern was associated with a lower risk of hip fractures. This pattern was related to a higher consumption of cheese, milk and charcuterie and a lower consumption of fruit and vegetables. Such a pattern is opposed to the MEDI score highly loaded in fruit and vegetables and inversely loaded in dairy products. The MEDI score cannot be considered as a universal healthy dietary pattern when analyzing the association between food intake and various health statuses.

B-5 MEASUREMENT AND DETECTION OF FOOD CONSUMED OUTSIDE THE HOME

FACTORS WHICH INFLUENCE THE CONSUMPTION OF STREET FOODS AND FAST FOODS IN SOUTH AFRICA-A NATIONAL SURVEY

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Background: Very little is known about street food and fast food consumption patterns in South Africa despite this being a large sector of the national economy in terms of employment provided and sales of food. The objective of this study was to determine the use of street foods and fast foods purchased by South Africans living in different provinces and geographic areas.

Methods: A cross-sectional survey was conducted. Structured interview-administered questionnaires in 11 official languages were conducted at the participants' homes. A nationally representative sample (n=3287) was drawn from all ethnic groups, and provinces including participants 16 years and older. Logistic regression was done to evaluate factors impacting on fast food consumption.

Results: Frequent (2 ≥ times/week) street food consumption ranged from 1.8% in Northern Cape to 20.6% in Limpopo; frequent (2 ≥ times/week) fast food consumption ranged between 1.5% in North West Province to 14.7% in Gauteng. The highest intake of street food was in the medium socio-economic category (14.7%) while the highest intake of fast foods was in the high socio-economic category (13.2%). Overall, fruit was the most commonly purchased street food by all ethnic groups over the previous week although this practice was highest in black participants (35.8%). Purchases of soft drinks ranged from 4.8% in whites to 16.4% in blacks and savoury snacks from 2.3% to 14.5% in whites and blacks, respectively. Consumption of fast foods and street foods were influenced by a number of socio-demographic factors including ownership of major home appliances. Frequent fast food consumers had a significantly higher dietary diversity score (4.69; p<0.0001) while frequent street food consumers had a significantly lower score (3.81; p<0.0001).

Conclusions: A large percentage of the population purchase street foods and fast foods. This is of some concern when one notes the high prevalence of soft drink consumption in terms of its association with obesity and non-communicable diseases. These findings need to be taken into consideration when evaluating dietary patterns and nutritional adequacy of population diets.

Available: Steyn NP, Labadarios L, Nel JH. Factors which influence the consumption of street foods and fast foods in South Africa- a national survey. *Nutr J.* 2011 Oct 4;10(1):104. (<http://www.nutritionj.com/content/10/1/104/abstract> . Funded by: Human Sciences Research Council

A NEW CLASSIFICATION OF FOODS BASED ON THE EXTENT AND PURPOSE OF FOOD PROCESSING

Carlos Augusto Monteiro and Geoffrey Cannon

It is generally acknowledged that increased consumption of industrially processed foods and drinks is an important cause of the current pandemics of obesity and related chronic diseases. However, dietary assessments, and dietary recommendations typically use food classifications that ignore or minimize the significance of industrial food processing. In this way, foods with very different nutritional profiles and impacts on eating patterns, energy balance, and health, such as whole grains, flours, breads, cookies, crackers, and 'power bars' are classified within the same food group of *grains* or *cereals and cereal products*. The same applies to *fruits and fruit products*, *meat and meat products*, and so on. Such classifications, derived from nutrient-based classification systems originally devised early last century, when obesity was uncommon, and when only a

relatively small amount of food was purchased in mass-manufactured form, still dominate accounts of population dietary patterns. Because food processing is overlooked in such classifications, the literature includes only fragmentary information about and insight into the relationships between processed foods, and eating patterns, energy and nutrient intake, and health. Some evidence has emerged but the focus so far has been on the effect only of specific types of processed foods, and not on the overall pattern of processed food production and consumption. Here we outline a new food classification which groups foodstuffs according to the extent and purpose of industrial food processing. Group 1 involves no processing or mostly physical processes used to make single whole foods more durable, accessible, convenient, palatable, or safe. Group 2 involves the extraction and purification of components of single whole foods, resulting in producing ingredients used in the kitchen preparation and cooking of dishes and meals made up from Group 1 foods. These ingredients are inedible by themselves, and provide essentially energy. The manufacture of Group 3 products involves Group 2 ingredients combined usually with small or even insignificant amounts of Group 1 foods, and often with cosmetic as well as other chemical additives. The use as ingredients of solid fats, sugars, processed starches and preservatives gives them a long 'shelf life'. They are typically formulated to be ready-to-eat or ready-to-heat, to be consumed virtually everywhere and doing any other thing, to be intensely attractive to the senses, and often to be habit-forming. The new classification is designed as a tool to describe food systems and dietary patterns, and how these may affect health and the risk of disease.

Oral Presentations:

OC 053

DOES ENVIRONMENTAL FOOD SUPPLY INFLUENCE JUNK FOOD CONSUMPTION OF PRESCHOOL AND SCHOOL CHILDREN? FIRST RESULTS OF THE IDEFICS STUDY

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Background: The availability of fast foods, sweets, and other snacks in the living environment are assumed to contribute to an obesogenic environment. In particular, it is hypothesized that higher availability of food outlets and fast food restaurants clustering around schools leads to higher consumption of energy-dense foods in children. Studies that support this relationship were mostly conducted in the US or Australia, but rarely in a European context. In a first approach, we used FFQ and SACINA data of the IDEFICS study as well as geographical data of one study region to investigate clustering of food outlets around schools and the influence of junk food availability on food intake in school children.

Methods: We geocoded food outlets offering junk food, i.e. supermarkets, kiosks, and fast food restaurants, located in the German intervention region of the IDEFICS study. Spatial cluster analysis of junk food supply around schools was conducted using an inhomogeneous k-function to calculate global 95% confidence envelopes. We considered the footpath network to generate service areas of schools using GIS. A food supply index was implemented calculating the mean kernel density of junk food supplies per service area, adjusted for residential density and land use mix. We linked the junk food supply index to FFQ and SACINA data of 404 6- to 10-year-old school children in the study region. To investigate the impact of the index on food intake, we used multilevel regression models adjusting for sex, age, BMI, parents' education and income, as well as over- and underreporting of food intake.

Results: With regard to the k-function, food stores and fast food restaurants did not significantly cluster around schools. Additionally, the food supply index showed no effect on weekly portions of junk foods ($\beta=0.04$, $p=0.67$) and simple sugar foods ($\beta=0.02$, $p=0.80$) as well as energy intake (100 kcal) ($\beta=-0.25$, $p=0.36$), fat intake (g) ($\beta=-2.6$, $p=0.21$), and carbohydrate intake (g) ($\beta=2.5$, $p=0.66$) per day.

Conclusion: In the built environment of the German study region, clustering of food outlets depends on major streets and the inner city, but not on schools. Additionally, the results suggest that the consumption of junk food in young children mainly depends on individual food choices than on environmental exposure to fast food. However, investigations should be expanded to increase environmental variability of the built environment to verify this hypothesis.

OC 054

OUT-OF-HOME EATING PREVALENCE IN THE CITY OF SÃO PAULO, SOUTHEAST BRAZIL

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Introduction. Out-of-home eating has been considered to have an influence on the increasing rates of overweight and obesity in Brazil, but as of yet, there has been no direct evidence supporting this assertion.

Objective. To identify foods and recipes consumed out-of-home.

Method. A population-based survey comprising 209 teenagers (12-19 years of age), 327 adults (20-59 years of age) e 298 elderly (60 years of age or more) of both sexes. The food intake was measured by 24-h dietary recall applied by telephone using the Automated Multiple-Pass Method incorporate into the Nutrition Data System for Research software developed at the University of Minnesota, Minneapolis. This software uses the food composition database of the US Department of Agriculture. The Automated Multiple-Pass Method is a 5-step dietary interview - (1) the quick list, which is an uninterrupted listing by the subject of foods and beverages consumed; (2) the forgotten foods list, which queries the subject on categories of foods that have been documented as frequently forgotten; (3) a time and occasion at which foods were consumed; (4) the detail cycle, which elicits descriptions of foods and amounts; and (5) the final probe review- that includes multiple passes through the 24 h of the previous day, during which respondents receive cues to help them remember and describe foods they consumed. The foods and recipes consumed out-of-home were ranked according to the absolute and cumulative frequency of consumption. The statistical analyses were performed in STATA (version 10).

Results. Overall, 36% of respondents reported have made at least one meal out-of-home, of which 31% were teenagers, 51% were adults and 17% were elderly. Higher prevalence of out-of-home meals were observed among women (58%). The out-of-home eating was composed of 90 different foods and recipes and only 10 of them accounted for 50% of the cumulative frequency of consumption: vegetables (11.28%), rice (6.30%), sugar (6.09%), refrigerant (6.03%), coffee (5.72%), candies and chocolate (4.24%), white bread (4.18%), beans (3.81%), milk (3.18%) and steak (2.86).

Conclusion. The out-of-home eating was more prevalent in adults and women and was composed of both of foods that have been considered risk factors for obesity (refrigerant, sugar, candies and chocolate) as well as Brazilian typical food, such as vegetables, rice, beans, milk and steak.

OC 055

ASSESSING EATING CONTEXT: NEW METHODS USING DIET DIARIES IN THE UK NATIONAL DIET AND NUTRITION SURVEY (2008-2010).

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There is currently limited understanding of the relationship between eating context (EC) and food consumption. This study presents a new methodology to identify relationships between four EC elements and fruit and vegetable (FV) consumption in UK children. Using a 4 d unweighed diet diary, data was collected for 642 children aged 1.5-10y in the first two years of the UK National Diet and Nutrition Survey (2008-2010). Participants recorded all foods and drinks consumed at each eating occasion (EO), as well as where and with whom it was consumed, whether the TV was on and if eaten at a table. Total fruit (F), vegetable (V) and FV consumption were calculated for each EO. The odds of consuming F, V, FV were calculated for each eating context factor using mixed-effects logistic regression. Given F, V, FV were consumed in the EO, associations between each eating context factor and quartiles of F, V, FV were established using multilevel multinomial logistic regressions. Analyses were performed on all ages, and stratified by age groups 1.5-3y, 4-6y and 7-10y. All models were adjusted for age, sex, time of meal, weekend/weekday variation. Total number of EOs was 16,840 over the recording period. The majority of EOs were at home (73%) and 14% at school (4-10y only). 31% of EOs were with parents. Frequency of eating alone and with friends increased with age. Compared to eating at home, children 1.5-3y were more likely to consume >10-50g (OR:2.57; 1.51-4.36) and >50-100g (OR:2.25; 1.31-3.85) of F at care outside home; to consume F (>10-50g OR:2.71; 1.24-5.93; >50-100g OR:3.65; 1.68-7.91) with friends and with carer and other children/others (>10-50g OR:2.40; 1.22-4.70; >50-100g OR:2.02; 1.01-4.04) than with parents. Similarly, those aged 4-6y were more likely to eat greater amount of F (>50-100g OR:3.45; 1.91-6.24; >100g OR:1.82; 1.03-3.22) and medium amount of V at school (>30-60g OR:3.57; 1.83-6.99) than at home; and to eat V with friends (>30-60g OR:3.89; 1.91-7.91) than with parents. In general, children were more likely to eat V without the television on, seated at a table, although the quantity consumed was not related to TV or at table. Differences of FV consumption were observed in children in different EC. Higher likelihoods of FV consumption were seen for structured settings such as school and care outside home compared to at home. This EC assessment method can be a simple addition to current dietary assessment tools to enable further understanding of diet determinants. Further validation is needed to verify these findings.

OC 056

THE HECTOR EATING OUT QUESTIONNAIRE: A DATA COLLECTION TOOL TO ASSESS OUT OF HOME DIETARY INTAKES

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INTRODUCTION: Comparisons of results on dietary intakes when eating out are limited by the lack of agreement on which occasions directly relate to foods prepared or consumed outside the home.

Furthermore, the number of surveys distinctly addressing this component of the daily diet is limited.

OBJECTIVES: To develop a questionnaire assessing eating out, described through a comprehensive definition. To pilot-test the questionnaire's performance in a sample of free-living adults.

METHOD: In the context of the EU-supported research project on "Eating out: Habits, Determinants, and Recommendations for Consumers and the European Catering Sector (HECTOR)" a questionnaire was developed to assess and monitor the frequency of eating out; record characteristics of recent eating out occasions; and understand attitudes towards eating and snacking out of home. Researchers from 10 European countries formulated the first questionnaire version and tested it for its feasibility as a self- or interviewer-administered data collection tool. Interviewers and respondents further replied to evaluation questionnaires and proposed improvements were incorporated. The final version was translated to Greek, using translation/back-translation procedures and was interviewer-administered in a sample of 115 Greek adults, supplementing a 24-hour dietary recall. Data collection took place through the pilot national health and nutrition survey coordinated by the Hellenic Health Foundation, undertaken during November 2010- July 2011 in ATTICA regions with a sample selected to represent age and sex-distributions of the population. The procedures included (in this order): (a) provision of a 24-hour dietary recall; (b) information and clarification on how eating out was defined; and (c) completion of the HECTOR eating out questionnaire.

RESULTS: Participants and interviewers noted that the use of an extensive definition on eating out which covered various cultural aspects and was provided prior to data collection, substantially facilitated the interview. Preliminary data analysis further showed that the questionnaire clarified and supplemented the data on food and beverage consumption outside the home collected through the 24-hour dietary recall. Indicatively, the information on the items and quantities consumed was supplemented by information on the place of food preparation and consumption, the reasons for choosing to eat out, as well as determinants of secular changes in the eating out habit.

CONCLUSION: Eating out is common in modern societies, but the related dietary intakes have not been adequately measured and detected. The HECTOR eating out questionnaire addresses this gap in dietary assessment methodology and can thus provide useful insights in understanding dietary habits and formulating food policies.

* List of full HECTOR Consortium is available at <http://www.nut.uoa.gr/hector>.

C-5 ASSESSMENT OF SEDENTARY BEHAVIOR

ASSESSMENT OF ADULTS' SEDENTARY BEHAVIORS: CONSIDERING CONTEXTS, TIME, BREAKS AND BOUTS

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Most adults spend the majority of their waking hours sitting. Evidence has been accumulating rapidly over recent years, showing that prolonged sitting time has deleterious health consequences, even for those who meet public-health guidelines on moderate-to-vigorous physical activity. Initial evidence came from studies that assessed television viewing (TV) time by self-report. In prospective observational studies, TV time has proved to be associated with premature mortality, as has overall sitting time measured by self-report. Recent evidence on the relationships of device-based measures of sedentary behavior (derived primarily from accelerometer counts) with risk biomarkers is providing new insights. For improving measurement, context must be considered: workplace, domestic and transportation environments in particular, within which distinct measurement challenges arise. Accurately characterizing overall sedentary time is a priority, but observational and experimental studies suggests that patterns of sedentary time – that will vary and may be more or less amenable to change in workplace, domestic and transportation contexts – can have distinct relationships with health outcomes. Findings from AusDiab (the Australian Diabetes, Obesity and Lifestyle Study) and NHANES (the US National Health and Nutrition Examination Survey) using device-based measurement (via accelerometers) show that more-frequent short breaks from sedentary time appear to be protective; for example, those in the lowest quartile of breaking up sedentary time had a 4.3cm greater waist circumference compared to those in the highest breaks quartile. The judicious combination of device-based measurement with the most appropriate self-report and/or observational methodologies is required to advance these new perspectives on physical activity and health.

Oral Presentations:

OC 057

MEASURING WORKERS' SITTING TIME BY DOMAIN: THE WORKFORCE SITTING QUESTIONNAIRE (WSQ)

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INTRODUCTION Sitting time is an emerging health risk, and many working adults spend large amounts of time sitting each day. It is important to have reliable and accurate measurement tools to assess sitting time in different contexts. We adapted an existing measure of total and domain-specific sitting time, Workforce Sitting Questionnaire (WSQ) and validated its measurement properties for assessing sitting time in workers based on work and nonworkdays. **METHODS** A convenience sample (N=95, 63% female) was recruited from two workplaces and by word-of-mouth in Sydney, Australia. Participants completed a study questionnaire on two occasions, seven days apart, and reported their domain-specific sitting time [i.e., a) while travelling to and from places; b) while at work; c) while watching TV; d) while using a computer at home; and e) while doing other leisure activities] on work and non-workdays. Participants also wore an Actigraph accelerometer for the seven days in between test-retest, recording the times they wore the accelerometer, the days they worked, and their work times in a logbook. Analyses determined test-retest reliability with intraclass correlation coefficients (ICC) and assessed criterion validity against accelerometers using Spearman's rho. We assessed concurrent validity against the International Physical Activity Questionnaire (IPAQ) sitting items. **RESULTS** Measuring total sitting based on a workday, non-workday and on average had fair to excellent test-retest reliability (ICC=0.46-0.90) and had sufficient criterion validity against accelerometry in women (r=0.22-0.46) and men (r=0.18-0.29). Measuring average total sitting time correlated well with average total sitting time assessed by IPAQ, indicating adequate concurrent validity in women (r=0.53) and men (0.69). Measuring domain-specific sitting at work on a workday was also reliable (ICC=0.63) and valid (r=0.45). **CONCLUSION** The WSQ provides a detailed assessment of sitting in working adults and has acceptable measurement properties for measuring sitting time at work on a workday and for assessing total sitting time based on work and non-workdays. Many working adults spend large amounts of time sitting each day. This questionnaire would be suitable for use in research investigating the relationships between sitting time and health in working populations.

OC 058

THE SEDENTARY TIME AND ACTIVITY REPORTING QUESTIONNAIRE (STAR-Q): A COMPREHENSIVE TOOL TO ASSESS SEDENTARINESS AND ACTIVITY ENERGY EXPENDITURE.

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Activity energy expenditure (AEE) and sedentary behaviours are of interest in etiologic studies of energy balance and chronic disease prevention; however, few logistically feasible, cost-effective tools exist for assessing these dimensions of activity in large population studies. Our newly developed, cognitively tested STAR-Q was designed specifically to estimate sleep duration, stair climbing, sedentary time and all dimensions and domains of physical activity over a 28-day period. Between 2009 and 2010, 106 free-living adults (61 women and 45 men) aged 30 to 60 years were recruited to the *Measuring Activity Related Energy Expenditure Study*, with the objective of validating and testing the reliability of the STAR-Q. Participants who had not been diagnosed with cancer, liver, kidney and metabolic (e.g. thyroid, diabetes) disorders, BMIs ≤ 35 and were 60 years of age or younger were eligible. We report reliability estimates for total energy expenditure (TEE; kcal/d), AEE (kcal/d), sedentary time (≤ 1.5 METs), and light (>1.5 METs ≤ 3), moderate (>3 METs ≤ 6) and vigorous intensity (>6 METs) physical activities. The STAR-Q was administered to participants on three occasions, at baseline (STAR-Q1), 3-(STAR-Q2) and 6-months (STAR-Q3). On average across all questionnaires, participants reported 8 hours of sleep, 5 hours of occupational time, and 2 hours of household, <1 hour of exercise and 3 to 4 hours of light leisure activity per day. Log transformed variables are used for estimates of intraclass correlation coefficients (ICCs (95% confidence interval)) for reported activities on STAR-Qs 1 vs 2 and 1 vs 3. ICCs (95%CI) for TEE and AEE were 0.79 (0.70; 0.85) and 0.71 (0.60; 0.80) for STAR-Q 1 vs 2; and 0.73 (0.62; 0.81) and 0.63 (0.49; 0.74) for STAR-Qs 1 vs 3. ICCs for sedentary behaviour, light, moderate and vigorous activity were 0.49 (0.32; 0.63), 0.62 (0.48; 0.73), 0.84 (0.77; 0.89) and 0.56 (0.41; 0.68) for STAR-Qs 1 vs 2; and 0.44 (0.26; 0.59), 0.51 (0.34; 0.65), 0.87 (0.81; 0.91) and 0.41 (0.23; 0.57) for STAR-Qs 1 vs 3. Fair to excellent repeatability of sedentary behaviour and physical activities across all intensities were observed for

STAR-Qs completed 3 and 6 months apart. Of note are the very good to excellent agreements for moderate intensity physical activities and estimates of overall energy expenditure despite administration of the questionnaires at 3 month intervals and during different seasons. Additional reliability studies and validation testing against doubly labelled water are underway.

OC 059

MEASURING EPISODES OF SEDENTARY BEHAVIOUR USING SENSECAM: A PILOT STUDY

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Sedentary behaviour is independently associated with negative health outcomes but its measurement is a challenge in public health. The study investigates the feasibility of using wearable image capture devices to objectively record, identify and categorize the type and context of an individual's sedentary behaviours in a free living context.

METHOD:

Adult participants (n=62), wore SenseCam (a person worn camera) for 2-3 days of normal free-living activities. Initial exploration of 16 days of images from 6 participants generated a provisional set of both context and types of sedentary behaviours. A protocol for identifying sedentary bout duration was devised and tested from analysis of a further random sample (n=10). Three researchers separately categorized the list of observed behaviours into a coding framework and applied it to a further random sample (n=20).

RESULTS:

59,656 images were reviewed. The interrater agreement for bout duration was ICC = 0.997. Agreement for categorizing behaviours was 0.646 (Cohen's Kappa). Mean time spent sedentary was 460.6 mins/day (95% CI: 397.5-523.6). At work individuals mean sedentary time was 320.35 mins/day (95% CI: 246.1-394.6) and 131.1 mins/day (95% CI: 80.0-182.1) in home settings. Mean sedentary time at a screen was 288.3 mins/day (95% CI: 224.2-352.4).

CONCLUSIONS:

We found Sensecam was able to identify sedentary behaviour in free living settings. In addition it also provided information on the duration, context and type of sedentary behaviour episodes. SenseCam may offer a pragmatic alternative to current objective measurements and provide new insight into the primary determinants of sedentary behaviour.

OC 060

AGREEMENT BETWEEN ACTIPAL AND ACTIGRAPH FOR ASSESSING CHILDREN'S SEDENTARY TIME

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Background: Accelerometers have been used to determine the amount of time that children spend sedentary. However, as time spent sitting may be detrimental to health, research is needed to examine whether accelerometer sedentary cut-points reflect the amount of time children spend sitting. The aim of this study was to: a) examine agreement between ActiGraph (AG) cut-points for sedentary time and objectively-assessed periods of free-living sitting and sitting plus standing time using the activPAL (aP); and b) identify cut-points to differentiate time spent sitting and sitting plus standing.

Methods: Forty-eight children (54% boys) aged 8-12 years wore a waist-mounted AG and thigh-mounted aP for two consecutive school days (9-3:30pm). AG data were analyzed using 17 cut-points between 50-850 counts·min⁻¹ in 50 counts·min⁻¹ increments to determine sedentary time during class-time, break time and school hours. Sitting and sitting plus standing time were obtained from the aP for these periods. Limits of agreement were computed to evaluate bias between AG50 to AG850 sedentary time and sitting and sitting plus standing time. Receiver Operator Characteristic (ROC) analyses identified AG cut-points that maximized sensitivity and specificity for sitting and sitting plus standing time.

Results: The smallest mean bias between aP sitting time and AG sedentary time was AG150 for class time (3.8 minutes), AG50 for break time (-0.8 minutes), and AG100 for school hours (-5.2 minutes). For sitting plus standing time, the smallest bias was observed for AG850. ROC analyses revealed an optimal cut-point of 96

counts·min⁻¹ (AUC = 0.75) for sitting time, which had acceptable sensitivity (71.7%) and specificity (67.8%). No optimal cut-point was obtained for sitting plus standing (AUC = 0.51).

Conclusions: Estimates of free-living sitting time in children during school hours can be obtained using an AG cut-point of 100 counts·min⁻¹. Higher sedentary cut-points may capture both sitting and standing time.

A-6 NEW TECHNOLOGIES FOR DIETARY ASSESSMENT

Oral Presentations:

OC 061

THE IMPACT OF USING CALIBRATED UTENSILS TO ASSESS PORTION SIZES IN INFANTS AGED 4-18 MONTHS

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Objective: The Diet and Nutrition Survey of Infants and Young Children (DNSIYC) was carried out during 2010-11 to provide detailed quantitative information on food and nutrient intakes, nutrient sources and nutritional status of a representative sample of infants aged 4-18 months in the UK. In 2009-10 a preliminary study was carried out to assess the effectiveness and validity of using calibrated utensils to measure food and drink consumption in infants aged 4-18 months. The aim was to determine if the use of calibrated utensils influenced the portion size offered to the infant and so affect their daily nutrient intake. **Method:** Food and drink intakes of 50 infants in North-East England were recorded using both an ESTIMATED and a WEIGHED 4-day food diary in random order, completed by the infant's parent/carer, over a 2 week period. Parents were provided with 4 graduated containers for food preparation and serving (2x150ml and 2x300ml), as well as 6 spoons (1.25ml-15ml), and were encouraged to use these to record all portion sizes in the ESTIMATED diary. Volume measures were converted to gram weights by the application of conversion factors, calculated for each food and drink consumed. **Results:** The mean daily intake for the weighed method was 932g (721kcal) and for the estimated method was 958g (776kcal). 41% of the sample had mean daily intakes (g) for the estimated method which were within 10% of the weighed intakes. 96% were within 50% of the weighed intakes. There was no difference in mean intakes between the two methods for different food types e.g. discrete food items and amorphous foods. **Conclusion:** The results indicated that the estimated intake method, supported by the use of measuring equipment, gave very similar results to those of weighed intakes. However the diary coding stage for these pilot data found the use of the equipment resulted in a much slower coding rate and a high number of queries. Based on the number of participants taking part in the main stage of DNSIYC, it was calculated many more coders would be required to manage the queries and meet deadlines. The final decision was to proceed with a household measures approach for dietary data collection; this method required no additional equipment and fewer coding resources. **Further work:** Although the household measures method has been extensively used in older age groups, further work is proposed to validate this method against weighed intakes, in 4-18 month infants. The study will follow the same method described above and will determine whether the household measures approach results in similar intakes as the weighed method.

OC 062

COMPARISON BETWEEN AN INTERACTIVE WEB-BASED SELF-ADMINISTERED 24H DIETARY RECORD AND AN INTERVIEW BY DIETITIAN FOR LARGE-SCALE EPIDEMIOLOGICAL STUDIES

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Online self-administered data collection, by reducing the logistic burden and cost, could advantageously replace classical methods based on dietitian's interviews when assessing dietary intake in large epidemiological studies. Studies comparing such new instruments with traditional methods are necessary. Our objective was to compare one NutriNet-Santé web-based self-administered 24 h dietary record with one 24 h recall carried out by a dietitian. Subjects completed the web-based record, which was followed the next day by a dietitian-conducted 24 h recall by telephone (corresponding to the same day and using the same computerised interface for data entry). The subjects were 147 volunteers aged 48-75 years (women 59.2 %). The study was conducted in February 2009 in France. Agreement was assessed by intraclass correlation coefficients (ICC) for foods and energy-adjusted Pearson's correlations for nutrients. Agreement between the two methods was high, although it may have been

overestimated because the two assessments were consecutive to one another. Among consumers only, the median of ICC for foods was 0.8 in men and 0.7 in women (range 0.5-0.9). The median of energy-adjusted Pearson's correlations for nutrients was 0.8 in both sexes (range 0.6-0.9). The mean Pearson correlation was higher in subjects ≤ 60 years ($P = 0.02$) and in those who declared being 'experienced/expert' with computers ($P = 0.0003$), but no difference was observed according to educational level ($P = 0.12$). The mean completion time was similar between the two methods (median for both methods: 25 min). The web-based method was preferred by 66.1 % of users. Our web-based dietary assessment, permitting considerable logistic simplification and cost savings, may be highly advantageous for large population-based surveys.

OC 063

VALIDATION OF A NOVEL METHOD OF DIETARY ASSESSMENT IN AN OLDER ADULT POPULATION: THE NANA PROJECT.

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BACKGROUND: Accurate dietary assessment methodology is essential to understand the potential links between diet and disease, and for the identification of those most at risk of malnutrition. Current dietary assessment methods have limitations including participant burden and dependency on memory that make some methods unsuitable for an older adult population. We have developed a novel method of dietary assessment using touch screen computer technology that can be used in the home for an older adult population. **AIM:** To validate a novel method of dietary assessment (NANA) for use with older adults against a 4-day estimated food diary. **METHOD:** Thirty older adults (over the age of 65 years) were recruited in Sheffield, UK. Participants were firstly asked to record their diet for 3 weeks using the NANA system. Following a 3 week washout period participants then completed a 4 day estimated food diary. Four days of dietary intake data from each method was entered and analysed using Windiets (version 2010). Statistical analysis was carried out using SPSS. **RESULTS:** Pearson's and Spearman's correlation coefficient were used to explore the differences between nutrient analysis derived from the NANA system and the four day food diary. The correlations show there is a positive relationship between the NANA system and the food diary for the following nutrients: Energy (KJ) [$r = .638$ $p < 0.001^{**}$], Carbohydrates (g) [$r = .554$ $p = 0.002^{**}$], Protein (g) [$r = .656$ $p < 0.001^{**}$], Fat (g) [$r = .684$ $p < 0.001^{**}$], Vitamin C (mg) [$r = .438$ $p = 0.015^*$]. Paired t tests and Wilcoxon signed rank were used to compare the mean values obtained by both methods and to establish whether there was a significant difference for any of the nutrients measured by the NANA system and the food diary. The two methods were not significantly different for estimated intake of Energy (KJ) $t = -1.286$, $p = .199$, CHO (g) $t = -.199$, $p = .906$, Protein (g) $t = -1.480$, $p = .217$ Fat (g) $t = -1.519$, $p = .188$ and Vitamin C (mg) $t = -.736$ $p = .468$. This suggests that NANA may be a suitable alternative to estimated food diaries in older adults. Further analysis of the NANA data against biomarkers is in progress.

OC 064

THE VALIDITY OF MICRONUTRIENT INTAKE IN A WEB-BASED FOOD FREQUENCY QUESTIONNAIRE: MEAL-Q

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INTRODUCTION: Accurate assessment of dietary intake is of great concern in nutritional epidemiology. With the aim for methodological improvement, we have developed a web- and meal-based food frequency questionnaire (FFQ) called Meal-Q, intended to assess habitual dietary intake in the Swedish adult population. The intake of iron, folate, vitamin D and sodium in the Swedish population are not meeting the recommendations, and together with Vitamin C, a valuable marker for fruit and vegetable consumption, they are of interest in epidemiological studies.

OBJECTIVE: To evaluate the validity of iron, folate, vitamin C, vitamin D and sodium intake assessed with Meal-Q, as well as with a classic food group-based FFQ developed in the 1980's and transferred to web format for comparison.

SUBJECTS AND METHODS: 177 healthy volunteers aged 20-63 years from Stockholm participated in a 21-day validation study. All participants were asked to fill out the 174-item interactive Meal-Q as well as the 72-item classic FFQ. The questionnaires were compared to web-based 7-day weighed food records (WFR). We excluded 13 individuals due to implausible energy intake based on Goldberg cut-off. Statistical analyses include absolute mean intakes, de-attenuated Pearson correlation coefficients adjusted for energy intake using the residual method, and Bland-Altman agreement plots.

RESULTS: Mean intakes of micronutrients in Meal-Q as percentage of the WFR were 92% for iron, 96% for folate, 84% for vitamin C, 79% for vitamin D and 76% for sodium. Only folate was statistically significantly different from WFR. Corresponding mean intakes in the classic FFQ were 63%, 61%, 59%, 103%, and 67% and all nutrients except vitamin D were significantly different from the WFR. Pearson correlation coefficients between the WFR and Meal-Q were 0.46 for iron, 0.55 for folate, 0.55 for vitamin C and 0.30 for vitamin D. Corresponding correlations for the classic FFQ were 0.44, 0.35, 0.53 and 0.24. Sodium did not correlate significantly with WFR for either questionnaire. Bland-Altman agreement plots between the WFR and Meal-Q showed a small trend of increasing under-reporting with increasing intakes for all micronutrients. Corresponding plots for the classic FFQ showed a similar trend for vitamin C and sodium, but a stronger increase in under-reporting with increasing intakes of iron and folate. For vitamin D, the classic FFQ showed better agreement with the WFR than Meal-Q.

CONCLUSIONS: Meal-Q yields a higher total intake of micronutrients and shows higher validity than the classic FFQ for a majority of the micronutrients under study.

OC 065

ADAPTING THE US AUTOMATED SELF-ADMINISTERED 24-HOUR DIETARY RECALL (ASA24) FOR USE IN MULTIPLE POPULATIONS

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Introduction: Extensive evidence indicates that 24-hour dietary recalls (24HRs) provide high-quality intake data, making them among the preferred tools for nutrition monitoring and, potentially, for studying diet and disease associations. To model usual dietary intakes, multiple administrations are required. Traditional 24HRs, however, are expensive and impractical for most large-scale dietary research because they rely on trained interviewers. To address these challenges, the US National Cancer Institute (NCI) developed ASA24.

System: The ASA24 system is a free publicly available web-based software tool that enables automated and self-administered 24HRs for adults. ASA24 consists of a Respondent application used by participants to enter recall data and a Researcher application used by researchers to manage study logistics and obtain analytic output. The format of the Respondent application is modeled on the US Department of Agriculture's interviewer-administered Automated Multiple Pass Method (AMPM) 24HR. Unique to the Respondent site are multi-level food probes to obtain details on food types, preparations, and amounts. A dynamic user interface, including a talking, animated guide, facilitates finding foods/beverages, jogs respondents' memories, and assists in estimating portion sizes from multiple images. Data files include food/supplement codes, nutrients, and MyPyramid food group equivalents for each day and food reported. Optional modules querying meal location, whether one ate alone, TV/computer use during meals, and supplement intake are available.

Adapting ASA24 for multiple populations: ASA24 has already been successfully adapted for US Spanish speakers, and efforts are underway to adapt it for use among Canadian adults and US children. Modifying system components for use in populations other than US adults requires collaborators to provide funding and nutrition expertise. The following system components can be modified to create population-specific versions:

1. Food term/food probe database (links food terms selected by participants to detailed probe questions; answers lead to assignment of nutrient/food group/supplement database codes);
2. Portion image database (up to 8 images for each food in US household measurements);
3. User interface text;
4. Audio recordings of instructions provided by the guide;
5. Nutrient, food group, and supplement databases.

Although the costs to adapt ASA24 are not trivial, modification of an existing system is likely to be more cost- and time-efficient than developing a new automated web-based 24HR system.

Conclusion: ASA24 has the potential to improve dietary assessment by enhancing the feasibility and cost-effectiveness of collecting high-quality dietary data. This resource can be adapted for use in multiple populations in collaboration with NCI.

OC 066

EVALUATION OF INNOVATIVE TECHNOLOGIES FOR MEASURING DIET IN EPIDEMIOLOGICAL STUDIES

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Introduction Innovation in dietary assessment include two basic conceptual notions: *new methodologies* as substantially different approaches of collecting dietary information (e.g. combining different self-report instruments) versus *new technologies*, related to the way of collecting the data (e.g. mobile phones, web-based systems). However, little is known about the relative merits of innovative technologies in nutritional epidemiological studies, which may be partially driven by current misconception that they are always methodologically new.

Objective To report on the inventory of available innovative technologies for dietary assessment in order to critically evaluate their practical feasibility, accuracy and possible impact in nutritional epidemiological studies. Particular attention is given to their performance in large-scale settings.

Methods Technologies were identified from English-language journals using PubMed and Web of Science. The inventory was based on date of publication (between 1995 and 2011) and combinations of predefined keywords. Searches resulted in the identification of 48 individual technology variants, which were summarized with respect to their “common” and “variable” application components and innovative features. Practical feasibility and accuracy of the technologies were evaluated according to relevant criteria (e.g. organisational efforts for the researcher, respondent’s usability, potential of standardisation and susceptibility to reporting bias) facilitating the relative evaluation of their capacity to improve, complement or substitute conventional dietary assessment instruments in epidemiological studies.

Results Six main groups of technologies were identified: ‘Personal Digital Assistant/PDA-’, ‘Mobile-phone-’, ‘Interactive computer-’, ‘Web-’, ‘Camera- and tape-recorder-’ and ‘Scan-and sensor-based technologies’. Compared to conventional written food records, PDA- and Mobile-phone-devices improve the recording through electronic assessment procedures, which is associated with enhanced data standardization. However, their accuracy for estimates of individual dietary intakes was low to moderate. For fully automated self-report 24-hour dietary recalls, there is limited knowledge on their accuracy and methodological problems, like the difficulty in recalling intakes and reporting portion sizes, might be more critical than in interview-administered approaches. In innovative self-administered instruments for long-term diet, such as web-based Food Frequency Questionnaires, measurement errors associated with the methodology are most likely independent from the mode of administration and comparable to conventional formats (i.e. paper-based). **Conclusion** Although there is evidence to support the potential of innovative technologies to enhance dietary assessment through cost-effective, less laborious and more acceptable ways of data collection, important considerations have to be made when designing and applying them for assessing diet in epidemiological studies. A clear distinction between innovative components that relate to ‘methodology’ or to ‘technology’ will help to critically evaluate the added value of the different technology groups for epidemiological research of diet-disease relationships.

B-6 MEASURING DIETARY DIVERSITY

A SIMPLE METHOD OF MEASURING DIETARY DIVERSITY AT POPULATION LEVEL.

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Background: In RSA there have been two dietary surveys which have measured dietary diversity. This method involved categorizing food from 24-hour recalls into nine food groups which are all important in the diet of South Africans, namely : 1) cereals/roots/tubers; 2) meat/poultry/fish; 3) dairy; 4) eggs; 5) vitamin A rich fruit and vegetables; 6) legumes; 7) other fruit; 8) other vegetables; 9) fats and oils. Another reason for the choice of grouping was based on the food-based dietary guidelines (FBDGs) for South Africans, since the groups were roughly aligned with the FBDGs. A dietary diversity score (DDS) was calculated for each person as the number of food groups consumed on the day of recall. Sugar and sweets (candy) were not included. This method was then used in two national dietary surveys after first testing its validity in children.

Methods: In the first study the DDS was calculated for children 1-9 years (n=2200) who had participated in a national survey¹. One objective of the study was to validate the use of the DDS method selected against the

anthropometric and dietary intake data of the same children. Mean adequacy ratio (MAR) of the diet was calculated based on results from a 24-hour recall. Results showed that MAR ($r=0.633$, $p<0.0001$), height-for-age z scores ($r=0.173$, $p<0.0001$), weight-for-age z scores ($r=0.192$, $p<0.0001$) and weight-for-height z scores ($r=0.8$, $p<0.01$) correlated significantly with DDS using Pearson correlation co-efficient. A DDS of 4 was shown to be the best indicator of MAR less than 50% since it provided the best sensitivity (75%) and specificity (70%). Keeping this in mind it was decided to use the same method when a national study on adults was done in 2008². A cross-sectional study representative of adults from all specified ages, provinces, geographic localities, and socio-economic strata was used ($n= 3287$). Trained interviewers visited participants at their homes during the survey. Dietary data was collected by means of a face validated 24 hour recall which was not quantified. Based on the earlier data on children a DDS <4 was regarded as reflecting poor dietary diversity and poor food security.

Results: The provinces with the highest prevalence of poor dietary diversity (DDS <4) were Limpopo (61.8%) and the Eastern Cape (59.6%). By contrast, only 15.7 % of participants in Western Cape had a low score. Participants in tribal areas (63.9%) and informal urban areas (55.7%) were by far the worst affected. There were significant differences in DDS by Living Standards Mean (LSM) analysis ($p<0.05$) with the lowest LSM group having the lowest mean DDS (2.93). The most commonly consumed food groups were cereals/roots; meat/fish; dairy and vegetables other than vitamin A rich, while eggs, legumes, and vitamin A rich fruit and vegetables were the least consumed. Further data will be presented and the advantages and disadvantages of using the DDS method selected will be discussed.

Conclusion: Overall, the majority of South Africans consumed a diet low in dietary variety. The tribal areas and informal urban areas were worst affected and eggs, legumes and vitamin A rich fruit and vegetables, were the least consumed. It is recommended that the FBDGs including these groups are targeted for health promotion efforts.

¹ Steyn NP, Nel JH, Nantel G, Kennedy G, Labadarios, D. Food variety and dietary diversity scores in children: Are they good indicators of dietary adequacy. *Public Health Nutr* 2006; 9(5): 644-650. (<http://www.ncbi.nlm.nih.gov/pubmed?term=Steyn%20NP%2C%20Nel%20JH%2C%20Nantel%20G>)

² Labadarios D, Steyn NP, Nel JH. How diverse is the diet of adult South Africans?

Nutr J 2011; 10:33 doi:10.1186/1475-2891-10-3 (<http://www.nutritionj.com/content/10/1/33>)

MEASURING DIETARY DIVERSITY IN RESOURCE-POOR COUNTRIES: A DECADE OF EXPERIENCE AND REMAINING CHALLENGES

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Dietary diversity is one dimension of diet quality, and is often low when poverty constrains choices. National and sub-national programs aimed at improving diet quality of the poor need simple measurement tools and indicators for advocacy purposes and to assess progress. Earlier research in developed countries showed associations between indicators of diversity and micronutrient intakes or adequacy, but until recently evidence was lacking for resource-poor countries where monotonous diets are common. Since 2000, evidence has emerged demonstrating the usefulness of dietary diversity indicators for the most nutritionally vulnerable groups – infants, young children, and women of reproductive age in developing countries. Evidence from single-site studies was supplemented by multi-country collaborative research projects, employing standardized methodologies and comparing performance of multiple candidate indicators across sites. Demonstration of a consistent association between food group diversity and nutrient density adequacy motivated inclusion of dietary diversity among the new World Health Organization indicators for infant and young child feeding, for global tracking of progress. Similarly, documented associations between simple food group diversity indicators and micronutrient adequacy for women of reproductive age has supported use of dietary diversity indicators by the Food and Agriculture Organization, the United States Agency for International Development, and others. In a separate but related effort, household-level indicators of dietary diversity have also been explored and put forward as indicators of household energy availability, one dimension of food security. Several guides for operationalizing dietary diversity indicators for global use are now available, and should help harmonize data collection methodologies and data analysis. Remaining challenges include: communicating on appropriate uses of these population-level indicators; improving operationalization to overcome recall and other errors; and additional documentation of responsiveness of the indicators to dietary change, whether seasonal or as a result of economic shocks or positive interventions. Finally, additional work may allow consensus on cut-offs and targets for diversity indicators, or may confirm the need for context-specific targets.

Oral Presentations:

OC 067

ASSOCIATION BETWEEN DIETARY DIVERSITY AND CHILD GROWTH IN RURAL UGANDA AND MOZAMBIQUE

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Previous studies have shown a fairly consistent relationship between dietary diversity and child nutritional status. However, because these studies were mostly based on a cross sectional design, little is known about the long term effects of dietary diversity. Moreover, it is still unclear through which pathway dietary diversity affects growth. This analysis was designed to address those questions, namely: (i) is improved dietary diversity associated with better weight and height gain on the longer term? (ii) does increased dietary diversity impact growth through higher energy intake or higher micronutrient density or a combination of both?

This analysis uses data from 2 cohorts of children in Uganda and Mozambique followed up after 2 and 3 years, respectively. At baseline, children were 3-5 years in Uganda and 6-35 months in Mozambique. Intakes were estimated using an interactive multipass 24-hour recall. The dietary diversity score (DDS) summed a total of 7 food groups based on the WHO recommendation. The mean micronutrient density adequacy (MMDA) was calculated as the mean of density adequacies for 9 micronutrients. The innovation in this analysis lies in the use of panel fixed effects regressions which allow us to control for unobserved time invariant effects and individual-specific heterogeneity such as genetic growth potential. Among young children in Mozambique, we found that DDS was strongly and positively correlated with long term gains in height ($p < 0.05$) but not weight ($p = 0.1$). The magnitude of the coefficient for DDS on height was decreased when household expenditure and size were introduced in the model but it remained strongly positive.

In Uganda, dietary diversity was a significant factor contributing positively to long term changes in both height ($p < 0.01$) and weight ($p < 0.01$) even when socio-economic factors were controlled for. When we broke down the effect of dietary diversity, we found that both energy intake ($p < 0.01$) and micronutrient density estimated with MMDA ($p < 0.01$) affected height in the same model. Interestingly, in Mozambique, when the effects of energy intake and micronutrient density were separated out, they were each found to have strong effects on weight whereas DDS did not. We found that improved dietary diversity was correlated with increased height gain over a period of 2-3 years depending on the country and age group of children. We also observed improved weight gains among older children with better dietary diversity. In the relationship between dietary diversity and growth, dietary diversity seems to reflect both diet quantity and quality.

OC 068

HOUSEHOLD FOOD CONSUMPTION: LOOKING BEYOND THE SCORE.

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As the UN food assistance agency, WFP understands the impact that a poor diet has on individual nutritional outcomes with inadequate nutrient intake leading to high levels of morbidity, mortality and wasting as well as stunted growth of young children. WFP has a key role in helping to address the threat and consequences of hunger and undernutrition.

The WFP Food and Nutrition Security Framework highlights the association between household access to food (as an underlying cause), individual dietary intake (as an immediate cause) and nutritional status (as an outcome) with analyses focusing on the household level. Deeper understanding of the food related causal factors of malnutrition is essential for WFP in part as household's lack of economic access to a diet that meets nutrient requirements is usually critical.

This paper explores opportunities to optimise analysis of household food consumption data in WFP assessments to give indications of the likely nutrient deficits of household members, the impact on nutritional outcomes and thus provide a simple tool for informing programmes to reduce undernutrition.

The empirical analysis uses Household Budget Surveys (HBS) data from Nepal (2009-10) and Malawi (2010-11), each including anthropometric measurements of respectively 2500 and 4500 children below 5 years of age. These surveys give detailed information on consumption of food items as well as the number of days they were consumed in the recall period.

Two scores/indicators are considered: Food Consumption (WFP) and Household Dietary Diversity (FAO). The former is based on a 7 days food frequency and the latter recommends 24 hours recall. The current analysis applies a 7 days recall to the same food groups as covered in the HDDS and analyses the numerical scores for each indicator. Further we test the Food Consumption Score variable with and without the weights (that are usually applied to capture nutrient density of the food groups).

Relationships between household food access and stunting are explored in multivariate regressions. The aim is to understand if, and how well, consumption of individual food groups as well as different variations of the food scores explain stunting among children under 5 years of age, while controlling for other factors important for nutritional outcomes: access to safe water and sanitation, whether the child was ever breastfed, child's health care and education level in the households.

Preliminary results show that although R-squares in the multivariate relations are low and therefore that such models have limited power in explaining stunting, the household food score variable is one of the important explanatory factors. The analyses also show that there is room for improvement in designing the diversity indicators: 12-rather than 8 food groups and frequency in the scores both improve the association in the multivariate regression with the individual nutrition outcome variable. The food score is far more powerful as a predictor for stunting than are the frequencies in consumption of single nutritionally important food groups, like those rich in Vitamin A and iron. Further, it is interesting to note that households with children under 5 years of age tend to have a more diversified diet, controlling for other important factors like welfare, location and education which may indicate that the household favours children although further exploration is required.

OC 069

COMPARISON OF DIET DIVERSITY SCORES FOR FRUIT AND VEGETABLES AND PLASMA CAROTENOIDS LEVELS IN THE CROSS-SECTIONAL STUDY OF THE EUROPEAN PROSPECTIVE IN

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Introduction: Research on the relationship between cancer risk and fruit and vegetable consumption is primarily focused on the quantity of consumption. Looking at the diversity of fruit and vegetable consumption, reflecting an intake of many different bioactive compounds present in fruit and vegetables, may complement the research on fruit and vegetable consumption and cancer risk. We have previously linked the variety in fruit and vegetable consumption, as measured by diet diversity scores (DDS), to lung and bladder cancer risk in the European Prospective Investigation into Nutrition and Cancer (EPIC). We found no relation between the DDS and bladder cancer risk and a reduced lung cancer risk with increased variety in vegetable consumption. In this current study we evaluated whether the DDS indeed captures a mixed intake of bioactive compounds by comparing the DDS to plasma concentrations of six carotenoids (α -carotene, β -carotene, β -cryptoxanthin, lycopene, lutein and zeaxanthin).

Method: Within the cross-sectional study of the EPIC (including 3,089 subjects), we calculated four different DDS based on dietary questionnaires: one represents diversity in vegetable and fruit consumption, two represent diversity in (subgroups of) vegetable consumption and one represents diversity in fruit consumption. Plasma carotenoids samples were analyzed by reversed-phase high-performance liquid chromatography (HPLC-1100 system, Hewlett Packard). To standardize the six plasma carotenoids, concentrations were re-scaled using a rank difference method; higher values represent larger and lower values represent smaller intra-individual variation in the concentrations of the six plasma carotenoids. Conceptually, the rank difference score should be inversely correlated with the DDSs. Correlation coefficients between the DDSs and the rank difference score were calculated for the full study population and stratified by subgroups of potential effect modifiers (e.g. gender, region).

Results: Complete data on the DDSs and plasma levels of carotenoids were available for 2,675 participants. The correlation coefficient (r) between the diversity in vegetable and fruit consumption and the rank difference score was -0.13. Diversity in vegetable consumption was not correlated to the rank difference score. The strongest, although still weak, correlation was found between the diversity in fruit consumption and the rank difference score ($r=-0.19$). Correlations were somewhat stronger for fasting samples, in women, and in Southern Europe.

Conclusion: The diet diversity scores show only weak correlations with rescaled plasma levels of six carotenoids. This might suggest that either questionnaire information or one measurement of plasma carotenoid levels or both cannot fully capture variety in fruit and vegetable consumption.

OC 070

U.S. TRENDS IN DIETARY VARIETY AND ITS ASSOCIATION WITH BMI AND MICRONUTRIENT INTAKES AMONG YOUNGER AND OLDER AGE GROUPS

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Background: Experimental and observational studies suggest the variety of foods consumed, particularly energy-dense variety, may be a leading factor in the obesity epidemic. We aimed to examine secular trends in dietary variety consumed by healthy U.S. adults and its relationship with BMI during a time when the prevalence of obesity was rapidly rising. We also aimed to compare the strength of the relationships of different types of variety (i.e., energy dense variety, micronutrient dense variety) with different outcomes (e.g., BMI and micronutrient intake) in both younger and older age groups. **Methods:** A cross-sectional analysis of data from the Continuing Survey of Food Intakes by Individuals (CSFII) 1989-91 was conducted in healthy adults aged 21-59 y (n=613) and >60 y (n=166). Results were compared to a published variety analysis of CSFII 1994-96 (Roberts et al 2005) in n=892 younger and n=282 older adults. In both surveys, individuals with BMI<17kg/m², on medically prescribed diets or with implausibly reported energy intake (Huang et al 2005) were excluded. Dietary intakes were coded and six different dietary variety scores were calculated: total, food group, energy-dense, energy-weak, micronutrient-dense and micronutrient-weak variety. Variety was defined as the total number of unique food or beverage items consumed over 2 days within each variety type. **Results:** Nearly every type of variety was higher in 1994-6 than in 1989-91 (p<.025). In 1994-96 in both age groups, energy-dense variety was higher with higher BMI, while energy-weak variety was lower with higher BMI (p<.05); these trends were not significant in 1989-91. In multiple regression models controlling for age and other confounders, energy dense variety was the best variety score predictor of BMI in both surveys (1989-91: $\beta=0.173\pm0.053$; 1994-6: $\beta=0.118\pm0.032$; model R² 0.09-0.12, p<.001). Micronutrient-dense variety was positively associated with mean micronutrient intake (%EAR) in both surveys in both age groups (r=0.15-0.27; p<0.02). In contrast, energy-dense variety was only weakly associated or not significantly associated with micronutrient intake (r=0.12 to -0.12; p=0.69 to 0.004) in either survey across age groups. **Conclusion:** From 1989-91 to 1994-6, all types of dietary variety increased. Different types of variety are important to consider since they differed in their associations with BMI and micronutrient intake. Combined with results from previous studies, these findings indicate that higher energy-dense variety may contribute to greater energy intake and weight gain without impactful benefit to micronutrient intakes.

C-6 CHARACTERISTICS AND IMPACTS OF MEASUREMENT ERROR IN PHYSICAL ACTIVITY DATA

A MEASUREMENT ERROR APPROACH FOR ESTIMATING USUAL ACTIVITY DISTRIBUTIONS

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Recall instruments provide a relatively inexpensive method of collecting physical activity patterns on a sample of individuals, but are subject to systematic and random measurement error. Statistical models can be used to estimate measurement error in short-term recall data and provide more accurate estimates of usual activity levels for population. The measurement error model describes the relationship between an individual's recalled activity for a short period of time (e.g., a day) and an individual's unobserved usual activity over a long period of time. For physical activity, multi-sensor activity monitors can be used as a reference measure to estimate both systematic and random measurement error in activity recalls. We will illustrate measurement error modeling using energy expenditure data from the Iowa Physical Activity Measurement Study. The survey design included replicate observations of a concurrent activity recall and an objective monitor measurement on a sample of roughly 1200 adults. Estimates of model parameters that describe the bias and sources of variation in recall and monitor data will be presented. The models are also used to estimate distributions of usual energy expenditure for population groups.

Oral Presentations:

OC 071

EVALUATION OF THE PERFORMANCE OF A PREVIOUS DAY RECALL AND THE ACTIGRAPH MONITOR FOR MEASURES OF ACTIVE AND SEDENTARY TIME

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Previous-day recalls (PDR) can collect detailed information about time spent in active and sedentary behaviors, are presumed to be less error prone than physical activity questionnaires, and therefore may be useful in studies of physical activity and health. We evaluated a PDR and contrasted its performance to that of the Actigraph (AG) monitor by comparing both instruments to a valid reference measure, the activPAL (aPAL). Adolescents (n=98; 12-17 yrs) and adults (n=88; 18-71 yrs) wore an aPAL and AG for 7 days and completed up to three PDRs to measure sedentary (sit/lie, <100 cpm) and active time (standing/stepping, 100+ cpm). Interviewers conducted PDRs eliciting open-ended reports of time spent sleeping, and in active and sedentary behaviors. Mixed models were fit to quantify the error structure of the PDR and AG compared to aPAL using the following equation: PDR_{ij} or $AG_{ij} = \beta_0 + \beta_1 T_{ij} + r_i + e_{ij}$, where T_{ij} is the estimate of truth from aPAL, β_1 is the slope of the regression of aPAL on PDR or AG. Variances were estimated for systematic (σ_{r_i}) and random errors ($\sigma_{e_{ij}}$) in PDR and AG. Participants reported 9.7 (SD=3.0) hr/d of sedentary, and 4.9 (SD=2.6) hr/d of active time on the PDR, while the aPAL and AG recorded 9.0 (SD=2.3) and 8.6 (SD=2.1) hr/d of sedentary, and 5.1 (SD=2.0) and 5.8 (SD=1.8) hr/d of active time, respectively. Mixed models comparing PDR to aPAL indicated: (1) a strong linear relationship between measures for sedentary ($\beta_1=0.80$ to 1.10) and active time ($\beta_1=0.64$ to 1.10); (2) that systematic reporting errors were lower ($\sigma_{r_i}=0.6$ to 0.8) than random errors ($\sigma_{e_{ij}}=2.5$ to 2.8); and (3) correlations between PDR and aPAL were high (Sedentary: 0.60 to 0.81; Active: 0.52 to 0.80). Models comparing AG to aPAL indicated: (1) a weaker linear relationship between measures for sedentary ($\beta_1=0.63$ to 0.73) and active time ($\beta_1=0.61$ to 0.72); (2) that systematic errors in AG tended to be larger ($\sigma_{r_i}=1.2$ to 1.6) than random errors ($\sigma_{e_{ij}}=0.7$ to 0.8); and (3) correlations between AG and aPAL were high (Sedentary: 0.68 to 0.77; Active: 0.57 to 0.79). The performance of the PDR measures of active and sedentary time was comparable to that of AG. Correlations between the PDR and aPAL were high and systematic reporting errors on the PDR were lower than random errors. PDRs may have value in studies of physical activity and health.

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OC 072

A MEASUREMENT ERROR MODEL FOR PHYSICAL ACTIVITY LEVEL MEASURED BY A QUESTIONNAIRE, WITH APPLICATION TO THE NHANES 1999-2006 QUESTIONNAIRE

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Physical activity questionnaires (PAQ) are prone to error, yet systematic investigations into the structure of this measurement error are lacking. We propose a measurement error model for PAQ using physical activity level (PAL), the ratio of total energy expenditure (TEE) to basal energy expenditure (BEE). The 1999-2006 NHANES PAQ was administered to 433 participants aged 40-70 y in the Observing Protein and Energy Nutrition (OPEN) Study who also had valid estimates of TEE from doubly labeled water (DLW). MET minutes from the PAQ were used to estimate PAL. The objective was to relate questionnaire-based PAL to true PAL. Truth was estimated from DLW, which conforms to a classical measurement error model, and BEE, which was estimated from an equation and exhibited Berkson error. Therefore, the non-questionnaire measure of PAL has a mix of classical (TEE) and Berkson error (BEE). We present a measurement error model that accommodates this mixture of errors and apply it to the OPEN study, using ancillary data from a US Department of Agriculture study. Correlations between the questionnaire-based PAL and truth were modest (0.31-0.41); attenuation factors (0.43-0.73) indicate the use of questionnaire-based PAL would lead to attenuated estimates of effect size. The results suggest that sample sizes for estimating PAL/disease relationships should be inflated, and that regression calibration may be used to provide estimates of activity/disease relationships adjusted for measurement error.

OC 073

PHYSICAL ACTIVITY ASSESSMENT: BIOMARKERS AND SELF-REPORT OF ACTIVITY-RELATED ENERGY EXPENDITURE IN THE WOMEN'S HEALTH INITIATIVE

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Objective: We used biomarkers of activity-related energy expenditure (AREE) to assess the measurement properties of self-report physical activity assessment instruments. **Methods:** Participants were 450 postmenopausal women from the Women's Health Initiative Observational Study. We oversampled women who were Black or Hispanic, aged 50-59 years at WHI enrollment and at the extremes of the BMI distribution (< 18.5 and ≥ 30 kg/m²) to support comparisons of measurement properties by these personal characteristics. Participants attended 2 clinic visits over 2 weeks where they completed self-report and objective measures of physical activity. The self-report instruments were the Arizona Activity Frequency Questionnaire (AAFQ), the 7-day Physical Activity Recall (PAR), and the WHI Personal Habits Questionnaire (PHQ). Biomarkers were doubly labeled water [objective measure of total energy expenditure (TEE)] and indirect calorimetry [objective measure of resting energy expenditure (REE)]. AREE was computed as [AREE = TEE-REE]. 88 women repeated the protocol 6 months later. Reporting error = [log (self-report AREE) - log (biomarker AREE)]. We regressed the reporting error on personal characteristics for each instrument to understand which characteristics were associated with reporting error. We next created linear regression models to understand the fraction of the total variance in biomarker AREE that could be explained by self-report plus personal characteristics. **Results:** The AAFQ and the WHI-PHQ underestimated AREE and the PAR overestimated AREE vs. the biomarker. Higher BMI was associated with under-reporting on the AAFQ and PHQ, but over-reporting on the PAR. Hispanic women underreported activity on the PAR while increasing age was associated with over-reporting on the PAR. The model R² were 4.0, 6.8 and 5.0 for the AAFQ, PAR and PHQ, respectively, suggesting that the participant characteristics explained only a small fraction of the variance in the reporting error for each instrument. Analyses regressing [log AREE biomarker] on [log self-report] revealed that the self-report alone explained small amounts of the variance in the biomarker (R² = 7.7, 4.8 and 0.2 for the AAFQ, PAR and PHQ, respectively). The R² increased to 23.4, 20.0 and 18.1, respectively when the models included participant characteristics. Use of the 6-month repeatability data to adjustment for temporal variation in AREE further improved the R² to 24.3, 15.1 and 0.6 for the self-report alone and 73.7, 63.0 and 57.0 when including personal characteristics for AAFQ, PAR and PHQ, respectively. Our results indicate that these calibration equations can 'recover' a substantial fraction of the variation in average AREE. **Conclusion:** Compared to objectively-measured AREE, the PAR overestimated activity while the AAFQ and WHI-PHQ underestimated activity. Participant-related reporting bias varied by self-report instrument. Calibration equations can valuably enhance AREE assessment.

A-7 CHARACTERIZING SUSTAINABLE DIETS AND BIODIVERSITY

FOOD SYSTEM METHODOLOGY AND THE IMPORTANCE OF CAPTURING BIODIVERSITY IN DIETARY ASSESSMENT – EXAMPLE OF INDIA

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India is home to 1.2 billion people with diverse dietary customs and habits owing to the ethnicity and religious beliefs. The National Nutrition Monitoring Bureau (NNMB) was established in 1975 with the objective to continuously monitor the dietary pattern and nutritional status of the population in India. Various dietary assessment methods and techniques exist to measure the food intakes; however this paper will focus on methods used by NNMB to evaluate the rural Indian households. The repeat NNMB surveys capture the nutrient intake of the Indian population and elucidate the importance of different species in the diet such as different cereals and millets which accounts for more than 70% of the nutrient intake. In India several varieties of eggplants, carrots, potatoes, etc. are known and frequently used but the NNMB diet survey fails to capture individual foods by variety/strain/breed preferring instead to group foods generically. At the same time dietary guidelines for Indians set a recommendation on the consumption of foods, including fruit and vegetables. However, in food and nutrition insecure populations like India, intake of one fruit or vegetable variety over another can be the difference between micronutrient deficiency and adequacy. For example, over 450 mango varieties are consumed in India but very few varieties have substantially high levels of β -carotenes that can make a difference in the vitamin A intakes. Many factors affect the nutrient composition of foods but varietal differences appears to be the most pronounced therefore, capturing the food by variety/cultivar in diet surveys is the need of the day.

Biodiversity is considered essential for food security and nutrition though it is seldom included in nutrition programmes and interventions. In India, key government policies such as the Public Distribution System and the Green Revolution Technologies of the 1960s indirectly encouraged monoculture resulting in the loss of food biodiversity. Time trends of the NNMB data showed that India is beginning to observe a dramatic change in food supply systems in response to rapid urbanization, diet diversification, and the liberalization of foreign direct investment in the food sector. It also appears that food system in India is not providing balanced nutrient requirement to meet all the nutritional needs, especially to the resource-poor women, infants and children. The paper discusses in detail the importance of generating cultivar-specific nutrient data and capturing the same in the Indian diet surveys in order to combat contemporary scientific and public health issues in the country.

Oral Presentations:

OC 074

IMPROVING DIETARY ASSESSMENT METHODOLOGIES FOR CHARACTERIZING SUSTAINABLE DIETS

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Dietary assessments methods and instruments take many forms and serve many sectors. Most notable among these is the health sector, with the agriculture sector a close second. Absent from the dietary assessment table has been the environment sector. In several important ways, the nutrition community has responded to the world-wide attention focussed on climate change and other environmental issues through activities under the banner of sustainable diets. Sustainable diets are those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources. In efforts to characterise sustainable diets in many diverse agro-ecological zones, it is necessary to know what people are eating and where that food originates. In 2009, an indicator on biodiversity and food consumption was created, consisting of a simple count in food consumption surveys of the number of foods reported reflecting food biodiversity. Reporting for this indicator also included the number of dietary assessment surveys taking food biodiversity into consideration in relation to the total number of surveys examined. Baseline data have been collected, showing that very few consumption surveys are amenable to providing useful data on food biodiversity or sustainable diets. For the few that do provide useful data, methodological details will be illustrated. Reporting for the first biennium is underway and will also be reported. It is hoped that through modifications to existing dietary assessment instruments and methods, a solid evidence base will emerge showing the benefits of food production and consumption within environmental limits, thus contributing to food and nutrition security for all.

OC 075

TOOLS TO IMPROVE THE EVIDENCE OF THE IMPORTANCE OF BIODIVERSITY FOR NUTRITION

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The importance food biodiversity is increasingly recognized in the agriculture, health and environment sectors. Food biodiversity is at the core of FAO's work including the "sustainable diets" initiative. Recent studies have shown varietal differences are responsible for some of the most dramatic variations in nutrient contents. Nutrient values may vary up to 1000 times between different varieties of the same food. Therefore, the nutrient content of foods can vary as much between different varieties of the same foods as among different foods. This means that the intake of one variety rather than another can mean the difference between micronutrient deficiency and adequacy. To demonstrate these facts more widely, more reliable, high quality data on food consumption and composition are needed on foods at the variety/cultivar/breed levels to correctly calculate nutrient intake and investigate the relationship between nutrition, biodiversity and health, especially in traditional food systems. These data need to be systematically generated, compiled and disseminated. FAO with other partners have developed two Nutrition Indicators for Biodiversity: Indicator 1 on food composition and Indicator 2 on food consumption. They are a count of the foods – with a sufficiently detailed description to identify genus, species, subspecies and variety, cultivar or breed – with at least one value for a nutrient or bioactive component for Indicator 1, or reported by at least one subject for Indicator 2. For wild and underutilized foods, information at species level is satisfactory. So far, over 10 000 foods have been reported for the food composition indicator and over 2800 foods for the food consumption indicator. In addition, version 2 of the FAO/INFOODS Food Composition Database on Biodiversity to be published in December 2011 will cover 5000 food entries with

solely analytical data on composition. It is a repository of evidence which illustrates, among other things, the differences among varieties and breeds of the same species, and the contribution of wild and underutilized foods to food and nutrition security. These tools and indicators are meant to encourage dietary assessment researchers to generate and compile more food consumption data on food biodiversity and to report them to FAO. This could encourage compilers of food composition tables to include more food composition data on biodiversity, provide the agriculture sector with more data to promote production of more nutritious cultivars, open new markets, contribute to sensible policy and programs for food aid and food fortification, and provide consumers with more information to meet their nutrient intake requirements from food; and at the same time contribute to the conservation of biodiversity through sustainable use.

OC 076

BRAZILIAN NORTHERN AND SOUTHEASTERN FOOD DIVERSITY

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Introduction: The Brazilian dietary guidelines strongly emphasize the adoption of traditional regional foods meaning to encourage healthy dietary habits, besides valuing Brazilian food diversity, contributing to environmental sustainability, and empowering family farming.

Objective: To compare the food diversity in the Northern and Southeastern Brazilian regions (less densely vs. most densely populated).

Methods: This work analyzes data of food acquisition obtained in the Brazilian Household Budget Survey carried out in 2008-2009. This research investigated a representative sample of the Brazilian population selected by a two-stage cluster sampling design. The data collection lasted one year and the units in each stratum were equally allocated among the four quarters of the survey to reproduce seasonal variations. This study considered data from the Brazilian Northern and Southeastern regions. In the Northern region, which includes seven states and 8% of the Brazilian population (74% in urban areas), 7,611 households were investigated. Nearly 90% of the region area is covered by Amazon forest. In the Southeastern region, 14,078 households were investigated. This region includes four states and 42% of the Brazilian inhabitants (93% in urban areas). In each investigated household, foods and beverages acquired exclusively for the family consumption during a seven-day period were recorded with detailed description of the products, the amount acquired, and the form of acquisition (monetary or non monetary). To depict the food diversity, all plants and animals used as foods were listed and described according to common and scientific names. Foods were classified as cereals, legumes, vegetables, starchy vegetables, nuts and seeds, fruits, meats, poultry and other birds, and marine and freshwater fish and shellfish.

Results: There was greater food diversity in the Northern region, probably due to the diversity of species found in the rainforest, where larger varieties of plants and animals were reported compared to the Southeastern region, for example: beans (49 vs. 10 species), freshwater (128 vs. 35) and saltwater fish (118 vs. 61), leafy vegetables (162 vs. 138), and fruits (226 vs. 160). Moreover, all cereals, fruits, nuts, beans and freshwater fish cited in the Southeast were also reported in the North.

Conclusions: The major problem to describe food diversity in Brazil is the broad variation of common names for single foods. The study will continue with the estimates of the population mean acquired amounts. Information on dietary habits is important to guide food and nutrition policies elaboration in Brazil.

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OC 077

EFFECT OF INTRODUCED FOODS ON THE DIVERSITY OF TRADITIONAL FOODS AND ITS POSSIBLE IMPLICATIONS ON DIETS AND NUTRITIONAL STATUS OF RURAL POOR COMMUNITIES IN SOUTHERN BENIN

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BACKGROUND: The socioeconomic changes occurring in developing countries under the influence of urbanization, globalization and market integration affect traditional food systems. It is suspected that local diversity of traditional foods is being replaced by a limited number of introduced foods. This study assessed the degree and reasons of this substitution and its implications for diets, nutrition and health status of rural poor from southern Benin. **METHODS:** An ethnobiological survey was conducted in 34 villages from six districts with high prevalence of poverty and children chronic malnutrition. In each village data were collected through individual interviews of key-informants and two focus groups discussions (FGDs). Key-informants interviews were based on a questionnaire aiming to inventory the existing plant and animal species consumed as foods. For each species, data on names (vernacular, French, English and scientific), seasonal and spatial availability,

physical and financial accessibility, types of uses, parts consumed and frequency of consumption (e.g.: everyday, 1-3 times/week, 1-2 times/month), level of domestication (wild, semi-wild, cultivated), etc. were collected. FGDs covered all foods currently consumed (exotic, traditional, imported, locally produced) and food habit changes including abandoned foods (foods consumed in the past but no more consumed currently), introduced foods (foods of recent consumption), substitution foods (foods replacing others which are no more consumed). Reasons and times of these changes were also recorded. **RESULTS:** Overall 170 food species were inventoried out of which 76 were animal foods and 94 plant foods. 109 foods were reported as abandoned within the last 20-30 years, 54 as introduced and replacing others. The main reasons reported to cause food abandonment were deforestation (38.7 %) and urbanization (12.2 %). Introduction of new foods was entirely approved by 28% of the respondents while 15% completely disapproved it, but are constrained to consume them because they lack alternative traditional foods. **CONCLUSION:** The combination of FGDs and key-informants' interviews in this study allowed the inventory of a great diversity of foods including local traditional foods which coexist with introduced foods in the diets of rural poor. Most of these introduced foods were adopted to cope with the disappearance of their traditional equivalents due to environmental degradation. Though introduced foods increase the overall dietary diversity, their contribution to the improvement of nutritional status of people is still questionable. Additional investigations with complementary methods (e.g. 24-hour food recalls, Food frequency questionnaire) are being implemented to explore specific associations between nutritional and health status of these people and the consumption of traditional versus introduced foods.

B-7 MEASUREMENT OF PHYSICAL ACTIVITY IN LOW AND MIDDLE INCOME COUNTRIES

MEASUREMENT OF PHYSICAL ACTIVITY IN PHYSICAL ACTIVITY PROGRAMS IN COLOMBIA AND BRAZIL

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Context: In Latin America free programs that use public spaces including parks and streets for community classes and leisure activities have been recognized as promising interventions to promote physical activity (PA). These programs are rapidly expanding in the region. However, only in 6 of the 21 countries of the region questionnaires and objectives methods of measuring PA have been reported. The evaluation of these promising programs requires multiple methods to measure PA.

Objective: 1) to describe the methods used to assess the dimensions and domains of PA from the users of the programs of Ciclovía, Recreovía in Bogotá and users of CuritibaAtiva and community classes in Brazil and 2) to describe the capacity building strategy to trained researcher in the region of Latin America.

Methods: For Ciclovía and recreovía the System for Observing Play and Recreation in Communities (SOPARC), and the International Physical Activity Questionnaire [(IPAQ) (Leisure time)], and accelerometry was used. For CuritibaAtiva and community classes SOPARC, and IPAQ (Leisure time) was used.

Results: SOPARC showed an excellent Inter-observer reliability [ICC 0.86-0.99]. The Spearman correlation coefficient between self-reported IPAQ responses and objective accelerometer measures was 0.42. To promote, in part, the evaluation of similar programs in the region, 10 international physical activity and public health training courses have been conducted between 2004-2012 with the support of CDC.

Conclusions: The evaluation of promising programs in Latin America to promote physical activity requires the use of questionnaires, direct observation and accelerometry. The courses conducted in Latin America have created a network of researchers within the region of Latin America.

Oral Presentations:

OC 078

PHYSICAL ACTIVITY AMONG ADOLESCENTS IN INDIA: OBJECTIVE MEASUREMENT

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Purpose: There has been an increase in the prevalence of overweight and obesity among children in India, which has been fuelled, among other factors, by low levels of physical activity. However, evidence to support this statement is based primarily on subjective measures of physical activity, and not much research has been done

using standardised, objective techniques, particularly among children and adolescents in India. Since subjective measures come with inherent biases associated with poor recall and social desirability, it is important to complement them with appropriate objective measurements, using standardized protocols. The aim of this study thus is to develop a standardised protocol to assess physical activity using an objective method (accelerometry), and assess its acceptability and feasibility among school-going Indian children.

Methods: The basic protocol was developed through consultations with Indian and international experts on physical activity research. This was translated into Hindi and back-translated by independent researchers to ensure consistency across the two versions. Boys and girls aged 12-15 years (grades VIII and IX), from one private and one government school in Delhi were the study population. The protocol included training material on data collection for the researchers, as well as instructions for the participants for use, wear and safety. The protocol was administered on 16 participants, 8 from each school. Feedback on overall acceptance and feasibility was obtained through individual interviews.

Outcomes: The information obtained from the interviews was used to make appropriate changes to the methodology, and develop a final protocol for use of accelerometers in the paediatric population in Delhi, India. Overall, there was high acceptability, particularly in the private school. The 7-day duration of accelerometer wear seemed acceptable by 15 out of the 16 participants. The major issues that were important included health concerns, safety and comfort of usage, and the protocol was accordingly modified for use in the two languages.

Conclusions: The present study thus resulted in the development of a standardized accelerometer protocol in two languages, and indicated high acceptability of this method of objectively assessing physical activity among school-going Indian children.

OC 080

PHYSICAL ACTIVITY PATTERN AND Pedometer COUNTS OF ADULTS FROM NITERÓI, RIO DE JANEIRO, BRAZIL: THE NUTRITION PHYSICAL ACTIVITY AND HEALTH SURVEY (PNAF)

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There is very little information on the pattern of physical activity (PAP) of the adult population in Brazil. The purpose of the present study was to assess the PAP of a probabilistic sample (n=1689) of adults from Niterói, a city in the metropolitan area of Rio de Janeiro. A 24 hour activity recall of a typical weekday was used to assess the PAP of the subjects who wore a pedometer during the waking time of the same day. The reported activities were coded as MET levels using the Compendium of Physical Activities. Total daily activities were compiled, classified as low (< 3 METs), moderate (3-6 METs) or vigorous (\geq 6 METs) and grouped in occupational, leisure-time, transportation and domestic chores. Pedometer counts were grouped as < 10000 and \geq 10000. Sample weights were calculated and calibrated to represent the population of Niterói according to the 2000 Census information and were used in the analysis. The results showed that 59.5% of the adults met the 30-min of moderate intensity physical activity recommendation with men being more active (63.8%) than women (55.9%). The most active men (73.5%) and women (65.6%) were between 30 and 40 years of age. Domestic chores in women and leisure-time activities in men contributed the most to meet the recommendations. Only 44.9% of the subjects (39.1% of women and 51.8% of men) had at least 10000 steps on that day and 53.5% of the subjects (47.2% of women and 60.1% of men) who reached the recommended 30-min of moderate intensity physical activity had at least 10000 steps. It is concluded that different methods of PAP assessment provide different results in the adult population of Niterói.

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OC 081

ADAPTING A CANADIAN PROCESS FOR THE SYNTHESIS AND TRANSLATION OF PHYSICAL ACTIVITY KNOWLEDGE IN MEXICO

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Similar to other first world and developing countries, Mexico has experienced a transition in the lifestyle of its population. Various cultural shifts (e.g., increasingly sedentary nature of work, changes in transportation, increasing urbanization, changes in recreational activities) have resulted in a decrease in physical activity for Mexican children and youth. Approximately 4.5 million Mexican children are overweight or obese. The Mexican Report Card on Physical Activity for Children and Youth (Mexican Report Card), the first of its kind in Mexico, was released this year and follows the Canadian Report Card model, which has been used successfully as a mechanism to increase awareness of the physical inactivity problem in children and youth across public, private and not-for profit sectors.

Modelled after The Active Healthy Kids Canada Report Cards on Physical Activity for Children and Youth, a comprehensive review of Mexican data relating to physical activity in children and youth was completed between 2009 and 2011, and included peer-reviewed literature and government reports. Instead of a letter grade system, which is common in the Canadian Report Cards, a numerical system was used to provide readers with an assessment of the physical activity levels of Mexican children and youth (0-10 with 0 being poor performance and 10 being the best). A panel of experts in Mexico discussed and confirmed grades based on a set of criteria used in the Canadian Report Cards. The grading procedure for the Mexican Report Card was overseen by the Scientific Officers of Active Healthy Kids Canada.

Eight physical activity indicators were graded in the Mexican Report Card including Physical Activity, Organized Sport Participation, Active Transportation, Screen Time, Physical Activity in Schools, Family Physical Activity, Physical Activity Programs and Policy. The Physical Activity indicator was given a grade of 5 out of 10. Four of the indicators were graded "Incomplete" due to lack of data.

The main finding from the Mexican Report Card was that physical activity levels are below the desired levels suggested by international physical activity guidelines. Important research gaps emerged from this first attempt to compile all national physical activity data, which signal a pressing need for better, national-level surveillance data in Mexico to determine the overall prevalence of physical inactivity in Mexican children and its impact on related health outcomes.

C-7 MEASUREMENT ISSUES IN WALKING AND CYCLING FOR TRANSPORTATION

MEASUREMENT ISSUES IN WALKING AND CYCLING FOR TRANSPORTATION

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This symposium will highlight problems related to methods used in assessing active transport. Data on active transport come from different sources including population studies, national statistics, and transport research. Comparison of data from different countries is difficult, because no standardized method has been used. Some studies report prevalence of people using walking or cycling as transportation to and from work, while others report percentage of trips of different transport modes. Other circumstances which make comparison of active transport levels between studies difficult are seasonal variation especially in Northern countries and the fact that many studies have not reported walkers and cyclists separately and others merge cyclists with mopeds.

Research on health related effects of active transport rely on accurate assessment of exposure and possible confounders. The choice of method depends on the type of study. Large scale epidemiological studies have mainly used different types of self-report, while more precise methods are possible in smaller studies of health effects of walking and cycling. This symposium will present different options for assessment of active travel, and discuss pros and cons of choices.

This presentation will give a historical background in the development of methods used in research related to health benefits of active transport. We will discuss differences in methods used in epidemiological studies compared to assessment of cycling to school in a randomized controlled trial. Methods include the degree of exposure of cycling to school in terms of mileage and intensity in a combined approach consisting of odometry, self-report, sms-track, and gps, and the association between cycling and health outcomes.

We will discuss the problems related to current differences in assessment methods related to the fact that research has different objectives for the transport sector and for health research, and further discuss how to overcome these problems in future research.

Other presentations will focus on a) a comparison of self-reported data with objective measurements, b) evaluation of how much accelerometer assessed MVPA is underestimated in children using cycling as transport, c) a comparison of moderate vigorous physical activity (MVPA) among children cycling vs. walking to school, d) monitoring of speed during active transport and estimating energy costs, and e) comparison of transport activity in rural and urban areas.

Oral Presentations:

OC 082

VALIDATION OF SELF-REPORTED TRANSPORT

Line Borrestad

Background: In order to provide more accurate assessment of commuting behavior and potential health effect, it is important to have accurate methods. It might therefore be appropriate to include both self-reported transport and objective measurements, such as cycle computers and accelerometers. Therefore, the current study aimed to: a) compare questionnaire reported commuting with objectively measured data from accelerometer and cycle computer; b) compare moderate vigorous physical activity (MVPA) among children cycling vs. walking to school c) and thus calculate possible underestimated MVPA, when using accelerometer to measure commuter cycling.

Methods: A total of 78 children (59% cyclist, CI=50.5-70.2 vs. 38.5% walkers, CI=27.0-50.0), average age 11.4, participated in the study. Physical activity was measured with cycle computers and accelerometers for four days. Mode of commuting and demographic information was self-reported in a questionnaire.

Results: Cycling trips per week reported by the questionnaire, was positively associated with kilometers cycled per week measured by the cycle computer ($r=0.599$; $p<0.001$). Walking trips per week, reported by the questionnaire, was negatively associated with data from the cycle computer ($r=-0.610$; $p<0.001$). Children who reported to cycle to school spent significantly more time bicycling than those who walked to school, 53.6 (SD= ± 33.9) vs. 25.5 (SD= ± 24.6) minutes per day ($p=0.002$). No significant association was observed between the different modes of commuting and accelerometer data. These findings show that questionnaire-reported cycling to school was related to the total amount of objectively measured cycling, but not to general physical activity measured by accelerometers

Conclusion: In order to provide more accurate assessment of active commuting in children and adolescents future studies should include both self-reported measured, and objectively methodology such as accelerometer and cycle computers.

OC 083

DIFFERENTIAL DISTRIBUTION OF DOMAIN-SPECIFIC PHYSICAL ACTIVITIES ACCORDING TO URBAN-RURAL AREA OF RESIDENCE AMONG ADULTS AND CHILDREN

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Background: Comparisons of physical activity between urban and rural adults have typically relied on measures of leisure time physical activity, largely ignoring occupational and domestic activities. Few studies comparing the physical activity of urban and rural children exist, with equivocal findings. Understanding where physical activity is accumulated may provide insights for intervention, and thus warrants investigation. This study aimed to explore the association between multiple domains of physical activity according to area of residence among children and adults. **Method:** In 1985, 6288 children (age 9-15 years) reported school-based, commuting and leisure time physical activity as part of the Australian Schools Health and Fitness Survey. In 2004-6, 1770 of these participants reported leisure, commuting, domestic and occupational physical activity via the International Physical Activity Questionnaire (long version), and wore Yamax Digiwalker pedometers for seven days. Area of residence was classified from postcode using a national index as urban, regional and rural. Analyses involved multinomial logistic regression to estimate odds ratios (OR) and 95% confidence intervals (CI) for being in the highest quarter of total and domain-specific physical activity according to area of residence (reference group: urban), adjusting for covariates in adulthood (age, sex, education, occupation, marital status, smoking) and childhood (age, sex, area-level socioeconomic status, language spoken at home, clustering by school). **Results:** Total self-reported physical activity and daily steps among rural adults was not significantly different from urban adults (OR 1.37, 95% CI 0.77-2.47 and OR 1.39, 95% CI 0.78-2.49, respectively). Rural adults reported significantly less leisure time (OR 0.34, 95% CI 0.18-0.63) and transport-related (OR 0.53, 95% CI 0.32-0.88) activity, while work-related and domestic physical activity were significantly higher among rural adults (OR 2.43, 95% CI 1.42-4.15 and OR 3.10, 95% CI 1.61-5.94, respectively). Rural children reported significantly less total physical activity (OR 0.72, 95% CI 0.54-0.97) and activity for transport (OR 0.35, 95% CI 0.24-0.51) than urban children, but there were no significant differences observed for leisure activity (OR 1.05, 95% CI 0.80-1.38), school sport (OR 0.96, 95% CI 0.56-1.64), or school physical education (OR 0.77, 95% CI 0.44-1.32). **Conclusion:** While urban and rural adults accumulated similar amounts of total physical activity, how they accrued this activity differed, highlighting the importance of measuring multiple domains of physical activity. Rural children were less active than urban children overall, which was mainly attributed to less transport-related physical activity; this domain may represent an opportunity for intervention.

OC 084

ACCURACY OF PREDICTION EQUATIONS FOR ESTIMATING THE OXYGEN COST OF SELF-PACED WALKING SPEED IN ADULTS

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The ACSM walking equation is commonly used to predict the oxygen cost of walking. However, the equation is best suited to speeds of 3–6 kph, and also assumes a linear relationship between oxygen cost (VO_2) of horizontal displacement and speed. Several alternative equations, which take into account the curvilinear relationship between VO_2 and speed, have been proposed. The purpose of the current study was to determine the agreement between measured VO_2 at self-paced walking (SPW) speed, and VO_2 predicted from the commonly-used ACSM walking equation, and from four other published equations in a heterogeneous group of adults. Two hundred and two adults (M=84, F=118; 21 – 64 yrs; 48 – 133 kg; 18 – 43 kg/m^2) were recruited via stratification in 2 sex (male, female), 4 age (20-34.9, 35-44.9, 45-54.9, 55-65 yrs), and 3 BMI (normal weight-for-height [NW], 18-24.9 kg/m^2 ; overweight [OW], 25-29.9 kg/m^2 ; obese [OB], 30-45 kg/m^2) groups. SPW speed was measured twice over 2 km walking on a 400m track. Oxygen cost of walking at SPW speed was measured via indirect calorimetry while participants walked on a treadmill at previously-determined SPW speed, and this was compared with VO_2 predicted from five published equations (ACSM equation and equations from van der Walt & Wyndham (A), Ralston (B), Cotes & Meade (C), and Grimby & Soderholm (D) with the basic form: $\text{VO}_2 = a * \text{Mass} + b * \text{Mass} * \text{Velocity}^2$. SPW speed was 5.93 ± 0.55 kph (range 4.51 to 7.56 kph). On average, the ACSM equation underestimated VO_2 by 3.27 ± 3.6 mL/kg/min ($P < 0.001$). The magnitude of the discrepancy was positively related to speed ($r = 0.65$; $P < 0.01$) with the degree of underestimation increasing with increases in speed. The equation underestimated VO_2 by an average of 2.4 ± 1.8 mL/kg/min ($P < 0.001$) even within the range of speeds for which it claims to be suited. The mean difference between measured VO_2 and VO_2 predicted from the four curvilinear equations was -2.33 ± 1.74 , -0.18 ± 1.80 , -0.04 ± 1.93 , and -1.21 ± 1.76 mL/kg/min, for equations A to D. While equations B and C had mean biases not different from zero, both exhibited a weak positive relationship with speed ($r = 0.24$ and 0.42 , $P < 0.001$), tending to underestimate VO_2 at lower speeds, and overestimate at higher speeds. In conclusion, equations that take into account the curvilinear relationship between VO_2 and speed may provide more accurate estimates of VO_2 during walking than the commonly-used ACSM walking equation, especially at the higher end of typical adult walking speeds.

OC 085

CAN WE USE DIGITAL LIFE-LOG IMAGES TO INVESTIGATE THE ERROR ON SELF-REPORTED JOURNEY BEHAVIOUR IN SCHOOL CHILDREN? RESULTS FROM A PILOT STUDY

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Background

The school journey is often studied in relation to health outcomes in children and adolescents. Active modes of travel such as walking and cycling can contribute to overall physical activity, while travel in motor vehicles adds to the time spent engaged in sedentary behaviour. Self-report is the most common method of investigating the school journey. The purpose of this pilot study is to investigate the possible error on self-reported journey behaviour in adolescents using a wearable digital camera called SenseCam.

Methods

Participants ($n = 17$; age = 13-15 years) from 4 schools were required to wear the SenseCam device for one full week of travel to and from school. The device automatically records time-stamped, first-person point-of-view images of the journeys, without any action required by the wearer. Participants also completed a researcher administered self-report travel survey over the same period for comparison. We derived within- and between-subjects correlation coefficients and Bland-Altman 95% limits of agreement (LoA) accounting for the multiple observations per individual.

Results

We collected self-report data for 150 journey bouts. Of these journey bouts we collected SenseCam data for 135 (90%). The within-subjects correlation coefficient for journey duration for the two measures was 0.89 (95% confidence interval (CI) = 0.84 to 0.93). The between-subjects correlation coefficient was 0.92 (95% CI = 0.79 to 0.97). The mean difference (bias) between methods at the whole sample level was small (10 s per journey; 95% CI = -33 to 53 s). However, the LoA were wide (± 501 s (-491 to 511 s)) revealing large random error at the individual level.

Conclusions

Compared to direct observation of travel behaviour from time-stamped images, self reported journey duration is accurate at the mean group level but imprecise at the level of the individual participant, indicating the two methods cannot be used interchangeably.

OC 086

HOW WELL CAN WE MONITOR THE HABIT AND SPEED OF TRAVEL-RELATED WALKING AND CYCLING AT THE POPULATION LEVEL

Dafna Merom*, Ralph Buehler, Hidde van der Ploeg, Grace Corpus, John Pucher and Adrian Bauman

BACKGROUND & AIMS: Walking and cycling for travel is considered an additional source of health-enhancing physical activity (PA) for children and adults. Information on daily walking and cycling is available from surveillance measures that use a diary format, such as transportation or time-use surveys. These surveys have been used extensively in the past decade for generating public health indicators for monitoring. The purpose of this study was to address two measurement challenges often mentioned as limitations of these surveys for public health surveillance, which are the extent to which these diaries 1) can represent individuals' travel habits, and 2) can provide data on intensity to determine health-enhancing energy expenditure.

METHODS: In 2009, the USA National Household Travel (NHTS) included two questions on the number of walking and cycling trips in the past week within the household questionnaire as well as the usual 24-hour diary on all trips undertaken on one day in the same week. We compared the agreement between two health-enhancing measures: walking/cycling for at least 30 minutes (i.e., recommended dose) generated from the travel diary, and walking/cycling ≥ 5 days per week (i.e., recommended frequency) taken from the household questionnaire. For the second objective we used data from Geographical Information Systems for trip distances and the reported trip duration from the 24-hour diary to compute trip speed in the Household Travel Survey of SGM.

RESULTS: From the NHTS we found excellent agreement (98%) between health-enhancing cycling on one day and regular weekly cycling, with "fair" Kappa of 0.38 (95% CI:0.35-0.39) $p < 0.0001$. Walking agreement was lower (70%), with "poor" Kappa 0.156 (0.153-0.159) $p < 0.0001$. In the HTS the cycling speed ranged from 5.6 km/hr to 30 km/hr, the mean being 9.8 km/hr (std=5.7), which is below leisurely speed, and the upper quartile was 13 km/hr or more. For the walking trip the mean speed was 5.2 km/hr, but the median, lower and upper quartiles, being 4.6 km/hr indicating limited variability, with the 90th percentile at 5.6 km/hr.

CONCLUSION: Travel diaries appeared to capture habitual cyclists but not habitual walkers. The difference in the scope (purposes) of cycling trips versus walking trips can partially explain the difference in regularity. The walking speeds are in the range of brisk walking, but distance accuracy needs to be more precise, in particular for capturing short trip distance. Only a quarter of cycling trips were in the moderate range. The validity of GIS distance of active travel, in particular short trips, should be further assessed if energy expenditure is a desirable indicator.

A-8 CHALLENGES IN ASSESSING DIETS OF CHILDREN AND ADOLESCENTS

CHALLENGES IN ASSESSING DIET AND VALIDITY OF REPORTED INTAKE OF CHILDREN AND ADOLESCENTS

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Measuring dietary intake among children and adolescents is of great challenge in nutritional research and is associated with high subject burden as well as high administrative and analysis cost. For young children the collection of dietary intake information is dependent on adults with good knowledge of the child's intake, which is more difficult if a lot of food is eaten outside home. The age at which children's cognitive skills are sufficiently developed to be able to report dietary intake is not well established and may differ between individuals as well as cross-cultures. However, when being able to report dietary intake children often find it tedious, difficult and too time consuming which may lead to uncompleted reports or large number of drop outs. Further challenges with older children and adolescents is that they generally have more unstructured eating patterns than young children and adults, are less motivated participants and sometimes have a high prevalence of restrained eating particularly among girls. These and other factors make it especially problematic to use traditional dietary survey methods in studies of children's and adolescent's dietary intake. Underestimation of energy intake is often larger with increased age in adolescence, and increased under estimation is similar to adults associated with characteristics as overweight and obesity. The objective of the presentation is to share experiences of challenges in assessing diet and validity of reported intake of children and adolescents. What are the main issues that may impact reports of dietary intake among children and adolescents? How well can dietary

intake be captured among young overweight and obese children's or adolescents eating vegan food? What about using new technology as digital camera or smartphones? Despite the many challenges and difficulties associated with assessing dietary intake of children and adolescents continuation of assessment is of great importance for nutritional research on links between diet and health. The traditional dietary assessment methods need to be furthered developed and there is a great need for improved dietary assessment methods that are both valid and user-friendly.

Oral Presentations:

OC 087

THE USE OF A HARMONIZED PROTOCOL TO CAPTURE DIETARY INTAKES OF CHILDREN FROM BIRTH TO 2 YEARS IN 8 COUNTRIES: THE MALNUTRITION-ENTERIC DISEASE (MAL-E

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The goal of the MAL-ED study is to evaluate the roles of repeated enteric infections and dietary intake on the long-term growth and cognitive development of children. More than two hundred newborns have been enrolled and are being followed in each of eight countries: Brazil, Peru, Tanzania, South Africa, India, Pakistan, Bangladesh, and Nepal, and evaluations of each child's diet and health status occur twice weekly as well as monthly. The sites differ with respect to culture, maternal nutritional status, size at birth, diet, the etiology of infection and the presence of co-factors such as malaria. Breast feeding, pre-lacteal feeding and introduction of liquids and solids are identified via questionnaire from enrollment to 8 months. Beginning at 9 months, a monthly 24-hour recall with timed replicate days is utilized to capture usual nutrient intake and day to day variation at each month within each site. For this, 24-hour data collection forms to identify foods and recipes served and amounts consumed were developed, and food models, utensils and other tools appropriate for each site were identified. Each site identified local nutrition consultants and trained their staff following common principles. Conference calls with the Nutrition lead, help to identify and resolve problems as they arise during data collection and entry. Entered data is sent to the Data Coordinating Center at Fogarty International Center in Bethesda, Maryland, USA where a series of quality checks are run, and issue logs are sent back to the sites. MALED investigators at The Johns Hopkins Center for Human Nutrition work with the data and the unique food composition data bases, to evaluate recipes and the dietary data to ultimately produce estimates of energy and nutrient intakes, principal food sources of each nutrient at each site, and other dietary intake measures to address the goal of the project. The presentation will cover the organization and elements of the dietary data collection methodology for the MALED study focusing on the data collected on children 9 months and older.

OC 088

FFQ- BASED INDICES TO REFLECT CHILDREN'S PROPENSITIES TOWARDS FAT AND SUGAR

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Aim: In large population-based studies with a comprehensive assessment protocol, short and simple dietary assessment is often required. We aimed to develop and evaluate simple indices that reflect children's propensity toward fat and sugar based on a short dietary screening tool.

Methods: Fat and sugar propensity ratios were calculated from parental responses to a short qualitative food frequency section in the Children's Eating Habits Questionnaire (CEHQ-FFQ) that was developed within the multi-centre study IDEFICS that comprised 8 European countries (Italy, Estonia, Cyprus, Belgium, Sweden, Germany, Hungary, Spain). It asks for the usual weekly consumption frequency of 43 food and beverage items of which 17 are high in fat and 12 are high in sugar. The propensity ratios were calculated by creating the sum of the weekly consumption frequency of high-fat or high-sugar items and dividing it by the sum of all 43 food items of the CEHQ-FFQ.

In order to check relative validity of the fat and sugar propensity scores, sugar and fat intake per MJ energy intake was assessed by means of a 24h dietary recall in more than 9,000 children aged 2-9 years that participated in the baseline survey. ANOVA was calculated with sugar and fat intake as dependent variable and quartiles of sugar and fat propensity ratios as independent variable.

Results: ANOVA results showed a significant association between sugar intake from 24h recalls and quartiles of sugar propensity ratios derived from the CEHQ-FFQ with strong indications of a positive linear correlation. The same result could be found for the relationship between fat propensity ratios and fat intake. Stratified analyses verified a significant positive association between sugar propensity ratio and sugar intake in all eight countries, but results differed between countries in the fat-related analyses. Additionally, the association did also not differ by age groups (2-6 years vs. 6-9 years) and gender in stratified analyses.

Conclusions: Although calculated from a qualitative FFQ, the sugar and fat propensity ratios were associated with energy-adjusted fat and sugar intake in children. Therefore, they are a short and easy tool to reflect propensity for fat and sugar in children.

OC 089

WHO IS THE MOST ACCURATE REPORTER OF CHILD ENERGY INTAKE – MOTHERS, FATHERS OR THE CHILD? - A DOUBLY LABELLED WATER VALIDATION STUDY OF AN FFQ.

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The ability of children (8-12y) to accurately self-report dietary intake using a food frequency questionnaire (FFQ) is unclear. No previous study has compared whether parents or children are the most accurate reporters of child energy intake using the gold standard doubly labelled water (DLW). The aim was to evaluate accuracy of mother, father and child reports of child energy intake (EI) estimated by the Australian Child and Adolescent Eating Survey (ACAES) FFQ compared to total energy expenditure (TEE) measured by DLW method. TEE was assessed in weight stable children (n=9, mean ±SD) 9.8±1.3 yr, BMI 17.6±2.9 kg/m², BMI z score 0.35 ± 0.94 over 10 days using the DLW method. Usual intake over the past 6 mo was estimated separately for mother, father and child ACAES FFQs. Mean daily EI (kJ) was derived from ACAES using standard child portions and national nutrient databases. Accuracy of reporting was calculated from absolute (EI-TEE) and percentage (EI/TEE x 100) differences between EI and TEE and testing associations using Pearson correlations and Bland-Altman plots. Children were the most accurate reporters (mean difference 13± 35 kJ) followed by fathers (121± 13 kJ) then mothers (144±26 kJ) with 44% of children over-reporting compared with 67% of fathers and 89% of mothers. Pearson's correlation between FFQ EI and TEE was statistically significant for fathers only, r= 0.92, P<0.001. Bland Altman plots for the difference in EI and TEE from child, mother and father showed the narrowest limits of agreement between measures was for fathers. Children and fathers were more likely to accurately report child EI, while mothers over-reported to a greater degree. Children aged 8-12y may be able to report EI accurately using the ACAES FFQ. When EI is estimated by proxy, a potential impact on reporting accuracy should be considered Source of Funding: University of Newcastle Early Career Grant to T Burrows. C Collins supported by an NHMRC Career Development Fellowship.

OC 090

TRACKING AN OBESOGENIC DIETARY PATTERN FROM 7 TO 13 YEARS OF AGE: THE AVON LONGITUDINAL STUDY OF PARENTS AND CHILDREN (ALSPAC)

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Background: Little is known about tracking of dietary intake during childhood and adolescence. Understanding dietary tracking during this critical developmental period may inform dietary interventions to improve dietary intakes and health outcomes. **Objectives:** To describe how adherence to an obesogenic dietary pattern (DP) and intakes of key food groups tracks from 7 to 13 y of age. **Methods:** Data was obtained from child participants in the Avon Longitudinal Study of Parents and Children (ALSPAC). A 3-d food diary was completed at 7, 10 and 13 y of age. An energy-dense, high fat, low fibre DP was identified using reduced rank regression and subjects scored for the DP at each age. Tracking coefficients for DP z-scores and standardised food group intakes were estimated using Generalised Estimating Equations. **Results:** Over 7,000 children completed a 3-d food diary at two or more time points. The DP tracked moderately from 7 to 13 y; tracking coefficients were 0.48 (95% CI: 0.44 to 0.52) for boys and 0.38 (95% CI: 0.35 to 0.41) for girls. Of the ten food groups key to this DP, fruit, vegetables, high fibre bread, high fibre breakfast cereals and full fat milk showed the strongest tracking, particularly among low consumers. A lower level of maternal education or a greater pre-pregnancy maternal BMI were positively associated with greater adherence to the DP, as well as increases in intakes of white bread, crisps, sweets, processed meats and decreases in intakes of vegetables, fruit, and high fibre bread during follow

up. **Conclusions:** An obesogenic DP is likely to be established by 7 y of age and therefore, early interventions are required to increase fruit, vegetables, high fibre breads and high fibre breakfast cereals. Specific groups of families may require additional support beyond the early years to foster lifelong healthy dietary habits.

B-8 NEW TECHNOLOGY FOR SELF-REPORT MEASUREMENT OF PHYSICAL ACTIVITY

INTERNET-BASED MEASURES OF PHYSICAL ACTIVITY: COMBINING TRADITIONAL APPROACHES WITH NEW TECHNOLOGY FOR BETTER EXPOSURE ASSESSMENT IN LARGE-SCALE STUDIES

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Large-scale etiologic studies typically employ questionnaires to estimate current usual amounts of physical activity and sedentary behavior (e.g., past year). While such questionnaires have provided many important insights, there has been only a modest evolution of the basic questionnaire-based approach since the inception of the method, about fifty years ago. Furthermore, measurement error remains a problem that can adversely affect statistical power and often results in attenuation of the strength of associations observed. Better self-report methods that provide more accurate and precise estimates of current amounts of physically active and sedentary behavior are needed to advance the field. New technologies (e.g., internet-based measures, mobile phones) offer the opportunity to administer self-report methods that rely more heavily on short-term recall, such as behavioral diaries and previous day recalls, at an affordable cost in large-scale studies. This new approach offers unique advantages over questionnaire-based methods, but it also has limitations that must be considered. Advantages include the possibility of capturing more accurate activity duration estimates and more detailed information about specific types of behavior and the context within which the behavior occurs. In very large studies, costs associated with data collection using these methods also can benefit from economies of scale. There are also challenges associated with this approach. Researchers must be able to effectively convert the original recall method into a self-administered format that employs an electronic user interface that retains the favorable measurement properties of the original. In addition, methods to translate a few “snap shots” of activity-related behaviors into useful long-term averages must be developed. This presentation will discuss the pros and cons of this approach and also describe the development and testing of the U.S. National Cancer Institute’s Activities Completed in Time over 24 Hours (ACT24), an internet-based measure designed for large-scale studies.

ECOLOGICAL MOMENTARY ASSESSMENT OF PHYSICAL ACTIVITY

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Advances in portable electronic technologies have created opportunities to collect real-time self-reports of physical activity and sedentary behavior in naturalistic situations. This data capture method, called Ecological Momentary Assessment (EMA), uses common mobile phones to deliver electronic surveys on the display screen of the device and record responses for instantaneous wireless transfer to a remote server or future download. Unlike recall instruments, which are prone to recall errors and biases, EMA can measure behaviors as they occur. In addition, this strategy is able to provide contextual information about physical activity such as where and with whom behaviors are taking place; how individuals perceive environmental features of those settings (e.g., safety, traffic, aesthetics); and how individuals feel before, during, and after physical activities. This presentation will describe how EMA methods can enhance the measurement of physical activity and related contexts. In particular, it will (1) discuss how EMA can complement and expand upon objective physical activity and location monitoring, (2) report results of feasibility and validity studies using EMA to measure physical activity and sedentary behaviors in children and adults, (3) describe EMA procedures to examine time-lagged effects and intraindividual variability, and (4) discuss how the next wave of Context-Sensitive Ecological Momentary Assessment (CS-EMA) will integrate information from built-in and external sensors (e.g., Global Positioning Systems, air pollution monitors, asthma inhalers) to trigger electronic surveys in response to key events, exposures, and experiences. It will conclude by addressing common challenges and limitations encountered in EMA research.

Oral Presentations:

OC 091

ESTIMATING PHYSICAL ACTIVITY USING CELL PHONES: A RANDOMIZED POPULATION-BASED STUDY

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Cell phones have the potential to improve data collection on physical activity in epidemiological research. We have developed a cell phone questionnaire to assess physical activity level (PAL) intended for large-scale settings. We have earlier reported that our procedure assesses PAL in good agreement with accelerometry and doubly labeled water. In this study we investigated whether mean PAL assessed using cell phones is equal to mean PAL assessed using the two most commonly used techniques in epidemiological research (paper and web questionnaires). Furthermore, we compared response rates for identical questions on physical activity delivered by three different media: cell phone, web and paper. In a randomized population-based Swedish study in 2010, PAL obtained with cell phones (n=171) was compared to corresponding estimates obtained with identical questions delivered by paper (n=211) or web (n=182) in 564 healthy participants aged 18-80 years. The difference between mean PAL for the cell phone group compared to mean PAL in the paper group was 0.02 (90 % confidence interval: -0.02, 0.06), and compared to mean PAL in the web group it was 0.02 (90 % confidence interval: -0.02, 0.05). The response rates were similar for the three groups (89 % paper; 93 % web and 91 % cell phone). In conclusion, mean PAL obtained using cell phones was equal to mean PAL obtained using web or paper. Furthermore, the response rate was similar using cell phone, web and paper questionnaires. Our cell phone procedure is a promising new tool for assessing physical activity in epidemiological studies.

OC 092

DEVELOPMENT AND TEST OF A SMARTPHONE APPLICATION FOR SYNCHRONIZED REAL-TIME DIETARY ASSESSMENT AND PHYSICAL ACTIVITY ANALYSES

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Introduction: Diet and physical activity (PA) assessments are central to public health nutrition research and practice. New technology enhancements, such as Smartphones, offer exciting opportunities to capture joint data on both diet and PA in real-time.

Objectives: Develop a Smartphone application (app) for synchronized real-time assessment of food intake and PA. Test the app prototype for feasibility/suitability/plausibility of integrated use in face-to-face lifestyle coaching.

Method: Technical development of an Android Smartphone app for touch-screen entry of food intake and PA measurement by accelerometer. Integrate it into a system for logging/analyzing/displaying data over time. Test it with two user groups from December 2010 to May 2011: (a) 5 female registered dietitians (RD), 6 consecutive days, structured group discussion; (b) 14 female and 6 male overweight volunteers, 2 x 6 consecutive days, 2 coaching sessions, individual interviews.

Results: "SmartAPP" comprising three modules: (1) window to complete a semi-quantitative food record from at least 920 items; (2) automated accelerometer PA level recorder based motion analysis/metabolic equivalent calculation; (3) administration/user characteristics mode for individual activity calibration/exporting data. SmartAPP-system consists of: Smartphone running SmartAPP, host computer for logged data analysis/display. Dietary and PA data, analyzed for user group differences (RD vs. clients) and time effects (clients week 1 vs. week 2), showed comparable patterns. RDs coped better with the food record. Group discussion/interviews revealed reasonable data plausibility and empowerment, but also factors limiting use.

Discussion/Conclusion: The SmartAPP-system offers a valuable strategy to automate and combine assessment elements. It can be updated to improve user friendliness and efficiency, e.g., by adding a photo app for portion size estimation. Further validation against more established methods is still needed.

OC 093

A DOUBLY LABELED WATER VALIDATION OF THE NEW WEB-BASED PHYSICAL ACTIVITY QUESTIONNAIRE "ACTIVE-Q"

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Background: Widespread access to the Internet has made large data collections via the web possible to implement in epidemiological studies, creating a need for web-based questionnaires. Compared to traditional paper-based questionnaires, web-based alternatives may not only simplify data collection but also improve the quality of data. To fill the need of a web-based questionnaire assessing physical activity and inactivity among adults, we have developed "Active-Q". Active-Q comprises questions within the domains of daily occupation, transportation to and from daily occupation, leisure time activities, and sporting activities.

Methods: We have validated total energy expenditure assessed with Active-Q against results obtained using the objective doubly labeled water (DLW) method in a group of 37 individuals, aged 20-65 years. The reproducibility of Active-Q was assessed by comparing the results from two admissions of the questionnaire. Study participants were further asked to fill in a short evaluation after having responded to the questionnaire.

Results: The median time required to complete Active-Q was 6:06 minutes and 73 % of the respondents reported the questionnaire to be "easy" or "very easy" to answer. The mean total daily energy expenditure assessed with Active-Q and DLW was 11670 kJ and 11230 kJ, respectively, thus the mean difference between Active-Q and DLW was 440 kJ. Total daily energy expenditure assessed with Active-Q was statistically significantly correlated to results from DLW, $r = 0.52$ ($P < .001$). The intraclass correlation coefficient for total daily energy expenditure assessed twice using Active-Q was 0.83 (95 % CI: 0.73-0.93).

Discussion: Our results demonstrate that Active-Q is a user-friendly questionnaire that provides valid and highly reproducible estimates of total energy expenditure when compared to objective DLW measurements. To the best of our knowledge, Active-Q is one of the first validated physical activity questionnaires specifically designed for web-based use. It is a suitable method for web-based data collection in large epidemiological studies. Active-Q is currently in use in three large ongoing cohort studies in Sweden, aiming at recruiting a total of approximately 700,000 participants.

C-8 BIOMARKERS IN DIETARY ASSESSMENT

Oral Presentations:

OC 094

CHECKING FOR COMPLETENESS OF 24-HOUR URINE COLLECTION USING PABA NOT NECESSARY IN THE OBSERVING PROTEIN AND ENERGY NUTRITION (OPEN) STUDY

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Introduction: Orally administered para-amino benzoic acid (PABA) is known to have near 100% excretion in urine and has, therefore, been used as a measure of completeness for 24-hour urine collections (referred to as PABAcheck). We are conducting a pooling project of large biomarker-based dietary measurement error studies, some with and some without PABAcheck that includes a measure of urinary nitrogen from 24-hour urine collections as a recovery biomarker for protein intake. The aim of the study is to investigate the homogeneity of the measurement error structure of self-reported dietary assessment instruments. To assess the feasibility of combining these studies we used data from the Observing Protein and Energy Nutrition (OPEN) Study to examine the effect of including urine collections deemed incomplete based on PABAcheck.

Methods: OPEN was conducted in 1999-2000 and included 484 men and women aged 40-69 years from Montgomery County, Maryland. A food frequency questionnaire and 24-hour dietary recalls were evaluated using recovery biomarkers of total energy expenditure assessed by doubly labeled water and urinary nitrogen and potassium assessed by two 24-hour urines. On urine collection days, participants were asked to take three (PABA) tablets throughout the day and PABAcheck was used as a measure of complete urine collection. In our original analyses, if PABA recovery in urine was below 85% of the oral dose, 24-hour urine collections were either adjusted (<85% - 70%) or deemed incomplete and excluded from further analysis (<70%). The data were recently reanalyzed with no PABAcheck-based adjustments or exclusions to assess the necessity of PABAcheck.

Findings: Means and coefficients of variation for urinary protein and potassium, and measurement error model-based correlations and attenuation factors based on recovery biomarkers were very similar whether or not

PABAcheck was considered. These findings were consistent when models were stratified by levels of self-reported missed voids.

Conclusion: PABAcheck is no doubt necessary in metabolic studies, but in large population-based measurement error biomarker studies such as OPEN, the additional expense may not be warranted. Our findings support the feasibility of pooling biomarker studies regardless of whether they have included PABAcheck. However, given that in OPEN, participants were informed that the purpose of PABA administration was to determine completeness of 24-hour urine collections, we cannot exclude the possibility that this may have led to the desired outcome of more complete collections. An implication is that researchers might consider administering PABA to encourage adherence but not analyze urines for its content.

OC 095

EVALUATION OF FOOD AND NUTRIENT INTAKE ASSESSMENT USING CONCENTRATION BIOMARKERS IN EUROPEAN ADOLESCENTS FROM THE HELENA STUDY

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Accurate intake assessment is essential with regard to the investigation of diet-disease relationships. The aim of this study was to evaluate food and nutrient intake assessment among European adolescents obtained from 24-hour recalls and a FFQ using concentration biomarkers. Fruit and vegetable intake versus vitamin C status and β -carotene status and fish intake versus the sum of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) status were included to evaluate food intake. In addition, vitamin B12, folate, vitamin C, β -carotene, and EPA and DHA were used to evaluate nutrient intake. For food intake assessment evaluation unadjusted spearman rank correlations were computed between concentration biomarker and mean food intake, concentration biomarker and frequency of food consumption and mean food intake and frequency of food consumption. Furthermore, the triads method was used to evaluate the correlation between the three measurements (FFQ, biomarker and 24-hour recall) and the true intake using validity coefficients. Usual food intakes, resulting from the two 24-hour recalls and with incorporation of information from FFQ as a covariate, were estimated using the Multiple Source Method. To evaluate nutrient intake assessment unadjusted spearman rank correlations were calculated for vitamin B12 status versus vitamin B12 intake, folate status versus folate intake, β -carotene status versus β -carotene intake, vitamin C status versus vitamin C intake, EPA and DHA status versus EPA and DHA intake. For the food intake assessment evaluation 390 adolescents were included while 697 adolescents for nutrient intake assessment evaluation. Except for DHA+EPA status versus fish intake, highest correlations were found between food consumption frequencies and mean food intakes ($r=0.51$ for fruits and $r=0.29$ for vegetables). Correlations were higher between frequency of food consumption and concentration biomarkers than between mean food intake and concentration biomarkers, especially for EPA+DHA ($r=0.35$ vs. $r=0.27$). In boys highest correlations were found between %EPA+DHA status and frequency of fish consumption ($r=0.42$). In girls highest correlations were found between mean fruit intake and frequency of fruit consumption ($r=0.56$), mean fish consumption and % DHA+EPA status ($r=0.36$) and mean fish consumption and DHA+EPA concentration ($r=0.34$). For boys, highest validity coefficients were found for frequency of fruit consumption (0.88) and for DHA+EPA biomarker (%) (0.71). In girls the highest validity coefficients were found for fruit consumption frequency (0.76), vegetable consumption frequency (0.74), mean fruit intake (0.90) and DHA+EPA biomarker (%) (0.69). In nutrient intake assessment evaluation, highest correlations were found for folate, active vitamin B12 and β -carotene for girls, while for DHA+EPA among boys. After exclusion of underreporters correlations slightly improved. Correlations between mean usual food intakes, adjusted for food consumption frequency, and concentration biomarkers were higher than correlations between mean food intakes and correlation biomarkers. In conclusion, two non-consecutive 24-hour recalls in combination with a FFQ seem to be appropriate to rank subjects according to their usual food intake. Exclusion of underreporters might be beneficial.

OC 096

RESULTS OF JOINT ANALYSIS OF FOUR LARGE VALIDATION STUDIES OF DIETARY SELF-REPORT INSTRUMENTS THAT USE RECOVERY BIOMARKERS

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A group of investigators conducting large (> 150 participants) validation studies of dietary self-report instruments with recovery biomarkers, have agreed to pool data from their studies to enable a common analysis of results. Four validation studies are included: NCI's Observing Protein and Energy (OPEN) Study, USDA's Automated Multiple Pass Method (AMPM) Validation Study, WHI's Nutrition Biomarkers Study (NBS), and UCLA's Energetics Study. The aims of the study are:

1. To build a database from the studies that includes information on dietary intake data from food frequency questionnaires (FFQ) and 24-hour recalls (24HR), urinary nitrogen and potassium levels measured in 24-hour urine specimens, and total energy expenditure levels measured by doubly labeled water.
2. Under the working assumption that these biomarkers provide unbiased assessment of daily intakes of protein, potassium and energy respectively, to use statistical meta-analysis to answer a range of issues pertaining to self-reported dietary intakes of these nutrients.
2. Preliminary analyses have been completed and show the following: For FFQ's, energy was under-reported in all studies by an average of 29% (range across studies: 27% to 32%); protein was under-reported by 16% (range: 6% to 27%); but overall potassium was not under-reported with an average bias of less than 1% (range: -13% to +11%). For 24HR's, under-reporting was less severe for energy: the average bias was -12% (range: -9% to -13%). Protein was not under-reported with an average bias of +1% (range -10% to 14%), and potassium was not under-reported with average bias +3% (range: -1% to 9%). For FFQ's, average overall attenuation factors, unadjusted for covariates, were for energy 0.05 (range: 0.01 to 0.09); for protein 0.16 (range: 0.08 to 0.24); and for potassium 0.25 (range 0.10 to 0.32). Energy adjustment improved the attenuation. For protein density the average attenuation factor was 0.42 (range: 0.38 to 0.47), and for potassium density 0.57 (range: 0.48 to 0.76). For the 24HR's, average attenuation factors were, for energy 0.11 (range: 0.07 to 0.15); for protein 0.23 (range: 0.18 to 0.32); for potassium 0.32 (range 0.16 to 0.48); for protein density 0.28 (range: 0.17 to 0.38) and for potassium density 0.43 (range 0.26 to 0.61). For both FFQ's and 24HR's, under-reporting of energy and protein intake was associated with higher BMI across all studies. Further analyses, such as whether attenuation factors vary according to personal characteristics, and the correlation between self-report and true usual intake, are under investigation and will be reported.

OC 097

URINARY ISOFLAVONOIDS AS BIOMARKERS OF SOY INTAKE DURING A RANDOMIZED CROSSOVER DIETARY INTERVENTION

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Background. Due to their estrogen-like structure, isoflavones are considered important bioactive components in soy beans. Large amounts of isoflavonoids are excreted in urine within 24-48 hours of consumption. The objective of this analysis was to compare self-reported dietary isoflavone intake (DII) to urinary isoflavonoid excretion (UIE) during a nutritional intervention. **Methods.** In a crossover design, we randomized 96 women to 2 groups who, in reverse order, completed a high-soy diet with 2 soy food servings per day and a low-soy diet with <3 servings of soy per week for 6 month each separated by a 1-month washout period. One soy serving (177 mL of soymilk, 126 g of tofu, or 23 g of soynuts) provided approximately 25 mg of isoflavones. Of the randomized subjects, 14 women dropped out and 82 participants completed the entire trial. To assess adherence to the study protocol, the participants completed 7 unannounced 24-hour dietary recalls and donated 8 urine samples, which were analyzed for isoflavonoid levels (daidzein, genistein, equol, and O-desmethylangolensin) using liquid chromatography tandem mass spectrometry; UIE was expressed as nmol/mg creatinine. Adherence to the intervention was defined as >40 mg/day isoflavones during the high-soy diet and <10 mg/day isoflavones during the low-soy diet. We computed Spearman correlation coefficients to examine the association between UIE and DII. Logistic regression was applied to predict dietary assignment and adherence to the intervention

using log transformed values of UIE; areas under the receiver operating characteristic curves (AUC) were calculated. **Results.** Participants reported mean daily intakes of 0.8 ± 1.6 , 0.2 ± 0.8 , and 2.1 ± 1.9 soy servings at baseline, during the low-soy and the high-soy diet, respectively. This corresponded to mean isoflavone intakes of 21.2 ± 39.7 , 5.9 ± 17.8 , and 68.5 ± 38.5 mg/day. The respective means for UIE were 5.0 ± 9.2 , 5.8 ± 11.8 , and 58.4 ± 62.0 nmol/mg creatinine. Using all observations, UIE was significantly correlated with DII ($r_s=0.52$, $p<0.0001$). However, using only baseline, low-soy or high-soy diet values, no association was observed; the correlation coefficients ranged between 0.01 and 0.13. DII based on 24-hour recalls and UIE were strongly associated with the high-soy diet in a logistic model ($p<0.0001$); the respective AUCs were 0.931 and 0.896. Adherence to the intervention strategy could be predicted equally well during the high-soy (AUC=0.637) and the low-soy (AUC=0.620) diet. **Conclusion.** UIE is an excellent measure to discriminate between low and high soy intake, but the association with DII is relatively weak when the range of soy intake is small.

OC 098

EVALUATION OF PLASMA C15:0 AND C17:0 AS BIOMARKERS OF DAIRY FAT INTAKE IN FIVE EUROPEAN CENTERS STUDIED IN THE EFCOVAL STUDY

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Background: The role of dairy in human health is controversial. An important problem is the error in assessment of dairy intake, and a valid biological marker of intake might contribute to its assessment. Two exogenous fatty acids, pentadecanoic acid (C15:0) and heptadecanoic acid (C17:0) have been advocated as biomarkers of dairy fat intake. **Objective:** To investigate whether C15:0 and C17:0 can be used as valid biomarkers of dairy fat intake in a heterogeneous population.

Design: Six hundred individuals (44-65y) from the Netherlands (NL), Belgium (BE), Norway (NO), the Czech Republic (CZ) and France (FR) were included by convenience sampling. Associations between dairy fat intake, estimated by two non-consecutive 24h dietary recalls (24HDRs) using EPIC-Soft, and contents of C15:0 and C17:0 in serum phospholipids, separately and in combination, were analysed using Spearman or Pearson's correlation coefficients after log transformation. Correlations were adjusted for BMI, age and fat from ruminant meat.

Results: For men, moderate correlations for CZ ($r=0.16$; $p=0.22$) and BE ($r=0.24$; $p=0.07$), and higher correlations for NO ($r=0.32$; $p=0.01$) and FR ($r=0.45$; $p<0.01$) were found between dairy fat (g/g total fat intake) and C15:0, but not for NL ($r=-0.03$; $p=0.81$). Correlations in women varied from moderate 0.11 ($p=0.37$) and 0.24 ($p=0.06$) in NL and NO respectively, to higher correlations of 0.41 ($p<0.01$, CZ) and 0.36 ($p=0.01$, FR), while an inverse correlation of -0.10 ($p=0.47$) was found in BE. C17:0 correlations ranged from -0.03 ($p=0.80$, CZ) to 0.24 ($p=0.06$, BE) in men, and -0.09 ($p=0.52$, BE) to 0.25 ($p=0.06$, CZ) in women. After correction for age, BMI and fat from ruminant meat, correlations of C17:0 for men improved significantly, especially for NO ($r=0.85$; $p=0.03$). We did not see such improvements for C15:0. Pooled correlations of C15 plus C17 were generally in-between those of C15:0 and C17:0, separately. For all centers pooled together, a higher correlation (C15~dairy fat) was observed for men ($r=0.25$; $p<0.001$) than women ($r=0.15$; $p=0.01$).

Conclusion: Fatty acids C15:0 and C17:0 in serum phospholipids have been reported as candidates for biomarkers of dairy intake in several Scandinavian studies. This result is partly supported by our study, but we noticed a high between-country variation. Our results may be related to differences in dietary patterns, characteristics of our heterogeneous population, or inherent large day-to-day variation of the two 24HDRs to assess intake. We conclude that these biomarkers should be used with caution for dairy fat assessments of populations for which they have not been evaluated.

OC 099

ALKYLRESORCINOLS AND THEIR METABOLITES IN PLASMA AND URINE AS BIOMARKERS OF WHOLE GRAIN WHEAT AND RYE: WHICH ONE WORKS BEST?

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Alkylresorcinols are phenolic lipids almost exclusively found in the outer parts of wheat and rye grains and only trace-levels are detected in refined products. AR are absorbed via the lymphatic system to the systemic circulation where they are present in plasma lipoproteins and erythrocytes. AR homologues are metabolized into two main metabolites, 3,5-dihydroxybenzoic acid (DHBA) and 3-(3,5-dihydroxyphenyl)-1-propanoic acid (DHPPA) which are present in plasma and urine in free and conjugated forms.

Previous feeding studies have shown that plasma AR concentrations increase proportionally with whole grain intake, and that concentrations remain stable within individuals when whole grain is consumed frequently and regularly. Plasma AR can therefore be used for assessment of compliance in whole grain intervention studies.

However, as the half-life is relatively short (~5h), the long-term reproducibility is expected to be dependent on intake frequency. Recent studies have indicated that the half-lives are longer for DHBA (~10h) and DHPPA (~15h). Therefore, these metabolites in plasma or urine may better reflect long-term whole grain intake.

In this presentation, we compared the feasibility of intact AR in plasma and their metabolites in plasma and urine as biomarkers by evaluating their 'relative' validity and their stability within individuals over a period of 2 mo - 3 y (reproducibility) in different populations.

Total plasma AR concentrations were highly correlated to whole grain wheat and rye intake estimated by weighed food records in a group of Swedish volunteers ($r=0.53$, $P<0.001$). The reproducibility of plasma AR over a period of 4 mo was moderate in a German population ($ICC=0.45$), whereas the long-term reproducibility (1-3 y) was high ($ICC=0.73$ for women; $ICC=0.54$ for men and women together) in a subsample from the Swedish VIP cohort, where a large variation in whole grain intake has been reported.

AR metabolite excretion in 24h urine showed similar 'relative' validity ($r=0.56-0.70$, $P<0.001$) and reproducibility ($ICC\sim 0.50$) as AR in plasma in free-living Swedish volunteers. Metabolites in urine spot samples showed lower reproducibility ($ICC\sim 0.35$) in the same group of subjects. Unexpectedly, reproducibility of AR metabolites in plasma was lower than for intact AR in the same German population ($ICC=0.17$ and 0.34 for DHBA and DHPPA).

We conclude that plasma AR can be used as biomarkers in epidemiological studies in populations where intake is frequent and stable. AR metabolites in plasma and urine spot samples are less precise, but may be used if repeated samples are available.

POSTER PRESENTATIONS



PP 001**MEASURING MOTHER-CHILD INTERACTIONS: PROVIDING RICH OBSERVATIONAL DATA AROUND HOME ROUTINES PERTAINING TO PRESCHOOLERS' EATING AND PLAYTIME ACTIVITIES**H. Skouteris¹, D. Demir¹¹School of Psychology, Deakin University

Recent developmental research shows that responsive parenting (i.e., parents who adapt their interactions and behaviours in response to their child's needs) is critical in initiating a chain of reactions that predict children's eventual internalization of parental values and standards for behaviour in the preschool years. More specifically, a history of responsive parenting fosters in the child positive affect which fuels a cooperative stance toward the parental agenda which in turn leads to eventual internalization of parental values in the absence of parental surveillance. This body of evidence also indicates that parent-child dyads who have come to cultivate such a mutually responsive orientation tend to show coordinated and smooth flowing daily routines (such as eating/feeding and play) and their interactions tend to be characterized by fewer struggles and instances of aversive interpersonal conflict around role asymmetries (or typical control issues). In this presentation, we outline an innovative observational methodology that provides rich data in relation to responsiveness, affect, and control in the mother-child dyad during home routines pertaining to mealtime and play for preschool children. Our project has been funded by the Australian Research Council and is the first study worldwide to evaluate how the extent of mother-child interactions influences the associations between parenting and child risk factors of unhealthy weight gain

PP 002**TOWARDS COMPREHENSIVE, MIXED METHOD ASSESSMENT OF THE IMPACT OF POLICY ON THE QUALITY OF THE FOOD ENVIRONMENT**D. Olstad¹, K. Raine², T. Caulfield³, L. McCargar¹¹Alberta Institute for Human Nutrition, University of Alberta, ²Centre for Health Promotion Studies, University of Alberta, ³Health Law Institute, University of Alberta

Background: Improved food environments are associated with healthier dietary behaviours and body weights, making the food environment a potent target for obesity prevention policy. However, although many such policies recommend environmental change, it is not clear how to fully assess their impact on the multiple dimensions of the food environment. Objective: The purpose of this study was to explore the use of mixed methods to assess the impact of nutrition policy on multiple aspects of the objective and perceived subjective food environment. Methods: This multiple case study used four quantitative (proportion of healthy items in concessions and vending machines, nutritional profile of vending machine items, Nutrition Environment Measures Survey in Restaurants (NEMS-R), policy implementation score) and two qualitative strategies (observations and interviews) to assess perceived subjective and objective aspects of the food environment. The study was completed in recreational facilities that had (adopters, n=2) and had not (non-adopters, n=2) adopted and implemented government-issued nutrition guidelines. Results: Compared to non-adopters, adopters had higher NEMS-R scores and their vending machine items had better nutritional profiles. Policy implementation scores were not consistently higher among adopters. Adopters had a higher proportion of healthy beverages in their vending machines (29%) compared to non-adopters (13%), but did not have a greater proportion of healthy items in food vending machines (range 0-4%) or concessions (range 11-22%). Managers from adopter facilities correctly perceived their food environments as unhealthy, whereas the manager of the non-adopter facilities incorrectly perceived these food environments as healthy. Observers noted that patrons in all facilities purchased primarily unhealthy items. Discussion: Mixed methods provided an enriched perspective of the food environment. Objective measures demonstrated that several aspects of the food environment were healthier in adopters than non-adopters, although the proportion of healthy items remained low in all facilities. Subjective findings suggested why this may have been the case, as a culture of unhealthy eating prevailed in all facilities and the government-issued nutrition guidelines did not specify what proportion of items should be healthy. Conclusions: Several factors within recreational facility food environments are amenable to, and in need of policy intervention. In the absence of more comprehensive tools, mixed, multiple strategies should be used to better assess the impact of policies intended to improve the quality of food environments. A more complete understanding of the subjective and objective dimensions of the food environment, and the linkages between them, is essential to develop effective obesity prevention policy.

PP 003

APPLYING A DIET QUALITY INDEX TO ASSESS THE HEALTHFULNESS OF COMMUNITY-LEVEL FOOD ENVIRONMENTS

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Efforts to characterize community-level food environments often focus on a subset of foods such as fruits and vegetables and salty or sweet snacks as an indicator of healthfulness. Application of a density-based diet quality index provides a means of assessing the overall quality of the mix of foods offered at food outlets and can be informative for comparing across subsets of items (e.g., children's menu versus overall menu) or across outlets. Diet quality information from an index can also be used in studies aimed at examining relationships between features of food environments and outcomes such as intakes and body weight. Drawing upon an evaluation of the menus at five popular fast food restaurants in the U.S. and using the Healthy Eating Index-2010 (HEI-2010), the process of applying a diet quality index to the community-level food environment is described. The HEI-2010 reflects congruence with U.S. dietary guidance as communicated by the 2010 Dietary Guidelines for Americans. It is made up of 12 components, nine of which assess adequacy of intakes of food groups and oils and three of which measure intakes of constituents that should be consumed in limited amounts. Each component is scored using a density-based standard (e.g., intake per 1000 kcal). Steps in applying the HEI-2010, or another density-based index to a food environment, include identifying the set of foods to be analyzed, quantifying and coding each item using nutrient and food group databases, and applying an algorithm to arrive at component scores and total scores. Because the focus is on assessing the quality of the menu offerings (not what is sold or consumed), each item is counted once. For comparing across outlets, standardization in the approach used to enumerate menus may be needed given that different restaurants may list items differently. Attention to differences between the restaurant's menu listings and the in-store default practices (e.g., preparing sandwiches with sauce or providing French fries rather than fruit in children's meals) may also be warranted to arrive at a realistic assessment. With appropriate databases that enable coding of both prepared (i.e., ready to eat) and unprepared foods, this index-based approach can also be applied to supermarkets, farmers' markets, and other retail outlets. The use of a common metric such as the HEI-2010 to assess community-level food environments can contribute to improved cohesiveness of the food environment literature, helping to enhance our understanding of their influence on health.

PP 004

IDENTIFYING THE VISITED FOOD ENVIRONMENT (VFE) OF YOUNG ADULTS: A PILOT STUDY

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BACKGROUND: Obesity is a significant problem in young adults; about one third of 16-24 year olds are overweight or obese and this figure is predicted to rise. Relatively little is known about the environmental factors which may influence the food choice and eating habits of young adults. Food choices are made within the food environment, which encompasses any opportunity to obtain food or influence food choice. Environmental exposures such as the availability and accessibility of 'more healthy' and 'less healthy' food options interact with individual factors, such as food preferences and taste, familiarity/habit and health to drive food choice. This pilot aimed to develop a method of identifying the Visited Food Environment (VFE) of individuals.

METHODS: Ten respondents attending the same school in the North East of England (mean age 17 years; 6 males, 4 females), completed detailed 4-day food diaries (FD). The FD were used to identify the VFE for each individual. For each identified eating occasion, the source of the food was recorded and classified using a 25 point classification tool ([Lake, Burgoine et al. 2010](#)).

RESULTS: A total of 231 eating occasions were recorded by participants; 5.8/person/day. The home (including relatives/friends homes) was the main source of food (74.9%), while for 25.1% of eating occasions food was sourced outside of the home (food outlet). Of these, food was most commonly sourced from supermarket (n=11), education/workplace (n=10), sandwich shop (n=8) and takeaway (n=5). Respondents made 52 individual visits to food outlets over the 4 FD days. All respondents made at least two food outlet visits over 4-days (range 2-10 visits) with a mean of 1.3 visits/ person/day. The same food outlet may have been visited more than once throughout the food diary period.

CONCLUSION: No previous research has linked individual eating behaviour to the food environment with respect to where food is obtained from, or the number and type of food outlets which an individual visits. The home is the primary source of food for young adults; however, the food environment is complex and crossovers between locations from which individuals obtain and then consume food are apparent. Further work is underway which will link individual food intake to VFE classification and assess the 'healthiness' of the VFE's from which individuals make food choices.

This work is funded by a Food Standards Agency PhD studentship. Lake, A. A., T. Burgoine, et al. (2010). "The foodscape: Classification and field validation of secondary data sources." *Health & Place* 16(4): 666-673.

PP 005

INDIGENOUS KNOWLEDGE ON IRANIAN TRADITIONAL ORGANIC FOOD

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Iran enjoys a wide diversity of cultural and ethnical entity. This has caused a tremendous array of food culture in the country. Though in the rural area the basic energy and protein requirements is fulfilled by different types of bread and in the recent decades to some extent by rice, dairy products particularly cheese play an important role as food item. Since most part of food is produced locally by the households, these foods are produced originally without the help of chemicals and therefore they could be regarded as organic. Since they are not certified, terms such as ignored organic may be proper for them. Nutritional qualities of these types of foods are higher than conventional types in terms of trace elements and vitamins and therefore in rural areas most people are healthier than those in the urban areas. In this paper an attempt has been made to revise the food habits of the rural areas based on the "ignored organic" identity and indigenous knowledge.

PP 006

CONTROL OF LABELS ON FRESH-VEGETABLE PACKAGES AND QUALITY CONTROL SYSTEM IN IN-HOUSE AND OUTSOURCED FOOD SERVICES OF CAMPINAS (SP) AND ITS DISTRICTS

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Studies have reported cases of contaminated vegetables being served in restaurants, which may lead to food poisoning. The objective of this study was to investigate a possible relationship between the use of a quality control system by in-house and outsourced food services and compulsory labeling of the boxes used for transporting fresh vegetables. The participants of this study were in-house and outsourced food services randomly selected from a list of 60 institutions. The list was provided by representatives of the sector in the municipality of Campinas, SP, Brazil, and its districts. A total of 16 in-house and 18 outsourced food services which had their fresh vegetables delivered were selected. Of the 34 establishments, 79.4% used some sort of quality control system and 61.8% used only the Good Manufacturing Practices (GMP). A significant association between the use of quality control systems and box labeling was not found (Fisher's exact test; p-value=0.559), even though some food services (11.8%) used the GMP and Hazard Analysis and Critical Control Points (HACCP). Furthermore, 5.9% of the establishments used not only these two quality control systems, but also standard operating procedures (SOP). Of the 27 food services that used some kind of quality control system, only 4 (14.8%) required labeled packages. According to the Normative Instruction 009 issued on November 12, 2002 by the Ministry of Agriculture and Supply, food services can only accept fresh vegetables if their packages are labeled. The label is the food's document and when absent, it is not possible to determine the classification of the vegetable, its origin and date of packaging. Suppliers of fresh vegetables to food services should be instructed and compelled to follow the law, thereby contributing to food quality and safety for the consumers.

PP 007

RELATIONSHIP BETWEEN VEGETABLE-RECEIVING PRACTICES AND NUMBER OF MEALS SERVED BY FOOD SERVICES

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The receiving practices of food services should include inspection of product quality. The objective of this study was to verify the relationship between the number of meals served by in-house or outsourced food services and their procedures for receiving fresh vegetables with respect to: status of the delivery vehicle, uniform status of delivery personnel and labeling of the delivery boxes. Of a total of 60 food services found in lists of pertinent food-service associations, the managers of 17 in-house and 22 outsourced food services in Campinas, Brazil, and its districts, were interviewed by means of a pretested questionnaire. The present analysis includes 16 in-house and 18 outsourced food services that had their purchased vegetables delivered. The cases that purchased vegetables at the supplier were excluded. Data distribution was completely asymmetric, that is, it did not follow a normal distribution (Shapiro-Wilk test, p<0.001). Therefore, the non-parametric Mann-Whitney test was used for crossing the variables related to the

receipt of fresh vegetables. The number of meals served daily in Brazil tended to be greater in units that checked the status of the delivery vehicle (Mann-Whitney; p-value=0.089). There were no significant differences between verification of the uniform status of delivery personnel and number of meals served per day (Mann-Whitney; p-value=0.329), or between verification of the labeling of delivery boxes and number of meals served per day (Mann-Whitney; p-value=0.157). Labeling of delivery boxes and uniform status of delivery personnel need to be in compliance with the legislation and not inspecting them may impact food safety. Transportation vehicles must be thoroughly inspected; yet, the Brazilian legislation allows vegetables to be transported in open vehicles. A quality differential would be the transportation of fresh vegetables in closed vehicles since open vehicles make the food more susceptible to contamination. The results indicate that bigger food services should inspect the vehicles that transport vegetables more closely.

PP008

MEASURING THE NUTRITION ENVIRONMENT: A DATA MINING APPROACH

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Accurately quantifying the nutrition environment is a necessary first step in examining its potential contribution to the obesity epidemic. A number of measures are typically used including the computed density of different types of food outlets (restaurants and grocery stores) in a geographic area, distance to large supermarket, resident perception of the nutrition environment, and on-site audits, checklists, and inventories. Audits or inventories are the most comprehensive and actually measure important elements of the nutrition environment. As a ground-truthed methodology, an on-site audit is likely a more valid measure, however, most are extremely expensive to conduct on a large scale. The Nutrition Environment Measures Survey (NEMS) consists of an on-site assessment of the availability and cost of healthy food choices and less healthy alternatives in all grocery stores, convenience stores, and restaurants. The availability of nutrition information and presence of healthy and unhealthy advertising and promotions in restaurants is also assessed. These data are then used to compute a nutrition environment score for the individual food outlet and survey area. Developers have estimated that it takes 75 minutes to survey a single large grocery store, 30 minutes for a convenience store and 90 minutes for a restaurant. Data entry or scanning of surveys and data cleaning contribute additional costs. Using NEMS audit data from two counties in West Virginia we intend to develop an alternative method to compute nutrition environment scores that would reduce on-site data collection. A total of 69 grocery stores, 227 convenience, department and specialty stores, and 591 restaurants were audited between April and November 2011. Surveys were scanned and NEMS scores computed for each retail food outlet and for neighborhoods. We will apply data mining techniques to these data to determine if a smaller set of food items can be identified and used to produce a score that will yield results similar to those produced by NEMS scores in multivariate analyses. Key indicators will be identified to develop a checklist audit tool as well. The tools developed will be compared to other commonly used methods and tools over varying community-level socio-demographic and geographic characteristics. The project was supported by the Agriculture and Food Research Initiative of the USDA National Institute of Food and Agriculture, grant number 2011-04526.

PP 009

THE CURRENT STATE OF FOOD SYSTEM MEASUREMENT IN THE UNITED STATES

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The American food system is described as contributing to an ‘obesogenic’ environment that promotes unhealthy eating and, ultimately, a number of negative health outcomes. In light of the need for novel and effective approaches for obesity prevention, it is necessary for professionals from various sectors to focus on strategies that change the current food system to one that promotes healthy eating environments. The food system encompasses food production, processing, distribution, access, consumption, and waste processing. Much obesity prevention research focuses on why consumers consume what they do within the food system. The sustainable food movement has gained momentum both in the US and globally, as evidenced by a proliferation of “farm to where you are” programs, which encourage local foods to be distributed in the community to places such as farmers markets, schools, hospitals, worksites, and other institutions. Currently, practitioners and researchers lack the practical tools to measure and evaluate food systems as an avenue for health promotion.

This session will focus on current research that describes approaches and tools for measuring sustainable food systems. Several methodologies exist to measure the broader food environment, including an examination of sales data, food receipts, menus, food availability and affordability, nutrient availability and intake, and accessibility through geographic analysis. These methods will be described, as well as newer methods more specifically focused on local foods and assessing various segments of the food system. Strengths and weakness of each type of methodology will be addressed, as well as any validity, reliability, and potential generalizability issues. Tools will be assessed by their ability to

measure a continuum of communities (e.g., rural, suburban, and urban) and gauge local and global food system change. In addition, the quality of the identified measurement tools will be described with regard to their capacity to inform policy, systems, and environment changes to help improve sustainable food systems. Lastly, recommendations of tools will be made, taking into account practical considerations to capture the nuances of measuring a local food system (i.e., limited access to more healthful food and seasonality). This work is important and timely since the improvement of measurement science in sustainable foods systems will ultimately extend efforts to improve public health in the United States and abroad.

PP 010

ASSOCIATIONS BETWEEN CHILDREN'S EATING BEHAVIOURS AND FEATURES OF THEIR RESIDENTIAL AND SCHOOL NEIGHBOURHOOD FOOD ENVIRONMENTS

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Objective: Among studies of the built environment, few examine neighbourhood food environments in relation to children's diets. We examined associations between residential and school neighbourhood access to different types of food establishments and children's eating behaviours. **Methods:** Data from QUALITY, an ongoing study on the natural history of obesity in Quebec youth aged 8-10 years with a parental history of obesity, were analysed (n=512). Children reported frequency of having a meal or snack in a restaurant and of consuming food delivered home using a questionnaire. Residential and school neighbourhood food environments were characterised using a Geographic Information System. Variables included distance to the nearest supermarket, fast-food restaurant and convenience store, and densities of each food establishment type computed for 1 km network buffers around each child's residence and school. Multivariate logistic regressions (residential access) and generalised estimating equations (school access) were used for analysis. **Results:** Overall, 44% of children had a meal/snack in a food establishment and 35% consumed delivered/take-out foods at least once per week. Supermarkets, fast-food restaurants and convenience stores were generally more accessible around schools than around residences. Living in a residential neighbourhood with a lower density of fast-food restaurants was associated with 48% (OR=0.52, 95% CI: 0.30-0.91) and 40% (OR=0.60, 95% CI: 0.36-0.99) lesser likelihood of eating/snacking out, for lowest and intermediate densities, respectively. Similarly, lowest residential density of convenience stores compared to the highest density was associated with a 56% (OR=0.44, 95% CI: 0.25-0.80) lesser likelihood of eating/snacking out. The school neighbourhood environment was only marginally associated with children's eating behaviours. Findings were similar when restricting the sample to 193 (38%) children who live >1.5 km walking distance from their school, thus to those who are more likely to have distinct residential and school neighbourhood food environments. **Conclusions:** More evidence was found for associations between access to food establishments and children's eating behaviours for residential than for school neighbourhood environments. Further investigations are needed to inform policies aimed at shaping neighbourhood-level food purchasing opportunities, particularly for access to fast-food restaurants and convenience stores in residential neighbourhoods.

PP 011

USE OF A MODIFIED NUTRITION ENVIRONMENT MEASUREMENT SURVEY TO ASSESS HEALTHY OPTIONS IN FILIPINO RESTAURANTS AND GROCERY STORES IN SAN DIEGO, CALIFORNIA

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Filipino Americans (FilAms) are the largest group of Asians in San Diego, California numbering 146,618 in 2010. The goal of the Healthy Eating Campaign (HEC) conducted from 2006-2009 and funded by The California Endowment was to prevent overweight and obesity in the FilAm population in San Diego by changing their eating habits through

education, media advocacy, and environmental strategies such as working with restaurant and grocery store owners to increase the healthy options served or sold. Our survey of 458 adults in 2002 showed that 48% are overweight and 13% are obese. We organized a broad coalition to gain the communities' support, formed an advisory committee and trained 20 advocates who worked with the restaurant and grocery owners. Ten FilAm restaurants and three chain grocery stores (Seafood City) participated in the project. We conducted an assessment of the healthy options available in the two places using a survey questionnaire developed by the Nutrition Environment Measurement Study (NEMS) in Atlanta, Georgia and modified for use with Filipino foods in restaurants and supermarkets. The form determined the availability and price of the low fat items versus the regular items. If the preferred item or size is not available, an alternative item was selected. For fruits and vegetables, the quality of products was also noted whether acceptable or unacceptable. The restaurant assessment showed that many were not serving healthy options; do not encourage their customers to eat healthy; served large portions of rice; fast food restaurants do not have menus; no healthy information was posted; and none provided nutrition information on dishes served. Grocery assessment showed that many sell healthy options such as fruits/vegetables, fish, low fat/skim milk, low sodium soy sauce, diet drinks and fruit juices but only one sold brown rice, baked chips, whole wheat bread, fat free hotdogs and lean ground beef. We modified two entrees from each restaurant and invited the community to taste them, posted healthy eating posters, and encouraged owners to serve healthy foods such as low fat entrees and green salads. We conducted grocery tours to highlight healthy options that were sold. This showed that the NEMS can be modified and used as a reliable tool in the assessment of healthy options served and sold in ethnic restaurants. As a result, the public were more aware of healthy eating, restaurant owners were cooking healthier, and grocery owners were selling healthier options.

PP 012

ASSESS THE NUTRITIONAL QUALITY OF FOOD MARKETING ACROSS COMMUNITIES

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Food manufacturers and distributors usually market products according to demographics, purchase history or observed behavior of desired consumer segments. This often leads to large discrepancy in food marketing activities across communities and population. Under-privileged neighborhoods, compared to others, tend to have less access to nutritious foods. For instance, organic and high fiber cereals are often sold as premium products and only available in high income neighborhoods. However, traditional food marketing metrics such as access to retail outlets and average price of a food category at a neighborhood are not able to capture variations of nutritional quality within a category, nor the correlation between nutritional quality and marketing variables.

We propose a new framework to assess both nutritional quality and food marketing simultaneously using the rich information embedded in modern marketing research database. We define nutritional quality of product at SKU (stock keeping unit) level using nutrient profiling model. We also measure a wide range of food marketing practice such as pricing and promotions of SKUs at stores. We further geo-code stores by community according to their addresses, and hence we can aggregate the nutritional quality and food marketing measures from store level to community level. This enables us to examine the variation of nutritional quality and food marketing across communities.

We use breakfast cereal market in Quebec, Canada as an example to illustrate the differences in nutritional quality, price and promotion across communities. We further link the nutritional quality and food marketing practice to neighborhood socioeconomic status and explore the connections. The results quantify the empirical discrepancy in both nutritional quality and food marketing, and help policy makers identify and eliminate potential equity issues, and empower communities to create healthy eating environment. Our method also allows us to study temporal change within a community and answer questions such as whether the food supply chain improves the nutritional quality of their offerings, and whether consumers are able to improve their food choices as well.

PP 013

DEVELOPMENT OF DIETARY FORMULATION USING LINEAR PROGRAMMING BASED ON TYPICAL INDONESIAN DIET

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Indonesian are generally over-dependent on white rice, they consume about 139,16 kg per capita/year and very low amounts of vegetables, fruits, and animal-based foods as side dishes. Typical Indonesian diet which is rice based diet consists of rice (60% of the diet), vegetables (20%), side dishes (10%), and fruits (10%). This condition could lead to deficient intake of certain micronutrients. The objectives of this research were to develop diet formulation based on typical Indonesian dietary pattern using linear programming, and investigate the effects of inclusion of sweetpotato and

cassava as partial substitutes for rice in the diet to the amount of rice required, with regards to energy, iron, zinc, and vitamin A fulfillment.

Data on typical Indonesian diet were obtained from Indonesian Socio Economic Survey in 2008. This data based on 24h recall methods. White rice, swamp cabbage, tempeh, and banana were most consumed foods from typical Indonesian diets. Diet I (white rice/swamp cabbage/tempeh/banana) and diet II (white rice/sweetpotato/cassava/swamp cabbage/tempeh/banana) were used for linear programming calculation. Linear programming calculations were performed using free edition of POM-QM for windows version 3. Established nutritional and palatability constraints were used. Further modification of palatability constraint was also performed in order to achieve a feasible solution for Diet I. The results were presented as amount of food needed for 12 different age groups (range: 4-49 years old) to give more detail recommendation.

The result indicated that using similar established nutrition and palatability constraint, there was no feasible formulation for diet I. Inclusion of sweetpotato and cassava in diet II (50-75 g) could meet all of the constraints and provided a suitable formulation. After modification of palatability constraints were performed, the average of rice requirement were 356,72 g/day. The inclusion of sweetpotato and cassava could decrease 12,03% of the rice consumption. The optimization result in all ages group were presented as a formula $Y = X_1 + X_2 + X_3 + \dots + X_6$ where X_1, \dots, X_6 were the amount (g) white rice, sweetpotato, cassava, swamp cabbage, tempeh, and banana, respectively.

Partial substitution of white rice with sweetpotato and cassava can decrease the rice dependency with respect to meet the energy, iron, zinc, and vitamin A requirements. Sweet potato contributes to vitamin A fulfillment, whereas cassava give valuable contribution on zinc and iron. Dietary formulation calculated using linear programming to achieve recommended daily allowance level of micronutrient could be used for different age groups of Indonesian.

PP 014

PHYSICAL ACTIVITY VERSUS POVERTY: WHAT DRIVES UNDERNOURISHMENT?

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Poverty compels people to consume fewer calories and enjoy a less diverse diet which translates into increased food insecurity. But we often see a contradictory picture: the highest levels of undernourishment (defined as consuming fewer calories than the daily recommended energy requirement) are often reported in urban areas, where poverty levels are generally lower and dietary diversity higher. Meanwhile the highest poverty levels are usually in rural areas, where calorie intake is generally higher and dietary diversity lower.

Someone carrying out physically demanding farm work needs to consume more calories than someone seated at a desk all day. In their work on India, Deaton and Dreze (2008) suggest that migration of people from rural to urban areas into physically less demanding jobs, as well as a shift to more mechanized work, has gradually lowered their energy requirements. The objective of this paper is to investigate to what extent differences in physical activity levels and hence energy requirements explain why undernourishment is often higher in wealthier areas and lower in poorer areas. Overall we aim to get a better understanding of how and whether the type of activity undertaken by the household influences its food consumption pattern. In other words, do households with a heavy workload sacrifice food quality in favour of food quantity? Do wealthier urban households, who do not carry out constant physical work, eat fewer calories but compensate for that with a more varied, nutritious diet?

Such factors will need to be taken into account when interpreting empirical differences in food consumption levels and determining the prevalence of undernourishment.

Poverty and undernourishment statistics are normally computed from Household Budget Surveys (HBS), which primarily estimate poverty by measuring monetary expenses, but can also measure the quantity and quality of the food consumed by households. These surveys also contain detailed information on how individual household members use their time, allowing us to analyse activity levels by gender, occupation and area. This paper uses HBS data from Nepal and Malawi as a basis for the discussion.

We will examine how the composition food basket consumed, in terms of energy value and diversity varies, by activity level. We will compute a "household activity level index" by analysing each household member's income and non-income generating activities. We will then compare this index with the household's caloric consumption pattern to decipher how one influences the other. In particular we discuss how the composition of the diet is influenced by the household activity level index while controlling for the welfare level of the household.

The paper concludes by proposing a different measure of food insecurity, namely the value of consumption. The value of consumption is defined as the monetary value of the household members' food intake. The measure relates closely to poverty measurements and better accounts for the difference in actual consumption.

PP 015

PREVALENCE OF HOUSEHOLD FOOD AND NUTRITION SECURITY IN A STATE IN NIGERIA

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The prevalence of food and nutrition security of households in Ikot Ekpene Local Government Area of Akwa Ibom State in south-south geopolitical zone of Nigeria was studied. A cross sectional survey was carried out on two hundred and fifty households made up of 105 rural and 145 urban households who were systematically randomly selected. Pretested and validated questionnaire was used to obtain information on socio- economic characteristics, and dietary habits. Food security module adapted from the United State Food Security Survey Modules (FSSM) was used to classify the households into food secure and food insecure. Nutrition security was determined using anthropometric data (wt-for-ht, wt-for-age and ht-for-age) for infants 0-5 years and Body Mass Index (BMI) for women in the households. Data was coded and analysis done using SPSS version 15.0. World Health Organization (WHO) Anthro for children used to classify stunting, wasting and underweight/ overweight. More than half (54.4%) of the households were food insecure at different levels. About 28% were food insecure with severe hunger, 20% were food insecure with moderate hunger, 13% were food insecure without hunger while 38% were food secure. Female headed households were more food insecure in both urban (49%) and rural (88%) than the males (urban 45%, rural 80%). Anthropometric data revealed that only 10% of the children in the households only 10% of the children were wasted (wt-for-ht), however 38% were stunted (ht-for-age) and 13% were underweight (wt-for age). Also 55% were not at risk of overweight (BMI-for age). Food security status was negatively correlated with height-for age z score ($r=-0.259$, $p=0.009$) but positively correlated with weight-for-height and BMI for age ($r=0.208$, $p=0.038$; $r=0.223$, $p=0.026$) respectively. Rural households were more food insecure than urban households ($r=0.3062$, $p=0.00$).

PP 016

COMPREHENSIVE POPULATION MEASURES OF FOOD SECURITY

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Measuring domestic food security is essential to inform effective policy, and to some extent, the definition defines the measurement. A reliable supply of nutritious, safe, and affordable foods is considered a determinant of food security. The Australian Government defines food security as *the ability of individuals, households and communities to acquire appropriate and nutritious food on a regular and reliable basis using socially acceptable means*. Curtin University, the Australian Bureau of Statistics and Western Australian (WA) Health Department collaborated to examine the cost, availability and quality of food. Firstly, access to food stores coupled with an objective measure of the price and quality of food determined capacity to access food. The 2010 Food Access and Cost Survey priced 430 foods in a representative sample of grocery stores with 90% response. Similar to US research, the least nutritious foods were the cheapest on a MJ cost per Kg basis. Welfare recipients needed to spend 50% of their income on food to purchase a healthy food basket compared to 16% for average income earners reflecting inadequacy of welfare payments for basic living requirements. Secondly, mapping store locations confirmed reliance on single stores in remote areas, and as foods cost more with increasing remoteness, there is an argument for some community food stores being essential services. Thirdly, store managers in remote Indigenous communities were asked about their perceptions of food security and their capacity to respond; 84.6% of the 39 trading stores participated. Most store managers (76%) identified problems with their stores particularly transportation and freight issues leading to high prices, limited choice and poor quality. Although only 36% said food security was a problem for their community, over half (52%) said people went hungry because there was not enough money to buy food. Finally, Nutrition Monitoring Survey of 1,284 adults 18 to 64 years found that in the last year 4% had someone in their household who had eaten less than they should because they couldn't afford enough for food. Together these measures help build the evidence to develop policy options to address food security. Trend information on food prices, quality and capacity to access food is required to inform and evaluate policy options to address food security. Improving the food supply chain and income support were priority recommendations for policy interventions to improve food security in WA. This suite of measures highlights the need for government/industry partners to work together to develop food security interventions.

PP 017

FOOD AND NUTRIENT INTAKES ACCORDING TO INCOME IN KOREAN MEN AND WOMEN

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The purpose of this study is to provide association between income and intake of nutrient and food in 19-64 aged adults (n=11,063) from the fourth Korea National Health and Nutrition Examination Survey (KNHANES IV) 2007-2009. KNHANES 2007-2009 data were derived from a cross-sectional survey with a nationally representative, stratified, multistage probability sample of the non-institutionalized Korean population. Each survey participant was interviewed at home to evaluate dietary intake and also underwent a physical examination and health survey conducted by trained

personnel at a mobile examination center. To examine relationships between individual dietary intake and anthropometric measures and family income, multiple linear regression models were constructed for each outcome variable. All models were adjusted for age, education, smoking, body mass index, physical activity and energy intake. Intakes of protein, calcium, phosphorus, potassium and vitamin C were lower in low income group compared to high income group in men. Intakes of protein and niacin were lower in low income group for women. The proportion of adults consuming selected micronutrients at or above the Adequate Intake (AIs) and Estimated Average Requirement (EARs) showed that very few adults had adequate potassium intakes, and only about a third of the lowest income group for men and a sixth of the lowest income group for women had adequate calcium intakes. About half or less than half the low income adults consumed riboflavin and vitamin C at the respective EAR levels. Low percentage of women in the low income group consumed thiamin, vitamin A and iron at the EAR level, compared to high income group. In addition, lowest income group ate less dairy products in men and less fruits and fishes or shellfishes in women. Low income group has food insecurity and low diet quality compared to high income group. Results from this study will assist with providing direction for public health efforts about dietary intakes according to economic status among Korean men and women.

PP 018

MEASURING FOOD INSECURITY AMONG DISPLACED NORTH KOREAN CHILDREN WITH THE HOUSEHOLD FOOD INSECURITY ACCESS SCALE

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North Korea has suffered severe food shortage from the mid 90s and the suffering continues until now. A significant number of North Koreans have left their home land and settled in diverse places such as China, South Korea, the U.S., etc. Impacts of such migration on health deserves more attention given the environmental changes they have experienced are drastic, from severe food shortage to affluent food environment. Understanding food insecurity level while in North Korea is important to identify the possible impacts from the migration. This research examined food insecurity level while displaced North Koreans were living in North Korea. This research was conducted as a part of displaced North Korean children research. This research was approved by Institutional Review Board. Measurement tool used was the Household Food Insecurity Access Scale (HFIAS). The scale was first translated to Korean and back-translated to English to ensure meaning of each question was not altered during the translation process. Pre-testing of the translated scale was conducted with a small number of displaced North Korean mothers. Questions of the scale were then edited to clarify the meanings based on the feedback from the mothers. A total of 112 displaced North Korean mothers completed a questionnaire including questions on HFIAS, basic demographic information, and others. Mothers were asked to complete the HFIAS thinking the situation when the child participating in the North Korean children research was born. The completed questionnaire was carefully reviewed and was followed up by a personal interview if necessary. Results showed 64.2% of the participating household was classified as food secure, while the rest (35.8%) was determined to have been food insecure. Among the food insecure households, the vast majority was severely food insecure; indicating the food situation in North Korea was in dire situation. Some mothers reported that their child was born in China, and such case showed significantly better HFIAS score ($p < 0.001$). Therefore, the food situation was better in China compared to that of North Korea. Mother's education level was significantly related to food insecurity level. This research was supported by National Research Foundation of Korea Grant.

PP 019

SPATIAL MARKET PRICE MONITORING (SMPM): A METHODOLOGY FOR USING GIS AND SPATIAL ANALYSIS TECHNIQUES TO PREDICT FOOD PRICES OUTSIDE OF MARKET CATCHMENT

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Food Security is a complex phenomenon, and establishment of comprehensive and effective monitoring systems requires substantial resources that are often beyond the capacity of developing countries. Market-based, food price monitoring, however, is a simple, cost effective way to gather key information on household food access issues. Food price monitoring, when examined in relation to wage rates, can help identify and prioritize geographic areas where food prices are unaffordable given local wages, serving as an important early warning tool in slow moving food security crises. Conventional price monitoring, however, report on food prices and wage rates in a set of specific markets/towns, thus providing important yet fragmented information and leaving food security programmers to draw their own conclusions as to what this means for populations living away from measured markets. The objective of Spatial Market Price Monitoring (SMPM) is to remedy this. By integrating the different parameters that impact food prices (i.e. road access, terrain, natural barriers, etc) into one spatial interpolation model, it is possible to predict (according to a set of clear and robust assumptions) how populations living away from markets are impacted by changing food prices in both local and regional market areas. SMPM, predicts households' ability to purchase food by considering retail food prices

at local and regional markets, location and the physical access to these markets at any given point considering type of roads, slopes and other natural barriers. After spatial analysis, it calculates the price to reach the market via the most economical route. Thus, the final mapped output takes into account price at the markets as well as transportation costs, which allows the price at the doorstep of each recipient to be extrapolated. SMPM provides a platform by which humanitarian actors and food security planners can better understand the impact of changing food prices on the food security status of households living outside of immediate market catchment zones. The basic implementation of this methodology expands the evidence base for food security programming and enables planners to identify potential problem areas which normally would be overlooked due data constraints. As this methodology is further refined, it is likely to be a useful tool even in acute emergencies as different shock scenarios can be integrated (i.e. washed away bridges and roads) providing rapid indications of potential hotspots of food insecurity while also providing a better indication of the magnitude of food security impact in affected areas.

PP 020

THE PILOT TEST OF FOOD SECURITY QUESTIONNAIRE FOR APPLICATION TO KNHANES

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This study was conducted to evaluate the feasibility of a new food security questionnaire (NFSQ) for Korea Health and Nutrition Examination Survey (KNHANES). The nutrition survey of KNHANES is including just one question for food security, which was modified in Korean from food sufficiency question of US. The proportion of food insecure household in KNHANES 4th (2007-2009) was approximately 90%. This index showed a reliable correlation with the socioeconomic states, however there was some limitation that this index could not differentiate the degree of insecure. The modified US Household Food Security/Hunger Survey Module (18 questions) was examined as the complement for making up this point. The questionnaire was composed in 3 common questions, 3 common questions for household with child, 7 questions for insecurity evaluation, and 5 additional questions for household with child. The common questions (3 for household without child, and 6 for with child) had to be reported from all of household, and the additional questions were for household having possibility of insecure evaluated by common questions. The total number of subject household was 168 (without child 104, with child 64) from 10 regions (8 urban areas and 2 rural area), and they had also participated in KNHANES. The responders were a representative of household (a major portion was a housewife), who was selected by some necessities such as adult (+19 years old) having charge of buying foods. The interviewers of KNHANES visited to home of sample household, and interviewed the NFSQ after the nutrition survey of KNHANES. The only 24% of households was the subjects for additional questions, and the proportion of secure households was 92%. The times required for survey were 1.59 minutes for households without child, and 2.07 minutes with child, which could be acceptable for KNHANES. The differentiation of food security by NFSQ was also comparable with secure/insecure grouping by one question in present KNHANES questionnaire.

PP 021

EFFECT OF MARKET (TYPE AND ACCESSIBILITY) ON HOUSEHOLD'S FOOD INSECURITY AND NUTRITIONAL STATUS OF MOTHERS AND CHILDREN OF RURAL POOR AREAS IN BENIN

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Objective: To assess the potential effect of market type and market accessibility on households food insecurity and nutritional status of mothers and their children in the context of market integration in rural poor communities of Southern Benin.

Methods: 472 households including one mother and one child less than 5 years was randomly selected by multiple steps sampling method in 34 villages according to their level of accessibility to the urban, semi-urban or rural market. Level of market accessibility was assessed by travel time in vehicle between each village and target market. Nutritional indices based on anthropometry were used to assess mothers and children nutritional status. The Household Food Insecurity Access Scale (HFIAS) developed by FANTA project was used to assessed the degree of food insecurity. Socioeconomic data were also collected.

Results: The overall food insecurity (61%) including mildly (18%), moderately (29%) and severely (14%) categories levels was significantly higher ($p < 0.001$) in the households participating to the urban (70.3%) and rural (78.2%) markets than one of semi-urban market (41.4%). Psychological food insecurity (worrying about not having enough food), qualitative food insecurity (eating a more monotonous diet than desired) and quantitative food insecurity without or with hunger (running out of food, going to bed hungry, or going a whole day and night without eating) were more prevalent in households participating to the rural and urban markets than their counterpart of semi-urban market ($p < 0.001$). Psychological, qualitative and quantitative food insecurity were also positively associated with the participation to urban and rural market, but inversely with semi-urban market ($p < 0.05$), as well as with agricultural

production as very important source of household income ($p < 0.05$). Children malnutrition (stunting: 35.7%, wasting: 21.4% and underweight: (8.8%) and of children respectively are and while the prevalence of underweight and Overweight/obesity among mothers were 11.1% and 18.2 % respectively. Maternal and children nutritional status were not affected by market type and level of market accessibility. Any interdependence between nutritional status parameters and food insecurity was observed, suggesting effect of confounding factors. Conclusion: The study showed a negative effect of urban and rural markets on household food insecurity and confirmed the important role of agricultural production against food insecurity. The lack of association of food insecurity with level of market accessibility and nutritional status of mothers and children suggest an effect of confounding factors such as infection, poor hygiene conditions and poverty.

PP 022

THE IMPORTANCE OF ASSESSING PHYSICAL ACTIVITY IN HEALTH PROMOTING SCHOOL M. SCATIGNA¹, L. LEONE², A. BERNABEI³, A. CUTILLI³, A. R. GIULIANI¹, M. DE FELICE¹, C. PESCE⁴, L. FABIANI¹

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Physical activity (PA) is a major component of a healthy life from early childhood to the old age. Last decades PA levels decreased dramatically in children all over the European countries. As consequence there was a rising appearance of risk factors and pathologic conditions in young such as overweight and obesity, increased blood pressure, unhealthy lipidic profile, diabetes, bone weakness. Moreover, scientific evidences highlight association between PA and mental health in children and adolescents (eating disorders, anxiety, depression) and between PA and cognitive positive development (e.g. ability to reason quickly and abstractly; cognitive skills of concentration and attention; academic achievement). World Health Organisation and other institutions explored the role of PA in the framework of Health Promoting School, recognising some important issues and objectives: assuring a safe environment for PA; enhancing Physical Education quality (enjoyable, motor abilities and fitness oriented, adapted to different needs); increasing the amount of time spent in movement during school days (curricular and extra-curricular PE, recreational PA during recess; active transport to and from schools); sustaining children's personal development by educating life skills through PE e sport activities; inserting PA into curricular lessons as learning approach and for relaxation/concentration (e.g. stretching breaks); offering PA opportunities and facilities for school staff and parents; collaborating with communities (e.g. sport team, municipalities, etc.). Aims. Our study was aimed to assess indicators for Health Promoting School at institute and student's level and their relationships, focusing attention on physical education and extra-school motor experiences. Methods. In 2010, sixteen high schools was enrolled in Abruzzo Region (Middle Italy). Teachers filled in an Italian validated version of School Health Index and 497 students a questionnaire on school wellness, school physical activity and behaviours affecting health. Results. School conditions (i.e. crowding, noise, lightness) is the worst feature in the students perception compared with social relationships and sense of fulfillment at school. Only in the area of physical activity the analysis highlighted an association between teachers and students judgment. Maybe, physical activity could be perceived by young people as more desirable aspect of school experience, and they could be more in deep involved in that concrete way. Physical activity, so, could be a strategic interface between adolescent-students and adult-teachers to promote a shared good school experience.

Concluding, positive outcomes could be expected from an active oriented school, so validated instrument for assessing setting and personal characteristics constitute a primary issue in the perspective of health promotion.

PP 023

SIMPLE TO COMPLEX MODELING OF BREATHING VOLUME

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Internal exposure to airborne environmental toxins and pollutants through respiration cause various health problems and diseases. Estimating breathing volume from activity intensity measured using an accelerometer may be useful to understand the dose-response relationship between internal exposure to toxins and human disease. Purpose: To develop and validate breathing volume categories estimated from hip-worn ActiGraph activity counts using simple to complex statistical modeling techniques. Methods: Secondary data analyses were conducted on vertical axis ActiGraph activity counts and corresponding oxygen consumption and breathing volume measured during treadmill ambulation (level and inclined walking and running), sports (basketball and tennis), household (cleaning and gardening) and labor-intensive

employment activities (painting and moving loads). Categories of low (<19.3 l/min), moderate (19.3 to 35.4 l/min) and high (>35.4 l/min) breathing volume were derived from activity intensity classifications (light <2.9 METs, moderate >3.0 and <5.9 METs and vigorous >6.0 METs). Estimation accuracy of various simple and complex modeling techniques were examined. Among these, multiple regression analyses (simple) and the Random Forest technique (complex) performed the best. Nine prediction features were used for both methods to predict breathing volume categories from ActiGraph activity counts. Additionally, simple cut-points for breathing volume categories were determined using Receiver Operating Characteristic (ROC) curves. Results: Prediction accuracy of the complex Random Forest technique was marginally greater than the simple multiple regression method. Both techniques accurately predicted breathing volume category almost 80% of the time. The multiple regression and Random Forest techniques had greater accuracy rate (85 to 88%) in predicting the moderate intensity breathing volume category. Both techniques predicted the high breathing volume category (70 to 73%) with greater accuracy than the low category (57 to 60%). The ROC cut-points for light, moderate and vigorous intensity breathing volume were <1380, 1381 to 3660 and >3661 counts/min. Conclusions: There were minor differences in prediction accuracy between the simple and complex estimation techniques. Unlike the complex Random Forest technique, the multiple regression prediction does not require specific analytical software or code. Thus, it may be more feasible to use the simple regression analyses to predict breathing volume intensity category from the commonly used ActiGraph monitor. This provides researchers with an easily deployed method to study the dose-response relationship between internal exposure to pollutants and disease.

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PP024

BUILT ENVIRONMENT AND PHYSICAL ACTIVITY IN ADULTS LIVING IN LOW SOCIOECONOMIC REGION IN SAO PAULO CITY, BRAZIL

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OBJECTIVE: To analyze the association between practice of physical activity in leisure time and the built environment among adults living in region of low socioeconomic level. **METHODS:** A cross-sectional study of 767 adults carried out in Ermelino Matarazzo District in São Paulo, Southeastern Brazil, 2007. The dependent variable was the practice of physical activity in leisure time (in minutes). Independent variables were environment variables that were evaluated for audit instrument and database of municipal administration of census tracts in Ermelino Matarazzo District. They were evaluated 100 environment variables. In the first analysis the physical activity in leisure time was correlated (Spearman coefficient) with all environment variables. All variables that had $p < 0.20$ were selected and variables with $p < 0.05$ had weight 2. **RESULTS:** The variables that had $p < 0.05$ were: public clubs, churches, places for walking, schools, courts of the sports, community associations and pedestrian crossings. The variables that had $p < 0.20$ were: gyms, courts of soccer, presence and quality of pavements/sidewalks, traffic lights, lamps in the streets and pollution. The score 1 was composed for: [(number of public clubs + number of churches + number of places for walking + number of schools + number of schools of sports + number of community associations) x 2 + (number of number of gyms + number of courts of soccer)]/size of census tracts. The score 2 was composed for: [(number of pedestrian crossings x 2) + (number of presence of pavements/sidewalks + number of good pavements/sidewalks + number of traffic lights + number of lamps in the streets) - (number of pollution in the streets)]/ size of census tracts. The score 1 and score 2 were divided in quintiles. The built environment score was composed for score 1 + score 2 and had variation of the 2-10 points. The quartile of built environment was calculated and the first quartile was considered with good environment for physical activity. The adults that lived in census tracts with good environment had larger of the minutes of physical activity in leisure time. **CONCLUSION:** The built environment is very important for practice physical activity in leisure time for people living in region of low socioeconomic level.

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PP 025

INADEQUATE VITAMIN D INTAKE AND VITAMIN D STATUS IN ADOLESCENTS FROM THE HEALTH SURVEY – SÃO PAULO (ISA-SP 2008), BRAZIL

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INTRODUCTION: Vitamin D status is influenced by sun exposure and dietary vitamin D intake. Vitamin D deficiency is related to rickets, diabetes mellitus, hypertension, osteoporosis and cardiovascular diseases. The purpose of the study was to estimate the prevalence of inadequate vitamin D intake and to evaluate the vitamin D status of a group of adolescents living in Brazil. **METHODS:** A total of 152 adolescents (56.6% male), mean age 14.8 years (SD

= 2.0 years) from the Health Survey-São Paulo (ISA-SP 2008), Brazil, were enrolled in the study. A single blood sample was collected after an overnight fasting and weight and height were measured. Dietary intake was evaluated by two 24h food records and the sample had their both between-person and within-person variances corrected. For nutrient analysis the Nutrition Data System for Research Software was used. Estimated Average Requirement (EAR) cut-point method was used to estimate inadequate vitamin D intake, and analysis was conducted in the PC-Side Software version 1.0. Student T and Pearson's Chi-Square tests were performed. Results were considered significant if $p < 0.05$. **RESULTS:** Mean BMI (body mass index) was 21.2 kg/m² (SD = 3.8), and 23.0% were overweight or obese. Mean vitamin D concentration was 30.2 ng/mL (SD = 12.8 ng/mL), significantly higher in female than male sex (33.6 ng/mL, SD = 14.8 vs. 27.6 ng/mL, SD = 10.4; $p = 0.004$). The prevalence of inadequate vitamin D intake was 84.5% and the prevalence of serum vitamin D insufficiency was 55.9%. Boys presented higher serum vitamin D insufficiency in comparison to girls (66.3% vs 42.4%; $p = 0.003$). **CONCLUSIONS:** Although the studied population inhabits a sunny country, the prevalence of vitamin D insufficiency was high, as well as the prevalence of inadequate vitamin D intake. These findings reinforce the importance of considering a policy of vitamin D food fortification, once natural dietary sources of this nutrient are scarce and its deficiency is known to be related to the development of chronic diseases.

PP026

ANALYSIS OF BODY COMPOSITION, WEIGHT CONTROL AND DIETARY BEHAVIORS WITH DIFFERENT AGE OF ADULT WOMEN IN SEOUL, KOREA

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This study was carried out to analyze body composition, weight control and dietary behaviors with different age and BMI divided into 3 age groups; 30's(78), 40's(77) and 50's (44) and 4 groups by BMI. The average body weight of the subjects group was 57.7± 8.9kg. The mean body water, protein, fat, mineral were 50.3%, 13.3%, 31.5% and 4.8%, respectively. BMI, waist hip ratio and body fat ratio were significantly increase with increased age Amount of skeletal muscle, body water, mineral and body fat were significantly increased with BMI. There were significant increase skeletal muscle 5.3kg(19.1?23.5kg), body water 5.3kg(26.3?31.6kg)and fat 15.2kg(11.2?26 4kg) from under weight to obesity group, respectively($p < 0.01$). There were significant decreased in the ratio of body water(10.3%), protein(2.7%) and body mineral(1.1%) from under weight to obesity, but significant increase 14.1% in body fat ($p < 0.001$). About 44.4% of under weight group and 40.1% of normal group and 50% of over and obesity group had dissatisfaction on their body images. Most of the women were concerned about their body images and experienced weight control. Dietary behavior scores of obesity group were significant lower than the other four groups($p < 0.001$). Their fat, water, protein, mineral composition of the subjects were closely related to BMI and dietary behavior rater than adult women's age.

PP 027

EFFECT OF WOMEN'S WEIGHT LOSS PROGRAM ON BODY WEIGHT, EATING HABIT, STRESS INDEX AND BLOOD VASCULAR AGE IN KOREA

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This study was conducted to analyze the effect of weight loss program (Juvis center) on weight loss, eating and sleeping habit, vascular age, stress index and health index. The 415 Subjects were completed 20 times participation of the program from June to December 2010, and the data was collected by questionnaire and mesuring, vascular age, stress, index, health index by the basic somatometry and HRV(Heart Rate Variability)/APG on 10th and 20th program participation. The mean age of subjects was 28.6±6.6 years, and the mean weight and BMI were 62.8±9.9kg /m² and 23.9kg/m²±3.5kg/ m². The 415 subjects showed weight loss, 4.6kg with decrease all index; 1.76kg/m² BMI, 0.58 vascular age. 0.19 in stress index, and 0.2 fatigue index during the program. 50% of the all subjects were positive change vascular age, 44.6% in the stress index, 43.9% in the fatigue index, 54.5% in the health index. Improving the diet and sleeping habits in had effectiveness in improving the vascular age and health index. There was a significant difference of the variations; the vascular age, stress index, fatigue index, and health index between improving weight and no change group. In conclusion, the weight loss program was effective on the weight loss and BMI reduction and eating and sleeping habit. Their eating and sleeping habit with nutrition consulting has effect to improve vascular age, stress index, fatigue index, and health index.

PP 028

RED MEAT INTAKES ARE ASSOCIATED WITH A WORSE LIPID PROFILE IN WOMEN

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BACKGROUND: Scientific evidence suggests that excessive meat intake may alter the lipid profile which is an important risk factor for cardiovascular diseases. However, several epidemiological studies have failed to support significant associations between meat intake and changes in lipid profile.

OBJECTIVE: Describe the meat consumption and to investigate the associations between meat intake and lipid profile.

METHODS: A total of 712 Brazilians aged 19 and older were studied in a large cross-sectional health survey performed in 2008 in the city of São Paulo, Brazil (ISA-Capital). Meat intakes were estimated by two non-consecutive 24-hour dietary recalls (24HDR) and a Food Frequency Questionnaire (FFQ). The Multiple Source Method (MSM) was used to estimate the usual meat intake. The frequency data provided by the FFQ were used as a covariate in the MSM models to improve the modeling of consumption probability and amounts of meat. The usual meat intake was expressed in mean and standard error (SE) for men and women separately. Blood samples were collected in household. Serum total cholesterol and fractions were quantified by enzymatic colorimetric assay. Linear regression models were used to examine the associations between cholesterol levels (total cholesterol, HDL-c and LDL-c) and meat intake (red, processed, and total meat) by adjusting for the c-reactive protein (PCR), educational level of the household head, smoking habits, BMI, energy, total fat, SFA, MUFA, and PUFA intake. All analyses were performed in Stata 10.0 correcting for the complex sampling design of the study. A p-value < 0.05 was considered as significant.

RESULTS: The usual mean of total meat intake was 184g/d (4,3g/d) for men and 128g/d (2,8g/d) for women. For red meat intake, the usual mean was 130g/d (3,0g/d) for men and 81g/d (2,0g/d) for women, and for processed meat intake, the usual mean was 40g/d (1,7g/d) for men and 25g/d (1,0g/d) for women. Only red meat was associated with lipid profile. In women, 100g of red meats increased in 4mg/dL in LDL-c and decreased in 3mg/dL in HDL-c, after adjustment for age, BMI, energy intake, total cholesterol, VLDL-c and PCR. In men, no significant associations were observed between red meat intake and lipid profile.

CONCLUSIONS: Red meat intake was associated with worse lipid profile by increasing LDL-c levels and lowering HDL-c levels in Brazilian women. Efforts to decrease the total and red meat intake would be an important target to Brazilian public health.

PP 029

INTERACTION BETWEEN IRS1 POLYMORPHISM AND MACRONUTRIENT INTAKES ON INCIDENCE OF TYPE 2 DIABETES IN WOMEN AND MEN FROM THE MALMÖ DIET AND CANCER COHORT

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Background: The minor T-allele of *IRS1* rs2943641 has been associated with improved insulin sensitivity and decreased incidence of type 2 diabetes (T2D). In addition, dietary intake may influence the expression of insulin receptors and thereby affect *IRS1* phosphorylation and insulin signaling. Genetic variations in *IRS1* and macronutrient intakes have shown sex dependent associations with anthropometry, metabolic traits or T2D. **Objective:** The aim of this study was to examine interaction between the *IRS1* rs2943641 polymorphism and dietary intakes of macronutrients and fiber on incidence of T2D in women and men from the Malmö Diet and Cancer cohort. **Methods:** In total 15 227 women and 9 614 men, 45 -74 years with data on dietary intakes and *IRS1* genotype, and without prevalent diabetes at baseline, were included. Dietary data was collected with a modified diet history method, including registration of cooked meals. During 12 years follow-up, 1567 incident T2D cases were identified. We used Cox proportional hazard model to calculate hazard ratios of diabetes incidence according to tertiles of energy adjusted dietary intakes and *IRS1* genotype with adjustments for several potential confounders. **Results:** We observed a significant 3-way interaction between sex, *IRS1* and carbohydrate intake (P=0.01), as well as between sex, *IRS1* and fat intake (P=0.01). Among women, there was only significant protective associations between the minor *IRS1* T allele and incidence of T2D in the lower tertiles of carbohydrate intakes (P for trend across genotypes=0.01) and in the highest tertile of fat intake (P for trend = 0.03) (P for interaction between *IRS1* and intakes of carbohydrates and fat = 0.01 and 0.14 respectively). In contrast, among the men significant protective associations with the *IRS1* T-allele was only seen in the highest tertile of carbohydrate intake (P for trend across the genotypes= 0.04) and in the lowest tertile of fat intake (P for trend= 0.02) (P for interaction between *IRS1* and intakes of carbohydrates and fat = 0.10 and 0.02 respectively). **Conclusion:** The *IRS1* T-allele was protectively associated with incidence of T2D in women at low carbohydrate intakes, but in men at low fat intakes. The diverse associations may be explained by gender differences in food choices or accuracy of dietary reporting. It is however also possible that biological differences, including sex hormone levels, influences the importance of genetic predisposition as well as optimal carbohydrate and fat intakes with regard to macronutrient metabolism and prevention of diabetes development.

PP 030**GENDER DIFFERENCES EXIST IN THE RELATIONSHIP BETWEEN ACCULTURATION AND DIETARY INTAKE AMONG MONGOLIAN IMMIGRANTS IN SOUTH KOREA**Z. Tserendejid¹, H. Park¹¹Dept of Food and Nutrition, Myongji University

Aims: Migrating to a different culture brings changes to people's diet and lifestyle, depending on the extent of acculturation. The food intake of typical Mongolians show too much animal-based food such as meats and dairy products and deficient amount of fruits and vegetables, resulting in a high prevalence of chronic diseases in the long run. This study targeted Mongolians currently residing in Korea and aims to examine the association between their acculturation level and their dietary intake in relation to males and females.

Methods: For measuring the acculturation level of a Mongolian in Korea, we developed the acculturation scale based on the Suinn-Lew scale. Dietary intakes were assessed using one-day 24-hour recall method, and demographic characteristics were obtained using the structured questionnaire. Subjects were five hundred Mongolian immigrants between the ages of 18 and 56. Food and nutrient intakes between both genders and acculturation levels were analyzed by using general linear models.

Results: Participants were grouped into low acculturated and highly acculturated categories. The females were highly acculturated compared to the males. Those who are younger than 30 years old, resided in Korea for more than 5 years, and have college or higher levels of education were associated with being highly acculturated. Mongolian immigrants had adequate protein, vitamin A, thiamine, phosphorus and zinc compared with the Korean DRI. Highly acculturated females consumed more than 400 grams of fruits and vegetables daily, compared to those of males. Both of males and females who were in the highly acculturated group showed a significantly lower intake of potatoes and meats as well as significantly higher intake of vitamin C, fiber, fish, fruits and vegetables than those of the low-acculturated.

Conclusions: The study results showed that acculturation had a positive impact on dietary intakes among Mongolian immigrants in Korea and this tendency was stronger among females than males. There should be various education programs on nutrition to address those in the low acculturation group, with an emphasis on males to improve dietary behaviors among Mongolian immigrants.

PP 031**THREE DAY RECORD OF DIETARY INTAKE OF KUWAITI CHILDREN 6-10 YEARS OF AGE**B. Al-Lahou¹, F. Al-Khulaifi¹, A. Al-Othman¹, Z. Hussain², A. Bader²¹Kuwait Institute for Scientific Research, ²Food and Nutrition Administration, Ministry of Health

Objective: To evaluate the dietary intake of 111 Kuwaiti children comparing the macronutrients and calorie distribution between males and females.

Participants: Our study group consists of 111 pre-adolescent healthy Kuwaiti school children (53 Boys and 58 Girls) aged 6-10 years old). Criteria for exclusion includes: children on medication that may affect body composition or metabolic rate, such as steroids, anti-psychotics or anti-depressants.

Design: Three day food record was collected from each participant, preferably two weekdays and a weekend. Mothers were asked to fill out the record for the child, mentioning each item taken hourly in details. A Food Instruction Booklet was used as a reference for the amount of the food items consumed by the child. ESHA Port SQL Software was updated with the Kuwaiti traditional foods and used for the analysis of the children's intake, individually.

Results: The three day record analysis was done for 111 children (Male: 53, Female: 58).

The results obtained were for the ages of 6-10 years. For males, the average intake was for proteins 78.8g (315 kcal), carbohydrates 308.0g (1231.9 kcal), sugars 119.7g (478.7 kcal), fat 81.3g (731.3 kcal), and saturated fat 27.2g (244.6 kcal). For females the average intake was for proteins 63.9g (255.8 kcal), carbohydrates 269.0g (1075.9 kcal), sugars 114.5g (457.9 kcal), fat 72.5g (652.2 kcal), and saturated fat 26.2g (235.8 kcal). For calorie distribution, both males and females seem to be consuming the highest calorie intake in their lunch meal (616.8 kcal M, 513.4 Kcal F), and the lowest calorie in their breakfast meal (367.7 M, 308.5 F). Simple sugars seem to be mainly consumed in snacks (38.9% M and, 42.6% F). Considering their energy intake from macronutrients, males and females have similar intakes. Carbohydrates seem to be the main source of energy for males (57.4%) and females (56.0%), fat the second source (32.3% M, 34.1% F) and proteins (12.2% M, 11.6% F).

PP 032

VALIDATION OF PROTEIN AND POTASSIUM INTAKE IN THE NORWEGIAN WOMEN AND CANCER STUDY FOOD FREQUENCY QUESTIONNAIRE

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Background

Food frequency questionnaires (FFQ) have been used extensively in large epidemiological studies, but questions have been raised about their validity. The Norwegian Women and Cancer (NOWAC) study is a study of more than 170 000 women, and more than 95 000 of them have reported their diet (1-3 repeated measurements) using a 4-page semi-quantitative FFQ.

Aim : The aim of this study is to describe the validity of the protein and potassium intake measured by the NOWAC FFQ. The reference method was measurements of nitrogen and potassium in 2*24-hour urine collections. An additional aim was to see if the questionnaire, which was originally developed for use among women, also could give a valid measure of these nutrients in men.

Material and methods: Participants in the Norwegian arm of the EFCOVAL study (n=61 men and 58 women) were given the NOWAC questionnaire after having completed 2*24 hours dietary recall, 2*24 hours urine collection, and a blood sample. Protein excretion was calculated as (urinary nitrogen/0.81)*6.25, potassium excretion as (urinary potassium/0.77). Statistical comparisons of information from the FFQ and urine collection included simple descriptive statistics, Pearson correlations, and analysis of covariance. Age, BMI, education level and energy intake was included as adjustment variables. The significance level was set to 0.05.

Results: Mean protein intake was 93.2 g/day for men and 76.4 g/day for women, and mean potassium intake was 4241 mg/day for men and 3661 mg/day for women. The intake protein and potassium estimated from the FFQ was lower than the amounts measured by the biomarkers, but only significantly lower for protein. For men the mean adjusted difference for protein was -19.8 g and for women -10.8 g. There was no significant difference in underreporting between men and women in the adjusted model, neither for protein nor for potassium. Adjusted correlations between intake and excretion was 0.33 (men) and 0.34 (women) for protein, and 0.53 (men) and 0.22 (women) for potassium.

Discussion The current version of the NOWAC FFQ underestimates protein intake with about 17% for men and 12% for women. More work should be done in order to explore the gender difference in ranking for potassium. *“The EFCOVAL Study took place with the financial support of the European Community Sixth RTD Framework Programme (Contract FOOD-CT-2006-022895). The content of this poster reflects only the authors’ views and the Community is not liable for any use that may be made of the information contained therein.”*

PP 033

IMPROVING ESTIMATES OF FATTY ACID INTAKE BY USING REPORTED COOKING FATS IN FOOD DIARIES IN EPIC-NORFOLK – AN EXTENSION TO THE DATA-ENTRY PROGRAM

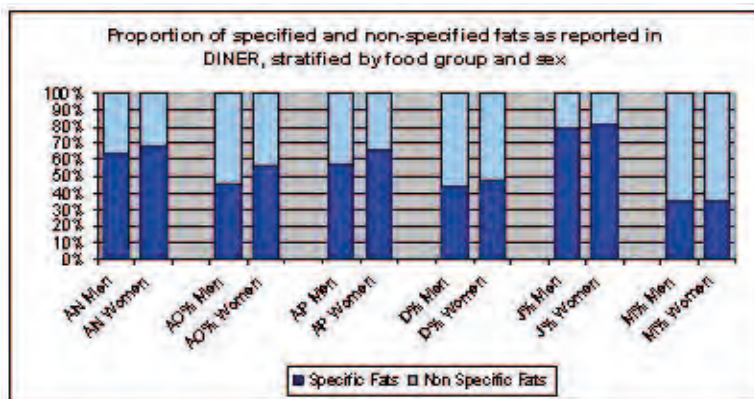
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The diary data entry system Data Into Nutrients for Epidemiological Research (DINER) was designed for the Norfolk arm of the European Prospective Investigation into Cancer (EPIC-Norfolk) Study. EPIC-Norfolk is a prospective cohort study of over 25,000 men and women aged 45-74 exploring links between diet and disease. A pilot study of an extension of the current DINER program builds on this work with the aim of better characterising fatty acid consumption from homemade and fried food items in 7-day diet diaries (7DD).

There were two parts to this process. Firstly, cooking fats reported by participants were captured as a food code in DINER during the 7DD data entry process; however, to date, this data has not been used. Secondly, all ingredients in McCance & Widdowson (M&W) recipes containing fat were entered into the modified DINER program: Recipe DINER (RDINER). Raw foods were used unless otherwise stated. The stated participant’s fats from the first stage were then used to replace the generic M&W fats in RDINER after which the recipe was recalculated. Participants who did not indicate which cooking fats they used kept the M&W specified recipe fat.

Baseline 7DD were available for 21,654 participants, 10,145 (47%) men and 11,509 (53%) women. These 7DD contained 4,388,501 food items, of which 199,492 (5%) were foods with a fat attribute of which 27% were homemade and 2% fried. The percentage of those who provided data for specific fats ranged from 80% to 35% for men and 82% to 36% for women. The figure shows relative frequency distributions by gender, for specified and non-specified fats used in homemade items from the following key food groups in terms of fat contribution: Biscuits and Cakes (AN), Savoury Pastries (AO%), Sweet Pastries (AP), Vegetable Dishes (D%), Fish Products and Dishes (J%) and Meat Products and Dishes (M%). Chi squared tests showed significant differences (P<0.001) between men and women in reporting specified fats for AN, AO and AP groups but not in the Vegetable Dishes, Fish Products and Dishes or Meat Products and Dishes groups.



Although the percentage of total food items with a fat attribute was only 5%, information on specific fats was provided for between 82% and 35% of these foods and so could be important. Once finalised, RDINER could improve the classification of types of fats consumed in EPIC-Norfolk with more impact expected on the fatty acid distribution in women than men.

PP 034

TRACKING OF PEDOMETER DETERMINED PHYSICAL ACTIVITY. A 10 YEAR FOLLOW UP STUDY FROM EARLY ADOLESCENCE TO EARLY ADULTHOOD IN SWEDEN

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Background. Tracking refers to the tendency for an individual to maintain their rank within a group over time. Longitudinal data of at least two points in time are necessary and inter-age correlations between the measurements can estimate tracking. So far to our knowledge no other studies of longitudinal design of this time span using objectively measures both at baseline and follow up have been published. **Aim.** The aim was to explore tracking of pedometer-determined physical activity. **Methods.** In October of 2000, 2003, 2005 and 2010, data of physical activity as steps/day was measured with sealed Yamax SW-200 Tokyo, Japan for four consecutive schooldays in 40 (19 females) Swedish individuals (mean age 12.7 in 2000). **Results.** In boys a decrease of mean step/day occurred between baseline and the three year ($p < 0.001$), the five year ($p < 0.001$) and the ten year follow-up ($p < 0.001$). In females no significant differences were found at any time span. Tracking of was non significantly low to moderate during the time span from childhood over adolescents into adulthood. A sex difference was seen with males expressing higher tracking ($r = 0.21-0.42$) than females ($r = -0.10-0.37$). A significant moderate tracking occurred in those at baseline classified insufficient active, both over the 3-5 year ($r_s = 0.56$, $p = 0.005$) and the 0-10 year span ($r_s = 0.47$, $p = 0.05$). **Conclusion.** Tracking of objectively measured physical activity was in general low to moderate during the period from early adolescents to early adulthood. Further, youth classified insufficient active according to published BMI reference standards at the baseline measures showed a significant moderate tracking over the ten year follow up period Therefore identifying individuals with low physical activity and at early adolescence and intervene is important since they tend to keep their position as low active into early adulthood. However, his intervention must be conducted without a decrease of the more active individuals' physical activity level.

PP 035

SURVEILLANCE OF IODINE STATUS IN BELGIUM BY MEANS OF NEONATAL TSH CONCENTRATIONS: TACKLING METHODOLOGICAL CHALLENGES

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Several surveys in the past have repeatedly indicated that Belgium is affected by Mild Iodine Deficiency (MID). In 1998, a representative survey in Belgian school-aged children showed a median urinary iodine concentration of 80 µg/L. Consequently optimizing iodine intake was chosen as a priority by the Ministry of Health in its "National Nutrition and Health Plan for Belgium 2005-2010". In 2009 an agreement was signed between the bakery sector and the Ministry of Health to encourage the use of iodised salt in the production of bread. From 2009 onwards a national surveillance system for neonatal thyroid-stimulating hormone (TSH) concentrations was put in place. The prevalence of an increased TSH level has been proposed as a good indicator for the iodine status of the population. The aim of the system is to follow the iodine status of the population over the years. However, there are some important methodological challenges which need to be solved before the system can be used. First only four out of six centres use the same methodology to assess TSH concentrations in newborns namely a time-resolved fluoroimmunoassay ((Auto)Delphia). The other two centres use a sandwich enzyme-immunoassay (EIA): the Quantase TM Neonatal

Screening Assay (Liège) and Enzyme-Linked Immunosorbent Assay ELISA (Louvain-en-Woluwe) respectively. In 2009 results were obtained from 126817 neonates, of which 91206 from the centres using the same method. Neonates with TSH level above 15 μ IU/mL were excluded. When comparing TSH concentrations between the 4 centres using time-resolved fluoroimmunoassay, the median TSH concentration differed significantly between them and differences ranged from 0.03 until 0.40 μ IU/mL. In two centres (Bruges and Brussels) more than 3% of the neonates had TSH levels above 5 μ IU/mL (3.78% and 3.36% respectively), which may indicate that there is still MID in those areas. In Liège and Louvain-en-Woluwe about 31.29% and 9.86% of the neonates respectively had TSH levels above 5 μ IU/mL. In 2010-2011 a correlation study was organised to evaluate whether those important variations might be explained only by the use of different methods in the respective laboratories or by regional disparities. In this correlation study TSH was measured in 100 anonymous blood samples by all centres. The results from the correlation study among the centres and the resulting prevalence of iodine deficiency in Belgium for the period 2009-2011 will be available for the congress in May 2012. In addition prevalence of iodine deficiency assessed via neonatal TSH concentrations in 2010 will be compared with the results from two representative national surveys on iodine status in the population organised in 2010 in Belgium: one in children and one in pregnant women. The second methodological challenge is the fact that there are several factors influencing neonatal TSH concentrations. The impact of several factors on TSH level of newborns (n=19313) was assessed for the centre in Brussels in 2009. It was found that pregnancy duration (p<0.001), birth weight (p<0.001), number of days between birth and screening (p<0.001), number of days between screening and reception of sample by the centre (p<0.001) and season (p<0.001), all had a significant impact on TSH level while sex of the neonate did not have an impact. The TSH level was significantly higher (p=0.006) during autumn compared to the other seasons. Another study assessing the impact of smoking habits, nutrition of the mother and type of delivery on neonatal TSH concentrations was performed. These results will be presented during the congress in May 2012. In conclusion, several factors other than iodine status, including the assay methods, affect neonatal TSH concentrations. These factors need to be taken into account in the interpretation of TSH values particularly in mild iodine deficient regions where more subtle variations of TSH are expected.

PP 036

USDA FOOD PATTERNS EQUIVALENTS DATABASE: ITS ROLE IN NUTRITION MONITORING AND SURVEILLANCE IN THE UNITED STATES

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The What We Eat In America (WWEIA) survey is the dietary intake component of the National Health and Nutrition Examination Survey (NHANES). WWEIA, NHANES is a continuous survey and is conducted by the U.S. Department of Agriculture and the U.S. Department of Health and Human Services as part of the ongoing nutrition monitoring and surveillance activities of the Federal Government. The survey captures, through a 24-hour dietary recall method, the type and amounts of foods and beverages Americans report that they consume. The Food and Nutrient Database for Dietary Studies (FNDDS) provides nutrient composition of the 7,000+ survey foods. The Dietary Guidelines for Americans, 2010 (DGA 2010) provide recommendations on how many Food Patterns equivalents of fruits, vegetables, grains, dairy, protein foods, and oils that Americans might consume to have a healthful diet. The DGA also place limits on the amounts of added sugars, solid fats and alcoholic drinks one could consume. In order to monitor whether Americans meet the recommendations of the DGA, the foods in the FNDDS should be first converted to the number of Food Patterns equivalents of fruits, vegetables, grains, dairy, protein foods, oils, added sugars, solid fats, and alcoholic drinks. The USDA Food Patterns Equivalents Database (FPED), which is currently being retooled, converts the FNDDS foods into the respective number of Food Patterns equivalents. The objective of retooling the FPED is to simplify the FPED development methodology and to apply consistent decisions across similar foods. The research work presented in this abstract will describe the development of a 100-gram FPED. Some of the steps in retooling the FPED include consolidation of the weights of one cup of fruits and vegetables such that similar types of fruits and vegetables will have the same weights; the use of 16 grams of flour as the basis for defining one ounce equivalent of grains for grain products made of flour; estimation of added sugar equivalents from the total sugar values of foods that are defined as added sugars; and using alcohol content of beverages to estimate the number of alcoholic drinks. United States mean intakes estimated in terms of Food Patterns equivalents for WWEIA, NHANES 2007-08 will be presented.

PP 037

RECIPE DATABASE DEVELOPMENT FOR RESTAURANT FOODS FOR PROCESSING OF DIETARY INTAKE DATA OF KNHANES

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This study was performed to develop a representative recipe database for restaurant foods to be used in the processing of the dietary intake survey results from KNHANES. The frequently consumed restaurant foods were selected to make

a list for recipe collection using dietary intake data from 2007 and 2008 KNHANES. Out of the 372,615 restaurants located in seven metropolitan cities and Gyeonggi province, 500 restaurants were selected by simple random sampling and more than 5,000 recipes were collected from 498 restaurants. For each foods (prepared dishes), ingredient foods were pooled among recipes from different restaurants and sorted by frequency and weight. Ingredient foods with less than 10% of frequency or ones with less than 1% of sum of ingredient weight were excluded. To produce a preparatory recipe, remaining ingredient foods were divided by number of recipes used for each prepared dish. Major dishes were experimentally prepared using preparatory recipes to examine the relationship between prepared dish volume and amount of ingredient foods and for a final adjustment. We produced a representative recipe database for 174 dishes with 11 or more recipe sources and a provisional recipe database for 464 dishes with limited number of recipes. This will be used in estimating ingredient food intake from restaurant food intake reported in volume in KNHANES. In addition, it will be incorporated into the fundamental nutrition database used in the processing of KNHANES dietary intake data and consequently enable the estimation of food and nutrient intake of Koreans with increased reliability and credibility.

PP 038

PEDOMETER-DETERMINED PHYSICAL ACTIVITY IN DANISH ADULTS INCLUDING NON-AMBULATORY ACTIVITIES: 2007-2008

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Background: Objective measurements of physical activity for surveillance are needed in Denmark.

Aim: To assess current levels of pedometer-determined physical activity (steps per day) in the Danish adult population from 2007 to 2008 without and with non-ambulatory activities (NAA).

Methods: A study was performed in a nationally representative sample of 229 Danish adults (52% men) 15-75 years of age. Participants were randomly selected from the Danish Civil Registration System and recruited for the 2007-2008 Danish National Survey of Dietary Habits and Physical Activity. Data of mean steps per day were collected during seven consecutive days using sealed pedometers (Yamax SW-200 Tokyo, Japan). All participants had at least four valid recording days. In addition, NAA such as cycling, swimming etc. were recorded daily in a questionnaire. Time spent on NAA was converted to step equivalents by adding 200 step equivalents/min (= 6 METs) using the Intermediate Conversion Method suggested by Miller et al. (2006). A pilot study showed a mean recording of 40 steps/min during cycling 18.4 km/h. To account for this "double counting" during cycling, only 160 step equivalents/min were added per min of cycling. Addition of >10,000 step equivalents/day was truncated to 10,000 to avoid overestimation.

Results: In 2007-2008, Danish adults averaged 8,912 steps per day and 10,406 steps per day when including NAA. The difference in steps per day without and with NAA was significant ($p < 0.001$) and corresponded to 1,494 steps per day (17%). 36% took at least 10,000 steps per day and 54% when including NAA. No significant difference in steps per day was found between genders. However, when including NAA, women were more active than men (11,011 vs. 9,856 steps per day) ($p = 0.03$). Steps per day correlated negatively with age without and with NAA ($p < 0.01$). Step equivalents were added for 53% of all participants. The most frequently reported NAA was commuting by cycle which was reported by 39% with a mean of 125 min per week. Truncation was carried out for 73 out of 364 conversion days (20%).

Conclusion: Overall, Danish adults are somewhat active to active. Still, a large part of the adult population is not sufficiently active if the reasonable target is 10,000 steps per day. Commuting by cycle is a main everyday activity in countries like Denmark and to avoid underestimation of the physical activity level, NAA should be considered when assessing pedometer-determined physical activity in the general population.

PP 039

RISK OF SUBOPTIMAL IODINE INTAKE IN PREGNANT NORWEGIAN WOMEN

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Background: Iodine is required throughout the life-cycle, however, pregnant women and infants are exceptionally vulnerable to deficiency because iodine is essential for normal foetal and child brain development and growth. Recently WHO/UNICEF increased the Recommended Nutrient Intake for iodine during pregnancy from 200 to 250µg/d. Iodine deficiency during pregnancy typically becomes worrying when iodine intake falls below 100µg/d. Few food items contribute to iodine intake in the Norwegian diet, and iodine-fortified salt contributes only marginally because the concentration of iodine is low (5µg/g) and there is no mandatory use of it.

Objective: To identify predictors of suboptimal iodine intake, defined as intakes below 100µg/d, in a large population of pregnant Norwegian women

Methods: A new FFQ was developed and validated for assessment of habitual diet during the first four to five months of pregnancy in the Norwegian Mother and Child Cohort Study, a nationwide pregnancy cohort carried out by the Norwegian Institute of Public Health. Intake of iodine from food and supplements was estimated in 62099 pregnant women. The study sample comprised women delivering singleton, live born babies and who had reported a total energy intake between 4.5 and 20MJ/d. In a subsample of 119 participants, estimated iodine intake showed good agreement with 24 hour urinary iodine excretion.

Important predictors for having iodine intake <100µg/d was identified using multiple logistic regression. Adjusted odds ratios (OR) and 95% confidence intervals (95% CI) are reported.

Results/Findings: The average intake of iodine from food was 153µg/d and the additional contribution from supplements for iodine supplement users was 115µg/d. Only 31.5% of the women reported use of an iodine-containing supplement. Very few women (1.1%) had iodine intakes below 50µg/d, while 16.1% had iodine intakes below 100µg/d. The risk of suboptimal iodine intake decreased with increasing age and educational attainment and was higher in smokers than in nonsmokers. However, the most influential predictors of suboptimal iodine intake were:

- no use of iodine containing supplements; OR: 56.0 (95% CI: 49.7, 63.2)
- low milk/yoghurt intake (≤200 ml/d); OR: 41.2 (95% CI: 38.3, 44.3)
- low fish and seafood intake (≤20 g/d); OR: 3.9 (95% CI: 3.6, 4.2)
- low energy intake; OR for lowest quartile versus highest quartile of energy intake: 14.7 (95% CI: 13.1, 16.4)

Conclusions: Suboptimal iodine intake was identified in 16.1% of otherwise well-nourished pregnant women. Public health strategies are needed to improve and secure the iodine status of pregnant women in Norway.

PP 040

FUNDAMENTAL MOVEMENT SKILLS: A NECESSARY PREREQUISITE FOR PHYSICAL ACTIVITY, BUT MISSING FROM POPULATION SURVEILLANCE

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Background Fundamental movement skills (FMS) are the building blocks for movement and form the foundation for many specialised skills required in popular children's sports and leisure activities. Developing FMS during childhood may be an important step towards establishing a lifelong commitment to physical activity (PA) and, importantly, mastery of FMS during childhood is correlated with health benefits including higher levels of PA, cardiorespiratory fitness, perceived scholastic/athletic competence and lower levels of overweight. Importantly, FMS are not naturally acquired; rather develop through teaching and opportunities to practice, with mastery attained around age 10 years. Australia has maintained regular population level surveillance of school-aged children's FMS mastery since 1997 through the Schools Physical Activity and Nutrition Survey (SPANS).

Methods Our FMS surveillance has been conducted in 1997-2004-2010 (N = 19,434) through cross-sectional surveys of school children aged 6.0-16.9 years. FMS mastery was determined using process-oriented tests to determine whether the form of the movement skill incorporates the observed performance criteria in a mature pattern. This qualitative method permits specific characteristics of the movement to be identified which reflect the developmental skill level rather than the physical growth and maturational levels of children. The major advantages of process-orientated assessment are that the information can be used to inform teachers/coaches which specific components of a skill an individual needs to practice and that assessment can be undertaken in a more meaningful context than quantitative methods.

Results Overall, the prevalence of FMS mastery among children and adolescents is low. In 10 year olds, (expected age of mastery) mastery for the sprint run was <40%; vertical jump <30%; side-gallop <65%; and in girls <10% for kick and over-arm throw). There are consistent positive associations between mastery and fitness and meeting PA recommendations. Further, mastery consistently differs by age, sex, SES and cultural background. Among high SES girls the odds of mastery are at least twofold higher, compared with low SES peers and among boys mastery was positively associated with being from English-speaking backgrounds.

Conclusions The low prevalence of mastery in school students indicates that FMS interventions need to start during the early preschool years. FMS training is a priority within the school curriculum and there is evidence that the mastery of these skills is associated with higher physical activity and fitness levels. Systematic monitor of children's FMS may assist other forms of physical activity surveillance.

PP 041

DINO (DIET IN NUTRIENTS OUT) – AN INTEGRATED DIETARY CODING AND ANALYSIS SYSTEM FOR DIETARY ASSESSMENT STUDIES

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DINO is a unique dietary assessment system developed for use in a variety of dietary assessment projects from small scale interventions to national surveys. It incorporates dietary coding and nutritional analysis within one platform, with additional functions including a recipe calculator and food query identifier. Food composition data is primarily from McCance and Widdowson's The Composition of Foods series, with project specific foods added as required. Written in Microsoft Access, DINO also benefits from an integrated, context sensitive help system.

DINO currently holds 6190 food codes, mostly composite foods, across 31 main food groups divided into 151 subsidiary groups for reporting requirements. Socio-environmental questions have been built-in to record where and with whom the person is eating, whether they are eating at the table, and if they are watching television, which allows examination between these determinants and the foods consumed. The nutrient fields in DINO have been expanded with recent additions of data for caffeine, wholegrain, phylloquinone and added sugars. Commercial toddler foods and drinks have also been assigned specific food groups to capture the exact nutrition composition and fortification levels for these products. All composite food codes in DINO have been disaggregated into fruit, vegetable meat, fish and cheese components enabling greater accuracy when reporting, particularly for adherence to 5-a-day recommendations. Recipes can be coded as separate component ingredients stated by study respondents and linked together by recipe groups, which classifies them as a single item alongside other composite food codes. Portion sizes in DINO are categorised in metric and imperial weights, with standardised portion sizes for age group. Regular reviews are undertaken for portion sizes and food composition to ensure maximum data accuracy. DINO can be study specific, with different versions being used for projects spanning specific time periods. Archived versions can be adapted to include new projects enabling contemporaneous dietary coding and analysis.

PP 042

VOLUNTARY FOOD FORTIFICATION IN THE UNITED STATES: POTENTIAL FOR EXCESSIVE MICRONUTRIENT INTAKES

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Introduction: Voluntary food fortification has the potential to impact the likelihood of excessive usual nutrient intakes, particularly in the context of widespread supplement use. Previous attempts to examine this issue have not adequately accounted for the effects of differential exposure to voluntary food fortification within the population.

Objective: To investigate whether individuals in the US with higher probability to consume micronutrients from voluntarily fortified foods (vFF) are more likely to have usual intakes exceeding the Tolerable Upper Intake Level (UL) for those micronutrients.

Methods: The National Cancer Institute method was applied to data from the 2007-8 National Health and Nutrition Examination Survey to estimate the joint distribution of usual intake from vFF and non-vFF sources for folic acid, retinol, zinc, calcium, iron, phosphorous, selenium, copper, choline, vitamin C, D, and B6. For vFF sources, we jointly estimated usual intake as the product of the probability to consume each nutrient from vFF on a given day and the usual amount consumed from vFF on consumption days. Non-vFF sources are ubiquitous and required only a model for usual amount. Separate usual intake distributions from all food sources (non-vFF and vFF) were then estimated by quintile of probability to consume vFF and examined relative to the UL. We also assessed the association between probability of consuming energy from vFF and consumption of a vitamin or mineral supplement.

Results: We observed large variation in probability to consume nutrients from vFF within the population, with older adults and young children having higher probabilities of consumption. An increased probability of consuming zinc, retinol, folic acid, selenium and copper from vFF was associated with a greater risk of excessive intakes of these nutrients among children. Among adults, increased probability of consuming calcium and iron from vFF was associated with a greater risk of excessive intakes among some age/sex groups. Supplement consumption was associated with an increased probability of energy consumption from vFF among girls 9-13y, women 31-50y and 71+y, and among men over 30y.

Conclusions: Increased consumption of nutrients from vFF is associated with an increased risk of excessive intakes of folic acid, retinol, zinc, selenium and copper among children, and calcium and iron among adults in the US population. The probability approach used here overcomes the inability to identify consumers and non-consumers of vFF based on only a few days of intake data, providing a more accurate picture of the potential impact of voluntary food fortification.

PP 043**NUTRITIONAL EVALUATION OF PREGNANT WOMEN BY SCORES OF HEALTHY AND UNHEALTHY NUTRITION**

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Objective: Evaluating the consumption of healthy and unhealthy food by pregnant women and verifying possible associations with socio-demographic and behavioral variables. Methods: cross-sectional study with a random sample of pregnant women treated in prenatal low-risk, public, of Southeastern city in Brazil. It was studied 107 pregnant women in 2nd trimester of pregnancy. It was applied a food frequency questionnaire, not quantitative, and a socio demographic questionnaire. To the consumption frequencies of embedded, fries and soft drinks (unhealthy food consumption indicators) and fruits and vegetables (healthy consumption indicators) were awarded points, such as: 0.00 for never consumed items, 0.05 for consumed up to two times per week, 0.46 for consumed three to four days per week, 0.73 for consumed five to six days per week and 1.00 for daily consumed items. Scores range from 0 to 3 points, whereas higher the score, more frequent consumption. In case of healthy score, closer to 3 points, better, and the opposite, in case of unhealthy score. It was tested by univariate linear regression, the presence of association between scores and the following variables: income, age, gestational age and prepregnancy BMI. To check if the scores were associated to categorical variables: education, physical activity, presence of partner, and work outside the home, it was used variance analysis (ANOVA). Analyses were performed using SPSS, adopting $p < 0.05$ as significance level. Results: The average healthy diet score was 2.02 ± 0.82 , and the unhealthy diet score was 1.53 ± 0.68 . The healthy diet score have increased with the per capita income ($p = 0.000$), and for an increase of 0.1 minimum wage there is an increase of 0.37 in healthy score. The healthy score was positively associated with presence of a partner ($p = 0.017$) and work outside the home ($p = 0.017$). There were no associations between the consumption of unhealthy food and studied variables. Conclusion: The pregnant women had a score to the scores of healthy food consumption greater than to unhealthy score. Determinants of the access to food were positively associated with frequency of fruit and vegetable consumption. Socio-demographic and lifestyle factors were not associated with the unhealthy food consumption.

PP 044**INADEQUATE INTAKE, ANTHROPOMETRY AND LIFESTYLE OF COLLEGE HEALTHCARE STUDENTS.**

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Objective: assessing the food intake, anthropometry and lifestyle of female university students in the health area. Method: 112 students who attend the 2nd year of some courses in the health area at UNESP-Botucatu were evaluated in 2007. Data on: physical activity, alcohol intake, smoking habits, anthropometry (BMI, waist circumference and bioimpedance) and dietary intake were collected through three days food records. Results: regarding the classification of students according to BMI, it was observed that 12.5% were overweight, 4.5% were underweight and the others showed normal weight. Waist circumference was below average students of predicted risk and the mean percentage of body fat within the limits considered acceptable. Smoking and alcohol consumption was less prevalent, however, there was a high level of physical inactivity. We have observed a statistically significant relationship between physical activity and body fat percentage ($p = 0.0182$). The average energy consumption was similar to the one expected from the group ($p = 0.184$) as well as the distribution of macronutrients. We found high percentages of inadequate intake of vitamin E (97.7%), Folate (94.4%), Zinc (38%) and thiamine (30%). Conclusion: the obtained results are worrying, since there is an imbalance in the intake of micronutrients for most of this population, and high rate of inactivity, especially because it is a population composed by students of the health area, who supposedly, should enhance the healthy eating and being multipliers of the information in society.

PP 045**CONSUMPTION OF FORTIFIED FOODS AND THEIR IMPACT ON TOTAL VITAMIN INTAKE – RESULTS FROM THE DUTCH FOOD CONSUMPTION SURVEY 2007-2010**

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Background: Foods are fortified with micronutrients to prevent deficiencies, provide additional health effects, or for better marketing. Because of changes in fortification policies and the ongoing introductions of new fortified foods, it is important to monitor its impact on total micronutrient intake.

Aim: To describe consumption of fortified foods and their impact on total vitamin intake in the Netherlands.

Methods: The Dutch Food Consumption Survey 2007-2010 collected data on 3819 Dutch persons aged 7-69 years. Two non-consecutive 24-hour dietary recalls were conducted per participant using EPIC-Soft®. Based on the information on fortification in the Dutch Food Composition Database, all foods consumed were classified as either fortified or not fortified with a specific nutrient. Spreads enriched with vitamin E, A or D were not classified as fortified products for these nutrients. Total vitamin intake was calculated taking into account intake from foods and dietary supplements. The contribution of fortified foods included both the added and the naturally present specific vitamin in the fortified product.

Results: Three quarters of the study population consumed fortified foods during the survey days. The most frequently consumed fortified products were 'Margarines', 'Non-alcoholic beverages', and 'Dairy products' on 28%, 19% and 12% of the consumption days, respectively. Food groups with the highest proportion of fortified foods were 'Soy products' (87%), Dietetic products (68%), Margarines (fortified with other nutrients than vitamin E, A or D). The contribution of fortified foods to total vitamin intake ranged from 1% for vitamin A (RAE) and vitamin D to 17% for vitamin B6. Other high contributions were observed for other B-vitamins and vitamin C (7-10%). There was a decline in fortified food use with age; the percentage consumers was almost 90% in 7-8 y old children and around 65% in adults 51-69 y. Also the contribution of fortified foods to the intake of many vitamins declined with age. The contribution of fortified foods to folate intake was highest for seniors. Very few people exceeded the safe upper level of intake for retinol, vitamin B6, and folate; whereas inadequate intakes were observed for vitamin D and folate.

Conclusion: Consumption of fortified foods in the Netherlands is considerable and increases with age. Contributions were highest for B-vitamins and vitamin C. Except for folate, for these vitamins there is no problem with inadequate intakes. The current consumption of fortified foods does not lead to excess intakes.

PP 046

DUTCH NATIONAL FOOD CONSUMPTION SURVEY 2007-2010 DIET OF CHILDREN AND ADULTS AGED 7 TO 69 YEARS

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Aim: To gain insight into the diet of the Dutch general population. The data should be suitable for answering research questions related to the consumption of foods, the intake of macronutrients, micronutrients and potentially harmful chemical substances as well as questions related to nutritional trends on the diet of the Dutch population.

Method: As part of the Dutch dietary monitoring system, data on the food consumption of children and adults in the Netherlands, aged 7 to 69 years, has been collected from March 2007 to April 2010. Two non-consecutive 24-hour dietary recalls were collected by dietitians with the software EPIC-Soft®. Habitual intake distributions were estimated (using SPADE) and compared with the recommended amounts.

Results: This survey showed that the consumption of fruit, vegetables, fish and dietary fiber is still insufficient. Compared to the past, intake of trans fatty acids reduced; less than 5% of the population had intakes above the recommended maximum of one percent of total energy intake. However, the proportion of saturated fatty acids in the diet was still too high for the majority of the population. Overweight remained common in adults and children. The survey also showed that the intake of vitamin B2, B6 and B12 and copper was sufficient in the whole population, while for vitamins A, B1, C and E, magnesium, potassium, zinc, iron (women of childbearing age) and calcium (adolescents) intakes below the recommended amounts were observed. More information on the possible health effects of these low intakes is desirable. Furthermore, age groups with specific higher intake requirements often do not meet these, i.e. concerning folate (for women with a pregnancy wish), vitamin D (women over the age of 50). This observation underlines the advice of the Health Council of the Netherlands to use folate and vitamin D supplements in these age groups.

Conclusion: Food consumption data provide insight into food consumption which can be used to stimulate healthier dietary patterns. This survey confirms that low intake of fruit, vegetables, fish, dietary fiber, obesity and too high intake of saturated fat are still the main nutritional points for improvement in the diet. In addition, the intakes of vitamin D and folate need attention. This can be achieved by changes in both the food supply and consumer behavior.

PP 047

SALT CONSUMPTION IN THE NETHERLANDS - DUTCH NATIONAL FOOD CONSUMPTION SURVEY 2007-2010

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Background: High salt intake is associated with a higher blood pressure and subsequently to cardiovascular diseases. Insight in the salt intake and its sources can be used to support nutrition policy in order to improve public health.

Aim: To get insight in the salt consumption and its sources in the Dutch population.

Method: As part of the Dutch dietary monitoring system, data on the food consumption of children and adults in the Netherlands, aged 7 to 69 years, has been collected from March 2007 to April 2010. Two non-consecutive 24-hour dietary recalls were collected by dietitians with the software EPIC-Soft®. In addition general information about among others discretionary use of salt was collected. These data in combination with the Dutch food composition database were used to estimate the habitual salt intake (including discretionary use). A recently developed model in SPADE was used to estimate habitual total salt intake from different salt sources (i.e. foods, discretionary use, dietary supplements) using a 'first shrink then add' approach. Uncertainty due to lack of detailed data on the discretionary use of salt was taken into account by Monte Carlo simulations. In addition, the consumption was calculated by its sources as well as time and place of consumption.

Results: Based on preliminary analyses, the habitual total intake of salt was far above the Dutch recommended maximum intake of 6 g/day for a large part of the population. Main sources were discretionary use of table salt, bread, processed meat and cheese. Adult men consumed more salt compared to children and women, but the food group sources were generally similar. Looking at the salt consumption without discretionary table salt, the most important sources from dinner were sauces and meat products. During lunch and breakfast sodium contribution was mainly from bread. In between meals, cakes and cereal(products) were the main sources. Most of the salt was consumed at home. Differences in food patterns between high and low salt consumers will be presented.

Conclusion: The salt intake is exceeding the recommended maximum intake levels. A population-broad salt reduction can only be achieved by substantial changes in the dietary habits, as well as product reformulation.

PP 048

CAPTURING USUAL INTAKES FOR A RANGE OF DIETARY SURVEILLANCE QUESTIONS: LAYERS OF COMPLEXITY

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One broad goal of nutritional surveillance is to assess the dietary adequacy of a population. This goal can be achieved in multiple ways, depending on the formulation of the research question, the available data, and the available methods. This talk explores how various types of research questions related to nutritional surveillance can be addressed by combining data from short-term dietary assessment instruments, such as 24-hour recalls or food records, with appropriate statistical methods. While many population-level surveys make use of short-term dietary assessment instruments, interest is often in usual or long-run average intake. In the simplest case of estimating the mean usual intake for a group or comparing intakes among groups defined by measured characteristics (e.g., age or sex), the simple mean of a single dietary measure (i.e., one recall) per person is sufficient (given data that are collected appropriately across seasons and days of the week). However, more complex questions that hinge upon the distribution are often of interest; in such cases, statistical modeling is needed to estimate the usual intake distribution from the short-term intake data. Several methods exist to account for excess within-person variation in short-term data, assuming availability of replicate dietary measures on at least some individuals in the sample. For the most part, the available methods operate on one dietary component at a time. Some research questions, however, require joint modeling of two or more dietary variables. For example, estimating the percent of energy from saturated fat requires models for usual intake of energy from saturated fat and for usual intake from energy and must allow for the fact that intakes of the two components are assessed concurrently. A second type of question requiring a multivariate approach is an examination of the distribution of usual intakes of one dietary component within subgroups defined by usual intakes of a second dietary component; for example, assessing usual intakes of key micronutrients among population groups with low, medium, and high intakes of added sugars. While the data needs for multivariate applications do not change as compared to methods of estimating distributions for single components (i.e., replicate measures are needed for at least some individuals in the sample), multivariate methods are significantly more complex and still evolving. In addition to detailing appropriate methods for the various types of research questions, the particular challenges of episodically-consumed foods will be addressed.

PP 049

COMPARED TO 24-HOUR RECALL DATA, SELF-PERCEIVED FOOD INTAKE FREQUENCIES EXHIBIT MISCLASSIFICATION DIFFERENTIALLY ACROSS FOOD GROUPS

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Background: Public health messages on recommended diet quantities are often simplified, hypothesizing that they are better understood by the population. Self-estimated frequency intake of main food groups can mediate the ability to adopt recommended dietary behaviours. Five Single Food Frequency Questions (SFFQs) such as "How often do you eat...?" on fruits, vegetables, meat/egg/fish, starchy foods and dairies have been filled in by participants in the French

National Nutrition and Health Survey (ENNS, 2006-2007). Our objectives were to compare SFFQ answers to the corresponding intakes estimated in the same sample through 24-hour recalls and to identify factors associated with misclassifications according to the French diet benchmarks. Methods: Using a three-level random sampling scheme, a national sample of 18-74 year-old adults was selected to perform three 24-hour recalls by trained dietitians by phone. Subjects answered the SFFQs and living condition questionnaires during a face-to-face interview. The N.C.I. variance reduction method was used to estimate usual intakes from the 24-hour recalls. Both SFFQ intakes and those derived from the 24-hour recalls were categorized according to the national benchmarks. We searched for sociodemographic factors associated with misclassification of the SFFQ compared to the 24-hour data using logistic regressions. Complex sampling scheme and weighting based on the national census were taken into account. Results: Out of 3,115 adults included in the survey, 2,691 exhibited complete data for the SFFQs and the complementary questionnaires and did not underreport their diet according to the 24-hour recalls. In median, a difference of half to two servings was observed between SFFQ and 24-hour recall estimations. Adherence to the recommendations estimated through the SFFQs was generally lower than observed using the 24-hour recalls, excepting for starchy foods which showed similar percentages (63.9% and 62.3%, respectively). Percentages of misclassification varied from 38.8% for starchy foods to 60.9% for fruit and vegetables. Gender and age were significantly associated with the likelihood of misclassification in a way variable according to the food group considered. Among other sociodemographic variables tested, education and occupation were related only to fruit and vegetable misclassification. Conclusions: Our observations contribute to the understanding on how simplified information on food group quantities is likely to be actually integrated in the population behaviours. Observed variations across food groups (likely related to the perception of their properties and of usual servings) differently according to gender and age can be used to better target information on the recommended frequencies of consumption.

PP 050

QUALITY CONTROL IN DIETARY MONITORING. EXPERIENCES IN THE DUTCH NATIONAL FOOD CONSUMPTION SURVEY 2007-2010

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Introduction: Dietary monitoring is an important instrument for the development and evaluation of policies oriented at healthy nutrition and food safety. It is important to assure data of good quality.

Objective: To describe quality assurance of the 24-hr dietary recall data collected with EPIC-Soft® in the Dutch National Food Consumption Survey 2007-2010 (n=3819).

Method:

A. Standardization of data collection: use of EPIC-Soft and training of the interviewers. Before the start of the survey the interviewers, all dietitians, were trained for 3-days. Twice a year 1-day refresher trainings were organized. Based on review of the collected data, news letters with points of attention for dietary assessment were sent every 3 months. Per interviewer 3 interviews were recorded on tape and 1 interview was done with a for them unknown 'fake' respondent. Notes made by interviewers during the recall were checked and handled.

B. Quality checks. Subsequently standardized quality checks were performed on processing variables, missing quantities, correct use of household measures, and outliers in food groups, energy and nutrient intake using Grubbs' method. Subsequently, the outliers were judged by a dietitian/nutritionist. Finally, energy intake was compared with the basal metabolic rate estimated with Schofield equations to estimate number of low reporters using age specific expected PAL values.

Results:

A. Based on the fieldwork and data handling feedback was given to the interviewers during data collection.

B. Few corrections on the data were done based on the standardized quality checks. The mean expected ratio of the energy intake and energy requirements of the study population was 1.74, whereas the mean observed ratio was 1.46. Based on age-specific cut offs, the proportion of low reporters was 17%, while the proportion of high energy reporters was 1.5%. We observed significant differences in energy ratios between the 36 interviewers (range 1.4 to 1.8).

Conclusion: Training and quality checks are important to assure good quality data. It is difficult to objectify the effect of standardization and quality checks. Subjectively, both interviewers and personnel involved in data checks, judged it as important. Furthermore description of standardization methods, quality checks and results give insight in the quality of the data.

PP 051

FRUIT AND VEGETABLES INTAKE AMONG HIGH INCOME BRAZILIANS

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Introduction: The Eating Guide for the Brazilian Population recommends 3 daily portions of fruits and vegetables. It is known that the majority of Brazilian adults consume below the recommended amounts. The objective of this study was to evaluate the consumption of fruits and vegetables among adults living in Brasília. Citizens from Brasília receive the highest mean income in the country, which allows evaluation of the characteristics associated with and reasons for consumption without the constraints of a low income. **Methods:** A total of 98 adults were interviewed. They were selected following a cluster sampling from regions that make up the city. Data were obtained on socio-demographic and anthropometric characteristics, frequency of intake, portions and self-assessment of consumption of fruits and vegetables. Participants answered open questions about reasons for current consumption. To evaluate the association between adequacy in the consumption of fruits and vegetables and socio-demographic characteristics, the prevalence ratio was calculated with a multiple Poisson regression and robust variance. The sample design was considered in the analysis. Agreement between self-assessment intake and technical evaluation was performed using simple kappa coefficient. **Results:** Most subjects consume fewer than 3 portions of fruits (68%) and vegetables (77%) daily. In the model, each year of study was positively associated with a 36% increase in adequacy of fruit and vegetable consumption (PR 1.36 (1.17-1.59, $p < 0.01$) and the agreement between self-assessment and technical evaluation of fruits and vegetables intake presented low values (Kappa: 0.41; IC 95% 0.22 – 0.59 for fruits; Kappa: 0.24; IC 95% de 0.09 – 0.39 for vegetables). The main reasons that motivated the interviewed subjects to consume fruits and vegetables were: benefits to health, good flavor and help in weight maintenance or loss. Among the barriers, most cited were: bad flavor, lack of habit, eat little and think that consumption is sufficient, available time and the fact that these products are highly perishable. Prioritization for barriers and motivators for fruits differs from that for vegetables. **Conclusion:** It is concluded that intake of fruit and vegetables below the levels recommended by the Brazilian Food Guide predominate among high income Brazilians. In this group, education level is associated to fruit and vegetables intake. It is suggested that educational interventions focusing on nutrition should be prepared according to the barriers and motivations for intake of fruits and vegetables and should prioritize the importance of nutritional composition characteristics of foods for maintaining a healthy diet.

PP 052

SURVEILLANCE OF FOOD QUALITY IN SCHOOLS – DEVELOPMENT OF THE WEB-BASED INSTRUMENT SKOLMATSVERIGE [SCHOOL FOOD SWEDEN]

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Background: Sweden is one of very few countries where free school lunches to all primary school children are guaranteed. From 2011, updated legislation specifies that meals must be “nutritious”. This development is expected to improve school food quality and thus impact favourably on children’s diet and health. However, no surveillance system is in place to assess either school food quality or intakes. Dietary assessment of individuals on a large scale, for example in organisations such as schools, is often logistically prohibitive. Assessing the nutritional content of school food provision is a viable alternative for the surveillance of school food quality.

Objective: To develop a valid, user-friendly instrument that can survey school food provision on a national scale through the voluntary use of the instrument by schools.

Methods: We formed a reference group representing relevant (non-commercial) stakeholders, e.g. national authorities, interest groups, community dietetics managers, school principals, school catering managers, and designed the content of the web-based instrument (spring 2010); we performed a pilot test (~80 schools) and tested the instrument’s feasibility and criterion validity (autumn 2010); we then tested the specificity and sensitivity of the instrument’s novel food-based criteria for fat quality, iron, vitamin D and fibre to identify schools that (according to a nutritional analysis) provide food meeting these nutritional recommendations, and we gathered baseline data in a random sample of schools nationwide (spring 2011).

Results: The pilot test identified problems with certain questions and that the instrument was too long. Questions were revised and the instrument divided into three levels, of which two are optional. Three of the four food-based criteria had good specificity and sensitivity. The criteria were adjusted accordingly and validated again (on-going, autumn 2011). In the national study, participating schools (n=192) were representative in terms of geographical spread and school organisation type. The majority of schools thought that Level 1 was “fairly”/“very” easy (85%) and continued to Level 2 (63%).

Relevance: From spring 2012, a validated surveillance system will be in place in Sweden to assess the quality of school food provision at local and national level for the first time. Consideration has been given to making the instrument as attractive as possible to all types of schools and to involve national authorities, in order to ensure that the instrument is

acceptable, that coverage will be representative, and that valid data is collected that allows for the study of associations between school food quality and health.

PP 053

WHY YOU NEED SURVEILLANCE OF POPULATION BASED DIETARY ATTITUDES AND BELIEFS

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Governments develop and implement dietary guidelines to provide credible, reliable nutrition information for health practitioners and the general public. Although dietary guidelines have existed for over 50 years, there is a significant gap between the recommendations and current behaviour. There is evidence that simply telling people what to eat and how much to eat does not necessarily change their behaviour. There are many ideas about why this might be the case. Many countries have comprehensive population based nutrition monitoring and surveillance systems focussing on dietary behaviours. The Health Department in Western Australia (HDWA) aims to increase people's eating behaviours consistent with dietary recommendations through planned health promotion programs. Health promotion planning theory suggests that effective interventions should be based on the target audience's amenability to change which is influenced by their perception of the promoters and barriers. In response to this need, since 1995 the HDWA has conducted tri-annual population based Nutrition Monitoring Survey (NMS) of adults' knowledge, attitudes and behaviour in relation to the Australian dietary guidelines. Globally there is recognition of the importance of promoting breastfeeding with the World Health Organization claiming that only about 1/3 (35%) of infants 0-6 months old are exclusively breastfed and in Australia the prevalence is even lower. Using a Computer Assisted Telephone Interview (CATI), 1284 Western Australian adults aged 18-65 years not only answered questions relating to the dietary guidelines breastfeeding targets, but also identified their beliefs in relation to breastfeeding. The data were analysed using STATA 10 Survey Module which adjusts for sampling design and post survey weighting. As well as identifying perceived benefits, barriers and enablers of breastfeeding, data were explored for factors related to these, using Principal Component Analysis and Factor Analysis. Associates of beliefs and behaviour were explored using Poisson, Logistic and Multivariate Regression. While barriers and enablers grouped into factors, benefits did not. Overall there was a relatively poor knowledge of the benefits of breastfeeding even among women of child-bearing age and those currently living with a partner and children. Other statistically significant associations with lack of knowledge were being male, being young, not perceiving breastfeeding as important and having no knowledge of the recommended duration for breastfeeding. This type of information is essential in planning effective population interventions.

PP 054

FACTORS AFFECTING THE FREQUENCY AND PREFERENCE OF VEGETABLE AND FRUIT CONSUMPTION

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Objectives: Chronic diseases have become more common in Korea and present a challenging future for healthcare in Korea. This increase in chronic diseases both will overburden the healthcare system and ultimately prove to be costly to the public. It has been proven that vegetable and fruit intake has beneficial effects against chronic disease. The foundations of eating habits are formed in childhood and the vegetable consumption of Korean children is quite low. In turn, this study was conducted to investigate vegetable and fruit consumption and related factors of demographic characteristics and weight status. It also seeks to provide baseline data to set the direction of the nutrition intervention and develop programs to increase vegetable and fruit intake.

Methods: With a stratified cluster sampling (probability proportionate to size), 400 kindergarten students in the Seoul metropolitan areas were selected by residential district, type(public vs private) and the number of children. A total 3,096 parents of the 3 – 6years old children answered the questionnaire. The questionnaire data included demographic characteristics, frequency and preference of vegetable and fruit consumption, unbalanced diet, practices of 'dietary behavior guidelines', stage of change, supplement intake and height and weight.

Results: Average frequency of eating vegetables was 1.2times per day and eating fruits was 1.4times a day. Average preference of fruits (3.17) was higher than vegetables (4.25) and vegetable preference of girls was significantly higher than boys. Forty eight percent of children had disliked foods, mostly vegetables. The frequency and preference of vegetable and fruit consumption was significantly increased with household income and practice score of 'dietary behavior guidelines'. The frequency of fruit and vegetable positively correlated with preference score of child. Vegetable and fruit consumption of obese children were lower than those of non-obese or overweight children. Applying 'stage of behavior change model', 61% of the subjects belong to the 'Maintenance' group. Additionally, both of the frequency and preference of vegetables were higher than those of other stages in the behavior change model.

Conclusions: We need to develop special nutrition intervention programs to increase vegetable and fruit consumption of children of low-income households, as well as paying close attention to obese children. When developing future nutrition intervention programs, increasing preferences for vegetables and fruits should be considered because this preference was highly correlated with consumption of vegetable and fruit.

PP 055

ENERGY AND NUTRIENT INTAKES OF IRISH ADULTS: RESULTS FROM THE IRISH NATIONAL ADULT NUTRITION SURVEY (2008-2010)

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Introduction: Nationally representative food consumption surveys are important sources of data for use in analyses relating to both food safety and nutrition issues in population groups. The recent Irish National Adult Nutrition Survey (2008-1010) provides data on habitual food and nutrient intakes and dietary behaviour of adults living in the Republic of Ireland (www.iuna.net).

Objectives: To estimate energy and nutrient intakes in a representative sample of Irish adults

Methods: Food consumption data were collected for 1500 adults aged 18 years and over, using a 4-day semi weighed food record. Nutrient intakes were calculated using food composition tables (UK and Irish). A subset of the sample, (adults aged 18-64y; *n*1274) was used for this analysis. Salt intakes were estimated from spot urine samples, adjusted for 24-hour volumes.

Results: Mean daily energy intake was 8.6MJ (men: 10.1 MJ, women: 7.2MJ). Fat provided 37% of food energy, with 45% coming from carbohydrate and 18% from protein. Fat intakes exceeded the recommended upper limit of 35% food energy from fat in 63% of the population. Mean intake of dietary fibre was 19.2g/d and intakes were lower than the EFSA recommendation of 25g/d in 81% of the population. Mean salt intakes were 11.1g/d for men and 8.5g/d for women, higher than the recommended maximum of 6g/d. Mean intake of vitamin D was 4.6 µg for men and 3.9µg for women, well below the recommended intake of 10µg/d. Nutrient intakes were less than the estimated average requirement in a significant proportion of women for calcium (16%) and iron (48%).

Conclusions: When compared with dietary recommendations, fat and salt intakes were high and dietary fibre intakes were low. Calcium and iron intakes in women and vitamin D intakes in both men and women were found to be inadequate.

PP 056

TOTAL WATER INTAKES IN A NATIONALLY REPRESENTATIVE SAMPLE OF IRISH ADULTS – INTAKES AND SOURCES

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INTRODUCTION: Adequate hydration of the body is essential for life. Current recommendations in Ireland pertaining to fluid intake are “drink plenty of water” (FSAI, 2011). Adequate total water intakes (from drinking water, beverages of all kinds and food moisture) have been defined as 2.5 L/day for males and 2.0 L/day for females (EFSA, 2010).

OBJECTIVE: To examine total water intake and dietary sources in Irish adults aged 18-90y.

METHODOLOGY: A 4-day semi-weighted food record was used to collect dietary intake data from 1500 adults aged 18-90y (Irish National Adult Nutrition Survey, 2011, www.iuna.net). Equal emphasis was placed on recording of foods and of beverages. Diaries were checked for completeness, clarification of food/beverage descriptors and quantities and recording of the nature of milk/water consumption e.g. as a beverage, added to cordials, in cereal. Milk and water used in food preparation e.g. milk added to breakfast cereals, were considered to be consumed as foods. Analysis of intake data was carried out using food composition tables (McCance and Widdowson’s, *The Composition of Foods*, 6th Edition and *The Irish Food Composition Database*).

RESULTS: The mean (SD) daily total water intake (L/day) for Irish adults was 2.31 (0.92); males 2.52 (1.00), females 2.09 (0.79). In males intakes were 2.82 (1.13) in 18-35y olds, 2.44 (0.92) in 36-50y olds, 2.40 (0.77) in 51-64y olds and 2.07 (0.87) in 65-90y olds. In females intakes were 2.07 (0.80) in 18-35y olds, 2.16 (0.82) in 36-50y olds, 2.15 (0.77) in 51-64y olds and 1.97 (0.69) in 65-90y olds.

Drinking water contributed 18.4% of total water intake (tap water 13%, bottled water 5.4%). Other beverages contributed 49.0% of total water intake (teas 20.7%, alcoholic beverages 9.7%, coffees 5.6%, milks 5.1%, carbonated beverages 3.8%, fruit juices & smoothies 2.0%, cordials & fruit juice drinks 1.3%, other beverages & 1%). Food moisture contributed 32.6% of total water intake, with meat & meat dishes, breakfast cereals and vegetables & vegetable dishes contributing almost half of this.

CONCLUSION: Total water intakes in the Irish population are similar to adequate intakes proposed by the EFSA. Intakes were higher in men than in women and were lowest in elderly adults. 67% of water came from beverages and 33% came from food moisture. Teas contributed the most of any food or beverage group total water intake in the Irish diet.

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PP 057

ASSOCIATIONS BETWEEN INTAKES OF WATER AND ITS MAIN DIETARY SOURCES WITH DIETARY QUALITY IN IRISH ADULTS

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Background: Water is essential for life and optimal health requires adequate hydration. The main dietary contributors to total water intake are drinking water, water from beverages and water from foods. Recent studies from the US have reported associations between intake of total water and its main dietary sources with dietary quality in both children and adults.

Objective: The objective was to investigate associations between intakes of total water and its main dietary sources with dietary quality in Irish adults.

Methods: This analysis is based on data from the Irish National Adult Nutrition Survey (www.iuna.net). A 4-day semi-weighted food record was used to collect dietary intake data from 1500 adults aged 18-90y living in the Republic of Ireland. Nutrient intakes were estimated using food composition tables (UK & Irish). Daily intakes of total water, drinking water, water from beverages (including tea, coffee, milk consumed as a drink, alcoholic and non-alcoholic drinks) and water from foods were estimated and divided into thirds, stratified by age and gender into low, medium and high consumer groups of each. The markers of dietary quality selected were energy-adjusted intakes of fat, saturated fat, sodium and dietary fibre, and dietary energy density (food only, excluding all beverages).

Results: Higher intakes of total water and drinking water were associated with higher intakes of dietary fibre and lower intakes fat, saturated fat and sodium (total water only) and a lower dietary energy density. Higher intakes of water from beverages were associated with lower intakes of dietary fibre, fat, saturated fat and sodium and a higher dietary energy density. Higher intakes of water from food were associated with lower intakes of fat, saturated fat, higher intakes of dietary fibre and a lower dietary energy density.

Conclusions: In Irish adults, higher consumption of total water, drinking water and water from food is associated with generally better dietary quality. Higher intakes of water from beverages are associated with better dietary quality for fat, saturated fat and sodium but poorer dietary quality for dietary fibre and energy density. These findings may be explained by differences in dietary patterns associated with the level of water intake.

PP 058

A METHODOLOGY DEVELOPMENT FOR A WEB-BASED SURVEILLANCE SYSTEM OF ADOLESCENT FOOD HABITS AND LIFESTYLES – THE ASSO PROJECT

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ASSO Project (Adolescents Surveillance System and Obesity prevention) is a study financed by the Italian Ministry of Health, aimed at developing an innovative web-based system for a standardized collection of data on food consumptions, lifestyles and body size in the adolescents attending high schools. One of the main objectives of the project is to develop user-friendly and cost-effective tools to create a web-based software. A Systematic Literature Review (SLR) on the most valid dietary and physical activity/fitness assessment methods used in the target population has been performed. The implementation of the software is being done by using JAVA and the data archive system is based on MySQL database, and a website of the project is being built up (<http://www.assoproject.info>). The following tools were delivered: informative letter on the project and informed consent of the parents; Standard Operating Procedure (SOP); questionnaires and forms to be embedded within the software. In particular, the questionnaires for the collection of food habits and lifestyle data include an ASSO-PIQ (Personal Information Questionnaire), an ASSO-PASAQ (Physical Activity, Smoke and Alcohol Questionnaire) and an ASSO-FHQ (Food Habits Questionnaire). For the food consumption data collection, an ASSO-FFQ (Food Frequency Questionnaire) has been developed on the basis of a SLR on the different European valid and reproducible assessment methods. Even for the fitness measurement tests, a SLR has been carried out on the most valid techniques, in order to develop an ASSO-FTB (Fitness Tests Battery). The

teachers will report anthropometric measures (weight, height and waist circumference) and results of the fitness tests on an ASSO-WHFF (Weight, Height and Fitness Form). The delivered ASSO-toolkit will be agreed by the Italian National Research Institute on Food and Nutrition (INRAN), to support the project with a high scientific quality. The establishment of a well-defined surveillance system will help to better understand public health problems related to life habits of the adolescents. It can be an example of good practice delivering a web-based surveillance instrument that allows a cost-effective, timely, updatable and potentially permanent collection of data.

PP 059

DIETARY EXPOSURE TO NITRITE AND NITRATE AMONG FINNISH ADULTS AND CHILDREN V. Mikkilä¹, C. Bäckman¹, T. Putkonen¹, K. Peltonen¹, K. Kanninen¹, U. Luhtasela¹, H. Tapanainen², S. M. Virtanen², M. Knip³, R. Veijola⁴, J. Ilonen⁵, O. Simell⁵, K. Savela¹

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Nitrates (NO₃⁻) occur naturally in vegetables and can also pass through the soil to ground water. The contents of nitrates in vegetables vary geographically, and excessive and/or unbalanced consumption of leafy vegetables may boost intake of nitrates to exceed accepted levels. The detrimental effects of nitrates materialize when metabolising into nitrite (NO₂⁻) leading to methaemoglobinemia. Excessive exposure has also been associated with the risk of cancer. Nitrites, as such, are used as additives in meat products and cheeses to prevent the reproduction of harmful microbes, particularly *Clostridium botulinum*, preserve the red colour in meat and prevent the oxidation of lipids. This project was launched to assess the risk from the exposure to nitrates and nitrites from natural sources and via additives among Finnish adults and children. We assessed the contents of nitrates and nitrites in vegetables (natural sources) and meat products and cheeses (use of additives) commonly consumed. The exposure assessment is based on food consumption data from national surveys (adults) or representative samples from the Type1 Diabetes Prediction and Prevention (DIPP) -study (children), extensive recipe information and nitrate/nitrite levels measured in an accredited laboratory. A Monte Carlo method was used to simulate long-term intake distributions among different age groups. The preliminary results among children show that less than 1% exceeded the acceptable daily intake (ADI) levels (3.7mg/kg bw), with the greatest contribution from carrots, fresh herbs and lettuce. As for nitrite, the main sources of intake were sausages and marinated fresh meat, with approximately 5% of the children exceeding the ADI (0.06mg/kg bw). Analyses will be completed in January-March 2012. Data comprises some uncertainties. Firstly, there is a large variation in the nitrate/nitrite levels within the same type on vegetables which contributes substantially to local exposure. Secondly, the recipe information is based on the amount added to a particular food item which may or may not be the level of exposure. This is particularly true in sausages in which the level of nitrites declines during the storage time. Based on the preliminary findings, it is noteworthy that foods relatively low in nitrate or nitrite (e.g. carrots and marinated meat, respectively) may become unexpectedly major contributors because consumed in larger amounts than foods with higher concentrations. To lower the uncertainties a comprehensive food consumption assessment is essential to better characterize the extent of exposure in a particular population. Results will be utilised in recommendations of eating frequency for specific foods.

PP 060

WHAT, WHEN AND WHERE DO DUTCH CHILDREN AND ADULTS AGED 7-69 YEARS EAT AND DRINK? DUTCH NATIONAL FOOD CONSUMPTION SURVEY 2007-2010

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Background and aim: To stimulate healthier dietary patterns, insight in current food consumption is necessary, not only in terms of quantities, but also in terms of when and where foods are consumed. This study aims to assess consumption of the main dietary components by time and place of consumption and differences in it between age-gender groups.

Methods: In 2007-2010 a Dutch national food consumption survey among 3819 children and adults aged 7-69 years was conducted. Two non-consecutive 24-hour dietary recalls with the software EPIC-Soft ® were collected by dietitians. With this method detailed information on time and place of consumption was gathered.

Energy and nutrient intake were calculated using the Dutch Food Composition Database (NEVO 2011). This survey established that consumption of fruit, vegetables, fish and dietary fibre was too low and the intake of saturated fatty acids too high. High prevalence of overweight indicated an imbalance between energy intake and expenditure. Analyses according to time and place of consumption were restricted to these food groups and (main sources) of these nutrients.

Results: The main meals (breakfast, lunch and dinner) provided 70-78% of the intake of energy, saturated fatty acids, and dietary fibre. Dinner was the most important food consumption occasion for these nutrients (36-38%) and also for the consumption of potatoes (95%), vegetables (89%), meat (products) (73%), fish (59%) and fat (44%). Fruits were predominantly consumed between meals (54%).

Lunch contributed most to the consumption of cereal(product)s (37%). No large differences (>5%) were observed between age-gender groups in the contribution of times of consumption to energy and nutrient intake, whereas the contribution to some food groups differed.

Overall 71-72% of intake of energy, saturated fatty acids and dietary fibre took place at home. All food groups were predominantly eaten at home, potatoes and vegetables for even more than 80%. Fruits and fish were relatively often consumed away from home (34-37%). Place of consumption differed among age-gender groups.

Conclusions and recommendations: Most of the foods and energy and nutrients are consumed during the main meals and at home. This differed slightly between different age-groups. For improving dietary quality the consumption of basic foods like fruit, vegetables, fish, potatoes, cereal(product)s, dairy products and fats low in saturated fat should be stimulated. Both changes in food supply and changing consumer behavior can contribute. Insight in consumption by time and place of consumption can be used in nutritional education tailored to specific age groups.

PP 061

THE DEGREE OF DIFFICULTY IN SURVEY OF FOOD FREQUENCY QUESTIONNAIRE DEPENDS ON AGE IN A PILOT TEST OF KNHANES

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This study was conducted to evaluate the feasibility of semiquantitative food frequency questionnaire (SFFQ) for Korea Health and Nutrition Examination Survey (KNHANES). The nutrition survey of KNHANES is including 3 kind of questionnaire, which are for dietary behavior, the consumption of food for 1-day (24 hour recall method), and food frequency. The food frequency questionnaire (FFQ) using from 2005 has 63 food items, which has evaluated only frequency. To elevate practical use of FFQ for nutritional epidemiology, the SFFQ was developed and evaluated by validation test. This SFFQ was composed in 109 dish based items, which were selected by considering the contribution and variation of nutrient intakes and proportion of consumer from KNHANES 4th (2007-2009) microdata. The number of subjects was 133 (+19 years, males 56, females 77) from 5 regions (4 urban areas and 1 rural area), and they had also participated in KNHANES. The interviewers of KNHANES visited to home of sample persons, and interviewed the SFFQ after the nutrition survey of KNHANES. The frequencies of dairy products, bread and rice cakes, and dishes including meats, poultry, eggs, and legumes were higher in relative young groups, while there was no difference in groups of rice, noodles, and alcoholic beverages. The mean time required survey was 30.2 minutes per person, and there was significant different between the time of 19~29 years (25.2 minutes) and that of the elderly (+65 years, 33.2 minutes). The burden of interview was also higher in the group of the elderly than younger ages, and the index of recognition was lower in the group of the elderly. The burden of interview and the index of recognition were valued by interviewers in 5 and 3 degrees respectively. Conclusively, there were differences in not only results of food frequency but also burden of survey between age groups. In KNHANES from 2012, SFFQ could be included for adults from 19 to 64 years old.

PP 062

VALIDITY OF TWO SHORT INSTRUMENTS TO ASSESS VEGETABLE INTAKE, BOTH INCLUDING AND EXCLUDING POTATOES, IN ADULTS

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This paper assesses the relative validity of 3-item (VEG3) and 5-item (VEG5) instruments, to assess group mean vegetable intake both including and excluding potatoes, in comparison to vegetable intake measured by seven day estimated records (7DDR). VEG3 included two questions on daily average non-fried potato intake (one question on frequency and the other a serve size photo choice) and a summary question on vegetable intake (excluding potato). VEG5 had the two non-fried potato questions added to three separate questions (developed by Ling et al. (1)) on the intake of vegetable soups, salads and cooked vegetables (excluding potato). To assess vegetable intake excluding potato using the short instruments the two questions related to non-fried potato intake were removed.

Sixty four Australian adult volunteers aged between 30 and 69 y, mean age \pm SD 55.7 \pm 9.6 y (30 males, mean age \pm SD 56.3 \pm 9.2 y and 34 female mean age \pm SD 55.3 \pm 10.0 y), were recruited by community announcement. Subjects completed VEG3 and VEG5 questions, as part of a longer 63-item FFQ (2), as well as the 7DDR. Food group data for the 7DDR was determined through coding of exported food lists from (FoodWorks Version 3.0 (Xyris software, Brisbane, QLD, utilising the NUTTAB98 database)). The ability of VEG3 and VEG5 to estimate group means was investigated using paired t-tests.

<i>Vegetable measures including potato (non-fried)</i>		<i>Vegetable measures excluding potato</i>	
All (n=64) 7DDR	Vegetable serves/d ¹ 3.6 ± 1.6 (3.2,4.0)	All (n=64) 7DDR	Vegetable serves/d ¹ 3.0 ± 1.5 (2.7,3.4)
VEG3	2.9 ± 1.3* (2.6,3.3)	VEG3-NOpotato	2.5 ± 1.1* (2.2,2.7)
VEG5	3.3 ± 1.5 (3.0,3.7)	VEG5-NOpotato	2.8 ± 1.3 (2.5,3.2)

¹mean ± SD (95% CI); *P<0.001 in comparison to 7DDR mean

Group mean servings of vegetables measured by VEG5 did not differ from that measured by the 7DDR. In contrast VEG3 was found to significantly underestimate vegetable intake when compared to 7DDR measures. Both of these results were found irrespective of the inclusion or exclusion of non-fried potato. These results indicate that VEG5 has characteristics useful for population-level monitoring independent of whether potato is included or excluded in its measurement.

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PP 063

DIET ASSESSMENT IN THE NUTRIGENOMICS ERA

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Background: Nutrient – gene interactions are responsible for maintaining health and preventing or delaying disease. In this context, we are dealing with two complex phenomena to integrate each other: nutrients intake assessment requires a complex measurement system to integrate with the genetic dimension. Suitable methodologies for nutrients intake estimate have to deal with two general questions. A first problem in diet assessment is related to impossibility of having a direct measurement of nutrients intake. A large set of survey methodologies has then been developed, varying for precision and acceptability to participants. These two factors are generally inversely related (the higher is the precision, the greater is the burden for the investigated subjects, therefore the lower is its acceptability). Actual and habitual intake are currently investigated using several different methods, here briefly illustrated to provide elements for methodological choice and study plan design.

Principle of nutrigenomics research suggest to investigate how to integrate topics in comprehensive population studies. Each principle leads to a multi-facet research theme, making challenging to study the interplay between diet and the activity of an individual's gene. Introducing diet assessment in omics studies concerning gene-nutrients interactions appeared as a primary issue.

Aim: The present work is aimed to outline a general framework where diet assessment study is functional to gene-nutrients interaction analysis.

Methodology: Revising the available methods in the light of nutrigenomics approach in population studies to identify new variables and new methods to integrate in the current population study protocols.

Results: A general stepwise approach has been defined to study the influence of environmental factors on gene expression: mapping, analysing, deepening the analysis, generalising the analysis (modelling), then implementing new survey methods. Variables to add for analysing the interaction gene-nutrition imply to integrate the analyses of specific biomarkers in the protocol of individual dietary surveys.

Factors increasing the variability must be taken into account when analysing food and food components intakes especially concerning bioavailability.

Future topics: Future research could be aimed at investigating whether new questions make sense or not. Does genes expression influence food choice? If so, in which way? In other terms, could the studies perspective be widened, including the genetic set effect on food choice (items, preparation methods, eating patterns and so on)? Are these studies suitable to estimate aspects defining a sustainable diet?

Acknowledgment: Study performed within the PALINGENIO project supported by the Italian Ministry of Agricultural, Food, and Forestry Policy

Keywords: diet assessment, dietary survey, population study, gene-nutrition interaction, nutrigenomics

PP 064**ASSIGNING A DAILY MAXIMUM FOR BREAST MILK INTAKE IN SURVEYS OF INFANTS AND YOUNG CHILDREN.**

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Assessing the contribution of breast milk to the dietary intake of infants in large studies and surveys is difficult. Various methods are used, such as assigning specific volumes for different ages of infant, or using an algorithm based on duration of each feeding occasion. Where resources allow, test weighing of infant or mother and infant before and after each feed can be carried out. One of the difficulties encountered is that infants are often put to or kept at the breast for comfort rather than real feeding, potentially resulting in overestimates of intake if based on duration estimates. In the UK, the Diet and Nutrition Survey of Infants and Young Children (DNSIYC) is currently being carried out on a nationally representative sample of infants aged 4 months up to 18 months, with diet assessed using a 4 day estimated diary. The method for breast milk intake is that from a previous national survey of infants, where duration of feeding was noted and a volume of 13.5g per minute applied for ages up to 8 months and 10 g per minute for 8 months upwards, to a maximum of 10 minutes for each feeding occasion.

Examination of the final dietary data for breast milk intakes in DNSIYC revealed some total daily weights higher than would be expected, even with the feeding maximums applied. This appeared to be largely due to frequent feeding occasions. An examination of the previous literature was therefore conducted to determine the maximum breast milk intake seen in earlier studies.

Studies using fixed volumes, methods similar to those used in DNSIYC, studies of infant weighing and studies using the dose-to-mother method using stable isotopes were all examined.

In no studies in western countries was a volume over 1200 ml per day seen for the age groups studied in DNSIYC, and only on rare occasions in those studies from developing countries, although higher daily volumes were seen in younger infants.

On the basis of past literature for breast milk volumes determined using a variety of methods, the decision was made to apply a maximum daily breast milk intake of 1200g for the DNSIYC survey. Other researchers conducting surveys of infants and young children may be unaware of the potential for overestimating breast milk intake by recording the duration of each feed, and care should be taken to examine daily maximums before finalising dietary intake data.

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PP 065**PROGRESS WITH A GLOBAL BRANDED FOOD COMPOSITION DATABASE**

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Excess energy, saturated fat, sugar and salt derived from processed foods and fast foods are a major cause of chronic disease worldwide. In 2010 The Food Monitoring Group established a global branded food composition database to track the nutritional content of foods and make comparisons between countries, food companies and over time. A protocol for the project was agreed and published in September 2011 and there are currently 24 collaborating countries. Standardised data collection tools and a website have been developed to facilitate data collection and data entry. In 2010 data were obtained from nine countries, in 2011 from 12 countries and in 2012 data are anticipated from 10 countries. The project has benefited from support from the World Health Organisation and national agencies in four participating countries. This collaborative approach to the collation and sharing of food composition data has engendered considerable enthusiasm from investigators in a range of developed and developing countries. The project should contribute significantly to tracking the progress of the food industry and governments towards broad commitments made at the recent United Nations high level meeting on chronic disease.

PP 066**PROGRESS WITH A GLOBAL BRANDED FOOD COMPOSITION DATABASE**

The Food Monitoring Group¹

¹Food Policy

Excess energy intake, saturated fat, sugar and salt derived from processed foods and fast foods are a major cause of chronic disease worldwide. The Food Monitoring Group was established in 2010 and has established a global branded

food composition database to track the nutritional content of processed foods and make comparisons between countries, between food companies and over time. The rationale behind the initiative is that ongoing systematic monitoring and reporting of product formulation worldwide will unequivocally document the changes that are occurring within the global food supply. Using this information it will be possible to more effectively direct resources to places of need and better identify the most appropriate strategies for improvement. A protocol describing the project has now been published and there are currently 22 collaborating countries with more anticipated to follow. Standardised data collection tools and a website have been developed to facilitate data collection. In 2010 nutrition composition data were obtained from four countries, in 2011 from nine countries and in 2012 data are anticipated from at least 10 countries. The project has benefited from support from the WHO and national agencies of 4 participating countries. The use of standardised methodology in conjunction with a collaborative approach to the collation and sharing of data will enable low-cost tracking of processed food composition around the world. It will then be possible to more identify countries and companies that do and do not achieve improvements in food composition and learn from them. If examples of best practice can be highlighted it will be possible to more efficiently provide support and advice to those that are not making the improvements. Chronic disease and the quality of the food supply are global problems and programs of work that cross international boundaries will offer opportunities that national initiatives cannot. This project represents a major step forward in the objective and transparent monitoring of industry and government commitments to improve the food supply.

PP 067

BUILDING THE CASE FOR INDEPENDENT MONITORING OF FOOD ADVERTISING ON AUSTRALIAN TELEVISION

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Background: Despite vigorous international debates about the adequacy of current food industry initiatives for self-regulation of food marketing to children, there are no established systems for monitoring food marketing and evaluating regulatory responses.

Objective: To provide an independent monitoring report examining the ongoing impact of Australian self-regulatory pledges on food and drink advertising to children on commercial television, in order to guide policy development.

Methods: The study analysed food advertisements across comparable sample time periods in April/May 2006, 2007, 2009, 2010 and 2011 on Sydney free-to-air television channels. The main outcome measures were changes in the mean rates of advertisements for core and non-core foods, from 2006 to 2011.

Results: In 2011 the rate of non-core food advertisements was not significantly different to 2006 or 2010 (3.2/hr vs. 4.1/hr and 3.1/hr), although there were variations across the intervening years. The rate of fast food advertising in 2011 was significantly higher than in 2006 (1.5/hr vs. 0.9/hr, $p < 0.001$), but the same as that in 2010 (1.5/hr). In 2011 the mean rate of core food advertisements was significantly lower than in 2006 (1.2/hr vs. 2.2/hr, $p < 0.001$).

Conclusions: The frequency of non-core food advertising on television has remained essentially unchanged between 2006 and 2011, despite the implementation of two industry self-regulatory pledges. This study illustrates the value of independent monitoring, as a basic requirement of any responsive regulatory approach, and necessary to support compliance, review and public accountability. This is particularly the case in the absence of any formal, national, independent monitoring, and in the context of the inconsistencies in industries' own reporting. Without a monitoring and review system, there is no formal means of determining if and when more stringent regulatory approaches would be required.

PP 068

THE WHAT, HOW, WHERE AND WHEN OF FOOD MARKETING TO CHILDREN: A MONITORING FRAMEWORK

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Background: Measuring and monitoring the extent and nature of food marketing that children are exposed to is a key step in implementing World Health Organization (WHO) recommendations for restricting food marketing to children.

Objective: To develop a compendium of measures for independent monitoring of the extent and nature of children's exposure to food and drink advertising, which may be used to guide policy development and assess the impact of regulation and initiatives.

Methods: We identified the major channels for food marketing to children and sourced relevant data within each channel. Data were analysed in terms of the nutritional quality of advertised food products; children's estimated exposure to food and drink advertising for different time periods, sites or locations; and the extent and nature of persuasive marketing techniques used.

Results: The main channels for marketing food to children identified were: television broadcasting, popular children's websites and magazines, and locations such as around schools and at community sport. Exposure to food and drink advertising was estimated by calculating mean frequency of different types of food advertisements (e.g., advertisements for energy-dense, nutrient poor foods). The protocols demonstrated high prevalence of unhealthy food marketing across different media, with the majority of identified food advertising being for energy-dense, nutrient-poor foods. Further, when applied to examining advertising patterns over time, the protocols have shown that food industry self-regulatory pledges have not reduced children's exposure to unhealthy food advertising. Persuasive marketing techniques, particularly cartoon characters, are widely used to promote unhealthy foods to children.

Conclusions: Specifications based on the scheduling and placement of advertisements of unhealthy foods provide simple and objective benchmarks for monitoring the implementation of policy limiting food marketing to children. By contrast, approaches that involve examining the content of advertisements to determine if they are specifically designed to appeal to children are more subjective, and would be difficult to apply as part of routine monitoring. A limitation of the proposed approach is that it is time consuming and labour-intensive. However, strengths include the ability to provide independent and accurate descriptions of advertising patterns and, flexible protocols that can be applied on a small or large scale. This body of research provides practical guidance about measures and methods to monitor the implementation of WHO recommendations for restricting food marketing to children.

PP 069

GLOBAL REPORT CARD ON THE PHYSICAL ACTIVITY OF CHILDREN AND YOUTH: A MODEL FOR INTERNATIONAL HARMONIZATION, COMPARISON AND MONITORING

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Active Healthy Kids Canada is a national organization committed to “powering the movement to get kids moving” in Canada. For the past seven years Active Healthy Kids Canada has published *Canada's Report Card on Physical Activity for Children and Youth*; a high profile, public disclosure of the best available evidence of the “state of the nation”. The 2011 report card provided evidence-informed grades for 23 “indicators” across the following categories: physical activity, sedentary behaviour, school, family and peers, community and the built environment, and policy. The report card serves as an accountability index for all Canadians, a surveillance mechanism, an advocacy tool for physical activity leaders and organizations, a policy driver, a process for identifying research and surveillance needs and a foundation to coordinate and motivate efforts to “improve the grade”.

The Active Healthy Kids Canada Report Card model has been replicated in the United States (Louisiana – past 4 years), South Africa (twice), Kenya, Mexico and in several sub-jurisdictions within Canada (provinces of Ontario, Saskatchewan and City of Toronto) in each instance generating significant attention and impact.

In their 2011-2014 strategic plan Active Healthy Kids Canada committed to celebrating the 20th anniversary of the organization and the 10th annual report card by planning and hosting a *Global Report Card Summit* in the form of an international congress for researchers, practitioners and policy workers. A process is being established to create a core set of indicators to be used by several countries to prepare national report cards for release throughout the 3-4 day congress. The congress will have content streams for each of the harmonized indicators to be included in each country's report card. These streams will provide oral and poster presentations, symposia and workshops in the designated content area (for example active transportation, physical education, sedentary behaviour) for those attending the congress. Throughout the congress, in a coordinated fashion, countries will “launch” their report card and the organizing committee will collate the collective results into an international report card matrix to be presented and discussed at the close of the congress.

It is hoped that this global report card initiative will allow countries to learn from one another and facilitate international comparisons and cross-fertilization; draw other countries into the process; encourage international measurement harmonization; be repeated periodically to monitor progress; challenge and motivate countries to “improve their grades”; and draw further attention and resources to the global crisis of childhood inactivity.

PP 070

IS THE DRI ASSESSMENT METHODOLOGY APPLIED CORRECTLY? EVALUATION OF DATA ON CHILD AND ADOLESCENT DIETARY INTAKE PUBLISHED BETWEEN 2005 AND 2011.

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Introduction. The publication in 2000 of the IOM/DRI book on assessment of dietary intake provided the basis for their use and application to assess intake. The objective of this review was to evaluate the application of the DRI methodology on dietary assessment of children and adolescents in articles published between January 2005 and November 2011. **Methodology.** A search was conducted in PubMed, Scielo, and Lilacs databases using the key words:

“assessment”, “food intake”, “dietary intake” “nutrients”, “micronutrients” and limits: “humans”, “all Child: 0-18 years”. Inclusion criteria were: quantitative nutrient assessment, inclusion of healthy groups of children and adolescents and use of DRI parameters for dietary analysis. The search strategy retrieved 142 publications, and 52 met the inclusion criteria. Included articles were classified according to the correct or incorrect use of the DRI methodology to describe and analyze dietary data; they were stratified according to publication year, impact factor and country of the journal. Correct application was considered when intra-individual variation correction was applied; the EAR, AI and UL were used to assess intake and 24h recalls or records were used on two or more non-consecutive days. Results. The majority of published articles (67%) were applying the DRI methodology incorrectly. The increase in the number of papers published (6 in 2005/6; 15 in 2007/8; 31 in 2009/11) was not accompanied by an increase in applying the correct methodology, which remained at 33% throughout the period. Thirty-one journals (60%) had impact factor, but the majority (n=20) applied the DRI methodology erroneously. Higher impact factor journals were not a guarantee of correct application. Journals with impact factor from 3 to 7 presented 5 articles classified as correct use and 2 articles classified as incorrect use of the methodology. Journals from Brazil and the US predominated, with 38% and 30% of the articles included in the review, but the percentage of articles classified as incorrect use of the methodology predominated (60%). This overview highlights the need for a careful examination of the methodology as the results can be biased. Lack of intra-individual variance correction causes overestimation of the prevalence of nutrient. Meaningful evaluations are obtained with the use of the wrong reference value. Conclusion. The question proposed received a negative answer, as the vast majority of articles used the DRI methodology incorrectly. Strategies to help the scientific community correctly use and apply the DRI methodology to assess dietary intake are needed.

PP 071

A NEW APPROACH TO ESTIMATE SAFE MAXIMUM FORTIFICATION LEVELS FOR MICRONUTRIENTS

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Introduction: As micronutrient fortification becomes more common, enforcing maximum fortification levels and/or preserving fortification to specific food groups is required to guard against risk of excessive intake. New legislation will harmonize the addition of vitamins and minerals to foods across the EU; however, minimum and maximum levels are still under debate. Previous methods of estimating safe maximum levels have taken a conservative approach by considering a single point in the intake distributions of the components of diet and have not accounted for potential interrelationships between these components. Such methods may result in unrealistic estimates, as was suggested in a Dutch evaluation study.

Objective: We propose a new paradigm for setting safe maximum fortification levels by extending recent developments in joint modeling of habitual nutrient intake distributions.

Methods: We build upon previous work based upon the estimation of i) a measure of the amount of the food supply that is potentially fortifiable with a micronutrient (i.e., the ‘fortifiable pool’), and ii) a ‘free space’ available for additional intake of that micronutrient from voluntarily fortified sources. Many foods are potentially amenable to fortification but it is not possible to enumerate them a priori. As a proxy for the fortifiable pool, we adopt the common practice of estimating the fraction of energy provided by potentially fortifiable foods, taking into account factors such as feasibility. The free space has traditionally been estimated as the difference between a tolerable upper intake level and an observed high value (e.g., the 95th percentile) from the population distribution of habitual intake of the micronutrient, sometimes accounting for the substantial contribution of supplemental sources. Using a single extreme value from each of the distributions involved results in a single conservative estimate of a safe maximum fortification level intended to reduce the risk of adverse effects among the entire population. We apply a probabilistic approach that provides a distribution of safe maximum fortification levels from which an appropriate level can be chosen. In addition, we jointly model the energy from the fortifiable pool, nutrient intake from food sources and, if applicable, supplemental sources, which allows these components to be correlated.

Results and conclusion: The proposed approach is expected to result in more realistic estimates of safe maximum levels and allow a risk manager to select an appropriate maximum fortification level, dependent upon the potential benefits to be achieved by increased intake and the risks associated with excessive intake.

PP 072**REACH: MONITORING AND EVALUATING THE COUNTRY LED PROCESSES OF UN COORDINATED, MULTI-SECTORAL APPROACHES TO SCALING NUTRITION**J. Fanzo¹, B. Ljungqvist¹, N. Chahid¹, A. Perez Zaldivar¹¹EDD/World Food Programme

The REACH Partnership is a United Nations interagency initiative between FAO, UNICEF, WFP and WHO to address the fundamental challenge of coordinated *national* nutrition management for successful scaling-up of nutrition interventions. REACH supports 12 countries in South Asia and sub-Saharan Africa to define and prioritize their nutrition-related capacity needs and tailor a roadmap of nutrition-supported activities and tools to strengthen specific capacities. These capacities include policy and action planning, multi-sectoral coordination and management, monitoring and evaluation, advocacy, resource mobilization and effective programme implementation. One of the key objectives of the REACH program is to create a monitoring and evaluation (M&E) framework to measure country progress that government counterparts can manage on their own. The REACH M&E system defines a set of indicators and a process for measuring the effectiveness and impact of improved capacities for multi-sectoral nutrition coordination and management to reduce undernutrition. The framework contains elements of nutrition governance and management with the double objective of measuring both progress and effectiveness in-country as well as comparing advancement between different countries participating in the REACH process. The framework outlines the relationship and distinction between the nutrition intervention M&E components utilized by the REACH partner agencies and other implementing partners and those components which relates to nutrition management. Whereas the M&E of nutrition carried out by implementing partners is geared toward programme implementation of direct and sensitive nutrition interventions and linked to nutritional impact, the REACH M&E system will focus on measuring the REACH process and outcomes with respect to nutrition governance and management, and link these components to nutritional impact. The major outcomes of the REACH model are to:

- (1) Increased awareness and consensus of stakeholders of the nutrition situation and the best strategies and priorities for improvement
- (2) Strengthened national policies and programmes that operationalize and address nutrition through a multi-sectoral approach
- (3) Increased human and institutional capacity on nutrition security actions at all levels
- (4) Increased effectiveness, coordination and accountability of stakeholders in implementing at scale and supporting nutrition actions

Building on what has been established by other technical experts and partners, including the WHO-led Landscape Analysis of countries commitment and readiness to scale up nutrition, the framework has the potential to assist all countries and their respective governments working to improve nutrition. Moreover, it will help identify a set of benchmarks at the global level for improving multi-sectoral nutrition governance and management. One of the first REACH countries to undertake an evaluation of the REACH process utilizing the M&E framework was Mauritania in early 2011, after two years of implementation in-country. This abstract summarizes the findings of the process in Mauritania, and the early lessons learned of the M&E framework to assess nutrition governance.

PP 073**TRIPLE FORTIFICATION OF SALT WITH IODINE, VITAMIN A AND ENCAPSULATED IRON COMPOUNDS: STABILITY AND BIOAVAILABILITY** E. Milani¹, A. Koocheki², M. Hasanabadi^{2,1} Department of Food Processing, Iranian Academic Center for Education Culture and Research (ACECR), ²Department of Food Science and Technology, Ferdowsi University of Mashhad (FUM)

Iron, vitamin A and the iodine deficiency disorders affect 30% of the global population. These deficiencies often coexist in children in developing countries. Salt is one of the few regularly purchased food items and could be a good fortification vehicle for iodine and iron, provided that a stable yet bioavailable iron fortificant is used. Triple fortification of salt could be highly effective because of the beneficial interactions of iron, iodine, and vitamin A in metabolism. However, ensuring the bioavailability of iron and the stability of iodine and vitamin A in fortified salt is difficult. Water-soluble, highly bioavailable iron compounds react with moisture and impurities in salt, which causes color changes and iodine losses. To minimize this interaction and increase the stability of iodine and vitamin A, microencapsulation system was developed. In this study salt was fortified with iodine, vitamin A and iron compounds (encapsulated compared to non encapsulated ferros sulfate) and Color, iron and vitamin contents were measured after storage for 1, 2, 4 month at two different moisture contents (100 and 40%). Results showed that, all encapsulated samples were more stable than the unencapsulated samples. Encapsulation of ferros sulfate increases its stability in salt, iodine stability in salt significantly increased when coated iron was used. Color stability was acceptable when the compounds were added to local meals. Salt containing iodine, vitamin A and encapsulated iron can be an effective fortification strategy.

PP 074**IS MINIMUM ACCEPTABLE DIET ASSOCIATED WITH CHILD GROWTH? M&E IMPLICATIONS FOR A GLOBAL AGRICULTURE AND NUTRITION INITIATIVE**R. Heidkamp¹, A. Zongrone¹, R. Stoltzfus¹, P. Menon²¹Cornell University Division of Nutritional Sciences, ²International Food Policy Research Institute

BACKGROUND: Launched in 2010, the US Government's Feed the Future (FTF) initiative aims to reduce the prevalence of childhood undernutrition in 20 countries by investing in agriculture and nutrition interventions. According to the FTF results framework, improved access to quality diets will contribute to reductions in childhood stunting and wasting. FTF has adopted the WHO 2008 Minimum Acceptable Diet (MAD) indicator to measure access to diverse and quality foods among children. MAD is a summary indicator that identifies children 6-23 months of age who meet both minimum dietary diversity and minimum meal frequency measures based on their current breastfeeding status. While various other measures of dietary diversity and food intake are associated with growth, the relationship between MAD and population-level growth outcomes has not been well described. We examined the relationship between MAD and anthropometric outcomes in nationally-representative data from two FTF target countries, Haiti and Bangladesh.

METHODS: We compared data from household-level Demographic Health Surveys in Haiti (HDHS 2005-6) and Bangladesh (BDHS 2007). Last-born breastfed children age 6-23 month with available anthropometric and IYCF data were included in analyses. Logistic regression was used to determine the association between MAD and prevalence of stunting (LAZ<-2 SD) or wasting (WLZ<-2 SD) in each country sample. Multiple linear regression was used to determine the association between MAD and weight-for-length (LAZ) or weight-for-length (WLZ). Complex survey designs were used given the hierarchical sampling design. All models controlled for child, maternal and household characteristics.

RESULTS: The proportion of currently breastfed children 6-23 months of age meeting MAD indicator was 15.6% in the HDHS (n=592) and 42.7% in the BDHS (n=1436). MAD was not associated with prevalence of stunting or wasting in either survey. MAD was not associated with LAZ or WLZ in the HDHS. However, in the BDHS, predicted LAZ was higher by 0.19 when MAD was achieved (p=0.024).

CONCLUSION: While results from Bangladesh suggest an association between MAD and linear growth, there was no relationship between MAD and the FTF-targeted outcomes of stunting and wasting in these nationally-representative datasets. Further investigation is needed to assess whether MAD is a useful indicator to evaluate the program pathway between improved diet quality and improved nutritional status under the FTF initiative.

PP 075**VALIDATION OF A FFQ TO ESTIMATE N-3, N-6 AND TRANS FATTY ACIDS INTAKE DURING PREGNANCY USING MATURE BREAST MILK AND FOOD RECALLS.**D. Sartorelli¹, R. Nishimura², G. Castro³, P. Barbieri², A. Jordao⁴¹Social Medicine, School of Medicine of Ribeirao Preto (FMRP), University of Sao Paulo (USP), ²Social Medicine, FMRP, USP, ³Internal Medicine, FMRP, USP, ⁴Internal Medicine, FMRP, USP, aulo

Introduction: Dietary fatty acids are of extreme relevance for the child development both before and after birth. The lipid fraction in human milk is related to the maternal dietary intake during pregnancy. However, the best approach to estimate fatty acids intake during pregnancy remains to be elucidated. **Objective:** to evaluate the ability of a food frequency questionnaire (FFQ), designed for Brazilian pregnant women, to estimate ω -3, ω -6, and trans fatty acids intake during pregnancy. Moreover, we evaluated if the fatty acids composition of mature breast milk could be applied as a valuable biomarker for ω -3, ω -6, and trans fatty acids intake during pregnancy. **Methods:** Prospective study conducted among 41 pregnant women, aged 18-35 years. Food intake during pregnancy was evaluated by 3 24-hour recalls (24hR), one in each trimester of pregnancy, and 2 FFQ. The 85 food items FFQ included questions about the frequency of intake and portion sizes during two periods: the first 24 weeks of pregnancy and throughout the whole period of pregnancy. The mean energy and nutrient intake estimated by 24hR and FFQ was considered. All dietary variables were natural-log transformed. Samples of mature breast milk were obtained at 5 to 10 weeks postpartum by manually expression after the infant had suckled the breast at the first time on the morning. The samples were frozen at -70°C until analyzed. The breast milk content of ω -3 and ω -6 and trans fatty acids was determined by gas chromatograph. The method of triads was used to calculate validity coefficients for the tested methods. Pearson partial correlations were adjusted by maternal age and post-partum BMI. The agreement between the methods was examined by joint classification between quartiles of intake and breast milk composition of fatty acids. **Results:** High adjusted partial correlation coefficients between 24hR and FFQ were found for total ω -3 (r= 0.48), linolenic (r= 0.50), and docosahexanoic acids (r= 0.65), total ω -6 (r= 0.62), linoleic acid (r= 0.63), and trans fatty acids (r= 0.43). Negative partial correlations between breast milk content and the percentage of fat from eicosapentanoic and trans fatty acids estimated by the FFQ were found. Negative correlation between breast milk composition and percentage of linolenic, total ω -3, linoleic, and total ω -6 fatty acids estimated by the food recalls were found. The highest validity coefficient was obtained for the docosahexanoic acid assessed by the FFQ (r= 0.77) and 24-hR (r= 0.77). Lower validity coefficients for arachidonic acid assessed by FFQ (r= 0.25) and 24-hR (r= 0.12) were found. Validity coefficients for docosahexanoic and arachidonic acids assessed by the biomarker were 0.39 and 0.40, respectively. The average agreement into the same

or adjacent quartile between the three methods was around 66%. The average extreme disagreements between breast milk composition and dietary methods was of 14% for the FFQ and 11% for 24-hR. Conclusion: The FFQ is an accurate tool for estimating ω -3, ω -6, and trans fatty acids during pregnancy when compared with 24-hR. The composition of mature breast milk is a reasonable biomarker for docosahexanoic and arachidonic fatty acids intake during pregnancy. Funding: Fapesp and FAEPA.

PP 076

TEST-RETEST RELIABILITY OF A FOOD FREQUENCY QUESTIONNAIRE FOR USE IN NEW ZEALAND ADULTS

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Background: Food frequency questionnaires (FFQs) are a relatively simple, cost-effective method of assessing diet in population-based studies. However, there are no up-to-date, validated multi-nutrient FFQs available for use in New Zealand (NZ) adults. A recent semi-quantitative 143-item FFQ has been developed to assess diet over the past year. The FOOD study was designed to assess both test-retest reliability and relative validity of this FFQ.

Objective: To evaluate the test-retest reliability of a multi-nutrient FFQ for use in NZ adults.

Design: This FFQ was tested in 135 adults aged 30-59 years. The FFQ was administered on two occasions 9 months apart (i.e. FFQ-1 and FFQ-2). Test-retest reproducibility of the FFQ was assessed using intra-class correlations (ICCs) for 37 nutrients.

Outcomes: The mean energy intake of the FFQ-1 and the FFQ-2 was 9.8MJ and 9.5MJ respectively. ICCs for energy and all nutrients ranged from 0.44 for retinol to 0.82 for alcohol. Relatively high reliability was observed for beta-carotene (ICC = 0.64), vitamin C (ICC = 0.72), vitamin E (ICC = 0.64), and folate (ICC = 0.72).

Conclusion: Our newly developed FFQ provides good reproducible estimates of energy and nutrient intake in New Zealand adults. A single administration of the FFQ is sufficient to provide reliable measures of most nutrients.

PP 077

IODINE AND ANTHROPOMETRIC STATUS OF PRIMARY SCHOOL CHILDREN IN A RURAL NIGERIAN COMMUNITY, OBUKPA

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This study was designed to assess the iodine and the anthropometric status of primary school children in a rural Nigerian community (Obukpa). The study was longitudinal lasting from March 2004 to February 2005. A multistage random sampling technique was used in selecting the respondents for the study. First, three out of seven primary schools in the community were randomly selected. In the second stage the schools' registers were used and stratified systemic random sampling was done. The sample size was three hundred and thirty children aged 6-13+ years. The anthropometric measurements of the children composing of 170 boys and 160 girls were obtained to assess the nutritional status using standard procedures. And the causal urine of a sub-sample of 33 children was subjected to laboratory analysis for iodine using "method H". Data generated from this study were analyzed using SPSS version 12, with frequency distribution, percentages, means, standard deviation, student t-test, analysis of variance and correlation coefficient (r) values. Anthropometric measurements of the children revealed that 25% were stunted, 13% were underweight while 6.3% were wasted. More (3.0%) girls than (2.3%) boys were wasted, 13.7% boys were stunted than 11.3% girls, while 6.7% boys were underweight than 6.3% girls with no significant difference ($P > 0.05$). Underweight children correlated positively with stunted children significantly ($P < 0.05$), while stunted children correlated negatively with wasted children significantly ($P < 0.05$). Urinary iodine showed 58.3% of the children had ($< 20 \mu\text{g/L}$ severe iodine deficiency). More boys (33.3%) had $< 20 \mu\text{g/L}$ than girls (25%) with no significant difference ($P > 0.05$). Iodine levels in urine correlated with stunting and underweight positively but with no significant difference ($P > 0.05$). This calls for state, national and global concern.

PP 078

RELIABILITY AND RELATIVE VALIDITY OF A FOOD FREQUENCY QUESTIONNAIRE (FFQ) FOR ADOLESCENTS IN NEW ZEALAND

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Introduction

Due to the absence of a food frequency questionnaire (FFQ) for use in New Zealand adolescents, there is a need to develop one as a cost-effective way to assess adolescents' food patterns in health and nutrition studies. This study aims

to examine the test-retest reliability and relative validity of an FFQ to assess food intakes in adolescents aged 14 to 18 years.

Methods

A non-quantitative, 72-item FFQ was developed and pretested. Fifty-two participants (aged 14.9±0.8 years) completed the FFQ twice within a two-week period for test-retest reliability while 41 participants (aged 15.1±0.9 years) completed four-day estimated food records (4d EFR) in addition to the FFQs for the validity study.

Results

Weekly intakes were estimated for food items and aggregated into 24 food groups. The repeated FFQs produced a median Spearman's correlation coefficient of 0.72, ranging from 0.47 to 0.87. The median intra-class correlation coefficient (ICC) was 0.72. No more than 10% participants were grossly misclassified for any food. The median correlation coefficient between the FFQ and the 4d EFR was 0.40. Correlations were 0.4 or above for over two-third of the food groups evaluated.

Conclusion

Despite a small sample size, the FFQ exhibited excellent short-term test-retest reliability and reasonable validity in ranking food group intakes among adolescents.

PP 079

FEMALE AND MALE STUDENT'S NUTRITIONAL BEHAVIORS AND STATES OF OBESITY

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AIM and METHODS: This study aims to identify the nutritional behaviors and obesity states of 425 students (209 female-49.2%, 216 male-50.8%) studying at a primary school in Ankara. The data were collected by means of a questionnaire. Students' height (m) and weight (kg.) measurements were gathered and body mass index (BMI) were calculated. In data evaluation, WHO 2007 reference values were used. The data were assessed by means of SPSS 13.0.

RESULTS: The mean ages of the students were 13.11±0.92 (f: 13.04±0.87, m: 13.18±0.96). With regard to students' nutritional behaviors, 68.5% consumed three meals, 84.9% skipped the meals, with breakfast being skipped the most frequently (47.3%). The most frequently consumed food in breakfast was cheese (90.1%, p<0.05), while the most frequently consumed drink was tea (79.8%, p<0.05). Of the students, 85.9% had snacks the most consumed food was Turkish bagels (46.9%, p<0.01), the most consumed drink was Cola (45.9%, p<0.01). In their free time, students mostly watched TV (47.5%), and secondarily spent time with their friends (32.2%). The other activities were reading books (8.5%), playing outside (8.5%), and spending time on the computer (3.3%). In addition, it was found that students did not perform physical activities regularly. Of the girls, 19.1% perceived themselves to be weak, 22% overweight, 58.9% of normal body weight while this rate was respectively 23.1%, 17.1% and 59.7% for males. According to BMI categorization, 17.7% of the females were very weak-weak, 52.1% were of normal weight, 20.7% of the males very weak-weak, 50.2% were of normal weight; 29.1% were slightly overweight-overweight. As for the factors influencing obesity, skipping meals was found to be significant (p<0.05). In the research, students' views about their physical appearance was compared to that of BMI values, and it was found that 28.5% of the very weak and weak students, 23% of those with normal weight, 70.3% of those who are slightly overweight-overweight were not pleased with their physical appearance. Of the girls who perceived themselves to be normal with regard to body weight (n=128), 16.1% were very weak-weak, 51.7% were of normal weight, 32.2% were slightly overweight-overweight while of the boys (n=134), 22.3% were very weak-weak, 48.5% were of normal weight and 29.1% were slightly overweight-overweight. **CONCLUSION:** In conclusion, it was determined that these students skipped breakfast, which is the most important meal, preferred unhealthy food as snack, did not carry out any physical activity, and did activities which might lead to more obesity. Also, some misperceptions were identified related to the physical appearance. This might negatively influence healthy nutrition and physical activity tendencies.

PP 080

CHILDREN'S FOOD PURCHASING BEHAVIOUR ACROSS THE SCHOOL DAY

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The 2010 Survey of Diet and Food Purchases Among Children in Scotland was commissioned by the Food Standards Agency Scotland (FSAS) as a follow-up to the 2006 Survey of Sugar Intake Among Children in Scotland. To reflect FSAS and Scottish Government interest in foods purchased by children 'beyond the school gate', a new module was developed to explore food and drink purchases made by children across the school day. The focus was on purchases made by children outside of school (to and from school, at breaktime/free periods and lunchtime) and the factors that influence whether children go outside school to purchase food or drink, including questions about access and

opportunities to purchase food, such as transport, whether children were allowed to leave school at break/lunch times, money, parental influence and other motivating factors.

Cognitive testing of the new questions highlighted issues which led to different methods of data collection depending on the age of the child. For primary school children (7-11y), all questions were asked as part of an interview, which automatically routed to the next appropriate question. For secondary school children (12-16y), the questions were split between an interview and a self-completion questionnaire (SCQ). The questions for secondary school children were routed both between the interview and SCQ and within the SCQ itself, however, a number of routing errors occurred where the child did not follow the appropriate routings. Although 1217 children (564 primary and 653 secondary) completed the food purchasing module, analyses were conducted only on children who provided consistent information, which limited the sample size in secondary school children for analyses (n=468 for to and from school, 594 for breaktime/free periods, 612 for lunchtime). Analyses were carried out separately for children in primary and secondary school. Data was analysed across the whole sample and also in the sub-sample of children with access to places selling food or drink (i.e. those who walked or cycled past places selling food or drink on the way to or from school, or those who could get to places selling food and drink at break/lunch time).

A higher proportion of secondary than primary school children bought food or drink on the way to or from school (42% secondary vs 16% primary across the whole sample). Across the whole sample, purchasing on the way to or from school was more common among children from more deprived areas, who were more likely to walk or cycle past places selling food or drink. However, no association was found with deprivation level when analysis was restricted to only those children with access to food or drink outlets. For secondary school children there was no difference in the proportion making purchases by sex or by school year, but primary school boys were significantly more likely to make purchases than primary school girls, and older primary school children were more likely to make purchases than younger primary school children. These associations were consistent for both the sub-sample with access to food or drink outlets and across the whole sample. Questions regarding lunchtime and breaktime/free periods were restricted to secondary school children as few primary school children were allowed to leave the school during these times. Sixty three percent of all secondary school children purchased food or drink outside school at lunchtime with 18% purchasing at breaktime/free periods. The proportion purchasing at these times again varied by age, sex and deprivation level.

PP 081

CHANGES IN NON-MILK EXTRINSIC SUGARS, PHYSICAL INACTIVITY AND OVERWEIGHT AND OBESITY IN CHILDREN IN SCOTLAND FROM 2006-2010.

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The 2010 Survey of Diet Among Children in Scotland continued the work of the 2006 Survey of Sugar Intake Among Children in Scotland (1) to monitor progress towards the Scottish Dietary Target for non-milk extrinsic sugars (NMES) intake in children.

In both surveys, children aged 3-16 years were randomly selected across Scotland using the HM Revenue and Customs Child Benefit Register. After an opt-out exercise, the Scottish Collaborative Group Food Frequency Questionnaire (FFQ) (<http://www.foodfrequency.org.uk>) was mailed to parents for completion by the parent and/or child (depending on the age of the child). Fieldworkers checked the FFQ, asked about time spent in front of a screen (television, computer or games console), and measured height and weight. Overweight including obesity was defined as body mass index $\geq 85^{\text{th}}$ percentile using the UK 1990 centile charts (2). In 2006, 1700 interviews were carried out and 1391 FFQs were available for dietary analysis (response rates 68% and 56% respectively). In 2010, 1906 interviews were carried out and 1674 FFQs were available for dietary analysis (response rates 63% and 55% respectively).

Between 2006 and 2010, mean NMES intake decreased significantly from 17.3% to 15.7% food energy (table). The mean time spent sitting at a screen on an average day was not significantly different between 2006 (1.8 hours) and 2010 (1.9 hours). The prevalence of overweight including obesity was unchanged from 2006 (31%).

Mean [95% CI] NMES intake (% food energy) in 2006 and 2010

	2006	2010	<i>p</i> (difference)
All ages	17.3 [16.9, 17.7]	15.7 [15.4, 16.0]	<0.001
3-7 y	15.8 [15.2, 16.3]	14.7 [14.2, 15.1]	0.003
8-11 y	16.8 [16.4, 17.3]	15.6 [15.1, 16.1]	0.001
12-16 y	19.0 [18.2, 19.9]	16.7 [16.1, 17.3]	<0.001

Whilst NMES intake remains considerably higher than the Scottish Dietary Target of <10% total energy, there has been encouraging progress towards the target since 2006. Overall, there was no clear change in time spent at a screen or in the prevalence of overweight including obesity.

1. Sheehy C *et al.* (2008) Survey of sugar intake among children in Scotland. Aberdeen, Food Standards Agency

Scotland. <http://www.food.gov.uk/multimedia/pdfs/sugarintakescot2008rep.pdf>

2. Cole T *et al.* (1990) Body mass index reference curves for the UK. *Archives of Disease in Childhood* **73**: 25-29.

PP 082

INTAKE OF SUGAR SWEETENED BEVERAGES, BUT NOT TOTAL SUGAR, MAY IDENTIFY DIET QUALITY WHEN ASSESSED USING A FOOD FREQUENCY QUESTIONNAIRE

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Dietary intake prior to pregnancy is a key factor affecting the health of the mother and infant, both during and after pregnancy. In terms of macronutrients, fat intake, for example, n-3 fatty acids, have been examined in this context, but carbohydrate intake has received less attention. There is growing interest in assessing pre-pregnancy sugar intake as it may be associated with increased risk of excess gestational weight gain, gestational diabetes and high birth weight infants. This study aimed to describe pre-pregnancy sugar intake and examined the relationship between sugar and micronutrient intakes during this time. In a prospective cohort study of pregnant women and their children (n = 489), women recruited at < 27 weeks gestation completed a validated, 154-item FFQ (adapted from NCI Diet History Questionnaire) to assess dietary intake in the 12 months prior to pregnancy. The nutrient database was updated to include total sugar, added sugar, natural sugar and sugar sweetened beverages (SSB), using the Canadian Nutrient File, and USDA and NCI food composition databases. On average, 22% of women's total energy intake came from sugars; 9% from added sugars and 13% from natural sugars. Percent energy from total sugars was positively correlated with vitamin A, vitamin C, folate, calcium, phosphorus, magnesium, iron, zinc and potassium and was negatively correlated with sodium intakes ($r = 0.129 - 0.324$, p-value <0.01 for all). A similar pattern was found with natural sugars; however, natural sugars were not correlated with iron or zinc intakes. Percent energy from added sugar was positively correlated with iron and zinc and negatively correlated with sodium intakes ($r = 0.191, 0.119$ and 0.116 , respectively; $p < 0.01$ for all), but was not correlated with any other nutrients. SSB intake was negatively associated with all micronutrients assessed except for iron and sodium (correlation coefficients ranging from $0.123 - 0.343$; $p < 0.01$ for all). Although mean sugar intakes were comparable to national estimates, the FFQ may not accurately assess added sugar intake in this population as added sugar was not correlated with micronutrients as has been described elsewhere. Alternatively, the link between added sugars and poor quality diet may not be causal, but driven by confounding dietary patterns in some populations. SSB intake was inversely correlated with micronutrient intake, suggesting that high SSB intake may be a hallmark of a poor quality dietary pattern.

PP 083

LEISURE TIME PHYSICAL ACTIVITY DURING THE TRANSITION FROM ADOLESCENCE TO ADULTHOOD: A MIXED METHODS APPROACH

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Background Late adolescence has been found to be a critical period when exploring participation in physical activity across the life course.

Aim This study explores individuals' participation in physical activity, particularly leisure time physical activity (LTPA), during the transition from adolescence to adulthood and identifies factors that impact on young adults' capacity to remain engaged in regular LTPA.

Methods Eight focus groups and one group interview were conducted with 50 young people aged 16-26 years (male = 18, female = 32) from a range of demographic backgrounds. Follow-up semi-structured interviews were conducted with 24 young people (male = 10, female = 14). Purposeful sampling ensured interviewees ranged from inactive to highly active and participated in various types of LTPA (team sports, lifestyle, gym and none). Participants were asked to discuss their experiences and views on physical activity. All interviewees completed the International Physical Activity Questionnaire (IPAQ) and 17 wore a pedometer for one week. Data from focus groups and interviews underwent an iterative thematic form of analysis.

Results No participant who completed the pedometer diaries was classified as sedentary (daily step counts <5000). IPAQ data analysis identified weekly time spent in LTPA (Median = 180mins, Interquartile Range IQR 52.5 – 457.5). Median percent of total weekly physical activity spent in LTPA was 30.1% (IQR 8.0 – 45.0). Analysis of focus group and interview data identified individuals with a long term pattern of persistent participation in LTPA (n = 13). Despite this pattern of persistence these young people described short term fluctuations in participation to accommodate current life circumstances, such as exams, changes in employment or moving house. Those young people with a pattern of persistent participation in LTPA considered participation integral to leading a balanced life and/or facilitating significant social relationships. They also had clear expectations about future participation in physical activity. There was no discernible pattern according to the type of LTPA although those young adults still involved in team sports (n = 6) had played team sports in childhood.

Conclusion Using mixed methods to measure physical activity participation provided data about current levels of LTPA as well as long term patterns of participation. Focus groups and interviews revealed a complex picture of short term fluctuations in LTPA even in young people with a long term pattern of persistence.

PP 084

PREDICTORS OF FOOD RECORD COMPLIANCE: EXPERIENCE FROM THE TEDDY STUDY

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Background: The food record (FR) is a widely used dietary assessment tool and its application in various types of epidemiological studies has been well studied. There is, however, a paucity of knowledge as to why study participants vary in their compliance with completing the FR, particularly in longitudinal studies that repeatedly collect FRs. The aim of the present study is to identify factors associated with failure to comply with FR collection in a prospective study.

Method: The Environmental Determinants of Diabetes in the Young (TEDDY) study is designed to examine the associations between islet autoimmunity and environmental exposures including diet in sites in Finland, Germany and Sweden, and three sites in the US. A 3-day FR is scheduled for 8677 pediatric subjects every 3 months between 6 and 12 months of age and every 6 months from 18 months up to age of 15 years. Subjects who have been enrolled in TEDDY for at least 3 years without missing a clinical visit or blood draw (n=2360) were included in this analysis.

Results: A total of 668 (29.2%) of these subjects missed at least one set of 3-day food records during the first 3 years of study participation. The percentage of missed records increased from 2.1% (n=49) at the 6 month visit to 4.0% (n=94) at the 12 month visit, 9.9% (n=234) at the 24 month visit, and 14.2% (n=335) at the 36 month visit. Study site, younger mother's age, increased household crowding, having multiple children, and smoking during pregnancy were found to be independent predictors of missing one or more food records between the ages of 6 and 36 months in multiple logistic regression analysis.

Conclusion: The results indicate that FR compliance in the early years of TEDDY participation is associated with demographic factors among the families who otherwise strongly comply with clinical visits and blood samples. We plan to extend this analysis to the whole TEDDY study population to examine how the FR compliance relates to overall study compliance. This will help in identification of intervention strategies that will optimize the participation with self reported FR data in prospective dietary studies.

PP 085

ENERGY DENSITY AND CARDIOVASCULAR RISK FACTORS IN THE POPULATION OF SÃO PAULO, BRAZIL

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Introduction. Energy density (ED) has been considered a factor related to sign appetite (hunger and satiety) and could therefore be a possible tool for controlling weight gain, and consequently the development of cardiovascular diseases.

Objective. To investigate the relationship among ED and cardiovascular risk factors.

Method. The sample comprises adults (n=222) and elderly individuals (n=254) from a large cross-sectional health survey performed in 2008 in the city of São Paulo, Brazil (ISA-Capital). Anthropometric measures were taken in light clothes and lifestyle data were collected by questionnaires. Plasma total cholesterol and its fractions were evaluated. To assess dietary intake it was collected two non-consecutive 24-hour dietary recalls (24HR) by using the Multiple-Pass Method proposed by USDA. ED was calculated using total energy consumed in kilocalories divided by the total weight of foods consumed in grams, excluding beverages intake. ED was categorized into tertiles: ED1 (0.73 to 1.69 kcal/g), ED2 (1.69 to 2.01 kcal/g) and ED3 (2.02 to 3.88 kcal/g). For statistical analyses, Pearson's correlation coefficient was calculated to investigate the relationship between ED and cholesterol (CHO), LDL-cholesterol (LDL), HDL-cholesterol (HDL) and smoking. For statistical analyses of association between qualitative data, Chi-square test were performed with STATA (version 11), correcting for the complex sampling design of the study.

Results. The average ED was 1.93 kcal/g (se = 0.032 kcal/g); 1.99kcal/g (se = 0.035 kcal/g) for adults and 1.67kcal/g (se = 0.035 kcal/g) for elderly. Most of them presented diets higher in ED than suggested as ideal (1.25kcal/g) for the American Institute for Cancer Research (2007): only 4.8% of population wer bellow this suggested threshold. A positive correlation between ED and total CHO as well as between ED and LDL levels were observed on individuals in the highest tertile of ED and as presenting inadequate CHO and LDL levels (r=0.41, p=0.005; r=0.72, p=0.003, respectively). In addition, the inadequate HDL (under 40mg/dl) was negatively correlated with the ED2 (r= -0.26, p = 0.020). Smoking presented association with ED3 (p=0.000). There were no significant correlations between ED1, ED2 and ED3 and triglycerides, waist circumference (WC) and body mass index (BMI).

Conclusion. These findings suggest that energy density is correlated with hypercholesterolemia and. More studies are required to confirm our findings.

PP 086

SELF-REPORT DATA IN A COMMUNITY BASED INTERVENTION (PHYSICAL ACTIVITY AND NUTRITION) WHILE CONSIDERING SUBJECT BURDEN

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Background Measuring changes in behaviour is integral to determining the impact of community-based interventions. There are a range of self-report measuring instruments that aim to assess physical activity and nutrition behaviours, however, finding suitable instruments that do not over burden participants is a challenge.

Purpose This presentation aims to summarise the challenges of finding suitable self-report measuring instruments to determine changes in physical activity and nutrition behaviours pre and post community based intervention with older adults (60-70 years). It will consider subject burden and processes for modification of instruments with particular reference to the IPAQ and Fat and Fibre Barometer.

Results The modified measuring instruments test-retest results were the satisfactory (ICC 0.43-1.00) along with the pre-post response rate (65%).

Discussion This paper will discuss the modification of measuring instruments, considering the role of: a) focus groups with the target population; b) review of the measuring instrument by experts and; c) conducting test-retest with the target population.

Conclusion Community based interventions require 'user friendly' measuring instruments that gather appropriate data to determine behaviour change but do not over burden participants.

PP 087

A THEORETICAL ASSESSMENT OF DIFFERENT METHODOLOGIES TO ASSESS FLUID INTAKE IN CHILDREN

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BACKGROUND: Dietary survey methods used in the past have focused mainly on obtaining data on foods and beverages containing macro- and micro-nutrients, but not specifically on fluids, particularly water. As a result the methodology for assessing fluid intake is poorly developed (Popkin *et al.*, 2010).

OBJECTIVE: To investigate the available literature and current opinions on measuring fluid intake in children aged 0-18yrs, and to consider the most appropriate method(s), by age group.

METHODS: A literature review was undertaken covering the subjects of food and fluid intake and assessment, with particular reference to assessments in children. Nine methods were considered relevant for the assessment of fluid intake in children, including test weighing, doubly labeled water technique, direct observation, weighed and estimated diet diaries, checklist, 24hr recall (single and multiple), short and long food frequency questionnaires and diet history. Practical, analytical and age group considerations were taken into account. Methods were given an overall rating: very suitable, moderately suitable, of limited suitability or not suitable, based on the different considerations and according to each age group (0-12months, 13-24 months, 2-4years, 5-8years, 9-12years, 13-18years). Considerations and ratings were shared with scientific experts working in this field (BL, AA, MN, NP), and their feedback was incorporated.

RESULTS: There are no well-validated methods to assess fluid intake in children according to the literature, or the experts. However, the estimated diet diary was considered to be an appropriate option for all age groups. In addition, different information should be collected according to the study objectives and a different format of the diary used according to the age group. Multiple 24hr recalls were also considered a good option for 13-18 year olds. Overall, it was believed that a combination of methods could be used to obtain more complete data, for example, including some weighing within the estimated diet diary for younger children and including a fluid checklist. Reviewing and checking the information collected in the diary after recording, and independent observations during nursery and school mealtimes were considered important to ensure optimum data quality.

CONCLUSIONS: Few methods are currently available to accurately assess fluid intakes, especially in children. Full, objective validation studies are clearly needed to provide a thorough understanding of the available methods and their fitness for purpose in different age groups.

REFERENCES: Popkin BM, D'Anci KE, Rosenberg IH (2010). Water, hydration and health. *Nutrition Reviews*, 68(8), 439-458.

PP 088**CHARACTERISTICS ASSOCIATED WITH FISH INTAKE IN INFANCY AND SCHOOL AGE: RESULTS FROM A SWEDISH BIRTH COHORT (BAMSE)**J. Magnusson¹, I. Kull², H. Rosenlund¹, N. Håkansson¹, A. Wolk¹, E. Melén¹, M. Wickman³, A. Bergström¹¹Institute of Environmental Medicine, ²Department of Clinical Research and Education, ³Sachs' Children's hospital

Aim To explore characteristics associated with introduction of fish as well as with fish intake at age 1 and 8 years.

Method Data was obtained from a Swedish population based birth cohort (BAMSE), with children born 1994-1996. The children were followed from 2 months of age by repeated parental questionnaires. Information about age at fish introduction and the current frequency of intake was collected at age 1 year. At 8 years, the families answered a food frequency questionnaire about food consumption during the past 12 months, including intake of herring/mackerel, salmon fishes and tuna fish (fatty fish), and of codfish/pollock/pike and fish fingers (lean fish). The following possible predictors for fish introduction and intake at age 1 year were tested using multivariate linear regression models: socioeconomic status, maternal smoking during pregnancy and/or infancy, parental allergic disease, symptoms of wheeze and/or eczema during the first year of life, sex and breastfeeding duration. At age 8 years, the analyses also included current overweight and total energy intake. The significance level was set to $p=0.05$. In total 3925 children were included at age 1 year and 2603 at 8 years. **Results** The mean age of fish introduction was 8.3 months (SD: 2.3). At age 1 year 62% of the children ate fish at least 1 time/week and the mean consumption was 1.0 times/week (SD: 0.7). Parental allergic disease, early onset of eczema and/or wheeze and longer exclusive breastfeeding delayed the introduction of fish in the child's diet and predicted lower intake at age 1 year. At age 8 years, 83% of the children ate fish at least 1 time/week, with a mean intake of 1.9 times/week (SD: 1.2). Almost 70% of the consumption consisted of lean fish. A higher fish intake at 1 year, female sex and high total energy intake predicted higher intake of total-, lean- and fatty fish at 8 years. Current overweight predicted higher intake of total- and fatty fish, while maternal smoking during pregnancy and/or infancy predicted lower intake of fatty fish. **Conclusion** Different characteristics were associated with fish intake at age 1 year, compared to 8 years. Parental allergic disease and early onset of allergic symptoms were associated fish intake in infancy but not in school age, while fish intake at age 1 year and sex were the most important predictors for fish intake at age 8 years.

PP 089**THE U.S. NATIONAL CANCER INSTITUTE'S DIETARY ASSESSMENT PRIMER: AN INTERACTIVE ONLINE TOOL**S. Kirkpatrick¹, F. Thompson¹, J. Reedy¹, S. Krebs-Smith¹¹National Cancer Institute

Effective monitoring of a population's diet and progress toward understanding diet and health relationships are dependent upon the availability of high-quality dietary intake data. However, several approaches to assessing diet can be taken. The choice of the most appropriate dietary assessment instrument for a particular study can be a challenge and is dependent upon a number of considerations, including the research question, dietary components of interest, study design, target population, and resources and constraints. The U.S. National Cancer Institute (NCI) is developing an online interactive resource to provide guidance on the selection of appropriate dietary assessment methodologies for characterizing the dietary intakes of a group or groups and to outline various considerations for the use of each assessment methodology. A key feature of the dietary assessment primer is an interactive decision making tool that allows researchers to specify a research question (e.g., describe intakes, assess relationships between diet and another factor, examine the effects of an intervention on diet, validate or calibrate an instrument), a study design (e.g., cross-sectional, prospective, retrospective, intervention), and the dietary components of interest (e.g., total diet, one or more specific components such as fruits and vegetables or fiber). Additional information about study characteristics help the researcher to narrow the list of appropriate tools. Another option allows comparison of the features of the potential instruments. The primer also provides in-depth information on each of the main assessment methodologies: 24-hour recalls, food records/diaries, food frequency questionnaires, screeners, observation, and biomarkers, with details on data collection considerations (e.g., cost, respondent burden, need for interviewer administration), analytical considerations (e.g., need for multiple administrations to assess usual intake), and validity. The online tool is being developed by subject matter experts within NCI, with internal and external review to ensure that the content reflects the current state of the science. User-centered design principles will be applied in finalizing the web-based interface to ensure optimal usability. The primer is intended to help researchers collect the highest-quality dietary data possible given their study resources and constraints, with the ultimate goal of contributing to our capacity to monitor diets among populations and to understand how diet impacts health.

PP 090**PREDICTING DIET, PHYSICAL ACTIVITY AND LIFESTYLE BEHAVIORS IN OLDER ADULTS – A LATENT CLASS MODEL**M. Södergren¹, J. Salmon¹, D. Crawford¹, K. Ball¹, S. A. McNaughton¹¹Centre for Physical Activity and Nutrition Research, Deakin University

INTRODUCTION: Latent class modeling is an optimal strategy for identify unobserved (latent) classes from categorical data, and to identify clusters which group together individuals who share similar behaviors (mutually exclusive groups). Latent class analysis (LCA) includes probability-based classification, and allows adjustment for covariates. Despite this advantage, few studies have used LCA in the context of health behaviors, particularly in the field of nutrition and physical activity. In this study we used LCA to identify lifestyle patterning in health behaviors among older adults. Our hypothesis was that various lifestyle patterns exist among older adults and that these patterns include both healthy and unhealthy behaviors. The aim was to predict probabilities for belonging to the healthiest class, (class membership probability).

METHODS: Cross-sectional data were collected among 3,632 older adults (48% men) aged 55-65 years from the Wellbeing, Eating and Exercise for a Long Life study, a population-based cohort study. Lifestyle behaviors addressed in the survey included dietary intake (FFQ) and physical activity (IPAQ). The latent class indicators were selected to represent multiple health dimensions of lifestyle: diet, physical activity and sedentary behavior as well as smoking and alcohol habits. Binary indicators were created based on existing recommendations or suggested by existing literature. Statistical analyses, stratified by sex, were performed by generalized linear latent and mixed models (GLLAMM), including covariates. Bayesian and Akaike information criterions were examined to select the final model solution.

RESULTS: The prevalence of a “Healthy Lifestyle” class (i.e. belonging to the healthiest class) was estimated as 0.72 and 0.54 for men and women respectively. Individuals belonging to the “Healthy Lifestyle” class had 86% (men) and 95% (women) probability of reporting low intake of fast food.

Also, women belonging to the “Healthy lifestyle” class had a 98% probability of reporting recommended intake of fruit. All men and women in the “Unhealthy lifestyle” class (i.e. belonging to the least healthy class) reported low intake of vegetables (specificity = 1). The probability for reporting recommended levels of physical activity were 52% (men) and 65% (women) in the “Healthy lifestyle” class. We also found that class membership relates to education, BMI and marital status.

CONCLUSIONS: Latent class modeling can be applied to examine complex lifestyle patterning and to help identifying predictors of class membership among older adults. In addition, to recognize subpopulations for which interventions may have the most substantial effect on healthy lifestyle behaviors and reducing the risk of chronic diseases.

PP 091**APPLYING THE 24 HOUR MULTIPLE PASS RECALL METHOD TO ASSESS FOOD AND NUTRIENT INTAKE IN TWO COHORTS OF ADVANCED AGE**C. Wham¹, A. Adamson², E. Foster², A. Jones², J. Mathers³, J. Collerton⁴, N. Kerse⁵, T. Kirkwood⁴¹Institute of Food Nutrition and Human Health, Massey University, ²Human Nutrition Research Centre, Institute of Health and Society, Newcastle University, ³Human Nutrition Research Centre, Institute for Ageing and Health, Newcastle University, ⁴Institute for Ageing and Health, Newcastle University, ⁵Department of General Practice & Primary Health Care, University of Auckland

BACKGROUND: Assessing food and nutrient intake presents significant challenges at an advanced age. We report our experience of applying the repeated multiple pass 24 hour diet recall method (MPR) to collect and compare food and nutrient intake data in two longitudinal studies of those in advanced age. **METHODS:** The Newcastle 85+ study (North East England, UK) is a detailed study of those 85 years and over. The MPR used in the national LIDNS survey was piloted and found to be suitable to collect detailed food and nutrient intake data from this population and so was adopted in the Newcastle 85+ study. Life and Living in Advanced Age a Cohort Study in New Zealand (LILACS NZ) is a study which has recruited 420 Maori and 523 non- Maori octogenarians. In both studies all data were collected by nurse interviewers and the dietary recall protocol developed for the Newcastle 85+ study was adapted for the New Zealand setting. This included piloting and adapting the ‘Photographic Atlas of Food Portion Sizes’ developed in the UK and rigorous training to enable the nurse interviewers to follow the Newcastle 85+ study protocol. Following completion of data collection by trained nurses all data coding is undertaken by qualified nutritionists. **RESULTS** In both studies the interactive MPR was found to be acceptable to the study participants and to the research nurses administering the tool. However the MPR required extensive nurse training to obtain sufficient detail to facilitate accurate coding. Once completed each recall requires manual coding, a task which requires understanding of food composition. Newcastle data coding is complete; 803 participants completed two MPR. Fieldwork for LILACS NZ commenced in March 2011 and will be completed by February 2012. To date 343 participants have completed two MPR. **CONCLUSION** Preliminary analyses from both the LILACS NZ and Newcastle 85+ studies indicate that the MPR is a practical and acceptable dietary assessment method for use in large populations of the very old. However this

requires considerable investment of investigator time, resources for training and time for data coding and entry. Experience of using the MPR with those of advanced age and available dietary data will be reported.

PP 092

USUAL INTAKE OF FOOD GROUPS AND NUTRITIONAL STATUS OF ADULTS OF SÃO BERNARDO DO CAMPO MUNICIPALITY, SP, BRAZIL

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Objective: Assess the intake of food groups according nutritional status and compared with the recommendations of a Brazilian Food Guide among adults treated in a nutrition clinic of a university of Sao Paulo, Brazil. **Methods:** Cross-sectional study with a sample of adults treated in a nutrition clinic at a private university of Sao Paulo State, Brazil. The data were collected in the first nutrition consultation with new patients of this clinic during 2011. We applied a nutritional interview and a quantitative food frequency questionnaire (QFFQ) constructed for the people of Sao Paulo, Brazil. Data on consumption of each food of QFFQ were brought together by food groups and this consumption was compared to the recommendations of the Food Guide for Brazilian Population published by Ministry of Health of Brazil. The collected data were tabulated in Microsoft Excel version 2003 and statistical analysis was performed using statistical software SPSS, v.15, with 5% significance level in statistical tests. The differences in the intake of food groups between genders were analyzed by Fisher's exact test. The research project was approved by the Ethics Committee of the Methodist University of São Paulo. **Results:** The sample consisted of 96 adults, 77 women and 19 men, with mean age 40,4 years. There was no statistically significant difference in the consumption of food groups according to gender and nutritional status. By dividing the sample into adults (up to 60 years) and elderly (60 years and older), statistically significant differences were observed in the consumption of food groups only for milk and dairy products ($p=0.002$), in which 69% of elderly had adequate intake against 23% of adults. The consumption of cereals, bread and roots food group was found below the recommendation (minimum 6 servings per day) in 76% of the sample. The fruit food group intake was below the minimum recommendation of 3 servings a day in 63% and the consumption of milk and dairy products was inadequate in 71% of sample. Intake of sugars and sweets and fats and oils groups has been excessive in most of the sample (80% and 91% respectively). Groups of foods with adequate intake were meat and eggs, legumes and vegetables (90%, 59% and 68% of adequate intake, respectively). **Conclusion:** Consumption of most food groups were considered inadequate according to the Food Guide recommendations. Public health and nutrition actions should be planned to improve the population's food consumption and prevent chronic diseases.

PP 093

DIETARY ASSESSMENT OF MUSICIANS WITH NIGHT PROFESSIONAL ACTIVITIES IN SÃO PAULO, BRAZIL

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Introduction: Many times a musician has an irregular schedule, mainly at night. This working condition causes changes in biological rhythms and feeding behavior. **Objective:** To assess the nutritional status and dietary intake of musicians with professional activities at night in the metropolitan region of Sao Paulo. **Methods:** Cross-sectional study that assessed 100 adult musicians (20 to 59 years) of both sexes. For the sample, musicians working in bars located in the metropolitan region of Sao Paulo were invited to participate of this study. We applied two 24-hour recalls (one on a working day and another in a day off), a sociodemographic and lifestyle questionnaire, and the short form of International Physical Activity Questionnaire (IPAQ). Energy intake was compared to estimated energy requirements and macronutrient intake was compared to acceptable macronutrient distribution ranges (AMDR) established by Dietary Reference Intakes (DRI). Energy and macronutrient intake was analyzed as the average of two days and also separately according to working day and day off. **Results:** Most of the sample was predominantly male (85%), aged between 30 and 50 years (51%) and single (67%). The average BMI was 27.18 (SD=4.94) kg/m², which means that there were 42% of overweight and 25% of obesity. The consumption of alcohol was mentioned by 74% of musicians. Most of the sample showed the consumption of carbohydrates, proteins and lipids within the AMDR. Regarding energy, 45% had an intake above their needs. Fat intake was higher than AMDR in 19% of the sample. Except for protein intake, the average consumption of other macronutrients and energy was higher in the working day than in the day off. The average consumption of food groups shown to be suitable only for cereals, insufficient for fruits, vegetables, and dairy; excessive for legumes (mean=2,9 portions), oils and fats (mean=2,1 portions), sugars and sweets (3,1 portions), and meats (mean=1,5 portions). The musicians showed excessive consumption of sodium and cholesterol. **Conclusion:** There was a high prevalence of excess weight and this could be consequence of excess of energy intake, as well as sedentary life, poor dietary habits, frequent consumption of alcoholic beverages, soft drinks and fat foods. It is relevant

to carry out studies about food consumption of that population as well as information campaigns directed at them that are critical for the prevention of chronic diseases.

PP 094

SOCIODEMOGRAPHIC AND LIFESTYLE DETERMINANTS OF DIETARY CHOICES DURING PREGNANCY AND LACTATION

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A range of sociodemographic factors underlie maternal dietary choices during pregnancy. Less is known about how these factors determine dietary choices during lactation. We set out to assess whether the sociodemographic and lifestyle factors associated with dietary choices are different during pregnancy and lactation. The present analysis is based on data from 4879 pregnant and 2918 lactating women taking part in the Type 1 Diabetes Prediction and Prevention (DIPP)-nutrition study. Data on food consumption during the 8th month of pregnancy and the 3rd month of lactation was queried by a validated semi-quantitative food frequency questionnaire (FFQ). Of all the subjects, 2841 returned the FFQ for both pregnancy and lactation. Logistic regression analysis was used to study the associations between background variables (parental age and professional education, degree of urbanization, parity, smoking during pregnancy, and BMI at the first antenatal visit) and dietary endpoints (the highest vs. other quarters of consumption of vegetables, fruits and berries, full grain cereals, fish, fatty foods, sugar rich foods, and energy density; usage of margarine, skimmed milk, coffee, and tea). Maternal smoking, parity, and mother's age were the strongest determinants of dietary quality during pregnancy, whereas BMI at the first antenatal visit was the strongest determinant during lactation followed by maternal smoking and degree of urbanization. Only the usage of skimmed milk was determined by the same set of background variables during pregnancy and lactation. Different sociodemographic and lifestyle factors are associated with maternal dietary choices during pregnancy and lactation.

PP 095

ADDITIONAL NUTRIENT INTAKE EFFECTS OF A TWO-YEAR INTERVENTION OF WHEY PROTEIN SUPPLEMENTATION ON DIETARY INTAKE AND BODY WEIGHT IN OLDER POSTMENOPAUSA

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When food-based interventions are undertaken the nutrient profile of the participant's food intake may be modified in response to taking the food supplement, due to either the food composition or its satiety effect. The aim was to investigate the effects of a dietary protein drink compared with a placebo drink on dietary intake and weight in a two-year study of 173 women aged 70-80 years. Participants were randomized to either a high protein drink (30g of whey protein and 810kJ/250ml) or a placebo drink (2g protein and 820 kJ/250ml). Dietary intake was assessed by a 3-day weighed food record. There were no significant differences between groups at baseline for weight or energy intake. Dietary intake was compared between groups without the drink, to examine how participants adjusted their food intake in response to the daily drink supplement. Participant's weight did not change over two years. There were no significant differences between the two groups in the intakes of energy, protein, carbohydrate, fat, fibre or alcohol at either time point. There was a significant decline in intakes of macronutrients at Yr 2 compared to baseline in both groups. These results suggest that the composition of the two drinks had a similar satiety effect and participants made small adjustments by reducing their overall food intake to ensure they maintained their energy balance and body weight over the 2-year study. However, the Hawthorne effect as a cause of change cannot be ruled out, as measuring peoples diets may lead them to change.

3-day food record	Protein drink		Placebo drink	
	Baseline	Year 2	Baseline	Year 2
Weight (kg)	67.2 ± 11.3	67.8 ± 11.4	69.1 ± 11.5	69.6 ± 11.5
Energy kJ with drink	7094 ± 1530	7323 ± 1745	7143 ± 1399	7197 ± 1432
Without drink:				
Energy kJ	7094 ± 1530	6660 ± 1741 ^a	7143 ± 1399	6502 ± 1404 ^a
Protein g/d	77 ± 18	71 ± 17 ^a	76 ± 16	71 ± 17 ^a
Carbohydrate g/d	185 ± 45	173 ± 52 ^a	190 ± 42	168 ± 46 ^a
Fat g/d	63 ± 18	60 ± 21 ^b	63 ± 20	58 ± 17 ^b
Fibre g/d	23 ± 7	21 ± 7 ^a	22 ± 7	20 ± 6 ^a
Alcohol g/d	6.0 ± 9.3	7.0 ± 9.9	6.4 ± 9.5	5.8 ± 7.9

Significantly different from baseline, ^a $p < 0.001$; ^b $p < 0.05$

PP 096

RELATIONSHIP BETWEEN DAIRY FOOD GROUP INTAKE AND CALCIUM INTAKE IN 55 TO 80 YEAR OLD AUSTRALIAN MALES

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The purpose was to investigate the relationship between dairy food group intake and calcium intake from the baseline measures of older men (55 to 80 y) participating in a 1-year exercise intervention. The dietary intake (no subjects used calcium supplements) was assessed at baseline by a 4-day food record using food scales and household measures. The records were analysed by trained nutritionists using Foodworks 2007 (Xyris Software, Brisbane, Australia) using the AUSNUT 2007 database (FSANZ,2007). All unique foods and drinks (1745 in total) eaten by participants in the food record were exported to Microsoft Access 2007 and then coded into three dairy food groups (low, medium, high fat) according to the specifications of the NHMRC New Food Guidance System (1). This coding was then re-linked to each participant's food record to allow calculation of daily averages (serves/d) for the three dairy sub-groups, and daily average for total dairy intake (serves/d), which was the sum of the subgroups totals. Descriptive statistics, independent sample t-tests and correlation analysis was performed for the whole sample and separately for those under and over 70 years (age groups with different nutrient requirements). Differences between dairy serve intake between those meeting and not meeting their Estimated Average Requirement (EAR) for calcium was also investigated with independent t-tests.

Age (y)	n	total dairy (serves/d) Mean (SD)	calcium intake (mg) Mean (SD)	total dairy (serves/d) for those meeting calcium EAR Mean (SD)	total dairy (serves/d) for those NOT meeting calcium EAR Mean (SD)
55-80	142	1.70±0.84	961±329	n=81 1.74±0.89	n=61 1.65±0.79
55-70	113	1.74±0.85	962±325	n=71 1.73±0.86	n=42 1.74±0.83
>70	29	1.57±0.82	959±348	n=10 1.80±1.08	n=19 1.45±0.65

There were no significant differences between dairy intake or calcium intake by age group. No correlation was found between calcium intake and dairy food group intake. Pearson correlation coefficients for the whole sample, 55-70 y, and greater than 70 y were $r = 0.046$, $r = 0.042$ and $r = 0.062$, respectively. There were no significant differences for total or sub-group dairy intake between those meeting or not meeting their calcium EAR for all age groupings. These results describe the dairy intake of older men, and suggest that in this group the relationship between dairy intake and calcium intake is not a simple linear one.

1. NHMRC, A modelling system to inform the revision of the Australian Guide to Healthy Eating, 2011a, Commonwealth of Australia: Canberra.

PP 097**ENERGY BALANCE OF ADULTS FROM NITERÓI, RIO DE JANEIRO, BRAZIL: A POPULATION-BASED STUDY**

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Energy balance (EB) is an important variable to assess in populations facing nutrition transition. There is very little information on both energy intake (EI) and energy expenditure (EE) of the adult population of Brazil. The purpose of the present study was to estimate EB in a probabilistic sample of adults (age ≥ 20 years) from Niterói, Rio de Janeiro, Brazil. EE was estimated by the procedure suggested by the FAO/WHO for sedentary lifestyle (EEWHO = estimated basal metabolic rate $\times 1.4$) and also by the flex-HR procedure using population specific parameters (EEHR). The subjects (n=1659) wore a heart rate monitor for 24 hours after which a 24 hour dietary recall was conducted to estimate EI. The food items were converted to energy using a compiled food composition table that includes popular Brazilian food products. Sample weights were calculated and calibrated to represent the population of Niterói according to the 2000 Census information and were used in the analysis. Overall EI was 1850.8 ± 27.3 kcal/day (mean \pm SE) and EEWHO was 2119.5 ± 10.2 kcal/day yielding a negative EB of -268.6 ± 25.6 kcal/day. However, EB was positive (159.1 ± 26.3 kcal/day) when EEHR (1691.7 ± 16.9 kcal/day) was used. Negative EB increased with increasing BMI reaching -623.1 ± 54.5 kcal/day for obese women (BMI ≥ 30 kg/m²) and -552.9 ± 123.0 kcal/day for obese men. EB using EEHR was $+24.6 \pm 56.5$ kcal/day for obese women and -3.2 ± 131.2 kcal/day for obese men. These results can be explained in part by the fact that BMR is estimated using body mass information which is higher in obese individuals. It is evident that better estimates of EE have to be developed to be used in the Brazilian population. Flex-HR is a promising alternative to more costly methods to estimate EE in developing countries.

This research was partially funded by the Brazilian National Research Council (CNPq, grants 141142/01-4; 471172/01-4; 475122/03-8; 302992/03-0; 308489/09-8) and by Fiocruz Foundation (PAPES III, 250.139).

PP 098**IMPACT OF FOOD PATTERN AND PHYSICAL ACTIVITY ON HEALTH RELATED QUALITY OF LIFE (HRQOL) IN ELDERLY IN AUSTRIA.**

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Objective As life expectancy continues to rise, one of the greatest challenges of public health is to improve the quality of later years of life. The aim of this study was to analyse the impact of food pattern, body composition, and physical activity on health related quality of life in elderly. **Subjects & methods** The study was carried out in a rural part of Austria, involving 186 individuals aged 70 years or more. Health related quality of life (HRQOL) was assessed using the SF-36 questionnaire; food pattern were examined by FFQ; body composition was measured by BIA and to evaluate functional status handcraft dynamometer were used. **Results** The mean age of the study population was 76.1 ± 4.6 years; 44.1% were within the age group 70-74 years, 34.9% 75-79 years, 15.1% 80-84 years and 5.9% 85 years and older. Two-third (64.5%) of estimated elderly were female and 35.5% male. A lower BMI and fewer diseases were found among interviewees with better dietary food pattern (higher consumption of cereals and vegetables). Average BMI was 30 kg/m² in female and 28.9 kg/m² in male participants. Body fat (BF) of men (22.5%) was lower compared to women (33.7%). Mean body cell mass (BCM), based on body weight as well as maximum handcraft was higher in men (39.3%; 40.2 kg) than in women (31.9%; 23.3 kg). A significant age-related decline in BCM and handgrip strength was detected in both, men and women. HRQOL was found to be worse in individuals at advanced ages, among women, as well as elderly with higher BMI, BF and lower BCM. **Conclusion** The results suggest that improving food pattern and maintaining body cell mass by physical activity are strong predictors for staying healthy in later years of life.

PP 099**FACTOR VALIDITY AND RELIABILITY OF CATEGORICAL OUTCOMES FOR THE EVALUATION RESEARCH OF A NUTRITION EDUCATION PROGRAM FOR LOW-INCOME CHILDREN**

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BACKGROUND: Given the problem of childhood obesity and food insecurity among low-income children, the Youth Expanded Food and Nutrition Education Program (EFNEP) needs an appropriate, valid and reliable evaluation tool to determine the program effectiveness.

AIM: To use comprehensive and rigorous statistical analysis to determine the factor-structure and reliability of EFNEP Youth Quest, a self-report questionnaire designed for 3rd, 4th and 5th graders, that includes nutrition, physical activity and food safety psychosocial mediating variables targeted by Youth EFNEP interventions.

METHODS: For hundred fifty-four multiethnic male and female 3rd, 4th and 5th graders, from low-income schools in South Carolina completed the EFNEP Youth Quest questionnaire. Exploratory factor analysis (EFA) was performed for each content domain: nutrition, physical activity and food safety. All responses were treated as categorical (8 were binary, 35 were 3-point ordinal). EFA was conducted with weighted least squares with mean and variance (WLSMV) estimator and the CF-Equamax oblique rotation in Mplus Software. The internal consistency of each psychosocial scale was measured with Cronbach's alpha using IBM SPSS software.

RESULTS: EFA yielded interpretable factors for the set of psychosocial items within the nutrition (3 factors, 12 items), physical activity (2 factors, 5 items) and food safety (1 factor, 7 items) domains, with large factor loadings (>0.40) and adequate goodness of fit. All the emerged factors were compared with the scales hypothesized/theorized by this study and were labeled as follows: nutrition factors (#): 1=healthy eating intentions, 2=outcome expectations of healthy eating, 3=self-efficacy for healthy eating; physical activity factors (#): 1=outcome expectations of physical activity, 2=self-efficacy to overcome barriers; and food safety factor (#): 1=self-efficacy for food safety. The internal consistency across final scales was acceptable (Cronbach's $\alpha > .50$).

CONCLUSION: This study provides an empirically tested measure, which can be used to evaluate Youth EFNEP programs. Although further work is needed, results of this study suggest the questionnaire is acceptable for Youth EFNEP evaluation.

PP 100

SHORT DIETARY ASSESSMENT INSTRUMENTS ("SCREENERS"): IS PORTION SIZE NEEDED?

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Short dietary assessment instruments are sometimes used to assess dietary intake because of resource or survey time constraints. Aside from frequency questions, the need for portion size questions is unclear. The Food Attitudes and Behavior (FAB) Study, conducted by the U.S. National Cancer Institute in 2006, offers an opportunity to evaluate the marginal gain in accuracy of reports when portion size is included in the analysis in addition to frequency information. The validation study sub-sample consisted of 244 adults: 57% females; 70% white and 25% Black. The objective of these analyses is to compare total fruit and vegetable (FV) intake estimates from the parent 16-item FV screener and 3 shorter versions of the parent screener to FV estimates from multiple 24-hour dietary recalls, our reference instrument, modeled to correct for measurement error, to determine which most closely mirrors estimated "true intake." The screener versions examined were the 16-item parent FV screener, composed of frequency and portion size questions for 8 types of fruits and vegetables, and three analytically reduced screener versions: the same screener but without reported portion size information (1 cup equivalent assumed) (8-item frequency), the same screener but with externally provided portion size (8-item median FV screener), and the same screener and the same externally provided portion size and calibration coefficients (8-item calibrated screener). Dietary recall data from a previous survey using a large representative sample of the U.S. population were used to estimate median sex/age portion sizes for each food group, and to generate calibration coefficients. Estimates of total FV intake (cup equivalents) from the 16-item parent screener (men: 2.7; women: 2.8) and the 8-item calibrated screener (men 3.0; women: 2.8) were relatively close to true intake (men: 2.9; women: 2.5). Estimates from the 8-item frequency screener (men: 1.9; women: 2.3) and the 8-item median screener (men: 2.1; women: 2.3) were lower than true intake, significantly ($p < 0.05$) so for men. The correlation between estimated true intake and screener for total FV was highest for the 16-item screener among males (0.54), and was highest for the 8-item frequency screener among females (0.39). The attenuation coefficient was highest (i.e. best) for the 8-item calibrated screener among men (0.44) and was highest for the 8-item frequency screener among women (0.34). The findings are complex, suggesting the recommendation as to the inclusion of portion size information may depend on whether the parameters of interest are means, correlations, or attenuation coefficients. Considerations for different applications will be discussed.

PP 101

PREVALENCE OF LOW PHYSICAL ACTIVITY AND SEDENTARY BEHAVIOR AMONG PRESCHOOL CHILDREN FROM A MIDDLE-INCOME COUNTRY

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Introduction: Physical activity in children has a decisive role in motor development and prevention of childhood obesity. The available evidence suggests that there is high prevalence of low physical activity in children, but little is known about the level of activity and sedentariness in preschool children from developing Countries. Thus, the purpose of this study was to identify the prevalence and factors associated with low levels of physical activity and sedentary behavior among preschool children. **Methods:** This cross-sectional study was performed by using the baseline data of a

longitudinal research project entitled ELOS-Pre (A Longitudinal Study of Health and Well-being in Brazilian Preschool Children) that is under development in Recife, northeast of Brazil. Data collection took place from August to November 2010 and measures were gathered through a parent-reported questionnaire administered by face-to-face interview. Logistic regression analysis were run to identify factors associated with low physical activity level (<60 minutes per day of outdoor playtime) and sedentary behavior (>2 hours per day watching television or playing videogame/computer). **Results:** The prevalence of low physical activity level was 37.5% (95%CI 34.6, 40.5) and did not differ by gender, age, familiar income, number of siblings, and other socio-economic and demographic factors; however it was found a positive linear trend association with maternal schooling as well as with the size of preschool. The prevalence of low physical activity level was higher among children enrolled in schools with more than 100 preschoolers (42,5%) and among children whose mothers had 12 or more years of study (48,5%). The prevalence of sedentary behavior was 73.9% (95%CI 71.1, 76.5) in week days and 73,7% (95%CI 71.0, 76.3) in weekend days. Regression analysis showed that period of day attending school and size of the school were factors associated to physical activity level. Gender, age, and period of day attending school were associated to sedentary behavior. Conclusions: The results showed that prevalence of low level of physical activity as well as sedentary behavior are high compared to the results of similar studies and that the factors associated with these behaviors might differ in preschool children.

PP 102

ASSESSING THE VALIDITY OF A QUESTIONNAIRE TO MEASURE TOTAL FAT INTAKE BASED ON THE ASSOCIATION WITH PLASMA HDL-CHOLESTEROL CONCENTRATIONS IN A MULTI-ETHNIC ASIAN POPULATION

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Comparative food frequency questionnaire (FFQ) validity assessments in multi-ethnic populations are infrequently reported for Asian populations. Using 24-hour recalls/ diet records or nutrient biomarkers for FFQ validation can be limited by correlated instrumental error-sources or lack of suitable biomarkers. Since recently, criterion methods have been used to assess FFQ validity. Such methods assess the ability of the dietary instruments to capture well-established relationships between dietary exposures and biomarkers, such as the relationship between fat intake and plasma HDL-cholesterol (HDL-C). The premise of such methods is that dietary questionnaires that are unable to capture relatively strong associations with biomarkers are less likely to detect weaker diet-disease relationships. We assessed the comparative performance of a 169-item semi-quantitative FFQ used in a Singaporean multi-ethnic population-based study comprising of 370 Indians, 501 Malay and 1977 Chinese aged between 24 and 95 years. We cross-sectionally examined the relationship between total fat intake (percent of energy intake) and plasma HDL-C concentrations. After adjusting for potential confounders, replacing dietary carbohydrate with fat was associated with a 3.8 % higher plasma HDL-C in the highest quintile of fat intake (35.6% energy from fat) as compared with the lowest quintile (21.7%) ($P_{\text{trend}}=0.02$) in Chinese participants. This association was weaker in Malays (1.8 %, $P_{\text{trend}}=0.79$) and Indians (0.1%, $P_{\text{trend}}= 0.59$). The FFQ appears to be suitable for examining the relationship between fat intake and health outcomes for Singaporean-Chinese, but the validity in Indians and Malays may be limited. Criterion validity using HDL-C as a widely available biomarker is a feasible and cost-effective method of assessing the utility of dietary questionnaires in different ethnic groups.

PP 103

NUTRIENT AND ENERGY CONTENT OF AUSTRIAN SCHOOL SNACKS

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Background: Currently, in Austria a lot of effort is being put on improving the quality of school snacks, especially on available snacks in school canteens and vending machines. However, currently only few data on the extent to which this meal contributes to energy and nutrient intake are available. The aim of the present study was to assess energy and nutrient content of school snacks in Austria and to compare it to intake levels during the entire school days. Methods: A cross sectional study was performed in the course of the project "Austrian Nutrition Report 2008". Current study examined food consumption data of 508 Austrian pupils (49.6% boys, 50.4% girls) aged six to fifteen years. Food consumption data were collected using three day food records and energy and nutrient content was calculated using the German Food Composition Table (BLS 2.3.1). Current analyses only include food consumption data of schooldays.

Results: 19% of all reported meals were consumed in the morning at school and were defined as school snacks. 22 out of the 508 (4.3%) investigated children did not consume any school snack during the observed period. School snacks contributed on average to 17% of total energy intake per day (300 kcal). Carbohydrate, fat, and protein content of school snacks were 59%E (percent of energy), 30%E, and 11%E, respectively. Sucrose intake through school snacks was high and about 18%E. Energy density of school snacks was significantly higher (1.08 g/kcal) compared with energy density of the whole diet (0.87 g/kcal).

Regarding vitamins, school snacks showed higher nutrient densities for folate, vitamin C, and vitamin A as compared to the entire school days; lower nutrient densities were observed for vitamin B1, B2, B6, B12, niacin, pantothenic acid, and biotin. Minerals with high supplies from school snacks were potassium, manganese, copper, and iron; lower nutrient densities were shown for chloride, zinc, iodine, calcium, sodium, phosphorus.

Conclusion: Current study showed that the majority of pupils consumed school snacks and that this meal contributes considerably to energy and nutrient supply. Furthermore, school snacks are good sources for the critical nutrients folate, vitamin A, and iron. However, especially regarding energy density, the potential for improvement of school snacks could be shown.

This study has been funded by the Austrian Federal Ministry of Health, Family and Youth (BMGFJ) within the Austrian Nutrition Report 2008" project.

PP 103 bis

FREE-LIVING PHYSICAL ACTIVITY AMONG CHILD-BEARING AGE URBAN MOROCCAN WOMEN USING A FREQUENCY QUESTIONNAIRE

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Introduction: In Morocco as in many emerging countries, especially in urban areas, nutrition transition is characterized by an increasing level of overweight/obesity. Physical activity (PA) is fundamental to energy balance and weight control, with a possible important role of a sedentary lifestyle in over-nutrition related chronic diseases. Baseline PA data, notably in relation to socio-demography, are lacking. Objectives: To describe PA patterns, energy expenditure (EE) and PA level (PAL) at population level among child-bearing age women from an urban environment and to assess relationship with current socio-demographic factors. Method/Design: Cross-sectional representative survey (2010) in Rabat, the capital city. Two-stage random cluster sample: 895 women (20-49 y). Validated frequency questionnaire was used to assess days and duration of 34 activities in a typical week according to 8 categories: at home (personal care, nursing, household chores, cooking), meals, work, transport, non-sport leisure activities, sports, prayers, and sleeping. Metabolic equivalent (MET) for each activity multiplied by time spent enabled estimation of EE and PAL. Adjusted relationships between activity duration or PAL and 9 socio-demographic variables (living area, household economic level and size, employment of the head of household and woman, woman marital status, educational level, age, and number of children) were estimated by general linear models. Results: Prevalence of overweight (BMI \geq 25 kg/m²) was 66.2% [62.3-70.0], and obesity (BMI \geq 30 kg/m²) 32.4% [28.4-36.4]. Mean EE was 2437 kcal/day of which a majority (57.5%) due to low intensity activities (<3MET) and only 2.6% to high intensity (\geq 6MET) activities, and 19% to sleeping. The contribution of the walking activity was the largest (15.5%). One out of 5 women did not perform any high intensity activities at all, and only 8.0% were doing sports. Mean PAL value was 1.78 (s.e. 0.01), a level which corresponds to a moderately active lifestyle. However, 47% of women had a sedentary lifestyle (PAL<1.70). After adjustment, a higher PAL was related to living in a precarious area ($P=0.0018$), having a professional activity ($P=0.0002$), having children ($P=0.015$) and a higher education level ($P=0.0020$). Conclusions: In urban Morocco where 2 out of 3 women were overweight, lifestyle was sedentary in almost half of the women. Duration of activities and PAL were related to some environmental, social, cultural and familial factors, whatever the economic level. These data will be useful to guide targeted interventions to promote physical activity and prevent a sedentary lifestyle.

PP 104

EXERCISE CAPACITY IN RELATION TO GLYCEMIC EQUILIBRIUM AND DIABETES CHRONIC COMPLICATIONS IN RECENTLY DIAGNOSED TYPE 2 DIABETICS PATIENTS

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Background: Exercise capacity is a predictor of cardiovascular morbidity and mortality. Whether recently diagnosed type 2 diabetic (T2D) patients present a reduced exercise capacity remains controversial. The aim of this study was to evaluate the exercise capacity of recently diagnosed T2D in Cameroon.

Methods: thirty two T2D, 16 healthy controls (NT2D) matched for age, sexe and body mass index (BMI) participated in the study. The T2D were included at 24 months of diagnosis. Cardiac adaptation to exercise was evaluated by heart

rate decay constant (τ) and heart rate recovery at 2 minutes (HRR2) whereas muscular tolerance was determined by the time-to-exhaustion. The exercise test was performed using the Astrand submaximal test. Glycemic equilibrium was determined by the measurement of glycated haemoglobin A1 C level (%HbA1C). The peripheral arteriopathy was the only one macroangiopathy screened by the ultrasonographic method of ankle to brachial pressure index whereas the microangiopathies were retinal, renal and peripheral neuropathy.

Results: There was no statistical difference between groups in matching criteria ($p>0.05$). T2D had muscular exhaustion just after 197 ± 13 seconds versus 275 ± 16 seconds ($p=0.001$). Those who had microangiopathy were exhausted after 168 seconds ($p=0.02$), those with peripheral arteriopathy exhausted after 193 seconds ($p=0.007$). The time-to-exhaustion was inversely related with glycosylated haemoglobin ($r=-0.5$, $p=0.008$). T2D presented with an elongated T (172 vs 133sec, $p=0.001$) and stunted HRR2 (39 vs 45bpm, $p=0.04$). The HRR2 was negatively associated to fasting blood sugar ($r=-0.423$ $p=0.02$). The presence of microangiopathy and peripheral arteriopathy further reduced HRR2 (45 vs 36 bpm, $p=0.03$ and 45 vs 38 bpm $p=0.04$) and prolonged T (133 vs 174 sec, $p=0.02$ and 133 vs 180 sec).

Conclusions: Recently diagnosed T2D presented with a reduced cardiac and muscular exercise capacity. This alteration is more severe in the presence of microangiopathy and macroangiopathy. Limitation in exercise capacity is associated with glycaemic status. This study highlighted on the necessity of early diagnosis and general screening of diabetes mellitus which presents with early alteration of the cardiovascular prognosis in Cameroon

PP 105

PHYSICAL ACTIVITY AND DIETARY HABITS OF THE ANDEAN POPULATION OF THE NORTHWEST OF ARGENTINE

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Globalisation and urbanization may also affect food supply and influence dietary patterns and lifestyle behaviours, as in many Latin-American countries. It can be speculated that a rapid decline in energy expenditure related to shifts towards much less physically demanding occupations and sedentary leisure activities might account for part of the increase in the prevalence of obesity. Physical activity, along with a diet high in fruits, vegetables and whole grains and low in fat and sodium, reduces the risk of overweight, obesity and other chronic diseases.

Objective: To analyse the energy intake, diets habits and physical activity pattern of a representative sample of the population of the Andean region of the Northwest of Argentine.

Materials and methods: A cross-sectional nutritional survey that included one 24h recall, a semi-quantitative food frequency questionnaire and anthropometric measurements was conducted among a representative sample of 688 adult participants (32% male and 68% female). Pregnant and lactating women were excluded. The dietary energy intake (EI) was estimated by means of the 24h dietary recall method. The adequacy of EI was assessed on the basis of the WHO/FAO/UNU recommendations (1985, 2002). Physical activity was recorded using a 24h activity recall list. Overweight and obesity were assessed according to body mass index (BMI). Dietary habits were described according to the mean nutrient and food intake.

Results: The mean adequacy of EI found was low: 64% for men and 75% for women and the mean \pm SD total energy intake of men and women was 1789 ± 779 and 1543 ± 649 kcal/day respectively. The mean physical activity level (PAL) was low and EI total, which was below the total energy expenditure (TEE). The average ratio between basal metabolic rate (BMR) and IE was less than 1.06, which is not compatible with the long-term maintenance of good health.

In this population, the mean BMI indicates a high prevalence of overweight and obesity, with no significant differences between the sexes. Dietary patterns revealed high consumption of farinaceous foods and refined sugars, and low consumption of fiber, pulses and dairy products.

Conclusions: Despite the low average EI, the population under study showed a high prevalence of overweight and obesity, and a high risk of cardiovascular disease according to the central adiposity values. These findings could be explained by the introduction of new high-energy foods and a sedentary lifestyle. Therefore, it is increasingly important for public health programs to focus on healthy eating habits and physical activity that will lead to optimal health.

Keywords: Dietary energy intake, nutritional survey, physical activity, body mass index.

PP 108**SYSTEMATIC REVIEW OF THE RELATIONSHIP BETWEEN SEDENTARY BEHAVIOUR AND HEALTH IN INFANTS, TODDLERS, AND PRESCHOOLERS**

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The early years (<5 years) represent a critical period for promoting health and healthy behaviours. Sedentary behaviour (SB) may be a threat to the promotion of healthy growth and development. Therefore, the purpose of this systematic review was to determine the relationship between SB and health indicators during the early years. Specifically, using the GRADE framework, this review (PROSPERO registration: CRD42011001280) aimed to present the best available evidence to determine the minimal and optimal amount of SB needed to promote healthy growth and development (i.e. healthy body weight, bone health, motor skill development, psychosocial health, cognitive development and cardio-metabolic indicators) in infants (1 month-1 year), toddlers (1.1-3.0 years) and preschoolers (3.1-5.0 years). Online databases (Ovid_MEDLINE, Ovid_EMBASE, Ovid_pscINFO, EBSCO_SPORTDiscus and Cochrane Central Database), personal libraries and government documents were searched for relevant studies examining the relationship between SB and the above mentioned health indicators. Only high quality studies (i.e. experimental, intervention or prospective cohort studies) were included in the review. -Twenty-six studies met inclusion criteria; of these, 11 studied the relationship between SB and adiposity, 14 between SB and cognitive development and 7 between SB and psychosocial development. No included studies examined the relationship between SB and motor skill development, bone health or cardio-metabolic indicators. Seven studies looked at these health outcomes in infants, 13 in toddlers and 13 in preschoolers. There was moderate evidence to suggest television viewing elicited no benefits and may be harmful to the cognitive development of infants and low quality evidence to suggest increased TV viewing was associated with unfavourable BMI. In toddlers, there was moderate evidence to suggest television viewing has a negative impact on cognitive development, moderate evidence suggesting its negative impact on adiposity and moderate evidence to suggest it negatively affected psychosocial health. In preschoolers, there was moderate evidence on the relationship between television and cognitive development, low to moderate evidence on television's negative impact on adiposity and low evidence between increased television and decreased scores on measures of psychosocial health. In conclusion, this review has found low to moderate quality evidence to suggest that increased television viewing is associated with unfavourable adiposity and decreased scores on measures of motor skill development and psychosocial health. As no benefits of increased television viewing were found, it is recommended that those <5 years should avoid exposure to sedentary screen time and especially television. Future work may use this evidence to inform public health guidelines.

RESULTS AND RECOMMENDATIONS FROM THE 2011 ACTIVE HEALTHY KIDS CANADA REPORT CARD ON PHYSICAL ACTIVITY FOR CHILDREN AND YOUTH

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Though scientific evidence continues to reinforce the health benefits of physical activity for children and youth, physical activity remains at alarmingly low levels in Canada. As a physical activity promotion strategy at the population level, Active Healthy Kids Canada released The 2011 Active Healthy Kids Canada Report Card on Physical Activity for Children and Youth (2011 Report Card), a knowledge translation tool that assesses how Canada is doing as a country at promoting and facilitating physical activity opportunities for children and youth.

The 2011 Report Card represents a comprehensive review of the literature and surveillance data analyzed and/or published in Canada in 2010 that relates to the physical activity of Canadian children and youth. Twenty-three indicators were organized into 6 categories (Physical Activity; Sedentary Behaviour; School; Family and Peers; Community and the Built Environment; Policy). A research work group of experts from across Canada convened to evaluate the aggregated evidence and assign letter grades for each physical activity indicator.

A theme focussing on the afterschool period for physical activity opportunities was the cover story for the 2011 Report Card. A short-form (6-page fold out) and long-form (83-page background rationale for grades) were published in English and French, in print and electronically, and distributed through a national network of partners and through a comprehensive media and public relations strategy.

The Physical Activity Levels indicator was graded an "F" (fail) for the fifth year in a row. Other indicators receiving a failing grade included Active Play and Leisure, Screen-Based Sedentary Behaviours and Federal Government Investments. Several indicators were graded "Incomplete" due to lack of data and highlight areas where future research needs to be directed including Non-Screen Sedentary Behaviours, Peer Influence and Nature and the Outdoors.

Little improvement was seen across indicators compared to previous years, signalling the need for more work across public and private sectors to provide and facilitate opportunities for physical activity among Canadian children and youth. Recommendations that may contribute to improvements in the grades include: social marketing efforts that communicate to children and youth the importance of lifestyle-embedded physical activity on a daily basis; implementation of household rules that permit only 1-2 hours of screen time per day; investigation of interventions that encourage families to be physically active together; and, strategies that change how adolescents view their community and built environment in an effort to increase the usage of public facilities, programs, parks and playgrounds.

PP 110

EVALUATION OF PHYSICAL ACTIVITY QUALITY DURING THE 2ND TRIMESTER OF PREGNANCY

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Background: Prenatal physical activity may improve maternal and infant health and lower future disease risk for both mother and baby. There are different guidelines for prenatal physical activity (PA) in the United States. ACOG currently recommends that pregnant women *accumulate 30 minutes* or more of moderate-intensity exercise on most, if not all, days of the week.

Recommendations in the 2008 Physical Activity Guidelines (US DHHS) state that pregnant women should engage in *a minimum of 150 minutes* of moderate-intensity aerobic activity a week.

However, for non-pregnant individuals, it is recommended that individuals complete moderate PA in at least 10 minute bouts. International recommendations are similar. As evidence accumulates for the physiological benefits of prenatal PA, little attention has been paid to the amount of time spent in sedentary/light (< 3 METs) activity. The purpose of this study was to describe time spent in sedentary/light, and moderate /vigorous (≥ 3 METs) PA during the 2nd trimester of pregnancy.

Methods: Forty-four pregnant women completed a physical activity record (PAR) and wore a SenseWear® Mini Armband (SWA) activity monitor over a 7-day period at 18 weeks gestation. Total minutes spent in sedentary, light, moderate and vigorous PA were summed from both modalities.

Time spent in moderate/vigorous PA in bouts >10 minutes were calculated from the PAR. **Results:** According to the SWA, 95% (n = 42) of the women met the recommendation of at least 150 minutes of moderate PA per week. However, of these women, only 10 (23%) met the recommendation when the criterion of a 10 minute bout was applied. An average of 1369 ± 36 minutes was spent in sedentary/light activity representing 95% of a day. There was no difference in time spent in sedentary/light time for the women that were exercisers (1363 ± 24)

(per the 10 minute bout criteria) compared to those that accumulated 150 minute moderate PA throughout the day.

Conclusion: From this analysis, it appears that the women in this study were very active according to prenatal PA recommendations. Regardless of time spent in moderate PA, nearly their whole day was spent in sedentary/light behavior. Future studies should assess the quality of prenatal PA by examining the health consequences of spending an excessive amount of time in sedentary/light activity regardless of meeting current prenatal PA recommendations.

PP 111

PATTERNS OF NEIGHBORHOOD ENVIRONMENT ATTRIBUTES RELATED TO PHYSICAL ACTIVITY ACROSS 11 COUNTRIES

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Neighborhood environmental studies used to support public policy recommendations have been mainly single-country focused, primarily in high-income countries. The International Prevalence Study (IPS) was a surveillance study of physical activity (PA) conducted in 20 diverse countries, presenting a rare opportunity to examine neighborhood features across countries. The purpose of this secondary analysis was to: 1) detect international neighborhood typologies based on participants' response patterns to an environment survey, 2) to classify participants into detected subgroup patterns, and 3) to estimate associations between detected subgroups and PA.

A Latent Class Analysis of pooled IPS adults (N=11,541) aged 18 to 64 years old (mean=37.5 \pm 12.8 yrs; 55.6% women) from 11 countries was conducted including Belgium, Brazil, Canada, Colombia, Hong Kong, Japan, Lithuania, New Zealand, Norway, Sweden, and the U.S. This subset adopted the optional Physical Activity Neighborhood Environment Survey (PANES) that briefly assessed 7 core aspects within 10-15 minutes walk of participants' residential neighborhoods including: residential density, access to shops/services, recreational facilities, public transit facilities, presence of sidewalks and bike paths, and likelihood of crime. LCA derived meaningful subgroups from participants' response patterns to PANES items and participants were assigned to detected subgroups. The validated short-form International Physical Activity Questionnaire (IPAQ) measured likelihood of meeting the 150 minutes/week PA guideline. Meeting the guideline was regressed on detected subgroups using a weighted generalized linear regression model, adjusting for gender, age and country.

A 5-subgroup solution fitted the dataset best and was interpretable. Subgroups were labeled, “Overall Activity Supportive (52%)”, “High Walkable and Unsafe with Few Recreation Facilities (16%)”, “Safe with Active Transport Facilities (12%)”, “Transit and Shops Dense with Few Amenities (15%)”, and “Safe but Activity Unfriendly (5%)”. Country representation differed by subgroups (e.g., U.S. disproportionately represented Safe but Activity Unfriendly). Compared to the Safe but Activity Unfriendly subgroup, two subgroups showed significantly greater odds of meeting PA guideline (High Walkable and Unsafe with Few Recreation Facilities, OR = 2.26 (95% CI 1.18-4.31); Overall Activity Supportive, OR = 1.90 (95% CI 1.13-3.21)).

Meaningful patterns of neighborhood attributes generalized across countries and explained practical differences in PA. These results support WHO/UN recommendations for programs and policies targeted at features of the neighborhood environment that increase PA.

PP 112

MEETING CURRENT PHYSICAL ACTIVITY GUIDELINES, INDEPENDENTLY OF SEDENTARY TIME, IS DETERMINANT FOR OBESITY PREVENTION IN CHILDHOOD AND ADOLESCENCE

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Background: Current physical activity (PA) guidelines for children and adolescents advocate that performing at least 60 min/day of moderate-to-vigorous PA (MVPA) is important to achieve health benefits. However, recommendations also recognize the need of reducing sedentary behaviours in youth. The main goal of this study was to analyse the association between being sufficiently active and the risk for being overweight or obese, independently of the time spent in sedentary behaviours. **Methods:** A total of 1232 boys and 1237 girls (aged 11.3 ± 1.5 years old) were assessed for PA using objective data with accelerometers (*Actigraph*, model GT1M). Body mass index was assessed and categorized into overweight or obesity using age and gender specific cut-offs according to the Center for Disease Control and Prevention (CDC). Binary logistic regression models were used to analyse if meeting the PA guidelines was associated with the odds ratio (OR) for obesity or overweight. Both models were adjusted for sedentary time and gender. **Results:** Binary logistic model showed that, independently of the time spent in sedentary behaviours, not complying with the 60 min/day of MVPA is associated with an increased OR for overweight (OR = 1.508; 95% CI: 1.221-1.863). Nevertheless, children and adolescents that do not meet PA guidelines presented an increased OR for obesity (OR = 2.024; 95% CI: 1.480-2.770). **Conclusion:** Our results indicate that children and adolescents that meet the current PA guidelines showed a lower risk of being overweight and obese, regardless of time spent in sedentary behaviours. These findings reinforce the importance of PA promotion in schools and other settings, in order to prevent paediatric obesity.

Keywords: physical activity guidelines, overweight, obesity, sedentary time.

PP 113

ATTITUDES TOWARDS PHYSICAL ACTIVITY ARE ASSOCIATED WITH THE RISK OF BEING INSUFFICIENTLY ACTIVE

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Background: Current physical activity (PA) guidelines for children and adolescents advocate that perform at least 60 min/day of moderate-to-vigorous PA (MVPA) is determinant for achieving health benefits associated with PA. The main goal of this study was to analyse the attitudes towards PA that represent a risk for not complying with the recommended PA guidelines. **Methods:** A national survey with a cross sectional sample of 448 boys and 580 girls (aged 10-18 years old) was used. MVPA was assessed using objective data with accelerometers (*Actigraph*, model GT1M). Attitudes for PA, namely the priority of PA in life, the comfort when performing PA, enjoying PA, and the lack of time for performing PA, were investigated. Binary logistic regression models were developed to analyse if these attitudes were associated with the odds ratio (OR) for not complying with PA guidelines. **Results:** Binary logistic model demonstrated that, adjusting for gender, the most important predictors for meeting the PA guidelines were the priority of PA in life and the lack of time to perform PA. Children and adolescents that did not consider PA as a priority for their daily life had an increased OR for being insufficiently active (OR = 2.587; 95% CI: 1.347-4.969). Children and adolescents, who did not face PA as a priority, presented lower mean MVPA values of 11.4 ± 1.7 min/day compared to those who consider PA a priority. The lack of time was also associated with OR for the lack of compliance with the guidelines (OR = 2.247; 95% CI: 1.493-3.382), with lower MVPA values of 11.5 ± 1.5 min/day when compared to those that did not report lack of time to perform PA. **Conclusion:** Children and adolescents that do not consider PA as a priority in their daily life and that reported lack of time to PA presented an increased risk of being

insufficiently active. Our results highlight the importance of promoting PA throughout adolescence and to encourage leisure time PA to facilitate the compliance with the current guidelines.

Keywords: physical activity guidelines, attitudes, children, adolescents.

Topics: Exercise, physical activity and recommendations; Diet and physical activities methodologies for children

PP 114

HEALTH EFFECTS MEASUREMENT OF DANCE CLASSES COMBINED WITH NUTRITIONALLY BALANCED DIET AND β -GLUCAN FIBRE DRINK

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Purpose: Cereal β -glucan, as a dietary fibre component, is being discussed as a potential obesity prevention strategy. We have evaluated whether or not a cereal β -glucan fibre drink (Actiglucane) added to a nutritionally balanced diet, combined with dance exercise, reduces anthropometric variables measured by InBody 720 and improves glucose and insulin fasting level as well as lipid profile in an 8 week long intervention study.

Methods: Young obese women (body fat percentage higher than 29%; n=45) were assigned into 3 equal intervention groups: drink (D), drink and exercise (DE) and exercise (E). 45g of Actiglucane concentrate (what provides 3g of β -glucan per day) was diluted in water and consumed with midmorning and afternoon meal in D and DE group avoiding other diet regime changes. E and DE group attended regularly newly designed dance exercise program Bellylatinofit (3 times a week, 75 minute per session) without additional diet or lifestyle changes.

Results: Actiglucane addition into the diet (D, DE) caused statistically significant changes in total fat and energy intake (evaluated with Alimenta nutrition software). Presented energy and fat drop in D and DE group, combined with exercise (DE) or exercise only (E) resulted in total weight (D: 2.0kg, DE: 2.6kg, E: 1.5kg), fat mass (D: 1.8kg, DE: 2.5kg, E: 1.0kg) and visceral fat area (D: 8.4cm², DE: 9.5cm², E: 5.5cm²) reduction.

Conclusions: The addition of β -glucan fibre drink into the diet, especially combined with Bellylatinofit dance exercise resulted in a significant fat mass loss and improvement of blood lipid profile, what may be used in obesity and cardiovascular disease prevention programs.

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PP 115

OBESITY, PHYSICAL INACTIVITY, AND HOMEOSTASIS MODEL ASSESSMENT (HOMA) AS PREDICTORS FOR PREDIABETES AMONG EGYPTIAN ADOLESCENTS

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The overall global prevalence of type 2 diabetes mellitus DM is rising steadily with an evolving epidemic among adolescents. This study was carried out to revise the prevalence of glucose disorders among adolescents, to test for the presence of insulin resistance among those with glucose disorders particularly the obese, to clarify the association between obesity and physical inactivity and dietary fat, and to test HOMA-R and fasting blood glucose as screening and monitoring tests among adolescents with glucose disorders. This study a part of a national Egyptian survey on (Diet, Nutrition, and Prevention of Non-communicable Diseases) which was carried out during the period between May 2003 and June 2004 by teams of national nutrition Institute (NNI). A probabilistic multistage cross-sectional sample representative of Egyptian preparatory and secondary school students was taken. Out of 6018 adolescents, 4251 were assessed by measuring their fasting blood glucose levels. Those were the targets of this study. Three main types of data were reported (medical, dietary and social) to cover topics related to obesity, diabetes, hypertension and physical activity. Blood pressure, weight, height, waist and BMI were measured and referred to their corresponding international reference values properly matched for age and sex. A Fasting blood sample was drawn to assess lipid (total cholesterol; TC, and triglycerides; TG), lipoprotein patterns (low density lipoprotein; LDL-c, and high density lipoprotein; HDL-c), and fasting plasma insulin. HOMA was calculated using a computer-derived equation to assess body response to insulin among target groups. Main results of this work showed that the prevalence of D.M. among Egyptian adolescents is 0.7% with no age, gender, or area of residence predilections. Pre-diabetic state was present among 15.0% of adolescents in the pre-pubertal stage up to 21.0% of adolescents in the post-pubertal stage. Fasting lipid and lipoprotein profile were similar in all glucose categories but high blood pressure; of either type, was more prevalent among the pre-diabetic

adolescents. Obese adolescents are more to have DM in their families than non-obese. The risk for adolescents with BMI above 85th percentile to have high systolic or diastolic blood pressure, high TC, high TG, or high LDL-c was nearly double that for non-obese as reflected by odds ratio. The risk was three times more in presence of central obesity (waist circumference > 90th percentile). Receiving more than 30% of total energy from fat was more prevalent among adolescents with central obesity. Physically inactive adolescents have 1.5 times the risk for obesity, and 1.2 the risk for diastolic hypertension more than the physically active adolescents. In conclusion, type 2 DM in young is serious in terms of morbidity and mortality suggesting that it may be appropriate target for screening. School-based programs promoting healthy eating and increasing physical activity are recommended for prevention of obesity. Major governmental actions that focus on lifestyle will be required. Hypertension and dyslipidemia are common among obese adolescents and require active intervention to postpone long term cardiovascular complications. Population-based prevalence studies among adolescents are still urgent for proper detection, diagnosis, and management strategies.

PP 116

ASSOCIATION BETWEEN EATING RESTRAINT AND ENERGY UNDERREPORTING HIGHER AMONG CAUCASIANS THAN AFRICAN-AMERICANS

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Underreporting is prevalent in most dietary studies and there is a need to reliably identify individuals who may underreport energy intake. We used confirmatory factor analysis to examine cognitive restraint eating among African Americans (AA) and Caucasians (C) and their associations to energy underreporting. The data comes from a population of 244 AA and C from Los Angeles who participated in the Energetics Study, designed to test the validity of a web-based automated 24-hour recall (DietDay) using doubly labeled water (DLW) as a biomarker for true energy. Energy underreporting was defined as reported energy intake over total energy expenditure (TEE) with a ratio of less than 0.70. Results show that the factor structure and factor loadings for eating restraint among AAs and Cs were very similar, and the alpha-reliabilities for the eating restraint scale were 0.82 for AA and 0.83 for C. We examined the associations of high, medium and low eating restraint with energy underreporting. Results show that for the overall sample, high (odds ratio = 2.9; 95% CI, 1.1-8.3) and medium eating restraint (odds ratio = 2.3; 95% CI, 1.1-6.2) were significantly associated with energy underreporting, after adjusting for age, gender, education, BMI and physical activity. AA were significantly less likely to underreport their energy intake (odds ratio = 0.37; 95% CI, 0.12-0.67). We also found significant dose-response associations between eating restraint and energy underreporting among C but not among AA. For C, a strong association between an eating restraint score of 9 or more (out of 21) was evident. This corresponds to a higher increased risk of 3.3 times for C to underreport. Eating restraint assessments may therefore be useful to identify and evaluate underreporting among AA and C.

PP 117

UNDERREPORTING OF ENERGY INTAKE IN ADULTS AND ELDERLY RESIDING IN THE CITY OF SÃO PAULO, BRAZIL.

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Introduction. Some individuals report energy intakes below the minimum requirement of energy for maintaining body weight. Thus making it difficult to comprehend the relationship between diet and health outcomes. **Objective.** Describe the prevalence of underreporting in adults and elderly according to sex and nutritional status. **Methods.** A sample of 365 adults and elderly from a cross-sectional population-based study called “Inquérito de Saúde de São Paulo – Capital 2008 (ISA-Capital 2008)” (São Paulo Health Survey) was analyzed. Height and weight were measured to calculate Body Mass Index (BMI). All subjects were sorted into two groups: Group 1 – normal weight (BMI < 25 for adults and BMI < 27 for elderly) and Group 2 – overweight (BMI ≥ 25 for adult and BMI ≥ 27 for elderly). Pregnant women, nursing mothers and subjects who reported a weight loss diet were eliminated from the analysis. Energy intake (EI) was evaluated by the mean of two 24-hour recalls collected in non-consecutive days. Total energy expenditure (TEE) was calculated according to Vinken’s et al (1999) equation developed for individuals age 18 to 81. In order to estimate energy intake underreporting we used the approach described by Mc Crory et al. (2002). The individuals whose energy intake was below 1 standard deviation of the ratio EI/TEE (method 1) and below 2 standard deviations of the ratio EI/TEE (method 2) were defined as underreporters. We used test of proportion for complex samples and values of $p < 0.05$ were considered significant. **Results.** The prevalence of underreporting estimated by method 1 was 66.8 percent and by method 2 was 15.3 percent. There was no statistically significant difference in underreporting prevalence between the sexes in both methods, although marginal association was observed in females by method 1 (72.2 percent; $p = 0.055$). Regarding the nutritional status, prevalence of underreporting of energy intake was significantly greater in overweight individuals only by

method 1. The prevalence of underreporting in overweight individuals was 76.0 percent by method 1 and 18.8 percent by method 2.

Conclusion. The prevalence of underreporting of energy intake differs significantly according to the cut-off point used and it was higher in overweight individuals. Our results suggest that underreporting of energy intake may compromise the validity of the results of population studies on diet and health, especially when being overweight can be a common characteristic of the individuals being studied.

PP 118

LAPLACE REGRESSION: A NOVEL METHOD FOR MODELING SURVIVAL DATA

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Cohort studies are conducted to prospectively assess the association between an exposure (e.g.: intake of specific nutrients, foods or dietary patterns) and the risk of an event (e.g.: death, incidence of myocardial infarction). Findings from possibly censored time-to-event data, collected from those studies, are often summarized in terms of hazard rate ratios or incidence rate ratios (commonly reported as relative risks).

The interpretation of these summary measures may be however problematic and it may be difficult for laypeople to understand these results. Therefore, we illustrate an alternative way of analyzing prospective studies. This approach, whose results are easily understandable by anyone (measures of association expressed in days, months, years), focuses entirely on percentiles of the time to some event, like median survival, conditionally on exposure and confounding variables. We utilize Laplace regression.

To show the potentials of this approach and its simple interpretation, we study the relationship between body mass index and time to death from any cause (expressed in years) in a population-based cohort of middle-aged and elderly Swedish men.

PP 119

MEASURES OF ABDOMINAL OBESITY WITHIN BODY MASS INDEX CATEGORIES, 1981 AND 2007-2009

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Introduction: Recent research has found that the waist circumference of Canadian adults with a given BMI value is now larger than in the past, similar to findings for the United States. Therefore, it is important to measure and monitor abdominal obesity within BMI categories. The primary objective of this study was to examine changes in abdominal obesity within BMI categories, based on waist circumference, waist-to-hip ratio, and waist-to-height ratio. **Methods:** This study assessed changes in obesity indicators between 1981 and 2007-2009 in Canadians aged 20 to 69 years, based on measured data collected in two population-based health surveys. Recent estimates are from the 2007-2009 Canadian Health Measures Survey (CHMS), which collected data at 15 sites across the country from 2007-2009. The survey covered the household population aged 6 to 79 years. The sample represented approximately 96% of the population. In addition to a questionnaire, the survey involved a series of physical measures at a mobile examination centre. The CHMS estimates in this article are based on 3,074 respondents aged 20 to 69 years. The overall combined response rate was 51.0%. Historical estimates are based on the Canada Fitness Survey (CFS), which collected data from a nationally representative sample of the population in 1981. The sample consisted of 13,500 households. The overall response rate for the physical measures component of the survey was 49%. The CFS estimates in this article are based on 10,605 respondents aged 20 to 69 years. Height, weight, waist and hip circumferences were directly measured by trained technicians. BMI, waist-to-hip ratio and waist-to-height ratio were calculated and interpreted according to standard procedures. **Results:** Among normal-weight men, the percentages at increased/high health risk based on these three abdominal obesity measures were not statistically different in 2007-2009 than in 1981. In contrast, among normal-weight women, increases were observed in the percentage at increased/high health risk based on each of the three measures. The percentage of overweight men at increased/high risk based on waist circumference rose from 49% in 1981 to 62% in 2007-2009, and among overweight women, the percentage at increased/high risk rose for each of the three measures (65% to 93% for waist circumference, 22% to 51% for waist-to-hip ratio, and 68% to 87% for waist-to-height ratio). Although substantial percentages of men and women in obese class I were at increased/high health risk based on abdominal obesity measures in 1981, by 2007-2009, almost everyone in this BMI category was at increased/high risk. **Conclusions:** This study reveals that abdominal obesity within BMI categories is increasing. As a result, Canadians with a given BMI are at higher risk of obesity-related health conditions than they were in 1981. The results of this study underscore the importance of measuring and monitoring abdominal obesity within BMI categories.

PP 120

DOES SELF-REPORTING OF HEIGHT AND WEIGHT IMPACT ON ASSOCIATIONS OF OBESITY WITH PHYSICAL ACTIVITY, SEDENTARY TIME AND EATING BEHAVIOURS?

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Background: Misreporting of height and weight can lead to the misclassification of body mass index (BMI) and overweight and obesity. Random or systematic biases in reporting may result in spurious estimates of associations, but how large the impact of misreporting is, and whether it should be of concern, is unknown. We explored the impact of using self-reported versus objectively-measured height and weight on associations with obesity-risk behaviours: physical activity, sedentary time and eating behaviours.

Methods: In 2004-6, 2410 Australian adults (age 26-36 years) attended one of 34 study clinics as part of the Childhood Determinants of Adult Health study. A sub-sample of attendees self-reported height and weight immediately prior to objective measurement (n=1523). Body mass index (BMI) was calculated and used to classify overweight (BMI 25-29.9kg/m²) and obesity (BMI ≥30kgm²). Participants wore pedometers; self-reported physical activity and sitting via the International Physical Activity Questionnaire (long version); and self-reported television (TV) viewing. Participants completed a dietary questionnaire. Intake of fruit, vegetables, dairy, lean meat, and bread and cereals was compared to the recommendations from the Australian Guide to Healthy Eating. The total number of dietary guidelines met was calculated, and consumption of take-away foods, fish, and breakfast was assessed. Multinomial logistic regression was used to calculate odds ratio (OR) and 95% confidence intervals (CI) for associations between obesity-risk behaviours and overweight and obesity, separately for objective and self-reported measurements, and results compared.

Results: Based on objectively-measured height and weight, 34.8% and 15.0% of participants were overweight and obese, respectively; using self-reported height and weight, the prevalence of overweight and obesity was 35.5% and 14.8%. Per cent agreement between classifications of weight status based on objective and self-report measures was 89.4% with a significant Kappa coefficient of 0.82. Few differences were observed in associations between physical activity or sedentary time and objectively-measured or self-reported weight status, although leisure-time physical activity was associated with obesity when weight status classification was based on self-reported height and weight (OR 0.59, 95% CI 0.38-0.93), but not objective measures (OR 0.75, 95% CI 0.49, 1.17). No differences were observed in associations with any of the dietary behaviours according to objectively-measured or self-reported weight status.

Conclusion: The use of self-reported measures of height and weight appeared not to be a source of bias in quantifying associations between obesity-risk behaviours and overweight and obesity in this sample of young Australian adults.

PP 121

ABDOMINAL OBESITY AND CARDIOVASCULAR DISEASE RISK FACTORS WITHIN BODY MASS INDEX CATEGORIES

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Introduction: Several organizations recommend that measures of abdominal obesity be used in conjunction with body mass index (BMI) categories to assess obesity-related health risk. Recent evidence suggests that the obesity phenotype among Canadians has changed: measures of abdominal obesity (waist circumference (WC), waist-to-hip ratio (WHR) and waist-to-height ratio (WHtR)) are increasing within BMI categories. This shift may have affected the utility of abdominal obesity categories and their relationship with cardiovascular disease (CVD) risk factors. The purpose of this study was to examine associations between measures of abdominal obesity and CVD risk factors within the BMI health-risk categories. **Methods:** Data are from respondents aged 20 to 79 years from the 2007-2009 Canadian Health Measures Survey which collected data at 15 sites across the country. The sample represented approximately 96% of the population. In addition to a questionnaire, the survey involved a series of physical measures at a mobile examination centre. Estimates in this study are based on respondents who were part of the fasted sub-sample. Pregnant women were excluded as well as those classified as underweight based on body mass index (BMI < 18.5 kg/m²) leaving a total of 1,662 participants. The overall combined response rate for the fasted sub-sample was 46.3%. Height, weight, waist and hip circumferences were directly measured by trained technicians. BMI, waist-to-hip ratio and waist-to-height ratio were calculated and interpreted according to standard procedures. The CVD risk factors considered in this study were components of the metabolic syndrome based on the new harmonized definition which requires having three or more of the following CVD risk conditions: high blood pressure (systolic ≥ 130 mmHg or diastolic ≥ 85 mmHg); high triglycerides (≥ 1.7 mmol/L); low high-density lipoprotein (HDL) cholesterol (<1.0 mmol/L for men, and <1.3 mmol/L for women); high fasting blood glucose (≥ 5.6 mmol/L); abdominal obesity. Abdominal obesity was omitted as a component since the purpose of the study to examine CVD risk factors in relation to abdominal obesity. Using logistic regression, this study examined CVD risk factors in relation to WC, WHR and WHtR *within* BMI health-risk categories. **Results:** Among men in the normal and the overweight BMI categories, WHR and WHtR were positively associated with having two or more CVD risk factors. All three measures of central obesity were associated with

increased odds of having two or more CVD risk factors among women in the normal weight category. Abdominal obesity was not associated with CVD risk factors for those in the obese class I category. Obese class II and III categories were not examined because previous studies have found that measures of abdominal obesity are not associated with additional health risk within these categories **Conclusion:** Even among men and women in the normal BMI category, measures of abdominal obesity are associated with increased odds of CVD risk factors. This underscores the importance of measuring and monitoring abdominal obesity among normal-weight men and women.

PP 122

ASSOCIATION OF SAGITTAL MEASURE (PROXY OF VISCERAL FAT) WITH OTHER ANTHROPOMETRIC MEASUREMENTS IN ELDERLY WOMEN AND MEN

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Background: Abdominal obesity is defined as the accumulation of abdominal fat leading to an increased waist circumference. There is a strong correlation between abdominal obesity and chronic diseases, especially cardiovascular disease. Visceral fat (also known as organ fat or intra-abdominal fat) is located inside the peritoneal cavity, packed in between internal organs and torso. An excess of visceral fat is known as central obesity. Because it is not possible to measure the visceral fat directly in large epidemiological studies, a proxy measurement is needed. Therefore, we wanted to explore how well sagittal measure corresponds to other anthropometric measurements.

Methods: In a clinical examination of men from the Cohort of Swedish Men and women from the Swedish Mammography Cohort, we measured the sagittal measurement as well as length, weight, hip and waist circumference. In total we have collected data from 782 men (age 80-92) and 200 women (age 66-91). The sagittal measure was assessed by measuring the distance from the small of the back to the upper abdomen at the point midway between the top of the pelvis and the bottom of the ribs measured while lying on the back.

Result: The overall mean sagittal measure among men was 22.6 cm (SD=3.1) and 21.0 (SD=3.1) among women. The values among individuals with BMI>30 were 27.9 (SD=2.6) for men and 25.4 (SD=2.6) for women. The mean values for individuals with normal BMI (20-25) are 20.7 (SD=1.7) for men and 19.0 (SD=1.5) for women. We found that the Pearson correlation coefficients were high when comparing sagittal measures with BMI and waist circumference. The correlation between sagittal measure and waist circumference was 0.87 for men and 0.86 for women. The corresponding correlation between sagittal measure and waist-hip ratio (which is a commonly used measurement) was lower, 0.62 for men and 0.53 for women. The correlation between sagittal measure and BMI was 0.84 and 0.88, respectively. When comparing BMI and waist circumference, we observed a correlation of 0.86 in both men and women.

Conclusions: Our results indicate that waist circumference and BMI are highly correlated with the sagittal measure in an elderly and old population of men and women and thus can be used in epidemiological studies where assessment of the individuals' abdominal fat is needed, whereas the waist-hip ratio is not as good proxy for abdominal fat.

PP 123

WHO ARE THE MIS-REPORTERS? A COMPARISON OF 3 METHODS TO IDENTIFY SOCIO-DEMOGRAPHIC CHARACTERISTICS OF MIS-REPORTERS IN A POPULATION OF MOROCCAN WOMEN

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Introduction: When measuring food intake, one of the most important sources of bias is the misreporting of food consumed, either the quantity or type, as respondents may not report having eaten some food items nor may they accurately recall the quantity (intentionally or not).

Objectives: i) to compare the effect of using 3 different approaches on identifying mis-reporters (MR); ii) to investigate the socio-demographic and anthropometric characteristics of MR vs. 'accurate reporters' (AR).

Method: A cross-sectional survey was conducted in 2009-2010 in Rabat-Salé of 894 randomly selected women (20-49y) within 45 randomly selected clusters. The socio-demographic characteristics investigated were: age, marital status, number of children, educational level, employment and economic status. A single 24 hour recall was used to assess energy intake. The 3 methods used to identify MR were: i) The Goldberg cut-off; ii) arbitrary threshold between 500-3500 kcal; iii) Thresholds excluded at the lower and upper 5% of the distribution.

Results: The Goldberg cut-off method identified 38.0% of women as MR (n=340) and the Mean energy intake was 1986 kcal ([1914-2058]) for the AR women (n=554); MR were more likely to be uneducated (50.8% MR vs 35.9% AR never attended school, p<0.001), have a lower economic level (36.3% MR vs. 30.1% AR in the lowest tertile, p<0.05), be obese, i.e. BMI ≥ 30 kg/m² (39.8% MR vs. 28.1% AR, p<0.05) compared to AR. The arbitrary cut-off identified 4.4% of women as MR (n=39) and the Mean energy intake was 1625 kcal ([1570-1680]) for the AR women (n=855); MR were more likely to be unmarried (55.6% MR vs. 32.9% AR, p<0.01). Thresholds at the lower and upper 5% of the

distribution identified 10.0% of women as MR (n=88) and the Mean energy intake was 1617 kcal ([1568-1666]) for the AR (n=806); there was no difference in socio-demographic characteristics between MR and AR.

Conclusion: None of the 3 approaches was entirely satisfactory for different reasons. With the Goldberg cut-off, assessment of energy intake appears more realistic (based on average energy requirements) but it resulted in the loss of almost 40% of the sample, i.e. much more than the other 2 methods. However their accuracy in assessing Mean energy intake appears less realistic. Therefore, whilst the Goldberg method is the most accurate, it compromises the socio-demographic diversity of the sample. In this study, using arbitrary cut-offs is the method which provides the best compromise between Mean energy intake and maintaining socio-demographic diversity.

PP 124

DECREASED UNDERREPORTING OF ENERGY INTAKE AFTER WEIGHT LOSS AMONG LACTATING OVERWEIGHT AND OBESE WOMEN

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Background

Underreporting of energy intake is a well recognized problem, which is increased in overweight and obesity. However, whether underreporting is decreased by weight loss in this group has not been studied. This has implications for analysing and understanding dietary data collected during interventions and treatments among overweight and obese individuals.

Objective

We here aim to investigate whether underreporting of energy intake changed in relation to achieved weight loss, among overweight and obese lactating women taking part in a lifestyle weight loss intervention.

Methods

At 10-14 wks postpartum, 68 lactating Swedish women with a pre-pregnancy body mass index of 25-35 kg/m² were randomized to 12 week dietary behavior modification treatment (D) to decrease energy intake, physical exercise behavior modification treatment (E) to implement moderate aerobic exercise or combined treatment (DE) or usual care (controls, C). Energy intake (EI) from dietary records for mother (4-day weighed) and infant (interview), body composition (BC), (dual x-ray absorptiometry, DXA), total energy expenditure (doubly labelled water (DLW), TEE) and breastfeeding data to calculate milk energy output (MEO) were collected at baseline and post intervention. Total energy output (TEO=TEE + MEO) was estimated with representative values for milk production during exclusive breastfeeding and corrected for energy of the infant's complementary foods. Baseline TEO is equal to true EI, during weight stability. Post intervention TEO corrected for the energy contribution of BC-changes was used as an objective measure of EI and energy balance over time. Underreporting of EI was calculated as the relative (%) difference between (a) baseline TEO and reported EI, and (b) post intervention BC-corrected TEO and reported EI. Linear regression was used to analyze the effect of weight loss on change in underreporting.

Results

All 61 women who completed baseline and follow up measurements underreported baseline EI relative to estimated true EI with C 33±36, D 37±28, E 24±20, DE 30±23 % respectively, irrespective of which treatment group they were thereafter randomized to (p=0.612 for difference). Estimates of true post intervention EI revealed that underreporting at follow up was, for C 58±52, D 32±49, E 40±31, DE 25±35 % respectively, with no difference between groups (p=0.174). However, weight loss, which mainly occurred in the D and DE groups, was associated with decreased underreporting of EI (p<0.001).

Conclusions

Weight loss is associated with decreased underreporting of energy intake among overweight and obese lactating women.

PP 125

CHARACTERISTICS AND DIETARY INTAKES OF ADULT MIS-REPORTERS ENTERING A WEIGHT LOSS STUDY

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Accurate reports of dietary intake within weight loss interventions will help identify food patterns amenable to change. Studies suggest that mis-reporting of energy intake occurs in 12% to 50% of subjects and is associated with specific socio-demographic characteristics such as a high BMI, gender, desire for weight change, social desirability, higher dietary restraint scores, and use of food frequency questionnaires to measure intake. Identifying specific characteristics

of mis-reporters and their dietary patterns will assist in interpreting dietary intake changes in weight loss interventions and in refining dietary strategies for weight loss. The study aims were to identify the prevalence of mis-reporting in adults entering a weight loss study and to describe the differences in socio-demographic characteristics and self-reported dietary intakes between plausible energy reporters and mis-reporters at baseline. Heights and weights of 304 overweight and obese adults from the Biggest Loser Club Online study (1) were measured at baseline and the Australian Eating Survey FFQ completed to assess dietary intake. Females accounted for 58.2% of the population, mean age was 41.9 years, and mean BMI was 32.2kg/m². Prevalence of mis-reporting was identified by comparison of reported EI to estimated basal metabolic rate, using confidence limits calculated by the Goldberg equation. Mean reported energy intake was 10143 ± 3186 kJ/day. Participants were categorised as under-reporters (15%), plausible reporters (84%), or over-reporters (n=1 and excluded from further analyses). Energy under-reporting for all participants was a mean of 3593 ± 2528kJ/day (27.2 ± 17.0%). Under-reporters mis-reported EI by 7763 kJ/day, with males (22.1%) more likely to under-report EI than females (10.8%). Married males and females were more likely to report plausible intakes. Male and female under-reporters were more likely to report a lower %EI from alcohol, lower fruit and vegetable serves. Male under-reporters reported a lower %EI from baked sweets, and female a lower %EI from savoury biscuits and confectionary. Female under-reporters were more likely to report a higher %EI from protein, meat, vegetables and deep-fried takeaway. Under-reporting of energy intake is prevalent among adults entering weight loss trials and is associated with different dietary intake patterns compared to plausible reporters. This supports the use of energy adjustment when evaluating dietary intake in the context of weight loss interventions. 1. Collins, et al. BMC Public Health, 2010 Nov 3;10:669. Funding Source: ARC Industry Linkage Grant, NHMRC Career Development Fellowship (Collins) and University of Newcastle, PRC in Physical Activity and Nutrition, Research Fellowship (Neve).

PP 126

NUTRIENT INTAKE ASSESSMENT AFTER BARIATRIC SURGERY USING DIETARY REFERENCE INTAKE (DRI).

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Introduction: Nutritional deficiencies, especially of micronutrients, can occur in obese individuals. Surgical treatment can aggravate or unleash these deficiencies depending upon the type of procedure, food and supplement intake. This present study's objective was to evaluate the nutrient intake of women who had undergone bariatric surgery. Methods: By way of a controlled transversal study involving 44 adult women who had undergone the bariatric technical surgery of Roux-en-Y gastric bypass (RYGB) more than one year previously and a control group of 38 healthy women matched by age and economic condition, were evaluated as to their dietary intake via a food register over four non-consecutive days. The *Dietary Reference Intake* was adopted as a reference. Results: The macronutrient contribution in relation to the energy intake value presented an acceptable distribution for proteins and carbohydrates. For lipids, the intake was high for the Operated Women (OW) and Non-Operated Women (NOW), being 43.2% and 55.3% respectively. In the micronutrients evaluation, a statistically significant difference was observed for iron, vitamin B12 and thiamine. A high risk of inadequate amounts of zinc and calcium was highlighted in both groups, and for iron and vitamin B1 this finding was observed only in the OW group. Conclusions: The nutrient intake of women submitted to RYGB surgery is very similar to that of non-operated women, with the exception of a reduced intake of iron, vitamin B12 and thiamine, probably due to the difficulty of consuming meats and the realization of a balanced diet. The findings re-enforced the importance of appropriate nutritional guidance and of medical supplements for these individuals. Key words: women, dietary intake, Roux-en-Y anastomosis.

PP 127

ENERGY DENSITY AND 3-YEAR OBESITY INCIDENCE IN EPIC-SPAIN: INFLUENCE OF MISREPORTING IN PROSPECTIVE STUDIES

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Introduction: Reducing energy density (ED) is thought to be effective for preventing weight gain. However, there is limited prospective observational data linking energy density to weight gain or obesity incidence, and results are conflicting. Dietary misreporting may contribute to these inconsistencies, as subjects who have experienced weight control difficulties may be more likely to underreport intakes. Methods: This study examines associations between dietary energy density (foods and milk) and 3-year obesity incidence among 28,266 participants in the Spanish

European Prospective Investigation in Cancer and Nutrition (EPIC) study not obese at baseline. Multivariate logistic regression was used to estimate associations between energy density and incident obesity, exploring the influence of additionally accounting for energy intakes misreporting. Misreporters were identified using doubly-labeled water prediction equations to estimate energy needs relative to reported intakes, applying methods described in the literature. Results: Incidence of obesity was 7.5%. Mean±sd energy density was 1.37±0.30 kcal/g. In multivariate models that did not account for misreporting, energy density was not significantly associated with incident obesity (OR highest vs. lowest quartile 1.11, 95% CI 0.89-1.38 in women; 1.23, 0.95-1.59 in men). Adjusting for misreporting substantially strengthened these associations (OR 1.41, 1.11-1.79 in women; 1.45, 1.11-1.75 in men). Excluding subjects who stopped smoking or adjusting for dietary factors such as fiber intake and percent calories from fat had no meaningful added effect. Results were consistent using several definitions of energy density. Conclusion: Findings suggest misreporting may substantially influence diet-obesity associations even in prospective analyses. Accounting for implausible diet reporting may be fundamental for identifying dietary predictors of adult weight gain and incidence of obesity-related disorders.

PP 129

CROSS COUNTRY USE OF FOOD DATA BASES: EQUIVALENCE OF USA AND AUSTRALIAN DATABASES FOR MACRONUTRIENTS?

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Background: Research that involves diet assessment in multiple countries requires a nutrient database that can accurately estimate intake in each country. The objective of our study was to determine whether self-reported intakes of Australian research participants estimated using a modified US food and nutrient database were similar to that when using an Australian database.

Methods: Sixty-eight Australian adults recorded their food, beverage, and supplement intake over a consecutive three-day period, including two weekdays and one weekend day. Nutrient intake was analyzed using the US-based Nutrition Data Systems for Research (USdb) and the Australia-based AUSNUT 2007 and NUTTAB 2006 (AUSdb) programs. A substitute food was identified for each Australian food item consumed in the study population but not available in USdb, and the substitute was modified if macronutrients per 100g of the food were not all within 10 per cent of their value in the original item. Mean differences between intake estimates were compared with a paired t-test.

Results: Carbohydrate intake was similar in USdb versus AUSdb (mean difference 2±41 g, p=0.75). Small statistically significant (p <0.05) differences were evident in other macronutrients: fat 9±16 g, protein 2.6±10.1 g, and fiber 1.3±4.9 g. Mean difference in energy intake was 62±261 kcal (p=0.055). There was no correlation between the difference in estimates from the USdb and AUSdb and the level of intake for any nutrient.

Conclusions: Differences in macronutrient calculations between the two databases, though statistically significant, were small and fall within the expected day-to-day variability in intake of these nutrients. Researchers must be aware of these differences when assessing dietary intakes in multiple countries.

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PP 130

THE EUROPEAN FOOD CONSUMPTION VALIDATION (EFCOVAL) PROJECT- RESULTS

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INTRODUCTION: For effective formulation and evaluation of European health and food safety policy, standardized data are required on the food consumption of the European population. Many member states collect such data at the national level using different dietary assessment methodologies limiting the development, evaluation and follow-up of European food policies.

OBJECTIVES: EFCOVAL was devoted to re-develop and validate EPIC-soft® for trans-European food consumption surveys and to evaluate exposures to nutritional and potentially hazardous chemicals in the European population.

METHODS AND RESULTS: The pre-existing EPIC-Soft® application for standardized 24-h recalls was reprogrammed into a Windows environment and > 60 new functions and specifications were added. Six country specific versions of EPIC-Soft were updated and one new version was prepared. Further activities included a validation study of repeated 24-h recalls using EPIC-Soft® among 600 adults, aged 45-65 years in BE, CZ, FR, NL and NO; feasibility studies in children, aged 7-8 and 12-13 years in DK and ES and the assessment of flavourings and the

development of the statistical software Multiple Source Method (MSM) to estimate the usual intake from repeated 24-h recalls. The validation study showed that repeated non-consecutive EPIC-Soft® 24-h recalls are suitable to describe the usual intake distributions of protein and potassium of European adult populations. In combination with a food propensity questionnaire (FPQ) the recalls are appropriate to rank individuals according to their fish and fruit & vegetable intake in a comparable way. Dietary intake of children can be assessed by the combination of EPIC-Soft® 24-h recalls and food records. The EPIC-Soft® standardized way of describing foods improved the estimation of dietary exposure to potentially hazardous chemicals such as specific flavouring substances.

CONCLUSIONS: The findings provide sufficient evidence that the repeated 24-h dietary recall using EPIC-Soft® for data standardization in combination with a FPQ and new statistical tools to model usual intake is a suitable method for pan-European surveillance of nutritional adequacy and food safety among healthy adults and is feasible in children of 7 years and older. Thorough preparation of protocols and tools together with capacity building are acknowledged as important next steps towards further harmonisation of food consumption data in Europe.

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PP 131

QUALITY ASSURANCE OF 24-HOUR RECALL ESTIMATES COLLECTED WITH EPIC-SOFT AND THE EXAMPLE OF UNKNOWN AMOUNTS FOR FATS, SAUCES AND SWEETENERS

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Background: The interview-administered 24-h dietary recall (24-HDR) EPIC-Soft® is currently under use in different international and national projects in Europe and planned to be implemented elsewhere. A series of controls are implemented in EPIC-Soft to guarantee the quality of dietary data across countries; however, a complete overview of these quality controls is still lacking.

Aim: To report on the quality control procedures applied in the EPIC-Soft methodology and provide specific example where such procedure could be of relevance.

Methods: The overview of quality controls comprised all steps of fieldwork preparation, data collection and management. An exhaustive list was generated to then describe each quality control in three distinct phases: 1) Before, 2) During, and 3) After the interview. To exemplify the contribution of EPIC-Soft quality controls to the 24-HDR estimates, the case of 'fats, sweeteners and sauces' was used. EPIC-Soft automatically calculates the amounts of these foods based on pre-entered coefficients/portions when the subject does not know the quantities. Thus, we simulated the possible impact of not assigning automatic calculations to the total reported dietary intake of these foods as well as to the total lipid and energy intake using 24-HDR data from 9 countries involved in the EPIC calibration study (1995-2000; n=36994, aged 20-84 y at baseline).

Results: Quality controls for consistency and harmonization are implemented *before* the interviews to prepare the 70 databases constituting an EPIC-Soft version (e.g., the use of algorithms to convert foods from raw to cooked). *During* the interview, EPIC-Soft makes use of cognitive approach by using a stepwise approach to recall the information (e.g., starting with a quick-list). In addition, there are controls for consistency (e.g., probing questions for often forgotten foods) and completeness of the collected data (e.g., system calculation for unknown amounts). *After* the interview, a series of controls can be applied by data managers to further guarantee the quality of data. For example, 'note files' that were created during the interview can be checked to correct the information initially provided. Also, each food reported in the 24-HDR gets a 'status' flag, which can identify foods that were not described and/or quantified. The complete overview of quality controls and their rationale will be presented in the conference. When considering the impact of automatic calculations, we observed that on average 27%, 0.6%, and 15% of the fat, sweeteners and sauces consumed, respectively, could have been possibly underestimated in the population, with considerable variations between the countries. For instance, the fat intake would have been underestimated for Spain by 58% while the sauce intake by 36% for Italy. The impact of these underestimations to the total lipids and total energy intakes would have affected more the Southern countries as compared to the others, ranging from 3% to 21% for total lipids and from 1% to 8% for total energy intake.

Conclusion: The quality controls employed in the EPIC-Soft methodology are not always perceivable but prove to be of assistance for the overall standardization and possible accuracy of the collected dietary intake estimates.

PP 132

PILOT STUDY FOR ASSESSMENT OF NUTRIENT INTAKE AND FOOD CONSUMPTION AMONG KIDS IN EUROPE (PANCAKE)

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INTRODUCTION: At present the national food consumption data collected in Europe are heterogeneous especially with respect to dietary assessment methodology. This hampers comparing results across countries. The PANCAKE project is one important component out of EFSA's many initiatives to harmonise food consumption data collection across Europe in order to prepare a pan-European survey, the EU menu.

OBJECTIVES: To develop, test, and evaluate tools and procedures for a future harmonized pan-European food consumption survey among infants, toddlers, children (up to 10 y), and breastfeeding women.

METHOD/DESIGN: In the first phase of the project, protocols, tools and procedures for the collection of food consumption data among the required age groups were developed. The protocols include instructions for random sampling, recruitment, administration and data handling of the food records, weight and height measurement, and evaluation. The tools include food diaries and out-of-home registration booklets for the four age groups with written instructions for the person that fills out the diaries, picture books for portion size estimation covering the four age groups and validated among parents (with children 3 mo-10 y), and software for data entry of the food diaries (EPIC-Soft[®]). Furthermore, a questionnaire on background characteristics, a food propensity questionnaire, and validated food picture book for portion size estimation and a web library for the picture series were developed. In the second phase two pilot studies were conducted using two alternative dietary assessment methods; each in about 100 participants in BE and CZ. Finally, the tools and procedures used and the data collected were evaluated providing recommendations for improvements and a choice in dietary assessment method for infants, toddlers and children.

RESULTS: The developed dietary assessment methods are 1/ the three-(consecutive) day food diary which is checked with the parent/caretaker and data entry is done afterwards using EPIC-Soft[®]; and 2/ two non-consecutive one-day food diaries followed by a completion interview with the parent/caretaker using EPIC-Soft[®]. From the pilot studies it was concluded that recruitment of participants is a challenge and that both type of diaries and connected administration protocols were feasible. The 3-day diary was more burdensome to keep; for the two times 1-day diary the logistics of appointments were a larger challenge. The overall and detailed evaluation of results will be available during the conference.

CONCLUSIONS: The proposed project is an important step towards fully harmonised food consumption data at European level among the younger age groups.

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PP 133

INTERACTIONS BETWEEN GENETIC VARIATIONS AND DIETARY INTAKE ON PLASMA CAROTENOID CONCENTRATIONS

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Intake of carotenoids has been considered to be associated with prevention of chronic diseases, due mainly to their anti-inflammatory roles. Recent studies have indicated that the SNPs near beta-carotene 15, 15'-monooxygenase 1 (BCMO1) gene and within the scavenger receptor class B type 1 (SR-B1) gene were associated with levels of beta-carotene and other carotenoids and with HDL-C.

Thus we intended to identify how circulating carotenoid levels may be expressed by interaction between these genetic variants and dietary intake of carotenoid. The employees of a city office in Japan (92 men and women with age from 20s to 50s) were voluntarily recruited with a written informed consent and buccal cells were harvested by using cotton swab. The SNPs of rs6564851 for BCMO1 and rs2278986 for SR-B1 were analyzed by PCR-RFLP method. Plasma carotenoids were measured using HPLC. Dietary intake of carotenoids were identified by food frequency questionnaire (FFQ).

Gene frequencies of rs6564851 were accounted for 68% for GG, 29% for GT, and 3% for TT, and rs2278986 accounted for 2% for CC, 23% for CT, and 75% for TT. Those with T allele showed a significantly lower level of plasma beta-carotene than those without T allele (median=0.248 and 0.295 μmol/L with and without T allele, respectively). No significant difference of plasma beta-carotene levels among rs2278986 SNP was identified. There was a border interaction between rs6564851 SNP and dietary intake of carotenoids on plasma beta-carotene level.

While the interaction between variant genes and dietary intake of the nutrients on circulating level of plasma carotenoids is not clear, further investigation will be required to develop a personalised nutrition introducing a notion of nutrigenomics.

PP 134**HARMONIZATION OF DIETARY QUANTIFICATION METHODS: CAN QUANTIFICATION BY A COMMON BASED PICTURE BOOK COVER SPECIFIC NEEDS OF A COUNTRY?**T. Rodrigues¹, C. Cruz¹, S. Vilela¹, C. Lopes², D. Torres³, S. Guiomar¹¹Health Promotion and Chronic Diseases, National Institute of Health Dr. Ricardo Jorge, ²Institute of Public Health, University of Porto, ³Faculty of Nutrition and Food Sciences, University of Porto

The Pilot study in the view of a Pan-European dietary survey – adolescents, adults and elderly (PILOT-PANEU) is being developed with the objective of harmonizing the collection of dietary data between countries. The collection of dietary information will be done by using the Epic-software and by the application of structured questionnaires. For the quantification of food intake, four methods can be used: food photographs, household measures, standard units or shapes. Regarding the quantification by photographs, for each country the original EPIC-soft Picture Book was adapted through the selection of the photos needed and the possible addition of new photos. The main purpose of this work is to access the ability of a picture book common to several countries to cover the traditional dishes and the specific portions consumed in a particular country. To answer this question we intend to analyze the case of Portugal, comparing the adapted EPIC-soft Picture Book with the two national picture books. Parameters as the number of photographic series, the food groups considered, the number of portions in each series, the portion weight, the application of a different methodology to estimate the same food item or the technical details of the photographs were considered. This study leads us to reflect about the susceptible situation of the harmonization process. If in one hand we have the generalization of concepts and methods, on the other hand the specificities of each country have to be considered. Aligning what is common with what is specific can be considered a starting point for harmonization of dietary quantification methods.

PP 135**VALIDATION OF FOOD PHOTOGRAPHS USED TO ESTIMATE FOOD PORTION SIZE ACROSS PILOT-PANEU COUNTRIES**S. Vilela¹, D. Torres², D. Torres³, S. Guiomar¹, T. Rodrigues¹, C. Cruz¹, C. Lopes⁴, C. Lopes⁵¹Department of Health Promotion and Chronic Diseases, National Institute of Health Dr. Ricardo Jorge, ²Faculty of Nutrition and Food Sciences, University of Porto, ³Department of Biochemistry (U38-FCT), Faculty of Medicine, University of Porto, ⁴Department of Clinical Epidemiology, Predictive Medicine and Public Health of Medical School Porto University, ⁵Institute of Public Health, University of Porto (ISPUP)

The Pilot study in the view of a Pan-European dietary survey (PILOT-PANEU) aims to develop and test methods and procedures for the estimation of dietary risks and identification of dietary habits in nationally representative samples of adolescents, adults and elderly in Europe. Food photographs are used to help subjects estimating more accurately the amounts of food consumed. These aids are used widespread including in PILOT-PANEU countries since they are easily adaptable to local conditions, cheap, reproducible and transportable. Three psychological constructs affect individual portion-size reports: perception, conceptualization and memory. In this study, the perception will be the only dimension covered, which can be defined as the individual ability to estimate the size of a presented food portion by selecting one photograph from a set of photographs depicting different amounts of a particular food. In this validation study, a minimum of 21 adolescents (10-17 years) and 21 adults (18-74 years) were recruited from each PILOT-PANEU country (Bulgaria, Finland, Germany, Hungary, Poland and Portugal). Representative food photo series were chosen to cover a wide range of food groups, achieving approximately 25% of the PILOT-PANEU Picture Book. Various dishes and food items were prepared; the majority were identical to the food item depicted in the picture series and prepared using the same recipe as the food presented in the picture series. A minority (approximately 30%) of the food served did not have exactly the same weight as the one in the photo, to simulate a more real situation. For the statistical analysis a weighted kappa was used to access the pattern of agreement between the served and estimated portion size. The percentages of portion correctly identified, over-estimated and underestimated with the photographs were calculated for each subject and each food and the chi-square test was used to access statistically significant differences between the proportions. To investigate how served portions, age, gender and Body Mass Index explain the variability of estimated weight, a multiple regression analysis was performed. The results of this study will contribute to the development of a harmonized and validated picture book to be used during the PILOT-PANEU, as recommended by EFSA.

PP 136

COMPUTERIZED DIETARY INTERVIEWS: DEFINING GUIDELINES FOR THE CONSTRUCTION OF FOOD CONSUMPTION ASSESSMENT SOFTWARES FOR EUROPEAN POPULATIONS

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According to the observed needs at European level in terms of harmonization of methodologies for assessment of food consumption, the softwares providing support on conducting interviews are one of the most useful tools at the moment. The main purpose of this work is to create guidelines for the construction of improved food consumption assessment softwares. To accomplish this purpose we examined which existing softwares were able to integrate registration of personal data, consumption and nutritional composition from different databases and determined which characteristics could be added to improve this type of software.

Conclusions obtained through this initial work resulted in a proposal for the development of a software to conduct and support an interview of assessment of dietary intake, with integration of multiple databases on personal data (e.g., sociodemographic, health and physical activity), consumption data (e.g. food, supplements, recipes, methods of quantification) and the nutritional composition data.

To provide a tool harmonized for all the countries interested, the data could be collected from the countries and compiled in the same way. All the food photos, recipes and portion sizes for each country should be used in a digital format, which will allow greater versatility during the interview or the dietary habits recall.

For the modeling of databases, tables of association can be created between the entries, enabling the synchronization between the personal data, the food consumption data and nutritional composition data and the subsequent transformation of food consumption data on nutritional data.

This software should present intuitive interfaces for the introduction of personal data and for the food intake record. The results of each interview should be presented as a unique report including personal, dietary and nutritional data.

This study urges as a response to the growing need for European harmonized dietary collection methodologies, providing the tools to the development of a new software that can enable countries to collect and compare background, health, physical activity and nutritional information.

PP 137

THE ASSOCIATION BETWEEN CRUCIFEROUS AND GREEN LEAFY VEGETABLE INTAKE WITH RISK FOR PREMENOPAUSAL BREAST CANCER RISK

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Introduction: Large epidemiological studies suggest that cruciferous and green leafy vegetables may be associated with reduced risk of some types of cancer, but the evidence is inconclusive. Cruciferous vegetables are rich in glucosinolates and other compounds which are important anticarcinogens. The study aims to examine the association between cruciferous and green leafy vegetable intake with risk for premenopausal breast cancer by harmonizing two international food frequency questionnaires (FFQ).

Design: The study design is a population-base case-control study (1942 cases and 703 controls) of premenopausal women participating in three international cancer centers (Ontario, California and Australia) in the NCI funded Breast Cancer Family Registry (BCFR). Two food frequency questionnaires were used: the Hawaiian FFQ, which includes 180 foods and beverages and the Australian FFQ with 119 food and beverages consumed within 12 months of study participation. Cruciferous vegetable consumption includes (e.g. broccoli, cabbage, cauliflower, brussels sprouts) and green leafy vegetable (e.g. kale/mustard greens, spinach).

Analysis: We describe a method for harmonizing nutrient intake data obtained from two sources where the measurements collected by one (frequencies; Australia) are a subset of those collected by the other (frequencies and amounts; Hawaii). We use the latter to develop and evaluate a model for imputing nutrient intake given the variables available in the former. We quantify its predictive accuracy in terms of its calibration, bias and mean squared error in predicting a 'test' set of samples not used in model construction and describe the implications of using values predicted in this way in lieu of the true values in a case control analysis. We highlight this method in an application to measuring the association between cruciferous and green leafy vegetable intake with risk for breast cancer using the BCFR data.

Expected Results: The method we develop allows for a co-analysis of data from two distinct sources where one collects a subset of the information necessary for complete assessment that is available in the other. We estimate the loss of power and bias that results from utilizing the imputed as opposed to the true nutrient intake data and describe an analysis of real data from the BCFRs.

PP 138**MOTIVATIONS FOR DIETARY SUPPLEMENT USE IN THE US**R. Bailey¹, J. Gahche², P. Miller³, J. Dwyer¹¹NIH/ODS, ²CDC/NCHS, ³NIH/NCI

Dietary supplements are used by more than half of adults and one-third of children yet the reasons motivating use remain uncertain. In 2007-8, motivations for use of supplements were queried for the first time in the NHANES, a nationally representative, cross-sectional survey. The purpose of this analysis was to examine motivations for use and to characterize the types of products that are used for the most common motivations among children (1-18y; n=3449) and adults (≥ 19 y; n=5570). Products were categorized according to major class types (multi-vitamin, minerals (MVMM) or botanicals), specific nutrient type (e.g. calcium or omega-3 fatty acids) or intended usage (e.g. joint health). The most frequently reported reasons for supplement use in adults were to improve (46%) or maintain (32%) overall health, for bone health (25%: 11% in males, 35% in females), to supplement the diet (22%), and to prevent health problems (20%). About 15% of adults use supplements to enhance immune function, for joint health or arthritis prevention, and for heart health or to lower cholesterol. Overall, the most frequently reported reasons for supplement use among children were to improve (44%) or maintain health (33%) or to supplement the diet (24%). Among teens, supplements were also used to prevent health problems (22%), “to get more energy” (8%), and for skin health (5%). MVMM were most frequently reported to improve, and maintain health, or prevent health problems for all ages; but, interestingly a much higher percentage of MVMM products were reported for these reasons in children than among adults. Among adults, calcium (62%) and vitamin D (45%) were frequently used for bone health and vitamin C (41%) was the most frequently reported product to enhance immune function, omega-3 fatty acids (38%) for heart health, and joint products for joint health (42% glucosamine, chondroitin, MSM). Very few supplement users report using products specifically for weight loss or for improving site-specific health (<5% for colon, eye, teeth, liver, thyroid, or respiratory,). Similarly, it appears as if dietary supplements are not being used to help manage health problems such as diabetes, asthma, or menopause or for stress reduction/relaxation, for liver detoxification, or as a sleep aid (<1%). In conclusion, it was more common for dietary supplement users to report health-related motivations for use than to report use to enhance nutrient intakes from foods.

PP 139**VITAMIN C SUPPLEMENTATION AND URINARY STONES INCIDENCE AMONG MEN: A POPULATION-BASED PROSPECTIVE COHORT STUDY**L. Thomas¹, C. Elinder², A. Wolk¹, A. Åkesson¹¹Institute of Environmental Medicine, Unit of Nutritional Epidemiology, Karolinska Institute, ²CLINTEC, Karolinska Institute

Vitamin C is metabolised to oxalate, which is then excreted in urine. Urinary oxalate is an important determinant of calcium oxalate stone formation and high doses of vitamin C may therefore increase the risk of stone formation. While the use of vitamin C supplements has long been suspected of increasing the risk of urinary stone formation there is only very limited data from prospective studies.

Exposure misclassification is a potential source of bias in studies relying on self-reported supplement use. However, if suitable validation data is available the effect of this bias on the hazard ratio can be evaluated. Using a large population-based, prospective cohort of men (COSM) we aimed to examine whether vitamin C supplements (~1000mg) and multivitamins containing vitamin C (~60mg) are associated with urinary stones, using dietary supplement, diet and lifestyle data collected using a self-administered questionnaire. Our study included 41,622 men, aged 45-79 yrs. at baseline, with no history of urinary stones. During 11 years of follow-up we ascertained 1,185 cases of urinary stones through computerized linkage of the cohort to the national inpatient and outpatient registers. Hazard ratios were calculated using the Cox Proportional Hazards model. A probabilistic sensitivity analysis will be used to assess the effect of exposure misclassification on the observed HRs using validation data on supplement use from a subsample (n= 248) of the study population. The sensitivity and specificity of the supplement use data have been estimated at 78% and 93% for dietary supplement use, 67% and 93% for vitamin C use and 69% and 98% for multivitamin use respectively.

Preliminary results suggest that the use of high doses of vitamin C supplements may be associated with an increased risk, multivariable-adjusted HR 1.31 (95% confidence interval 1.03-1.68), while the use of multivitamins was associated with HR 0.74 (95% confidence interval 0.57-0.98), of urinary stone formation among men.

PP 140

VITAMIN C CONTAINING SUPPLEMENTS AND THEIR ASSOCIATION WITH PLASMA VITAMIN C CONCENTRATIONS AND MORTALITY IN THE EPIC-NORFOLK STUDY

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Dietary supplements are used by 33% of men and 45% of women participating in the EPIC-Norfolk study. In this cohort plasma vitamin C, which correlates with fruit and vegetable consumption, is associated with mortality, but supplement use in general is not. An improved Vitamin and Mineral Supplement (ViMiS) database is now complete. The absolute contribution of supplement vitamin C can be assessed, as well as a more accurate categorical classification, i.e. non-supplement users (NSU), supplement users not consuming vitamin C in supplement form (SU-C) and supplement users consuming vitamin C in supplement form (SU+C). These results were validated against the biomarker plasma vitamin C (plasma C) and associations with all-cause mortality were assessed. EPIC-Norfolk is a prospective cohort study investigating determinants of chronic diseases in free-living individuals, aged 40-79 years, recruited from the general population between 1993 and 1997. Participants filled in a 7-day diet diary, in which they recorded their dietary supplement use. Anthropometric measures were taken during a clinic visit; socio-demographic variables were collected via a posted questionnaire. Participants' death was ascertained through the Office for National Statistics; median follow-up time was 14-15 years. 11% of men and 17% of women were SU+C consumers. The SU group was not homogenous. SU+C participants were younger, reported fewer illnesses, had higher education levels, were less likely to have a manual occupation or drink more than recommended alcohol units; however, they were more likely to smoke than SU-C participants. Inclusion of supplement vitamin C to food sourced vitamin C increased median intakes and created stronger Spearman correlations (r_s) with plasma C. Quintiles of vitamin C intake with and without supplement sources caused a shift in 26% of the participants.

	All ⁺		NSU		SU-C		SU+C	
	Median (IQR)	r_s	Median (IQR)	r_s	Median (IQR)	r_s	Median (IQR)	r_s
MEN n (%)	7,785		5,231 (67%)		1,702 (22%)		852 (11%)	
Fruit + vegetables (g/d)	290 (198-399)	0.39	277 (191-382)	0.42	310 (218-425)	0.36	314 (215-447)	0.18
Food vitamin C (mg/d)	75 (51-111)	0.48	72 (49-106)	0.51	81 (56-116)	0.47	83 (56-123)	0.25
Total vitamin C (mg/d)	80 (53-121)	0.55	-	-	-	-	174 (112-362)	0.47
Plasma C (umol/L)	48 (35-59)	-	46 (32-56)	-	48 (37-59)	-	61 (52-73)	-
WOMEN n (%)	8,703		4,805 (55%)		2,400 (28%)		1,498 (17%)	
Fruit + vegetables (g/d)	315 (218-426)	0.34	299 (203-408)	0.37	330 (238-438)	0.33	344 (249-459)	0.19
Food vitamin C (mg/d)	81 (55-116)	0.43	77 (51-111)	0.46	84 (59-120)	0.45	88 (59-126)	0.26
Total vitamin C (mg/d)	89 (59-134)	0.51	-	-	-	-	178 (121-338)	0.43
Plasma C (umol/L)	59 (47-70)	-	56 (43-67)	-	59 (48-69)	-	70 (59-83)	-

*Plasma C is available for 88% of the cohort.

The association of supplement use with all-cause mortality was tested using a Cox proportional hazards model, adjusted for aforementioned possible confounders. Participants who reported a history of stroke, heart infarct or cancer at baseline were excluded, leaving 6,437 men and 7,154 women for analysis. In men, SU-C and SU+C were associated with 14% and 16% lower mortality rates (CI:0.77-0.98; CI:0.70-1.02), whereas higher rates of 15% were observed for SU+C women (CI:0.96-1.37). Concluding, plasma C concentrations were significantly higher in SU+C. Though plasma C was differentially associated with mortality rates, the role of supplements needs further clarification, since these associations may be due to residual confounding of supplement use, fruit and vegetable consumption as well as misclassification of SU+C participants over time.

PP 141

SUPPLEMENT CONSUMPTION AMONG FITNESS CENTER USERS

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Introduction: The increase in the number of fitness centers in Brazil and the widely spread consumption of dietary supplements among fitness center's users are related in various studies.

Method: A structured questionnaire was applied with adults and adolescents fitness center's users in Rio de Janeiro state to determine the use of supplements and from who they were prescribed. Self-report weight and stature were used to compute de body mass index (kg/m²). To compare proportions a chi-square test was used (p<0.05).

Results: Were assessed 68 adults (Women: 24; Men: 44) and 32 adolescents (Women: 25; Men: 7). 27% of adults and 31% of adolescents had overweight (BMI \geq 25.0 kg/m²). 41% (n=28) of adults and 28% (n=9; all girls) of adolescents used at least one type of supplement. Women with more than 20 years old used more supplements than men from the same age (62% vs. 29%; $p < 0.01$). The supplement consumption didn't change according to age and nutritional status ($p < 0.05$). The most consumed supplements were: amino acids or other protein products (32%), followed by vitamins and minerals (24%), energetics (22%), thermogenics and sugary sports drinks (11%). The daily intake of supplements was the most reported (52%). Only 22% from the users related having consulted a doctor or a dietitian. The consumption of supplements was significant in the evaluated group.

Conclusion: More studies about supplement's consumption and the inclusion of this topic in consumption questionnaires would be important in order to increase the level of information about them and to guarantee the safety of their use.

PP 142

PREBIOTIC EFFECTIVENESS OF β (2?1) FRUCTANS OF EXTRACTED FROM SALSIFY ROOTS

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To investigate the in vitro fermentability of short chain β (2?1) fructans of extracted from salsify roots (SCSF) consist of fructooligosaccharide, by measuring *Lactobacillus acidophilus* (La-5) and *Escherichia coli* PTCC1330 growth (turbidity, pH, specific growth rate and generation time). Bacterial growth was monitored during the 48 hours incubation period. The results of in vitro studies on *Lactobacillus acidophilus* (La-5) confirmed the prebiotic effectiveness of SCSF, indicating selective increase in this strain count. In addition, effects of SCSF were better than that of HP-inulin in the case of both of bacteria. The population of lactobacilli and *E. coli* increased much better with SCSF than that with HP-inulin after 20 h cultivation. The results indicated that utilization of β (2?1) fructans by *Lactobacillus acidophilus* (La-5) and *Escherichia coli* PTCC 1330 depended on the DP of fructo-oligomeric chains. It indicated that both of these bacteria significantly utilized SCSF with short chain (lower DP) better than HP-inulin with higher DP ($p < 0.05$). (2% w/v) HP-inulin was not fermented by *E. coli* and La-5. In case of *E. coli*, No difference between medium containing HP-inulin and medium without HP-inulin was observed ($p > 0.05$). We also found that the effects of SCSF (2% w/v) for *Lactobacillus acidophilus* were significantly higher than that for *E. coli* ($p < 0.05$).

PP 143

FUNCTIONAL PROPERTIES OF CHICKPEA PROTEIN ISOLATED

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Chickpea protein have received attention during recent years owing to their higher biological values and better functional properties than oilseed proteins. In present study, the effect of protein extraction method from kabuli chick pea seeds on functional properties obtained by two extraction methods includes alkaline extraction and acidic extraction was investigated. In research protein extraction had to pH=2.5 and pH=9.5 and followed by Isoelectric precipitation (pH=4.5). Functional properties of Kabuli chickpea protein isolates such as oil absorption capacities, water absorption capacities, foaming capacity and stability, emulsion capacity and stability were evaluated. All experiments were performed in triplicate and Duncan multiple range tests with a confidence interval of 95% was used to compare the means. Results showed that; Isolates obtained by acid method had higher emulsification (capacity emulsion 87.77% and stability emulsion 87.92%), and foam properties (capacity foam 41.42% and stability 57.16%) than alkaline method. While alkaline method enhanced water absorption capacities (1.52 g/g) and fat binding capacities (1.68g/g). Whereas suitable functional properties of chick pea protein isolate could be used for substituting other proteins in food systems.

Key words: protein isolate, functional properties, chick pea

PP 144**DEVELOPMENT OF DATABASE FOR VITAMIN AND MINERAL CONTENTS OF DIETARY SUPPLEMENTS FOR CHILDREN**

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With the increase in the intake of vitamins/minerals (V/M) from dietary supplements (DS) including health functional foods among children and a recent rescission of restrictions in the shape/form of health functional food, the possibility of excessive V/M intake of children is getting higher in Korea. Therefore, dietary supplement database was developed to be used in measuring total V/M intake from DS and in determining if it is necessary to establish the maximum level of V/M in dietary supplement for children differently from adults.

To develop the database, information on V/M content of DS was collected from various sources, including information from KFDA and nutrition labeling on each product. The database includes product name, company name, nutrient name and the amount per tablet or capsule (or commonly used serving size), shape and other descriptions for 2,264 health functional foods and 486 over-the-counter (OTC) V/M products. For those DS reported by children but lacking appropriate information, default values for V/M content was calculated based on DS designated for children. For each nutrient, mean nutrient content per recommended servings of 875 DS for children was calculated and used as a default value. After merging these databases with DS consumption data from the survey on children, total V/M intake of children from various sources can be measured. Supported by a grant 09082KFDA999 from KFDA in 2008-9

PP 145**PREBIOTIC EFFECTIVENESS OF OLIGOSACCHARIDES EXTRACTED FROM JERUSALEM ARTICHOKE TUBERS ON SELECTED LACTOBACILLI AND PATHOGENIC MICROORGANISMS**

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Knowledge of the fermentative capacity of probiotic species can assist in both understanding of the effects different non-digestible carbohydrates have on population dynamics in the intestinal microbiota and mechanisms of polysaccharide fermentation in the human colon. The prebiotic potential of fructooligosaccharides derived from native Jerusalem artichoke tubers (JA-Fr) was assessed by monitoring in vitro effects of JA-Fr on bacterial growth. The studies showed the greater survivability of beneficial bacteria in cultures media containing JA-Fr in comparison with HP-inulin. Results in this study demonstrated that the improvement of growth, activity, and viability of *Lactobacillus acidophilus* and *Escherichia coli* in the media are dependent on the carbon source and concentration. Jerusalem artichoke fructooligosaccharides can affect probiotic survival during a 24-hour incubation period in, in vitro conditions and provide the greater stability and acid production to *L. acidophilus*; however, further studies are needed with other probiotic strains used in human dietary. In addition, in vivo health benefits of native Jerusalem artichoke fructooligosaccharides still need to be investigated.

Keywords: inulin, prebiotic index, salsify roots, *Lactobacillus acidophilus*, *Escherichia coli*

PP 146**USE OF VITAMIN AND MINERAL SUPPLEMENTS AMONG A GROUP OF TURKISH UNIVERSITY STUDENTS**

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Background and aims: There is general agreement among health professionals that a balanced diet provides most persons with those nutrients essential for good health. Vitamin and mineral supplements are used for any reasons. The purpose of this study was to analyze use of vitamin and mineral supplements among a group of Turkish university students.

Methods: The cross-sectional study was conducted among 1166 volunteer university students (526 boys and 640 girls) between 19-23 years old, and attending Ankara and Gazi University in Ankara, Turkey. The survey which was formed by the researchers to determine the use of supplements was conducted face to face and the data was collected. We evaluated the effects of factors on using nutritional supplements.

Results: 59.2% of the students stated that they had never used any supplements, but 40.8% stated that they had. 35.4% of the students who had never used any supplements prefer to have natural nutrition. 35.7% of the students using supplements take iron, 18.9% take B complex vitamin. 42.9% of the students using supplements stated that their body

resistance had increased, and 18.1% of them stated that they had less hair loss. The use of supplement is low among the boys, overweight and studying health sciences students.

Conclusions: The use of nutritional supplements is common among the young. The blind use of supplements may have a negative effect on our health. That's why, the young should be thought adequate and balanced and natural nutrition.

Key words: vitamin, mineral, supplements, university students, nutrition.

PP 147

PSYCHOSOCIAL FACTORS IN DIETARY ASSESSMENT: BIOMARKERS AND SELF-REPORT IN THE WOMEN'S HEALTH INITIATIVE

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Background: We examine whether the addition of psychosocial factors and dietary behavior improves calibration equations that account for measurement error of self-reported dietary assessment tools. **Methods:** This study was conducted in 450 postmenopausal women in the Women's Health Initiative Observational Study who were enrolled in the Nutrition & Physical Activity Assessment Ancillary Study. Doubly Labeled Water and urinary nitrogen were used as biomarkers of objective intake for total energy expenditure and protein respectively. They were compared against self-report using three dietary assessment tools (24 hr dietary recall, FFQ and 4DFR). The calibration equations that include age, ethnicity and body mass index were examined with and without the addition of psychosocial and/or diet behavior variables. We tested whether the addition of these participant characteristics, specifically social desirability (Marlowe-Crowne), body image (Stunkard Body Image Silhouettes), Three Factor Eating Scale (eating restraint, disinhibition, hunger) and eating away from home, further explained biomarker-assessed variation in energy intake, protein and protein density. **Results:** Using linear regression of log(self-report) – log(biomarker) on body mass index, age, race/ethnicity and the psychosocial and dietary behavior variables we show that compared to the biomarker assessments, participants with higher social desirability scores were significantly more likely to under-report energy intake on the FFQ and participants who consumed a higher percentage of meals at home were significantly less likely to under-report energy intake on the FFQ. With social desirability categorized as low, medium or high, participants with high versus low scores reported significantly lower protein intake on the FFQ compared to the biomarker. Calibration equation results combining FFQ, 4DFR, and 24 HR dietary recall, with psychosocial variables defined as low, medium or high, indicated the following contributions of the variation:

	energy (%)	protein (%)	Percent energy from protein
More meals at home	0.23	0.48	0.24
Body image discordance (between ideal and real)	0.23	0.76	0.77
Eating restraint	0.29	0.03	0.18
Disinhibition	0.49	0.51	0.52
Hunger	0.65	0.99	0.38
Social desirability	0.18	0.03	0.54
Total explained variation (R ²)	47.35	38.30	20.16

Results combining all diet tools indicated that all psychosocial variables taken together and defined as low, medium or high, significantly increased the R² for protein intake by 3.62% and protein density by 4.51%. Corresponding contribution for energy intake of 2.41% was not statistically significant (p=0.12). **Conclusion:** The addition of psychosocial factors to the calibration equations increases the amount of total variance explained for energy, protein, and protein density.

PP 148

INVESTIGATING DIETARY MEASUREMENT ERROR: APPLICATION OF REGRESSION CALIBRATION TO ASSOCIATION OF SUGAR-SWEETENED BEVERAGE INTAKE AND LIPIDS

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Intake of sugar sweetened beverages (SSB) has become a high profile topic in health research and public health policy. We have previously shown that high sugar-sweetened beverage intake is associated with higher levels of total

cholesterol, LDL-cholesterol, and plasma triglycerides in youth with type 1 diabetes mellitus (T1DM) in the SEARCH for Diabetes in Youth study population. The recent completion of a diet assessment sub-study in the same population allowed us to re-evaluate these cross-sectional associations, adjusting for measurement error in SSB exposure. We applied regression calibration based on the NCI method for episodically consumed foods with standard energy adjustment. SSB intake was assessed with a food frequency questionnaire (FFQ) on 2,403 youth with T1DM in SEARCH (aged 10 - 23 years) and included non-diet sodas (e.g. Coke, Sprite, etc.) and other sugar sweetened drinks (e.g. Kool-Aid, Gatorade, Sunny Delight, Hi-C, Hawaiian Punch, Ocean Spray, sweet tea, etc.). The calibration sub-sample included 172 youth in whom 24-hour dietary recalls were conducted in the course of one week (157 youth had three recalls, and the remaining 15 had one or two). Multivariate linear regression was applied to evaluate the association with lipid levels.

Mean intake of SSB was 1 serving per day among the 55% of youth reporting SSB intake on the FFQ, with 45% not reporting any SSB consumption. In the entire study population, higher SSB intake was significantly associated with higher levels of total cholesterol (beta=3.8, p-value=0.012), LDL-cholesterol (beta=3.7, p-value=0.002), and plasma triglycerides (log-transformed) (beta=0.01, p-value=0.009), adjusted for energy intake, age, diabetes duration, race, and gender in the regression calibration model. In terms of impact on lipid levels, our models suggested that youth with high SSB intake (90th percentile) have on average 6.1 mg/dl higher total cholesterol levels, 5.9 mg/dL higher LDL-cholesterol, and 10% higher triglyceride levels (8.4 mg/dl in the average participant) than youth with SSB intakes at the 10th percentile. Models adjusting for BMI z-score yielded similar results. As expected, the effect estimates adjusted for measurement error were markedly stronger than the unadjusted (attenuated) estimates. Concretely, the de-attenuated estimates were 60% larger for total cholesterol, 200% higher for LDL-cholesterol, and 400% higher for triglycerides. In conclusion, our results underscore the importance of adjusting for measurement error related to dietary exposure assessment in nutritional epidemiologic studies.

PP 149

STANDARDISING INFANT LENGTH AND INFANT HEAD CIRCUMFERENCE MEASUREMENTS ON THE DIET AND NUTRITION SURVEY OF INFANTS AND YOUNG CHILDREN (DNSIYC)

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Objectives: The Diet and Nutrition Survey of Infants and Young Children (DNSIYC) is a nationally representative survey of infants and young children funded by the Department of Health and Food Standards Agency. The purpose of this survey was to provide detailed information on diet and nutritional status of infants and young children aged four to 18 months. One aspect of the survey required the collection of infant length and occipito-frontal (head) circumference measurements by interviewers from the National Centre for Social Research (NatCen). Given the age of the participants and the need to ensure accurate measurements the project team aimed to develop a standardised quality assurance process to improve and demonstrate adherence to the protocol.

Methods: Alongside the usual face to face survey specific briefing, a formal accreditation process was developed which all interviewers measuring infant length and occipito-frontal (head) circumference had to complete and pass. These sessions were led by paediatric nurses from the Department of Paediatrics, University of Cambridge. NatCen interviewers were observed by the nurses performing each of the measurements on a life-sized doll. The purpose of the certification process was:

- To ensure that the nurses felt confident that each interviewer could perform each measurement as accurately and confidently as possible whilst in the field
- To ensure that interviewers were comfortable performing each of the measurements and were confident carrying them out in the field
- To ensure that the measurements were carried out accurately

NatCen interviewers were not permitted to work on the survey until they had passed the accreditation process.

Results: All NatCen interviewers who went through the accreditation process achieved the required standard in the briefings. A Quality Control (QC) assessment held part-way through fieldwork demonstrated that interviewers were still confident and capable of performing the measurements accurately. The absolute technical error of the measurement (cm) (TEM) for inter-interviewer measurements at the QC assessment day showed acceptable levels of precision between interviewer measurements.

Conclusion: The adherence to strict protocols for all aspects of survey methodology is integral to ensure the collection of high quality data. Providing sufficient support is given, a formal accreditation process is a sensible approach to ensuring accuracy of measurements taken by interviewers in the field.

PP 150**VARIABILITY OF EXCLUSIVE BREASTFEEDING RATES BASED ON MATERNAL RECALL OF DAILY, TWICE WEEKLY AND MONTHLY RECORDS IN LIMPOPO, SOUTH AFRICA**R. Ambikapathi¹, C. Nesamvuni², C. Mahopo², P. Bessong³, R. Guerrant⁴, L. Baret⁴¹Fogarty International Center, ²Dept of Nutrition, Univeristy of Venda, ³Dept of Microbiology, Univeristy of Venda, ⁴University of Virginia

Currently, WHO recommends exclusive breast feeding for child's first six of months of life to offer best protective defense against common childhood diseases and to provide for optimum growth, especially in low resource settings. Insofar, there is no consensus on standards for accurately measuring breastfeeding prevalence in longitudinal studies. Most of the validation studies focus on maternal recall on cross sectional surveys and weekly recalls rather than daily self recorded information (Engebretsen et al 2007, Bland et al 2003, Aarts et al 2000). Here, we selected 62 mothers who have completed daily, twice weekly and monthly 24 hr diet recall for their infants enrolled in the Malnutrition-Enteric Disease (MAL-ED) longitudinal birth cohort study to demonstrate the variability at each time scale. Enrollment began in November 2009 in rural Limpopo Province of South Africa. Daily maternal record was established, as the enrolled mothers commute frequently to school and work, and this proved to be an efficient alternative for the mothers to track the feeding patterns of her child. Mothers were given diary forms to record frequency of breastfeeding and infant formula, various liquids and solids on a daily basis. Using proportional hazards model, rates of exclusive breastfeeding were extracted at month 2, 4, and 6 from daily, twice weekly and monthly records. In addition, responses to question about initial breastfeeding status at birth were also integrated in the analysis. First cessation of exclusive breastfeeding is counted as a failure event. By month 2, exclusive breastfeeding rates are as follows: 22% from daily records, 43% from twice weekly and 62% from monthly records. At month 4, 2% from daily records, 2.4% from twice weekly and 6% from monthly records were breastfed exclusively. At month 6, there were no children who were exclusively breastfed by all three records. It was observed that there is gross overestimation of exclusive breastfeeding rates with twice weekly or monthly surveillance in comparison to daily records, which is used as a gold standard. Given its efficiency and economic implementation, we emphasize daily self written records as an accurate measure of exclusive breastfeeding indicators in longitudinal cohort studies, especially among highly mobile population.

PP 151**TEST-RETEST RELIABILITY OF A QUESTIONNAIRE MEASURING PERCEPTIONS OF NEIGHBORHOOD FOOD ENVIRONMENT**X. Ma¹, T. L. Barnes¹, D. A. Freedman², B. A. Bell³, A. D. Liese¹¹Epidemiology and Biostatistics, ²College of Social Work, ³College of Education

Purpose: Recent research suggests that an individual's perception of the food environment is associated with dietary intake. There is little information on the reliability of instruments measuring perceptions of the food environment. We aimed to estimate the test-retest reliability of a questionnaire assessing self-reported perceptions of the food environment. Methods: Participants were primary food shoppers of households sampled in an eight-county region in South Carolina for a telephone survey. Seven of the counties were rural and one urban. The questionnaire on perceptions of the food environment included five questions previously developed for the MESA Neighborhood study which focused on (a) availability and (b) quality of fresh fruit and vegetables, (c) availability of low fat products, (d) opportunities to purchase fast food in the neighborhood, and an overarching question on (e) access problems for food shopping. Neighborhood was defined as within a 20-minute walk or one mile from home. Additionally, we included questions assessing the presence of different food outlet types in the neighborhood. One-hundred-one participants were included. The survey was repeated approximately one month after the initial administration. Spearman's correlation coefficients were reported as a measure of reliability for continuous variables and Phi estimates for dichotomous variables. Results: Reliability was good for questions assessing the availability of fresh fruit and vegetables (0.60), availability of low fat products (0.63), opportunities to purchase fast food (0.65), and the lack of access to food shopping (0.69). Reliability was excellent for the perceived presence of a supercenter (0.96) and very good for drug stores or pharmacies (0.83). Reliability was good for the presence of a supermarket (0.77), specialty store (0.65), dollar store (0.71), fast food restaurant (0.79) and sit-down restaurant (0.65). Reliability was fair for questions on the availability of high quality fresh fruit and vegetables (0.55), and the presence of a small grocery (0.51) and convenience stores (0.58). Participants living in urban areas demonstrated better reliability on questions pertaining to opportunities to purchase fast food, problem of lack of access to food shopping, availability of supercenter, drug store or pharmacy than those living in non-urban areas (all $p < .05$). Conclusion: The majority of questions on perceptions of the neighborhood food environment appear quite reliable. However, for a subset of questions, urban residents demonstrated higher reliability than rural residents. Future research is needed to understand why small grocery and convenience stores were not consistently identified and the different reliability between residents of urban and rural areas.

PP 152

COMPARING THE PRECISION OF A QUALITATIVE AND A SEMI-QUANTITATIVE FOOD FREQUENCY QUESTIONNAIRE.

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Background: Food frequency questionnaires (FFQ) are generally administered with other measures in studies addressing diet-disease relationships. A semi-quantitative FFQ asks respondents to identify consumption frequency and usual portion size for each food. We considered eliminating the portion size question to lessen participant burden in the Canadian Cohort Obstructive Lung Disease (CanCOLLD) study. **Objectives:** 1. Determine FFQ completion time without the portion size question (“test” FFQ); 2. Compare intakes (energy, macronutrients, vitamins, minerals, food groups) estimated by the test FFQ to those obtained by the semi-quantitative (“reference”) FFQ. **Methods:** Ten adults self-administered the test and reference FFQ and their completion times were compared to accumulated data. A dataset from a validated, self-administered 78-item semi-quantitative FFQ completed by 55 older adults was used as the reference FFQ. The test FFQ was created by removing the portion size options from the FFQ computation algorithm, imputing the standard “medium” portion for all participants for each food/beverage item, and rerunning FFQ analyses using the modified algorithm. **Analyses:** Mean % difference, Spearman correlations, Bland-Altman analyses and cross-classification into quartiles compared test and reference FFQ estimates. Possible imputation-related misestimates in food reports were explored. **Results:** Mean reference FFQ completion time was 31±9 (range 15-55) minutes. The test FFQ took 16±4 (range 10-24) minutes. In the simulation exercise, all mean nutrient intakes were underestimated by the test FFQ relative to the reference FFQ. Imputing a standard portion led to small, significant underestimates for energy, total and saturated fat, calcium, iron, zinc, sodium, vitamin D, riboflavin and folate (mean -3.4%, range -2.3% to -4.3%, .05<p<.0001), suggesting that a variety of foods were under- or overestimated by the test FFQ. For example, 22 food sources contributing to 80% of calcium intakes were overestimated by the test FFQ, ranging from 0.6% (nuts and seeds) to 300% (mashed potatoes), while 21 foods were underestimated, ranging from -1.6% (whole grain breads) to -100% (green leafy vegetables). Correlations between test and reference estimates were, however, robust and highly statistically significant (mean Spearman r=0.91, p<.0001). **Conclusions:** A qualitative FFQ could characterise general dietary patterns or food habits. However in studies quantifying relationships between diet and disease risk, a qualitative FFQ will not provide the precision needed for determining risk estimates between consumption of specific foods, food groupings, nutrients, and health outcomes.

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PP 153

RELATIVE VALIDITY OF A FOOD FREQUENCY QUESTIONNAIRE IN YOUTH WITH TYPE 1 DIABETES

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Few validated diet assessment instruments exist for children and adolescents. SEARCH for Diabetes in Youth, a multi-center study of youth with diabetes, uses the Block Kids food frequency questionnaire (FFQ). The only published study on this instrument has reported reasonable validity for nutrients but not for food groups (FG). We evaluated the relative validity of the SEARCH FFQ in a sub-population of youth with type 1 diabetes (T1DM) aged 10 - 24 years enrolled in the SEARCH Nutrition Ancillary Study (2008-2011). In total, 172 participants completed two FFQs at a study visit followed by three randomly-assigned 24 hour dietary recalls (24HR) by telephone within one month. Using the 24HR as the reference, we estimated the correlation between true intake and 8 FFQ-derived nutrients (fructose, starch, total fat, saturated fat, protein, fiber, calcium, magnesium) and 10 FFQ-derived FG (fruits, vegetables, grains, whole grains, fats, dairy, low-fat dairy, meats and eggs, nuts and beans, sweets), using measurement error adjustment methods. Specifically, we applied a two-part measurement error model for FG (NCI method), which incorporates episodically-consumed foods. We also estimated the correlation of an index of overall dietary quality, the Dietary Approaches to Stop Hypertension (DASH) score, created according to the DASH eating plan using the FG listed above.

The FFQ-based intake estimates tended to be lower than those based on the 24HR for all nutrients except fructose. The FFQ provided higher estimates of intake than the 24HR for some FG and lower estimates for others. Estimated energy-adjusted correlations between 24HR and FFQ-reported intake of the 8 nutrients ranged from 0.28 (calcium) to 0.54 (saturated fat) with 8 nutrients exhibiting correlation coefficients >0.35. Energy-adjusted correlations for the 10 FGs varied more widely, ranging from 0.08 (whole grains) to 0.58 (nuts and beans) with 7 FGs exhibiting correlations

>0.35, but 3 performing poorly (grains, whole grain, fats). The energy-adjusted correlation for DASH was 0.46. Energy-adjusted attenuation factors, which quantify the amount of bias due to measurement error, ranged from 0.03 to 0.30 for the nutrients, and from 0.01 to 0.62 for the FGs (DASH score 0.47).

Our findings suggest that the Block Kids FFQ performs adequately for the assessment of nutrient composition in a sample of youth with T1DM. Given the importance of also understanding FG intake in youth, our results suggest there is some need for improvement in the assessment of a select subset of FGs in this questionnaire.

PP 154

ALTERNATIVES FOR ENERGY-ADJUSTMENT OF NUTRIENT INTAKES

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Background: Adjustment for total energy intake is important in epidemiologic analyses of diet and disease relationships. Adjustment for body weight and physical activity has been suggested as an alternative to adjusting for reported energy intake. We therefore examined which of these approaches would yield stronger correlations between nutrients and their corresponding blood biomarkers.

Methods: We used data from a nested case-control study of erythrocyte fatty acids and coronary heart disease risk (N=442), and of plasma carotenoids and breast cancer risk (N=1254) to adjust dietary fatty acids and carotenoids for total energy intake estimated by food frequency questionnaire, and for body weight and physical activity. We used the residual method for both adjustments and computed correlation coefficients between the adjusted nutrients and their biomarkers.

Results: Energy-adjusted trans fatty acid intakes had significantly stronger correlations with blood biomarkers than did intakes adjusted for weight and activity (for plasma fatty acid levels, $r=0.17$ unadjusted, 0.30 energy-adjusted, and 0.16 weight- and activity-adjusted; for erythrocytes, the corresponding correlations were 0.25, 0.37, and 0.25). Similarly, for intakes of linoleic acid and alpha-linolenic acid, correlations with their respective biomarkers were significantly stronger when adjusted for reported energy intake than when adjusted for weight and activity. For intakes of docosahexaenoic acid and carotenoids, which were only weakly correlated with total energy intake, adjustments made little difference.

Conclusions: Adjustment for energy calculated from the same questionnaire used to estimate nutrient intakes appears to be preferable to adjustment using body weight and physical activity in epidemiologic analyses.

PP 155

SPADE: A STATISTICAL PROGRAM TO ASSESS DIETARY EXPOSURE

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For dietary assessment at the population level, nutritionists are generally interested in the habitual intake distribution, reflecting individuals' long-term mean intake of dietary components. As the recommendations differ by age-gender categories, most of the available statistical methods proposed for estimating the habitual intake distribution from repeated short-term measurements (at least 2-days) perform these analyses by age-gender categories.

This is a drawback, since results may depend heavily on the chosen classification. As an alternative we developed SPADE (a Statistical Program to Assess Dietary Exposure) to estimate habitual intakes as a smooth function of age by fractional polynomials.

In this method two distributions (representing variation among individuals) are estimated: one for the intake frequency (fractions of days with nonzero intake) and one for the long-term intake amount (for days with nonzero intakes). The final habitual intake distribution is the convolution of the two distributions and is computed by Monte Carlo simulation. In case of daily intakes, e.g. nutrients, only the second part of the model for the amounts is needed and further calculations on the habitual intake distribution can be carried out exactly, without any Monte Carlo simulation.

SPADE handles also the following special cases:

- Intakes with real never-consumers, identified by e.g. food frequency questionnaires (FFQ).
- Intakes from supplements, which show often a distribution with spikes at the dosage level and need therefore a different modelling approach of the amounts than the amounts from food sources.
- Intakes from two or more different sources, which require separate modelling steps to get valid results (first shrink then add), e.g. intakes from different food sources or intakes from different food sources and one supplement with known never-consumers of the supplement.

Confidence intervals for the percentiles of the habitual intake distribution as well as for the population proportions are obtained in SPADE by a non-parametric bootstrap. Survey weights, without clustering, and user defined age classes for the output are allowed.

SPADE become available in 2012 as a user-friendly, non-official R package, written in R and Fortran and with a users guide. SPADE can be used interactively as well as in batch mode, allowing an efficient and user-friendly analysis of many nutrients and foods with clear graphics and printed output.

At the conference the usefulness of SPADE will be demonstrated with examples from the Dutch National Food Consumption Survey (2007-2010).

PP 156

DESIGNING A VALIDATION STUDY OF THE ASA24 AND OTHER SELF-REPORTED DIETARY ASSESSMENT TOOLS USING BIOMARKERS: IDATA STUDY

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Among the dietary assessment instruments commonly used in research, evidence suggests that 24-hour recalls measure diet with less error than Food Frequency Questionnaires (FFQ). The Automated Self-Administered 24-hour recall (ASA24) developed by the US National Cancer Institute is a user-friendly, web-based, dietary assessment tool that can be repeatedly administered over a period of time to estimate typical intakes. Successful incorporation of ASA24 into cohort studies holds promise for a new generation of epidemiologic studies with high-quality dietary data. We designed the Interactive Diet and Activity Tracking in AARP (IDATA) study to evaluate the measurement error structure of ASA24 and other self-reported dietary assessment instruments against unbiased recovery biomarkers. The IDATA Study will be conducted with a target sample of 760 male and female AARP (formerly the American Association of Retired Persons) members, 50-74 years of age, residing in Pittsburgh, Pennsylvania, and includes participants in the National Institutes of Health (NIH)-AARP Diet and Health Cohort Study. Participants will visit a study center three times and complete assigned activities at home over a 12-month period. Dietary assessment tools will be administered as follows: ASA24 six times, every other month; FFQs and 7-day food checklists twice, at months 1 and 12; and 4-day food records twice, 6 months apart. Recovery biomarkers include total energy expenditure (used as a biomarker for energy intake) based on doubly labeled water, administered once in all participants and repeated at month 6 in a subsample of 50 participants to measure within- person variability. Biomarkers for protein and potassium intakes, urinary nitrogen and potassium, based on 24-hour urines, will be collected twice, 6 months apart. Body weight, height, and waist and hip circumferences will be measured at months 1, 6, and 12, and fasting blood and saliva will be collected twice, 6 months apart. The core data elements of the IDATA study will be pooled with two other large biomarker-based diet and physical activity assessment studies as part of the Multi-Cohort Eating and Activity Study for Understanding Reporting Error (MEASURE) study. The results of IDATA and MEASURE will provide valuable insights regarding measurement error of self-reported dietary assessment tools, whether combining such instruments leads to improvement in exposure assessment, and how best to adjust observed relative risks for dietary exposure measurement error in nutritional epidemiology.

PP 157

BIOMARKER-BASED EVALUATION OF MEASUREMENT ERROR IN FFQ-, 24-H RECALL- AND FOOD RECORD- MEASURED INTAKE OF SUGARS IN WHI/NPAAS

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Measurement error in self-reported sugars in nutritional epidemiology may have obscured the true association between sugars intake and disease. A predictive biomarker for total sugars (i.e. sum of fructose and sucrose in 24-hour urine (24HU)) was developed in two controlled feeding studies (Tasevska et al, 2005, CEBP). Here, we use this novel biomarker to assess measurement error (ME) in reported total sugars intake in free-living individuals from the Nutrition and Physical Activity Assessment Study (NPAAS). NPAAS, a sub-study of the Women's Health Initiative (WHI) Observational Study, included 450 post-menopausal women aged 50-79 years at WHI baseline, recruited from nine centers. Participants' diets were assessed using FFQ, 4-day food record (4DFR) and three 24-h dietary recalls (24HDRs). Participants collected one 24HU, which was analyzed for sucrose and fructose. We measured energy intake using a doubly-labeled water (DLW) protocol. Eighty-eight participants repeated the protocol six months later. We used ME parameters estimated in the feeding study, to calibrate the biomarker measured in NPAAS participants (Tasevska et al, 2011, CEBP). The calibrated biomarker was then used as a reference to assess the ME structure, the attenuation factors (AFs) for reported intakes and the Pearson correlation coefficient between true and reported intake of absolute total sugars and sugars density for the FFQ, 4DFR and 24HDRs. Geometric means of self-reported total sugars intake (FFQ: 83.2; 4DFR: 86.8; 24HDR: 86.7 g/d) were half the biomarker-based estimates (171.7 g/d). The AF (SE) for absolute sugars (g/day) was 0.30 (0.09) for FFQ, 0.36 (0.11) for 4DFR and 0.38 (0.11) for the average of three

24HDR. The AFs for sugars density (g/1000 kcal) for FFQ and for 24HDR markedly increased to 0.50 (0.14) and 0.58 (0.14), respectively, whereas AF barely changed for 4DFR (AF = 0.32; SE = 0.14). The correlation between self-reported and true intake (g/1000 kcal) was 0.33 for FFQ, 0.21 for 4DFR and 0.37 for the average of three 24HDR. On a group level, sugars intake was under-reported on all self-reporting instruments. In a disease model with sugars density, three 24HDR would provide the most accurate risk estimate for the sugars effect, followed by FFQ, and lastly 4DFR. Biomarker-based risk correction factors derived from calibration sub-studies should be applied in cohorts to obtain more definite answers on the role of sugars in disease. Yet, more feeding studies across different populations are necessary to investigate the stability of the sugars biomarker ME parameters used in this analysis.

PP 158

CORRECTION FOR MEASUREMENT ERRORS IN AN FFQ BY USING DUPLICATE PORTION, 24 HOUR RECALL AND A BIOMARKER AS THE REFERENCE METHODS

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In epidemiological research the food frequency questionnaire (FFQ) is an often used dietary assessment method. Though this method is known to assess dietary intake with systematic and random errors. Therefore various validation and calibration methods have been proposed in the literature to correct for these errors. However for the majority of nutrients no recovery marker is known and the reference methods often share various characteristics in common with the FFQ, including usage of the same food composition database and the reliance on the participant's memory. Consequently the underlying assumption of independent errors between the methods is violated. We therefore will use duplicate portions as an extra reference method in a validation study. This dietary assessment method is a prospective approach we assume to have truly independent errors with the FFQ.

The main objective of this study is to develop a novel approach to assess the validity of FFQs and identify the extent of their errors with the use of duplicate portions. The second objective focuses on the 24 hour recall (24hR), an often used reference method to validate an FFQ. This objective aims to determine the correlation between errors of FFQs and 24hRs for specific nutrients.

During a period of twelve months, 200 participants (100 men and 100 women) will complete nine 24hRs (web- and telephone based), collect two 24-h duplicate portions, fill out two times the same FFQ, collect 24-h urine and provide blood samples for biomarker analysis on two occasions. In this study the focus will be on the following nutrients: energy, protein, potassium, fatty acids, carotenoids and tocopherols. In the duplicate portions these nutrients will be determined by chemical analyses. During data collection seasonal differences and day of the week (week or weekend) will be taken into account.

Data collection started halfway 2011 and preliminary results are expected by 2013.

PP 159

CAN'T SEE THE TREES FOR THE WOOD? AGGREGATING DAIRY FOODS TO "TOTAL DAIRY" MAY OBSCURE IMPORTANT DIET-DISEASE RELATIONSHIPS

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Background: Dairy foods are a diverse group of foods differing in structure, composition, usage and method of production. They are commonly treated as a singular group in dietary studies, and dietary recommendations seldom distinguish between them (the recommendation to consume low-fat versions notwithstanding). However, specific dairy foods are associated differentially with cardiovascular disease (CVD) risk factors such as cholesterol and hypertension but very few studies have examined the relationship between specific dairy foods and risk of CVD.

Objective: We examined the association between specific dairy food intakes and incidence of myocardial infarction (MI) in the prospective, population-based Swedish Mammography Cohort.

Results: Over 11.6 y of follow-up, we ascertained 1392 cases of MI. Total dairy intake was, comparing the highest quintile with the lowest, inversely associated with MI risk after multivariable adjustment (HR 0.77, 95 % CI 0.63-0.95). However, among the specific dairy products, total cheese was inversely associated (HR 0.74, 95% CI 0.60-0.91), and butter used on bread but not on cooking was positively associated (HR 1.34 (95% CI, 1.02-1.75), with MI risk. Total milk showed a tendency towards increased risk of MI and cultured milk/yoghurt towards decreased risk, but these did not remain statistically significant after adjustment for confounders. No differences were observed between consumption of specific low-fat and high-fat dairy foods, expressed as either absolute intakes or intakes relative to total dairy, and MI risk.

Design: We followed 33,636 women (48-83y), free from CVD, cancer and diabetes at baseline (1997). Consumption of milk, cultured milk/yoghurt, cheese, cream, crème fraiche and butter was obtained from a validated self-administered

food-frequency questionnaire at baseline. MI incidence was ascertained from national registries. We used Cox-proportional hazards regression models to estimate hazard ratios (HR) and 95% confidence intervals (CI).

Conclusion: The relationship between dairy foods and MI risk appears complex. Due to the apparent divergent associations of specific dairy foods with MI, failure to consider and report dairy foods as a heterogeneous group in epidemiological studies may mask important diet-disease associations and could hamper important insights of relevance for the development of dietary guidelines.

PP 160

IMPUTATION OF PORTION SIZE DATA IN A FOOD FREQUENCY QUESTIONNAIRE

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Background: Many older food frequency questionnaires (FFQs) did not have questions about portion size, thus there were no individual correction of energy intake. **Objective:** To test whether a model based on linear regression or a model based on probabilities for categorical answers is the better predictor of portion size for use in imputation of data in FFQs without portion size. **Material:** KRAM (“Diet, Smoking, Alcohol, and Exercise”) data were collected in 2007 - 2008 in 13 municipalities across Denmark. Nutritional data were collected among 18,065 adults on an internet based version of the FFQ used in the Danish EPIC cohort. There were 29 items on portion size and size categories were shown with pictures. **Methods:** The hypothesis was that age, sex, height, weight, number of potatoes with warm meals, physical activity and socioeconomic status predicted reported portion size. To test this the data set was split in two. One half (KRAM_G) was used to generate two imputation models, and the other half (KRAM_T) was used to test the two models comparing observed portion sizes (KRAM_TO) to imputed portion sizes (KRAM_TI). “The continuous model”. Portion size categories were converted to continuous variables. A range of independent variables were used in 29 linear regression models with each of the 29 portion size items as the dependent variable. Values for imputation into KRAM_TI were sampled randomly within the variance of these regressions. “The categorical model” was based on five key determinants for portion size (sex, age, weight, number of potatoes with warm meals and physical activity). Dichotomized on median values, 32 (2^5) groups were created (ex: female sex, age>52 years, weight<74 kg, >2 potatoes and <3 in reported physical activity). Imputation with random sampling of observed portion size answers from the equivalent group in KRAM_G gave rise to KRAM_TI. **Results:** The two methods of imputation, and possible improvements, will be compared (KRAM_TO to KRAM_TI) on measures of model fit (e.g. root mean squared error, mean bias) and with Bland-Altman plots for total energy intake, protein, carbohydrates, fat, fiber, fructose and portion sizes. We are currently working on the results - numbers and graphs will be presented at the conference.

PP 161

HOW MANY 24 HOUR DIETS RECALL ARE NECESSARY TO CORRECT THE MEASUREMENT ERROR OF VITAMIN C?

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BACKGROUND: Dietary intake variables come from questionnaires, which measure the frequency of consumption over a defined period of time (e.g. the last month; the previous year, etc.) in grams per day for each food. These variables usually have misclassification related to the true intake: random error and systematic error. So, it can be difficult to find the real relation between the dose and response. To obtain more reliable results is necessary correct the measurement error. The way to control for bias is to use a reference instrument, which is called the ‘gold standard’. Reference method is usually multiple-day food record or multiple 24-hour dietary recalls (24HR). A single 24HR is limited to provide an estimation of a long-term intake. Previous studies used 3, 4, 5 or 7 24HR. Yunsheng (2009) studied the number of 24HR needed to accurately estimate the energy intake and conclude that three 24HR appeared optimal.

OBJECTIVE: To assess the number of 24HR of vitamin C are needed to correct the measurement error

METHODS: Different methods can be used to correct measurement error. Here we applied one based on correction of the measure (regression calibration). The basic idea of regression calibration is predict the true consumption for each individual using a reference measure, that we assume is error-free, and a set of noise variables for a subsample. Then the predicted values are therefore used as measurement error corrected covariate to model the relation between the outcome and the risk factor. To evaluate the number of 24HRs optimal to correct the measurement error we will use a simulation study of 500 samples considering different number of 24HRs from 1, 3, 4, 5 and 7. The mean squared error, bias and confidence interval coverage will be reported as performance measures of the different estimations.

PP 162

WOMEN'S LIFESTYLE VALIDATION STUDY FFQS

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To quantify more precisely the measurement errors associated with different methods for assessing diet and physical activity in large epidemiologic studies, we are conducting a large validation/calibration study among women. The Women's Lifestyle Validation Study, conducted by the Harvard School of Public Health with National Cancer Institute collaborators, uses multiple self-reported and biomarker measures of diet and physical activity, collected over one year, among participants in the Nurses' Health Study (NHS) and Nurses' Health Study II (NHSII). The study design consists of two food frequency questionnaires (FFQs) administered one year apart; in the year between these measures we are collecting four 24-hour recalls using the new, automated, web-based self-administered 24-hour recall (ASA24) (once every 3 months), two 7-day dietary records (once every 6 months), and biomarkers of diet including one assessment of energy expenditure using doubly-labeled water (DLW, with a

replication in 100 women), four 24-hour urinary measures of nitrogen (a measure of protein intake), sodium and potassium (once every 3 months), and two fasting blood samples for plasma levels of specific fatty acids, standard lipids, carotenoids, and folate (once every 6 months).

Physical activity will be assessed twice, one year apart (together with the FFQs), by the modified Paffenbarger physical activity questionnaire used in our studies, four 24-hour recalls using an automated web-based system developed by the NCI (ACT24) (once every 3 months), twice by an objective physical activity monitor (once every 6 months), and by DLW (subtracting resting metabolic rate). These multiple measurements will allow an evaluation of the error structure associated with

dietary and physical activity assessment methods, in particular, the influences of variation over time for each method and correlation of errors between methods. This will provide information on the relative and absolute validity of the different measures, allow better correction of observed associations and confidence intervals for measurement error, inform the interpretation of the published literature on diet and health outcomes, and guide the design of future validation/calibration studies. Additional analyses will indicate the optimal approaches to adjust nutrient intakes for total energy intake, which is

critical for the interpretation of epidemiologic findings. To date, 572 (72%) of 796 women recruited have successfully completed the study, 190 (24%) are in the last three months of the study, and only 4% have dropped out. All data collection activities will be completed by March 2012. A parallel validation/calibration study among 750 men has recently been initiated.

PP 163

SIMULTANEOUS VALIDATION OF THREE DIETARY ASSESSMENT METHODS: COMPARISON WITH DOUBLY LABELED WATER ENERGY EXPENDITURE ESTIMATE.

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Background: The 24-hour recall (24h-R), the food record (FR) and the food frequency questionnaire (FFQ) are the most used dietary assessment, but few studies have measured their accuracy in Brazil which is important for improving the estimators on diet and disease association. The double label water (DLW) is the gold-standard to estimate energy expenditure and has been used in the validation of dietary assessment methods.

Objective: To compare the deattenuated mean energy intake (EI) estimated from an FFQ and two FR and three 24h-R means with total energy expenditure (TEE) assessed by doubly labeled water (DLW).

Subjects and setting: Adults (33 men and 53 women), 20 to 59 years old, sampled from a population-based survey conducted in Duque de Caxias, in the Rio de Janeiro Metropolitan Area, Brazil.

Methods: FFQ, FR and 24h-R were administered by personal interview before applying the DLW technique. The FFQ has 80 items and nine frequency options. Three 24-h recalls were obtained in non-consecutive days along a three week period. The FR was obtained on two non-consecutive. EI estimates from FR and 24h-R were adjusted for within-individual variability. The DLW procedures included one baseline urine sample, taken before the doses administration and samples collected three, four and five hours and in the first, fifth and tenth days after the doses administration. Nutritional status was assessed using BMI and the WHO cut-off limits. The comparison between the estimated energy intake and expenditure was done by the Wilcoxon Signed Ranks Test, Pearson correlation coefficient (CC) ($\alpha=0.05$) and the Bland-Altman and Survival-Agreement (S-A) plots.

Results: Men presented mean TEE higher than woman (2.733 vs. 2.395kcal; $p<0.01$). The mean difference between EI and TEE varied according to method. The mean underreport of energy intake among men was 27% and the highest differences (EI – TEE) were observed for 24h-R, and the lowest for the FFQ (FFQ: -567kcal; FR: -726kcal; 24h-R: -968kcal). Mean underreport among women was 27%, and was higher for the FR (FFQ: -490kcal; FR: -786kcal; 24h-R:

-711kcal). Significant correlation as observed only for the FR of normal weight participants (0.46; $p < 0.05$). Limits of agreement estimated according to Bland-Altman method were similar for FR and 24h-R (FR: 38% - 122%; 35%-128%) and wider for the FFQ (28%-190%). According to the S-A plot, the food record was the method with more agreement proportions.

Conclusion: Based on the results of this study, adult men and women tend to underreport the energy intake, regardless of the assessment method used.

PP 164

CAN WE ACCURATELY ESTIMATE THE VALIDITY OF DIETARY ACRYLAMIDE MEASUREMENTS?

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Background: Acrylamide is an environmental chemical found mainly in tobacco smoke and food. It is a potential human carcinogen and a known human neurotoxin. Acrylamide is formed in foods, typically carbohydrate-rich and protein-low plant commodities, during cooking or other thermal processing. As acrylamide presence in foods was suggested to pose a public health concern, in this study it was aimed to estimate the validity of (dietary) acrylamide measurements.

Methods: Within the European Prospective Investigation into Cancer and Nutrition (EPIC) study, acrylamide exposure was assessed in subgroups of the EPIC study population. Using information from 510 subjects from 9 European countries, randomly selected and stratified by age, gender, and an equal number of non-smoker and smoker participants, acrylamide 24-hours dietary recall (R) and questionnaire measurements (DQ) were compared to haemoglobin adducts of acrylamide (AA) and its primary metabolite glycidamide (GA). Blood samples were analyzed for haemoglobin AA and GA by HPLC/tandem mass spectrometry. Correlation coefficients between acrylamide measurements were primarily computed, overall and by smoking status. Assuming a classical measurement error structure for R measurements (reference), R, DQ and the ratio GA/AA measurements were linearly related to unknown true acrylamide levels in a structural equation model to account for the measurement error structure, and to estimate the validity of each acrylamide measurement.

Results: After adjustment for smoking status, country, sex, BMI and alcohol intake, the correlation coefficient between DQ and R measurements ($r_{DQ,R}$) was equal to 0.19, while $r_{DQ,GA/AA}$ and $r_{R,GA/AA}$ were 0.10 and 0.05, respectively. In non-smokers, $r_{DQ,R}$, $r_{DQ,GA/AA}$ and $r_{R,GA/AA}$ were equal to 0.16, 0.01 and -0.01, respectively. Correlation coefficients between self-reported (DQ and R) measurements and AA and GA were low. Estimates of the validity coefficients were equal to 0.66 for DQ, 0.28 for R and 0.16 for the ratio GA/AA. However, in non-smokers an estimate of the validity coefficient could not be obtained.

Conclusions: There has been an increasing interest towards accurately relating acrylamide exposure to the risk of different cancer types. Findings from the EPIC study suggest that dietary self-reported acrylamide measurements correlate weakly with haemoglobin levels, this observation being even more dramatic in non-smokers. This suggests that haemoglobin adducts are not sufficiently specific in distinguishing between dietary and other environmental sources of total acrylamide exposure levels, thus raising concerns on their use in validation studies of self-reported dietary measurements.

PP 165

MEAT INTAKE AND COLORECTAL CANCER RISK BEFORE AND AFTER MEASUREMENT ERROR CORRECTION IN THE NORWEGIAN WOMEN AND CANCER STUDY (NOWAC)

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Background: Intake of red and processed meat is an established risk factor for colorectal cancer (CRC), but the effect size vary by anatomical sub-site, and is often weaker in women. Few studies have assessed the effect of measurement error in self-reported meat intake and other dietary covariates, on estimates of CRC in women, as we do here. We also present some methodological challenges encountered using publically available software to perform regression calibration on our data.

Methods: We examined associations between meat intake measured with a food frequency questionnaire (FFQ) and risk of incident colorectal cancer within a population based cohort of Norwegian women with linkage to the Cancer Registry of Norway. The study sample included 84 538 women aged 41-70 yrs at FFQ completion (recruited in 1996-1998 or 2003-2005 with follow-up through 2009, median 11.1 yrs). Cox regression (age as time scale) was used to estimate hazard ratios (HRs) for CRC risk and meat intake adjusted for energy, alcohol, fiber, calcium, smoking, body mass index, and physical activity. Continuous effects were corrected for diet measurement error using a sub-sample of 220 NOWAC women with both FFQ and 24-hour recall data (mean of four recalls) and the SAS macro BLINPLUS for regression calibration : (<http://www.hsph.harvard.edu/faculty/donna-spiegelman/software/blinplus-macro/index.html>).

Results: There were 674 cases of CRC (459 colon, of which 242 proximal and 167 distal, and 215 rectal) with follow-up ≥ 1 year. Significantly increased risk of proximal and distal colon cancer and rectal cancer was found in the highest intake category of processed meat (≥ 60 vs. <15 g/day). The HR (95% CI) for CRC overall per 15 g increase in processed meat intake was 1.06 (1.00, 1.12) before and 1.25 (0.94, 1.65) after measurement error correction. No clear associations were found between intake of red meat or chicken, and risk of colon or rectal cancer.

Conclusion: High intake of processed meat was associated with increased risk of colon and rectal cancers in this cohort study of Norwegian women. The associations were further strengthened by regression calibration, but the correction may not be optimal as the cohort data violate some assumptions of the procedure, and correlated errors in FFQ and 24-recall validation data have not been taken into account.

PP 166

THRESHOLD MODELING IN THE PRESENCE OF MEASUREMENT ERROR: APPLICATION TO SERUM VITAMIN D

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Vitamin D is essential to ensure bone hardness and strength. Consequently, insufficient levels of vitamin D can lead to fractures and osteoporosis. Those exhibiting vitamin D deficiency have been characterized by low levels of serum vitamin D (25(OH)D) and elevated levels of serum intact parathyroid hormone (iPTH). A function that has been suggested for the relationship between usual iPTH and usual 25(OH)D, where usual represents the long run average of the daily measurements of these quantities, is the segmented regression function. Simulation is used to compare alternative estimation procedures. An estimation procedure based on likelihood methodology is proposed and yields encouraging results in a simulation study.

PP 167

ASSOCIATION BETWEEN INTAKE OF ADDED SUGARS AND DISCRETIONARY FATS WITH NUTRIENT INTAKES FOR CHILDREN AND ADOLESCENTS AGES 4-18 YEARS OLD

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The term “empty calories” has been in use for many years, and refers to the calories that are contributed by some starchy foods, saturated fats, alcohol, and refined sugars (Jenkins, 2004). The effect of empty calories on a person's diet is at odds with the goals of individuals who are trying to maintain a healthy lifestyle. Data for children and adolescents aged 4 to 18 years old in the United States from NHANES 2003-2004 (the latest survey for which intakes of added sugar and discretionary fat are available) were used to estimate the association between intake of added sugars and discretionary fats with intake of essential nutrients. We fit a regression model that allows for non-independent measurement error between the dependent and the response variables, to account for the fact that observed daily intakes are noisy measurements of usual intakes. The response variable in our models is the nutrient density (units of the nutrient per 100 calories). Calories from added sugar and from discretionary fat were expressed as percent of total energy as well. Other covariates in the model (e.g., BMI and age) are assumed to be measured with no error. For certain age-sex groups, added sugars and discretionary fats are found to be negatively associated with intake of some nutrients, suggesting that intake of foods with high content of added sugar and fat displace consumption of some nutrients.

Keywords: Measurement error model, empty calories, added sugar, discretionary fat

PP 168

SELECTING TARGET POPULATIONS FOR COMMUNITY NUTRITION INTERVENTION USING SPATIAL ANALYSES

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Target populations for community-based interventions are often selected using subjective methods, despite the push for increasing objective, quantifiable methods in public health intervention design. The selection of target populations in this manner often proves difficult to reproduce and stands as a threat to both the internal and external validity of the intervention. A quantifiable method for identifying or comparing potential target populations across a variety of locations would serve to strengthen the existing knowledge base in the field of community based nutrition interventions. The objective of this study was to determine if spatial patterns exist among environmental influences on childhood obesity and to establish the effectiveness of spatial analyses in determining the location of the population in greatest need of nutritional intervention. Three environmental risk factors for childhood obesity were selected; socioeconomic status, the proximity of grocery stores with healthy options, and the walkability of the study area.

Prevalence data from each influence was mapped by the census tract in Berkeley County, West Virginia using the ArcGIS program (ESRI). The resulting maps exhibited patterned clustering of the selected risk factors within the county. By ranking each census tract by degree of prevalence it was possible to highlight a single census tract with the greatest cumulative risk for obesity in children, with respect to the selected risk factors. Prevalence data for childhood obesity in Berkeley County was obtained from the Coronary Artery Risk Detection in Appalachian Communities (CARDIAC) project, and served to confirm that the location with the greatest cumulative risk for childhood obesity occurred in the same location as the area with the highest prevalence of childhood obesity.

In conclusion, this study has found an objective method with which to determine the target population at greatest need for nutrition intervention.

PP 169

DEVELOPMENT OF AN OUTCOME MEASURE FRAMEWORK FOR THE EVALUATION OF CHILDHOOD OBESITY TREATMENT INTERVENTIONS

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Background: There is a lack of consensus in determining appropriate outcome measures for the reliable and valid assessment of childhood obesity interventions. Comparisons between interventions are difficult, partly because of a shortage of validated outcome measures available, but also because the selected outcome measures differ between studies.

Aim: To develop a framework of outcome measures for use in the evaluation of childhood obesity treatment interventions to act as a guide for future researchers and clinicians.

Search strategy: Two searches have been conducted to identify (1) randomised controlled trials, pilot and feasibility studies of childhood obesity treatment evaluation studies; and (2) outcome measures developed for use in childhood obesity interventions. Data were obtained for both searches using online databases: Ovid Medline, Medline in process, EMBASE, PsycINFO, HMIC, AMED, Maternity and Infant Care, Global Health, CINAHL, Cochrane Library and Web of Science. Restrictions on language and date were not set and unpublished articles were included.

Data extraction: Systematic review and appraisal of outcome measures for use within children (equal to or less than 18 years of age) within the domains: anthropometry, diet, eating behaviours, physical activity, fitness, sedentary behaviour, psychological wellbeing, economic evaluation, environmental outcomes and physiological outcomes. Outcome measures must describe its development or evaluation of within any one of these domains and must have been used (or intended to be used) in childhood obesity treatment intervention evaluations.

Data analysis: Outcome measures will be appraised using international guidelines and a framework containing robust measures will be developed. This framework will be appraised and agreed by expert review (including 18 obesity and methodology experts).

Results: After removal of duplicates, 25,486 manuscripts were identified. Data extraction forms have been prepared for each outcome domain to facilitate appraisal. Key findings for diet and physical activity domains will be presented.

Conclusions: This is an exciting project that has immense implications for childhood obesity research. Alongside peer reviewed publication, findings will be used by the National Obesity Observatory (NOO) to inform a set of resources that are being developed to accompany the Standard Evaluation Framework (SEF) for weight management interventions which is intended for use in a public health setting. In addition to the production of an outcome measure framework to facilitate methodologically enhanced, high quality research; it will also identify important gaps in the methodology literature to guide future tool development.

Acknowledgement: 'This project was funded by the NIHR Health Technology Assessment programme and will be published in full in the Health Technology Assessment journal series. Visit the HTA programme website for more details www.hta.ac.uk/link to project page. The views and opinions expressed therein are those of the authors and do not necessarily reflect those of the Department of Health'

PP 170

REPRODUCIBILITY AND VALIDATION OF A FOOD FREQUENCY QUESTIONNAIRE FOR PRESCHOOL CHILDREN USING MULTIPLE METHODS

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Background: Validity of Food frequency questionnaire (FFQ) for preschool children using parental report and anthropometric measures are limited. **Objective:** To test the reproducibility and relative validity of a food frequency questionnaire (FFQ) for young children against 24-hour food recalls (24HRs), anthropometric measurements, and a comprehensive feeding practices questionnaire (CFPQ). **Design and setting:** Children (aged 5-6) and their mothers were recruited during 2008 from preschools. Children's anthropometric measurements were obtained and mothers provided during a personal interview on three occasions during a school-year a 110-item semiquantitative FFQ, 24HRs and CFPQ. **Statistical analyses performed:** Pearson correlation coefficients were calculated to assess the reliability of the

FFQ and the relative validity compared to the 24HR. Validity coefficients between the FFQ and the different measurements were calculated. Scores of the 12 factor factors of the CFPQ were calculated and then divided into tertiles. The ANOVA procedure was used to compare nutrients consumption across the tertiles. Results: Sixty-six healthy children (47% boys) were recruited. The FFQ seemed to overestimate the nutrient intake when compared with 24HRs. Pearson's correlations between the average of the FFQs and the average of the 24HRs ranged from 0.3-0.6 ($P < 0.05$ for all correlations tested). The highest correlation coefficients were 0.59 for total fat intake and 0.56 for energy. Dietary intake of energy and carbohydrates differed significantly ($P = 0.05$, 0.001 respectively) across the three BMI z-score levels (normal-weight, overweight, obese) and the three waist circumference tertiles (0.019, 0.006 respectively). Obesogenic factors from the CFPQ correlated with consumption of empty calories like sweets, snacks, junk foods and sweet drinks. Conclusions: The modified FFQ is a relatively valid instrument to estimate mean energy intake in a group of 5- to 6-year-old children. The questionnaire performs reasonably well to rank children with respect to macronutrients intake as well as obesogenic food groups.

PP 171

ALTERNATIVE CHILDREN ANTHROPOMETRIC INDICES CONSISTENTLY ASSOCIATED WITH A MEDITERRANEAN DIET SCORE: CROSS SECTIONAL AND LONGITUDINAL FINDINGS

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Aim: Research is needed to assess how to evaluate children's overnutrition in relation to the prevention of overweight. It is common to convert BMI to age and sex adjusted z-scores based on the Cole method, but according to Cole (2000) short term changes in adiposity, BMI z-scores turned out not to be the best adiposity measure change in children, as their variability gets smaller with increasing weight. We compared the association of relative adherence to a Mediterranean dietary pattern to different measures of overweight and adiposity (BMI, BMI z-scores, waist circumference, waist-to-height ratio (WtHR) and % fat mass) both cross sectionally and longitudinally. **Methods:** IDEFICS is an intervention study including 16,220 children (2-9 yrs) recruited in selected centres of eight EU countries (Sweden, Germany, Hungary, Italy, Cyprus, Spain, Belgium, Estonia). Anthropometry outcomes were defined as: overweight including obesity according to Cole's definition, $WtHR > 0.5$, waist circumference and % fat mass (cross sectional analyses) and as the highest age and sex specific quintile of change in: BMI, BMI z-scores (defined according to Cole), WtHR, waist circumference and % fat mass (prospective analyses). A Children's Eating Habits Questionnaire (CEHQ) was administered to parents to assess their children's consumption frequency of 43 foods. A food frequency-based Mediterranean Diet Score (fMDS) was created based on high frequencies of cereals, fruit, vegetables, fish and low of dairy and meat products. High and low intakes were defined according to medians (above and below): 1 point was assigned for each intake above or below median. The fMDS was finally calculated as the point sum and associated to the anthropometry outcomes mentioned above. **Results and conclusions:** Cross sectionally, Mediterranean diet was shown to be inversely associated with overweight (OR = 0.9, 95% CI: 0.8; 0.9, $p < 0.01$) and with % fat mass ($\beta = -0.2$, 95% CI: -0.4; 0.0, $p < 0.05$). Longitudinally, the highest quintile of change in: age and sex adjusted BMI z-score (OR = 0.9, 95% CI: 0.8; 1.0, $p < 0.01$), BMI (age and sex adjusted) (OR = 0.9, 95% CI: 0.8; 1.0, $p < 0.01$), WtHR (OR = 0.9, 95% CI: 0.8; 1.0, $p < 0.05$) and waist circumference (OR = 0.9, 95% CI: 0.8; 1.0, $p < 0.05$) were all inversely associated. It seems that Mediterranean diet in children is a reliable index predicting changes in weight status, by all available methods, as well as initial values. More research is needed, not only to improve methods to measure dietary patterns in children, but also to understand how to best assess healthy weight status.

PP 172

EXCLUSIVE BREASTFEEDING RATHER THAN COMBINATION BREASTFEEDING IS AN IMPORTANT DISTINCTION WHEN MEASURING ASSOCIATIONS WITH CHILDHOOD OBESITY

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Aim: Breastfeeding has been reported to be associated with a number of positive health outcomes including reduced childhood obesity. However there are inconsistencies in the literature that may relate to residual confounding, differences in defining weight status, or differences in examining exclusive breastfeeding versus any breastfeeding which includes combination feeding. This study assesses exclusive breastfeeding and combination feeding in relation to overweight in a large, European sample, IDEFICS, from examination centers in eight countries. Exclusive rather than partial breastfeeding is the focus of this study due to the theoretical relationship between exclusive breastfeeding and

development of dietary self-regulation. The aim of this study is to evaluate measurement of exclusive breastfeeding compared to measurement of combination breastfeeding which includes any breastfeeding and the association with childhood overweight (including obesity).

Methods: Subjects included 14,726 children aged 2 to 9 years for whom early feeding practices were reported by parents in standardized questionnaires. Children's measured heights and weights were used to calculate weight status as a body mass index (BMI) z score and to calculate a waist-height ratio using 0.05 as a cut-point. Skinfold measures were examined as alternative indicators of adiposity and fat patterning from measured skin folds taken at two sites with two repeated measures. Adiposity was calculated using the slaughter equation and a cut-point was set at the 80th percentile.

Results and Conclusions: After controlling for survey center, child's gender, age and birth weight, maternal education, and tobacco use, maternal obesity, one or more foreign born parents, and single parent households we consistently observe that exclusive breastfeeding is protective of overweight while combination feeding in three discrete models is not. Respectively, for exclusive breastfeeding in our fully adjusted model we found an OR=0.97, 95%CI: 0.95-0.99 with BMI as the outcome, OR=0.97, 95% CI: 0.96-0.99 with WtHR <0.05, and an OR=0.96, 95% CI: 0.94-0.98 for adiposity measured by skinfold. However combination feeding was not statistically significant in any of the models with respective estimates OR=0.99, 95% CI: 0.98-1.0 for BMI, OR=1.0, 95% CI: 0.99-1.0, for WHR and OR=1.0, CI: 0.98-1.0) for adiposity. Our method of defining breastfeeding as exclusive breastfeeding rather than combination breastfeeding is an important distinction. Previous studies have failed to make this distinction and this may in part explain differences in findings when examining associations between breastfeeding and overweight including obesity.

PP 173

USE OF A YOUNG PERSON'S PHOTOGRAPH FOOD ATLAS IN THE UK NATIONAL DIET AND NUTRITION SURVEY

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The National Diet and Nutrition Survey Rolling Programme (NDNS) uses a 4-day unweighed food diary where portion sizes are usually recorded in household measures. The estimation of portion sizes from food photographs increases the accuracy of portion size estimation compared with unaided estimates. Three photograph atlases for different age groups were developed by Newcastle University and validated using 313 children aged 1.5-16y. The atlas performed well at the group level, producing mean estimates of both portion size for individual foods and mean daily nutrient intakes very close to values reported in weighed food diaries.

To evaluate the feasibility of using these atlases in a national dietary survey, a pilot was carried out in Quarter 2 of Year 3 of NDNS. Thirty-one different foods were included and most photographs could be used to estimate amounts for other foods e.g. photograph of rice could also be used for couscous. These alternatives were listed on a separate Equivalent Foods List (EFL). Participants were instructed to record portion sizes in household measures as usual and these were checked by the interviewer when reviewing the diary. For those aged under 16y, the interviewer also used an atlas when reviewing the diary, asking the participant or parent to select a photo for each food that appeared in the atlas or EFL. Following diary collection, interviewers were asked to complete an evaluation form.

During Quarter 2, 171 children aged 1.5 to 15y kept a diary, and the atlas was used with 124 of them (73%). The pilot showed that when interviewers used the atlas, they did so correctly and the atlas received positive feedback from most interviewers and participants.

However, on 54% of the occasions when a participant ate a food that appeared in the atlas or EFL, the interviewer had not shown them a photograph. Some interviewers found it difficult to ask participants to pick a photograph when they had already provided a portion size, especially if they had provided '...detailed amounts'; others felt that they didn't use the atlas or EFL enough to become sufficiently familiar with the foods in it, or they didn't use it when they were time-pressured in the participant's home.

The pilot highlighted some of the issues in using food atlases in surveys. Several measures were put in place before the atlas was fully incorporated into NDNS in Year 4. These will be discussed along with whether they have improved usage.

PP 174

RELIABILITY AND RELATIVE VALIDITY OF A SHORT FOOD SURVEY DERIVED DIET QUALITY SCORE

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Background: Diet quality indexes are useful as they acknowledge the synergistic nature of dietary habits and interpret diet against recommendations. The Dietary Guidelines Index for Children and Adolescents (DGI-CA) assesses compliance with the Australian dietary guidelines. The DGI-CA was developed and validated based on food intake

assessed using 24-hour recalls. Dietary assessment via 24-hour recall is not always practical. A short tool, of known reliability and validity, from which DGI-CA scores can be derived is needed.

Aim: Determine the reliability and validity of a short food survey to assess children's whole of diet quality compared with three 24-hour recalls.

Method: The sample comprised 63 parents of children aged 4-12 years, living in Adelaide, Australia. Parents reported children's usual intake on a 38-item survey, administered online, on two occasions, one week apart. The survey asked about usual intake of 7 food groups and 4 food habits. Parents also completed 3 24-hour recalls, one face-to-face and two via telephone (representing two weekdays, one weekend day) with a dietitian. Diet quality was calculated using the DGI-CA scoring criteria (score out of 100). The diet quality score is comprised of 11 components: fruit, vegetables, breads and cereals, meat dairy, extra foods, beverages, proportion of dairy as reduced fat, wholegrains, healthy fats and diet variety. Food group intake and diet quality scores were calculated for each administration of the short food survey and for the 24-hour recalls (average of 3 recalls). Test-retest reliability of the survey was assessed, and validity examined by comparing the short food survey to the mean of the 24-hour recalls. Intra-Class Correlation Coefficients are presented (ICC).

Results: The mean age of the children was 7.1 (2.1) years (55% boys). Almost all parents were female. Diet quality index scores demonstrated good reliability (ICC=0.92) and validity (ICC=0.44). Reliability for food groups ranged from 0.52 for breads and cereals to 0.84 for extra foods. The ICCs for validity ranged from 0.03 to 0.43. Bland-Altman plots showed agreement between the two methods, but systematic bias towards overestimation of intake and diet quality by parents in the short food survey compared to the 24-hour recalls.

Conclusions: DGI-CA scores derived from a parent-completed short food survey showed good reliability and comparative validity. The survey is one of a few simple and validated dietary intake assessment methods from which a diet quality score can be derived. Refinement will further improve its usefulness for intervention and population research.

PP 175

ASSESSING PRESCHOOL CHILDREN'S UNDERSTANDING OF HEALTHY WEIGHT PRACTICES

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The prevalence of overweight among young children is increasing at an alarming rate. Global efforts to address the issue can benefit from understanding how young children's experiences across multiple contexts shape their perspectives of healthy weight. This presentation will describe the development of an interactive assessment designed to examine the substance and sources of preschool children's knowledge related to healthy eating, physical activity and media practices. A role-play combined with a semi-structured interview were developed and piloted with 81 young children ages 4-5. Children were asked to make decisions related to specific practices identified in the empirical literature as supportive of healthy nutrition and physical activity or associated with risk of overweight. The role-play used an ethnically diverse selection of healthy and unhealthy life-size food props; and two dolls, at least one of which reflected the child's gender and skin color. Children were asked to play the role of the doll's caregiver. During the role-play children fed the dolls a breakfast, snack, and lunch; provided beverages; suggested leisure time activities; responded to "less healthy requests" from the dolls (soda for breakfast, watching television all the time); addressed feeding issues (failure to finish food, spills, refusal to try an unfamiliar food, repeatedly asking for more); and addressed barriers to physical activity such as inclement weather; inability to master a skill and preference for watching television. During the semi-structured interview children sorted the plastic food items into three categories: healthy, unhealthy and unsure. They were asked to explain: 1) How they knew a food was healthy; 2) What happened if they ate the foods they had identified as unhealthy; and 3) Whether it was acceptable to eat unhealthy foods sometimes. The assessment asked what children did to stay healthy and about their favourite activities at home and in child care/preschool. Finally, the child was shown six photos (a child drawing, riding a tricycle, reading, walking outside, going down a slide, and watching television) and asked to select the three photos that showed children doing something that helped keep their bodies healthy. The assessment effectively identified young children's understanding of concepts and practices that support healthy weight as well as inaccurate information and key gaps in their knowledge.

PP 176

WITHIN-PERSON VARIANCE OF MICRONUTRIENTS FOR ADJUSTING NUTRIENT INTAKE DISTRIBUTION OF MEXICAN CHILDREN

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Objective: To present the within-person variance component for adjusting nutrient distribution in Mexican children.

Methods: Cross-sectional study collected data in two schools in the city of Monterrey in Mexico. The sample consisted of children aged between 6 and 13 years, of both genders. Dietary intake was assessed by 3-day food record, completed

by parents of children. Being non-consecutive days with 2 week days and one day of weekend. For the analysis of dietary intake, portion sizes presents in the food record were transformed into grams and then entered the Mexican Nutrikcal VO Software (version 1.1) to obtain energy and nutrients content of each day. The values for between-person variance and within-person variance and the kurtosis of the distribution of the measurement error of each nutrient was obtained from estimates of the distribution of usual nutrient intake, by means of the method put forward by Iowa State University, using the Software for Intake Distribution Estimation (PC-SIDE version 1.0). From the estimates of between-person and within-person variance, it was possible to calculate the within-person variance component given by the ratio of within-person variance in relation to total variance. The result was the component of the variance that was attributable to the within-person effect, i.e. the percentage corresponding to each type of variance in relation to the total. These results were compared to the US children data from NHANES of 2001 to 2002. The project was approved by Research Ethics Committee of the Mackenzie Presbyterian University. **Results:** The sample was composed by 49 children (25 males and 24 females) which one has 3 day of dietary assessment. Values of within-person variance components were calculated to sodium, iron, calcium, potassium, magnesium and vitamins A, C and E and according to three groups: males and females 4-8, males 9-13 and females 9-13 years. The within-person variance components varied between 0.35 to 0.95. Calcium, magnesium, vitamin A and vitamin E had the largest gender differences among children aged 9 and 13, since for calcium and magnesium values were higher for boys. Of the total 19 values of within-person variance components obtained, 8 were lower in the Mexican data than the American data and 3 were similar (with differences less than 5%). **Conclusion:** The results of this study can be used in Mexican children samples for adjusting nutrient intake distributions, since lack of adjustment may result in biased data analysis and interpretation.

PP 177

RELIABILITY AND RELATIVE VALIDITY OF FOOD-FREQUENCY QUESTIONNAIRE BASED ON FOOD GROUPS DEVELOPED FOR CHILDREN - RIO DE JANEIRO/BRAZIL.

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Introduction: The evaluation of children food consumption is a challenge due to errors and bias of measurement, as well as due to the lack of efficient dietary assessment methods to estimate the intake among this age group. The objective of this study was to assess the reliability and relative validity of a food-frequency questionnaire (FFQ) designed to estimate food intake of children from metropolitan area in Rio de Janeiro/Brazil. Methods: This study enrolled 107 children, both genders, aged 2 to 5-years-old. The FFQ's food list included 73 food types and eight portion size options. Four 24-hours dietary recalls were used as the reference method. Total energy intake and 14 food groups were estimated based on four 24-hours dietary recalls and two FFQ. The reliability was estimated by Spearman and intra-class coefficients (ICC). Analyses included quartiles using weighted Kappa coefficient. The relative validation was assessment by Spearman coefficients and Bland-Altman method among estimated food groups. Results: The means of first FFQ were significant higher than 2nd FFQ for energy, cereals, sugar drinks, cookies, sweets, sausages, and meat. The Spearman coefficients ranged from 0.24 (bean) to 0.77 (infants foods). ICC ranged from 0.22 (bean) to 0.98 (lettuces). The weighted Kappa ranged from 0.20 (cereals) to 0.47 (fats). To relative validity, the Spearman coefficients ranged from 0.03 (meat) to 0.51 (infants foods). Conclusion: The FFQ evaluated may be a suitable instrument for evaluating children dietary intake based on food groups. However, the 24-hours dietary recall provided the best estimation for young children.

PP 178

DEVELOPMENT AND VALIDATION OF THE UK YOUNG PERSON'S FOOD ATLAS

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Age appropriate food photographs were developed for children of pre school (18m to 4yrs), primary school (4-11 yrs) and secondary school (11 to 16yrs) age. The foods selected (n=104) and portion sizes depicted (n=2050) were derived from intakes recorded during the National Diet and Nutrition Surveys carried out in Great Britain. As children rarely consume all of the food served to them and may never have seen the amount of food they consumed the decision was taken to produce tools for estimation of the amount of food served and the amount leftover. Seven weights from the 5th to 95th centile of weight served were calculated as equal increments on a log scale. The decision to present the portion sizes on a log scale was made because of evidence from visual perception research. The just noticeable difference (JND) is defined as the minimum difference between two stimuli that leads to a change in experience. Weber's Law asserts that as the magnitude of a stimulus increases, the JND increases, so for example the difference between 5g and 10g of baked beans is much more noticeable than the difference between 105g and 110g. Estimates of food portion sizes using the food photographs were validated against 4-day weighed intakes (WI) along with in-school / nursery observations. Interviews were conducted the day after completion of the WI with parents, and

for children aged 4 to 16 years, also with the child themselves. Interviews were completed for 105 pre school children, 115 primary school children and 96 secondary school children.

Statistical analysis compared the estimated weight consumed with the actual weight consumed using the method of Bland and Altman. The mean ratio of estimated weight to actual weight consumed was 1.00 indicating perfect agreement at the group level. The limits of agreement however were wide from an under-estimate of 75% to an over-estimate of 305%. The limits of agreement were skewed by a small number of wildly inaccurate estimates. 65% of the estimates were within 50% of the actual weight of the food. Mean daily energy intake reported using the food photographs was under-estimated by 3%. The limits of agreement were from an under-estimate of 40% to an over-estimate of 58%. 96.3% of the estimates lay within 50% of the energy intake reported in the weighed food diary.

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PP 179

THE US NATIONAL COLLABORATIVE ON CHILDHOOD OBESITY RESEARCH (NCCOR) MEASURES REGISTRY: A TOOL FOR CHILDHOOD OBESITY RESEARCH

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Background: The US National Collaborative on Childhood Obesity Research (NCCOR) is a collaborative effort among the United States (US) Centers for Disease Control and Prevention, the US National Institutes of Health, the Robert Wood Johnson Foundation, and the US Department of Agriculture. The Measures Registry, released April 2011, is one of NCCOR's new research tools.

Methods: To develop the Measures Registry—a searchable online tool of childhood obesity measures—NCCOR conducted a literature review of all articles with relevant measures published between 2004 and 2010. Measures were categorized according to four domains: individual dietary behavior, individual physical activity behavior, food environment, and physical activity environment. Subject matter experts abstracted all articles using a standardized form that included details on validity, reliability, health outcomes, protocols for use and scoring, and other specifics regarding the populations in which the measures were used. Expert panelists and focus groups determined layout design preferences and functionality.

Results: Over 700 measures are included in the Measures Registry (available at www.nccor.org/measures) and about 150 of these measures are available for download at the Registry site. Measures are defined broadly as tools and methodologies to assess individual diet, physical activity, and the environments in which these behaviors occur. Examples of measures in the Registry include questionnaires, instruments, diaries, logs, electronic devices, direct observation of people or environments, protocols, and analytic techniques. The tool will be updated regularly and additional evaluation is planned to optimize use.

Conclusions: The Measures Registry is intended to facilitate access to existing measures in childhood obesity research, identify gaps, and fuel the development and validation of new measures. Our description of the Registry at ICDAM will describe the development process and contents of the Registry as well as challenges in ranking the quality of measures related to childhood obesity and harmonizing different measures.

PP 180

THE NCCOR CATALOGUE OF SURVEILLANCE SYSTEMS: A TOOL TO REVIEW, SORT AND COMPARE DATA RESOURCES RELEVANT TO OBESITY RESEARCH

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Background: To encourage awareness and use of relevant data sets, and spur innovation in childhood obesity research, the United States (US) National Collaborative for Childhood Obesity Research (NCCOR) created an online, searchable directory of relevant surveillance systems. NCCOR is a collaboration among the US Centers for Disease Control and Prevention, the US National Institutes of Health, the Robert Wood Johnson Foundation, and the US Department of Agriculture.

Methods: Potential surveillance systems were reviewed for inclusion in the Catalogue by subject matter experts. Systems included meet the following criteria: they are relevant to childhood obesity; include data collected in the last 10 years; provide publically available, raw data; and are gathered in the United States. A profile summarizing key information details was developed for each surveillance system and subject to expert review. Each system profile includes information on: sampling, key variables, data access and cost, geocode/linkage, selected publications, and relevant resources.

Results: The NCCOR Catalogue of Surveillance Systems interactive website (www.nccor.org/css) was launched early in 2011. Seventy-seven surveillance systems were included in its initial version, and new data systems are added on an ongoing basis. With this Catalogue, users can identify surveillance systems to meet research needs; compare attributes across systems; find relevant information on individual systems; and link to other surveillance-related resources

of interest. The Catalogue includes local, state, and national-level systems, providing data at multiple levels of the social-ecological model.

Conclusion: The Catalogue is intended to improve efficiency, effectiveness, and innovation in childhood obesity research. The NCCOR Catalogue of Surveillance Systems provides one-stop access to obesity-related data resources, and is the only known web resource of its kind. Research networks in other countries may want to consider developing similar tools.

PP 181

COLLECTION AND MANAGEMENT OF ACCELEROMETER DATA IN A MULTICENTER INTERNATIONAL STUDY: EXPERIENCE FROM THE TEDDY STUDY

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Background: Accelerometry provides objective measurement of physical activity and is associated with relatively low participant burden, which makes it a preferred method to study free-living pediatric populations. In order to use this method most effectively, researchers need to carefully plan the study protocol, particularly when the assessment is to be conducted across countries. This abstract summarizes accelerometer data collection and management protocol implemented in a multinational study, the Environmental Determinants of Diabetes in the Young (TEDDY).

Method: The TEDDY consortium is a prospective observational study designed to examine the associations between environmental exposures and increased risk of islet autoimmunity and type 1 diabetes (T1D) in 8677 children enrolled in six centers in Finland, Germany, Sweden, and the US. One objective is to investigate how accelerator and overload theories play a role in the etiology of T1D based on anthropometric measures, physical activity and dietary assessment.

Results: TEDDY subjects aged 5 years and older wear the Actigraph® GT3X+ accelerometer annually for seven consecutive days and their caretakers complete a supplemental log indicating hours of sleep and durations of activities not sufficiently captured by the accelerometer (e.g. swimming). All study staff receive central in-person training before giving the families in-person or mail-in instructions. Procedures to boost participant compliance include leaving the device stop time undefined to allow for delayed data collection, offering accelerometer belts in multiple colors, providing pre-paid padded return envelopes and incentives for fast return of the device, drafting letters to school personnel that explain the need of TEDDY participant wearing the accelerometer, and giving reminder calls and emails during data collection. The clinics use ActiLife® Lite Edition to operate the accelerometer. Compressed GT3X+ raw data are electronically transferred to the data coordinating center (DCC) in Tampa, FL after the file names are verified by the uploading system. Once the uploaded files are detected by a background process running on a DCC server, the GT3X+ files are then converted to AGD files using the ActiLife®, followed by another automated process that parses the AGD files using a background windows service and the ActiveRecord object-relational-mapping software. After data extraction and validation, the ActiveRecord is used again to push that data into a dedicated Oracle database warehouse at the DCC.

Conclusion: A thorough protocol constructed by multidisciplinary experts would facilitate subject compliance and timely capture and process of accelerometer data in the multicenter TEDDY study.

PP 182

THE VALIDITY OF A SHORT FOOD FREQUENCY QUESTIONNAIRE: ADVANTAGES AND LIMITATIONS FOR INDIGENOUS AND NON-INDIGENOUS CHILDREN INTERNATIONALLY

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Few valid short food frequency questionnaires (SFFQ) exist internationally, despite common use in population health research. This paper presents information about the reliability and validity of a SFFQ for Indigenous and non-Indigenous rural children.

A total of 215 rural Australian children (82 Indigenous), aged 10-12 years, completed 3 x 24 hour food recalls as well as the "Many Rivers" SFFQ.

Reliability was determined by administering the SFFQ twice within a 2 to 4 week period of time. The survey has moderate to good reliability with weighted kappas for most questions of between 0.41 and 0.80.

Validity was established by using the Kruskal-Wallis test in SAS and the <nptrend> command in STATA to compare the results of the survey with that of the mean of 3 x 24 hour food recalls completed with each participant. In addition the strength of association between the 2 rankings was compared using the Kendall Tau rank correlation coefficient. Questions on food type were examined using *t* tests and ANOVA. Eighteen of the 23 questions demonstrated good validity with statistically significant increasing trends ($P \leq 0.05$) for mean daily weight and/or frequency as survey response categories increased.

Results show that actual intake differs from that reported on the SFFQ with children tending to over report intake of 'healthy' foods and under report intake of 'extra' foods. Examples from Indigenous children include:

1. 'Soft drink' consumption: those reporting an intake of ≤ 1 cup/week on their SFFQ report a mean daily intake on 3 x 24 hour recall of ≥ 1 cup/day (283mL).

2. Vegetable consumption: those reporting an intake of ≥ 5 serves/day on their SFFQ report a mean daily intake by 3 x 24 hour recall of around 2 serves/day (145g).

This data suggests that when using results from a SFFQ, caution should be applied to interpreting the data in terms of absolute quantities and proportion meeting guidelines, however data from an SFFQ can discriminate between different response categories as reflected by the trend results.

Therefore this SFFQ can be used to measure change in percentage of children reporting to consume specific foods over time within a given population, and monitor and/or evaluate dietary aspects of population-wide health programmes for both Indigenous and non-Indigenous children.

PP 183

CLUSTERING OF ENERGY BALANCE-RELATED BEHAVIORS AND PARENTAL EDUCATION IN EUROPEAN CHILDREN: THE ENERGY PROJECT

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Background: Recent research and literature reviews show that, among schoolchildren, some specific energy balance-related behaviors (EBRBs) are relevant for overweight and obesity prevention. It is also well known that the prevalence of overweight and obesity is considerably higher among youth from lower socio-economic backgrounds. This study examines whether sugared drinks intake, physical activity, screen time and usual sleep duration cluster in reliable and meaningful ways among European children, and whether the identified clusters could be characterized by parental education. Methods: The study comprised a total of 5284 children (46% male), from seven European countries participating in the ENERGY ("European Energy balance Research to prevent excessive weight Gaining among Youth") project. Information on sugared drinks intake, physical activity, screen time and usual sleep duration was obtained using self-reported questionnaires. Based on these behaviors, gender-specific cluster analysis was performed. Associations with parental education were identified using chi-square tests and odds ratios. Results: Five meaningful and stable clusters were found for both genders. Four of five clusters had almost identical characteristics for both sexes. These four clusters were labeled as "active pattern", "long sleepers inactive pattern", "sedentary sugared drinks consumers", "short sleepers inactive pattern". The fifth cluster was labeled as "low activity pattern" for girls and as "sedentary pattern" for boys. The cluster with high physical activity level showed the highest proportion of participants with highly educated parents, while clusters with high sugared drinks consumption, high screen time and low sleep duration were more prevalent in the group with lower educated parents. Odds ratio showed that children with lower educated parents were less likely to be allocated in the active cluster. In addition, children with lower educated fathers were more likely to be allocated in the cluster with high sugared drinks consumption and high screen time levels. Conclusions: The obtained cluster solutions were useful to classify subjects according several health indices, and test the association between those indices and parental education. Children with lower educated parents seemed to be more likely to present unhealthier EBRBs clustering, mainly characterized by their physical activity and screen time scores. Therefore, special focus should be given to lower educated parents and their children in order to develop effective primary prevention strategies.

PP 184

FINNISH CHILDREN HEALTHY EATING INDEX (FCHEI) AND ITS ASSOCIATIONS WITH FAMILY AND CHILD CHARACTERISTICS IN PRESCHOOL CHILDREN

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Sociodemographic differences in diet and health are seen throughout the lifespan. Risk factors for several chronic diseases, including unhealthy diet, are clustered in the lower socioeconomic groups. The main known defaults of

Finnish children's diet are low consumption of vegetables, fruits, fish and vegetable oil-based fats, high consumption of foods rich in sucrose and poor quality of drinks. Studies on overall diet quality and its determinants are scarce.

Our aim was to develop and validate The Finnish Children Healthy Eating Index (FCHEI) and to describe sociodemographic and lifestyle characteristics of the family associated with the FCHEI.

The subjects consisted of cross-sectional samples of children born in 1998-2003 and participating in the Type 1 Diabetes Prediction and Prevention birth cohort study in Finland. Three-day food records from 455 1-year-, 471 3-year-, and 713 6-year-old healthy children were kept in 2003 and 2005.

Validity of the FCHEI was assessed by studying the associations between FCHEI scores and nutrient intakes of the children. In all age groups, energy-density of the diet as well as energy-adjusted intakes of saturated fatty acids and sugars decreased while energy-adjusted intakes of polyunsaturated fatty acids and dietary fibre as well as absolute intakes of vitamin D and E increased across increasing quarters of FCHEI score. In logistic regression models, the strongest determinants of belonging to the lowest FCHEI quarter (lowest diet quality) were being cared for at home and living in a semi-urban area among the 3-year-olds, and being cared for at home, maternal lower education and smoking during pregnancy among the 6-year-olds.

The study confirms that the FCHEI represents a useful tool in the description of the quality of the diet in pre-school children. The results demonstrate the need for targeted dietary counselling within the health care system.

PP 185

VALIDATION OF THE PANCAKE PICTURE BOOK FOR PAN-EUROPEAN AND NATIONAL DIETARY SURVEYS

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Background/aim: The European Food Safety Authority (EFSA) is planning to organize a first Pan-European food consumption survey, EU Menu, in collaboration with Member States during the next 10 years, in order to provide reliable and harmonized food consumption data for exposure and nutritional assessments. The PANCAKE project was established to develop and (pilot) test tools for conducting Pan-European food consumption surveys among children 0-10 years of age. The aim of this study was to validate the PANCAKE picture series for portion size estimation and to recommend criteria for development and evaluation of extra picture series to be used in future pan-European and national dietary surveys. **Methods:** Identical validation sessions were conducted in three European countries at worksites and research institutes, by convenience samples of parents having children 3 months - 10 years of age in Belgium (n=108), Czech Republic (n=108), and Denmark (n=106). In each country 45 foods were evaluated using the 38 common picture series of 6 pictures each. For each food 36 pre-weighed portion sizes were evaluated. Each picture within a series was evaluated 6 times by means of two portions lower, two portions equal and two portions higher than the depicted portion size, except for two series which were constructed differently from the others. Percentages of participants choosing the correct picture and the picture adjacent or distant to the correct picture were calculated and the performance regarding over- and under-estimation of individual pictures within the series was assessed. **Results:** For 20 food items the picture series performed acceptably. Mean difference between the estimated portion number and served portion number was less than 0.4 and Std. dev.<1.1 corresponding to 39-71% of participants choosing the correct picture and 1-16% choosing a distant picture. An additional 12 food items were rated acceptable after adjustment for density differences, while, some other series became acceptable after in-depth analyses at country level. However, performance of the series of (mixed) salads and cakes remained problematic. **Conclusion:** All of the picture series were acceptable for inclusion in the Pancake Picture Book. However, picture series on baby food, (mixed) salads and cakes either can only be used for very similar foods as depicted on the pictures or need to be substituted by another quantification tool. It is recommended to EU countries organizing national dietary surveys to use the proposed method for developing and evaluating new picture series and to determine their level of acceptable accuracy.

PP 186

MEASURING DIET IN YOUNG CHILDREN: USE OF THE CADET DIETARY QUESTIONNAIRE IN PRIMARY SCHOOLS IN LONDON

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Introduction: The current recommendations suggest children should eat 400grams or five portions of fruit and vegetables a day; assessment of this goal is challenging in population research. This study uses a questionnaire developed specifically for use with young children and explores how the home environment and parental attitudes and values affect children's fruit and vegetable (F&V) intake.

Methods: This study includes baseline measurements from children attending 51 primary schools in London, England. These children are taking part in two randomized controlled trials to evaluate a school gardening programme. Baseline data collection consisted of a previously validated 24-hour food ticklist, the Child And Diet Evaluation Tool (CADET). The CADET uses age and gender specific food portion sizes to calculate food and nutrient intake. Children's intake at school was recorded in the CADET tool by trained fieldworkers and intake at home was recorded by parents/carers. A DVD with instructions for completing the questionnaire was sent home for parents/carers and children to watch.

Results: The total sample consists of 2314 children with a mean age of 8 years old (SD: +/- 0.65). Overall, the CADET tool found that children consumed on average 286.0g (95% CI: 274.5, 297.5) F&V. 1531 (66%) children and/or parents watched the training DVD. Children of families who ate a family meal together 3 or more nights a week, had on average, 152g (95% CI: 78, 226, p<0.001) more F&V than those families who ate a family meal together less than 2 nights a week. Parents who always/most days, eat F&V, had children who ate on average 169g (95% CI: 79, 259, p<0.001) more F&V than children with parents who sometimes or never ate F&V. All results were adjusted for age, sex and Index of Multiple Deprivation score. The CADET has been further developed and validated for children aged 7-11 years. This is currently being used for follow up data collection in the same schools.

Conclusion: The results show that the CADET tool can be used to estimate F&V intake in young children. Our baseline data identified that family evening meal behaviour plays an important role in children's F&V intake. DVD training of parents and children was successful. It is possible to get parents to provide dietary data for their young children using a simple ticklist questionnaire format.

PP 187

DEVELOPMENT OF A QUANTITATIVE FOOD FREQUENCY QUESTIONNAIRE FOR 7 TO 10-YEAR-OLD CHILDREN

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Background: The early occurrence of chronic diseases in adulthood related to inappropriate feeding practices at younger ages, makes diet monitoring and identifying important in the epidemiological and health areas. Instruments which allows to assess habitual food intake and which have serving sizes regularly consumed by 7-10 year-old children is necessary. In Brazil, however, this population has not been covered by Food Frequency Questionnaires (FFQ), which have only been developed for young children (under five years of age) and adolescents. **Objective:** To present a Quantitative Food Frequency Questionnaire (QFFQ) that allowing to assess the habitual diet of 7 to 10-year-old children with regard to energy and macronutrients. **Methods:** The QFFQ was developed from a Food Diary (FD) completed by eighty-five 7 to 10 year-old schoolchildren enrolled in a state school in São Paulo, Brazil, in a 3-day-FD after being trained. In order to develop the QFFQ, all foods consumed were listed and diet composition in relation to energy, carbohydrates, proteins and lipids was calculated. Foods were grouped into items and the percentage of the contribution of each item to the diet was calculated. The QFFQ was based on the items which contributed to up to 95% of total intake. Serving sizes were established according to the 25th, 50th and 75th percentiles of intake and seven categories were selected to measure food frequency in the previous three months. **Results:** Three hundred ninety-three foods were identified and grouped into 129 items. Seventy-six items were used for developing the instrument, and 16 other items reported in the literature were also included, resulting in 92 items in 17 food groups. **Conclusion:** a QFFQ, which is to be completed in an interview, for the assessment of energy and macronutrient intakes of 7 to 10 year-old children in the previous three months is presented.

PP 188

EVALUATION OF A FOOD FREQUENCY QUESTIONNAIRE TO ASSESS NUTRIENT INTAKE IN UK CHILDREN AGED 3 YEARS

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Background: Dietary assessment in pre-school children is challenging. As young children lack the cognitive abilities to describe and quantify food consumption, researchers rely on proxy-reports from parents and other caregivers. These are likely to vary in accuracy, and validity may be further affected by differences in eating patterns, together with rapid changes occurring in food habits at this age. Prospective food records provide detailed dietary data, but are burdensome and completion rates can be low. Food frequency questionnaires (FFQ) may be more accessible, and are widely used in adult studies. Their use is less common in studies of children.

Methods: The Southampton Women's Survey (SWS) is a large prospective cohort study of mothers and children in Southampton, UK. 1640 children born to SWS women before the end of 2003 were seen at 3 years. Diet was assessed using an administered FFQ that was developed for the study. Consumption of 80 foods and drinks over the previous 3 months was recorded; portion sizes were quantified using household measures. Prompt cards were used to help

standardise responses to the FFQ. In addition, consumption of any other foods, consumed at least once a week, and daily consumption of milk and sugar were recorded. Frequency of eating meals and snacks each day was reported, and categorised as 'mainly meals' or 'frequent eating: meals and snacks'. Two-day prospective food records (FR) were kept for 893 of the children. Nutrient intakes were calculated using UK food composition tables. Intakes from the FFQ were compared with those from the FR.

Results: Median (IQR) energy intake was 6466 (5562,7698) kJ from the FFQ and 5410 (4632,6205) from the FR. Spearman rank correlation coefficients for energy-adjusted nutrient intakes ranged from 0.41 (thiamine) to 0.59 (calcium). There appeared to be little difference in the level of agreement between dietary assessment methods according to gender or frequency of food consumption during the day.

Conclusion: We have developed an 80-item FFQ to assess the diets of 3-year-old children in a large population study. The difference in absolute energy intakes between the FFQ and FR suggests that the FFQ may over-estimate energy intakes at this age. However, there is reasonable agreement in terms of ranking when energy-adjusted estimates of nutrient intake are compared. This administered FFQ can be used to obtain dietary data across the population and appears to provide useful estimates of nutrient intake to rank pre-school children.

PP 189

SUBSTANTIAL VARIATION IN KEY NUTRIENTS IS EXPLAINED BY CHILD DIETARY PATTERNS OBTAINED USING PRINCIPAL COMPONENTS ANALYSIS: RESULTS FROM ALSPAC

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Background: Diet is very complex and the use of statistical methods to describe overall patterns of diet has become increasingly popular. Dietary intake must provide adequate levels of nutrients in order to maintain optimal health and it is therefore important to ascertain how dietary patterns relate to nutrient intakes.

Objective: To assess how much of the variation in nutrient intakes throughout childhood can be explained by dietary patterns.

Methods: Dietary patterns of children were obtained using Principal Components Analysis (PCA) from parent-completed food frequency questionnaires (FFQ) collected at 3, 4, 7 and 9-years of age from the Avon Longitudinal Study of Parents and Children (ALSPAC). Nutrient intakes from each FFQ were calculated using nutrient contributions from standard portion sizes appropriate to each age, a mixture of commonly consumed foods in each food group and the frequency with which each food group was eaten. Data were available for 10023, 9550, 8286 and 8010 children at respective ages and for 6177 at all 4 ages. General linear models assessed the variation in nutrient intake explained by child dietary patterns. Both absolute and energy adjusted nutrient intakes were investigated.

Results: Three dietary patterns were consistently obtained over time: 'processed', 'health-conscious' and 'traditional'. Some nutrients were explained well by the dietary patterns at each age (energy adjusted or not). These were protein, fibre, magnesium, iron, zinc, carotene, thiamin and niacin; at each age a quarter to a half of the variation was explained. The 'processed' pattern was positively related to absolute intakes of energy and most nutrients at each age. However, after energy adjustment the relationship with micronutrients was universally negative despite positive associations with fat and sugar intakes remaining. The 'health conscious' and 'traditional' patterns were positively associated with all absolute nutrient intakes. Energy adjustment did not greatly change these associations with protein and micronutrients, however, at many ages the associations with fat and carbohydrate were reversed. Thus the 'processed' pattern was related to a less favourable nutrient profile and the 'health-conscious' and 'traditional' patterns to more favourable ones at all ages.

Conclusions : Dietary patterns are strongly associated with child nutrient intakes and explain a large proportion of their variation. High scores on the 'processed' pattern at each age were associated with less micronutrient content and more fat and sugar per unit of energy than both the 'health conscious' or 'traditional' patterns.

PP 190

RELATIVE VALIDITY OF THE CHILDREN EATING HABITS QUESTIONNAIRE AMONG YOUNG EUROPEAN CHILDREN: THE IDEFICS STUDY

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Objective: Investigation of diet-disease relations requires reliable and accurate methods of dietary and food intakes. The aim of this study was to evaluate the relative validity of a qualitative proxy-filled food frequency questionnaire (CEHQ-FFQ) in estimating food group intake in a large sample of European children compared with two 24-hour dietary recalls

(24-HDR). Design: Data was obtained from the IDEFICS cross-sectional study conducted in 2007-2008 among 2-to-9-year-old children from eight European countries. The CEHQ-FFQ was designed to investigate the intake of foods to be related positively or negatively to overweight or obesity in children. For that reason, estimates of food group intake assessed via the 43-food-group CEHQ-FFQ were compared to those obtained by a computerised 24-HDR (n=2033, 49.6% boys). Intake of 38 common food groups was examined. Agreement between frequencies of intake (equalled to number of portions per recall period) between the two instruments were examined using crude and de-attenuated Pearson's correlation coefficient, cross-classification analyses and weighted kappa. Results: Significant differences between the intake estimates from the two methods for the majority of food groups was observed except for meat, meat replacement & soy products and pizza. In general, the CEHQ-FFQ provided higher intake estimates than the 24-HDR excepting for vegetables, soft drinks, cold cuts, meat, white bread, pasta & rice, pizza, and sweets. Crude Pearson correlation coefficients ranged from 0.01 for milled cereal to 0.48 for water with a mean of 0.20. De-attenuated Pearson correlations coefficients ranged from 0.02 (milled cereal) to 0.51 (water), mean value 0.23. The proportion of subjects classified within the same quartile by CEHQ-FFQ and 24-HDR ranged from 36.3% (fruit) to 27.4% (meat), and within the extreme opposite was <12% for all food groups. Conclusions: Observed level of agreement was considered to be low. Taking however, into consideration the questionnaire aims, the CEHQ-FFQ may provide useful qualitative information about long-term intakes of individuals which can be in parallel used with a more accurate method.

PP 191

CLUSTERING OF LIFESTYLE BEHAVIOURS AND ITS RELATIONSHIP TO OBESITY INDICATORS IN A SAMPLE OF EUROPEAN CHILDREN. THE IDEFICS STUDY.

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Background: Knowledge of the prevalence and clustering of multiple lifestyle behaviours is needed to elucidate the synergetic effects presented in chronic diseases like obesity Aim: To examine the effect of obesity-related behaviours clustering on obesity-related indicators including body mass index (BMI) and waist circumference in a sample 2 to 10 years old children from eight European countries (Italy, Estonia, Cyprus, Belgium, Sweden, Germany, Hungary and Spain). Methods: Data obtained from children participating in the cross-sectional IDEFICS (Identification and prevention of Dietary- and lifestyle induced health EFfects In Children and infants) study (n=12.311, 51% of males). Physical activity and sedentary behaviour were measured using parental reported questionnaires and dietary intake via dietary recalls (two 24 hour-recalls). Cluster analysis was performed by gender. Logistic regression was used to examine the association of identified cluster to body mass index (BMI) and waist circumference, controlling for gender and socioeconomic status. Results: Six stable and meaningful clusters were identified both in males and females. Clusters with the highest mean of sedentary time, in both genders, increased the odds of being overweight/ obese based on the BMI (reference cluster 'Healthy diet and low sedentary'). In males, this effect was observed in the cluster 'Sedentary and physically active' (OR 1.77; 95% CI 1.39, 2.24) and 'Sedentary' (OR 1.34; 95% CI 1.08, 1.67), compared with males in the reference cluster. In females, the highest effect was observed in children in the cluster 'Sedentary and physically active' (OR 1.66; 95% CI 1.31, 2.11). Males being in the clusters with the highest average of sedentary time, increased the odds of having waist circumference higher than 75th percentile. Strong effects were observed in children of cluster 'Sedentary and physically active' (OR 1.28; 95% CI 1.03, 1.60) and 'Sedentary' (OR 1.31; 95% CI 1.07, 1.59). Females being in the cluster with the highest average of physical activity, decreased the odds of having waist circumference higher than 75th percentile (OR 0.79; 95% CI 0.63, 0.99 in females) compared with the reference cluster. Conclusions: Co-occurrence of healthy and unhealthy behaviours exists in this sample of young children, and sedentary behaviour identified as an important determinant of obesity-related indicators. Prevention strategies, especially in high risk groups, should take into account the effect of multiple lifestyle behaviours.

PP 192

DOUBLY LABELLED WATER VALIDATION OF TODDLER TOTAL ENERGY INTAKE ASSESSED BY A FOOD FREQUENCY QUESTIONNAIRE

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Food frequency questionnaires (FFQ) have a lower subject and analytic burden and reduced costs to administer compared to other dietary assessment methods. The ability of parents to accurately report energy intake in very young children has rarely been validated using the gold standard doubly labelled water (DLW) method. The aim was to evaluate the accuracy of parent-reported toddler energy intake (EI) estimated using the toddler version of the Australian Child and Adolescent Eating Survey (ACAES) FFQ compared to total energy expenditure (TEE) measured by DLW. TEE was assessed in weight stable children (n=12, mean±SD) 3.2±0.5 yr, BMI 16.2±0.9 kg/m², BMI z score 0.1±0.8, % body fat 20.8±3.7%, resting energy expenditure (REE) 3992±482 kJ/day (950±115kcal/day) over 10 days using the DLW method. Usual intake over the past 6 months was estimated for the child by the parent using the ACAES FFQ. Mean daily EI (kJ) was derived from ACAES using standard toddler portions and national nutrient databases. Accuracy of reporting was calculated from absolute (EI-TEE) and percentage (EI/TEE x 100) differences between EI and TEE, and testing associations using a Bland-Altman plot. Mean (±SD) toddler EI assessed by parent report using the ACAES FFQ was 4969±1179 kJ/day (1183±281 kcal/day) and measured DLW TEE was 5254±626kJ/day (1251 ±149kcal/day). Parents were considered accurate reporters at the group level, mean difference -285±1166 kJ (-68±278kcal), with 50% of parents considered adequate reporters, 17% of parents considered over-reporters and 33% under-reporters of energy intake. The Bland-Altman plot of the mean difference between EI and TEE indicated that all values fell within the 95% limits of agreement (-624, 488 kcal) demonstrating good agreement between measures. In conclusion, the ACAES FFQ provides an accurate assessment of parent-reported toddler energy intake as determined by a gold standard comparison measure. Funding Source: Hunter Medical Research Institute. C Collins supported by an NHMRC Career Development Fellowship.

PP 193

USING HEALTHY EATING INDEX TO EVALUATE DIET QUALITY OF EGYPTIAN ADOLESCENTS

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Aim of the study: use the healthy eating index to assess the diet quality among Egyptian children and adolescents, assess the compliance with specific dietary guidelines, give a single measure to monitor change in food composition pattern and help developing more effective nutrition promotion messages for the public.

Design: The American Healthy Eating Index was applied with slight modifications to measure how well the studied Egyptian students' diet conforms to recommended healthy eating pattern. A probabilistic multistage stratified cross-sectional sample representative of preparatory and secondary school students was taken. Six governorates were randomly chosen from upper and lower Egypt in addition to Giza as a metropolitan governorate. The data were based on representative sample (2145) of children and adolescents under age group between 10 -18 years. One day of dietary intake data (24 hours recall) was collected, during an in-person interview. Ten dietary components have been identified and the overall Index has a total possible score ranging from zero to 100. Each of the 10 dietary components has a scoring range of zero to 10. Individuals with an intake at the recommended level received a maximum score of 10 points. A score of zero was assigned when no foods in a particular group were eaten.

Results: the average Healthy Eating Index score was 59.1 out of a possible 100 and it ranged from 20 to 86, Only 0.5 percent of the students had Healthy Eating scores above 80; while 16.9 percent of them received scores below 50 and the majority (82.5 percent) had scores on the Healthy Eating Index between 51 and 80. In an effort to provide a "rating" of the overall student's diet, a grading scale was developed, the majority of students had diets rated as "Needs Improvement", only 0.5 % received diets rated as "Good" and 16.9 % had diets rated as "Poor". Males achieved a slightly higher average Index than females (59.7 Vs 58.2). The average score for food groups is much lower than that for dietary guidelines (23.5 Vs 35.6) out of total score of 50 for each. . More than 80 percent of the sample achieved the recommendations of the American Dietary Guidelines for total fat and cholesterol. Fewer than two-thirds of the students met the recommendations for saturated fat, Almost 30 percent of the students had the maximum score for sodium. Only 1.0 percent of them received a score of 10 for fibers. There was a significant positive correlation of BMI with caloric intake for male adolescents while, for females the correlation was insignificant and negative.

Conclusion: the majority of Egyptian children and adolescent' eating patterns, as measured by the HEI, need improvement. The results of the Index are useful in targeting nutrition education and health promotion activities. The Healthy Eating Index is a single summary measure of diet quality that can be used to monitor changes in food consumption patterns over time. The results of this study are useful in targeting nutrition education and health promotion activities for adoption of healthy lifestyles by improving dietary habits and preventing malnutrition.

PP 194

IMPACT OF OBESITY AND PHYSICAL INACTIVITY ON FASTING BLOOD GLUCOSE, LIPID PROFILE AND HOMEOSTATIC MODEL ASSESSMENT (HOMA) AMONG CHILDREN

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Purpose: to illustrate the impact of overweight and obesity on fasting blood glucose level and lipid profile among children, to test for the presence of insulin resistance among those with glucose and lipid disorders and to clarify the association between overweight, obesity in one hand and physical inactivity and bad dietary habits on the other hand. **Methodology:** A cross sectional study included 200 child aged 2 -12 years was done to screen for plasma glucose, lipid profile and insulin abnormalities. They were assessed by interview questionnaires, anthropometric measures and by measuring their fasting blood glucose and plasma lipid levels. Food intake assessed by “24 hours recall” method to obtain accurate and detailed information about food and beverage consumed by studied participants on the day before the data collection. Insulin resistance among children were measured by HOMA-R; that is derived from the following equation: $HOMA-r = \text{Insulin } (\mu\text{IU/ml}) \times \text{fasting glucose (mmol / l)} / 22.5$. **Results:** prevalence of chronic non communicable diseases (CNCD) was higher among families of obese children than those of non-obese. Obesity, diabetes mellitus and hypertension were prevalent among families of obese children by 7 times, 3 times and 2 times their occurrences in families of non-obese children respectively. The risk for having high triglycerides and low HDL levels is more than double among obese children compared to non-obese. Physically inactive children have 7.8 times the risk for obesity compared to active children. The risk for overweight and obese children to have high HOMA-R > 2.5 was 7.5 times compared to non-obese with significant result. Significant high percentages among obese as regards prediabetes state and insulin resistance. The results also showed that physical inactivity was linked to BMI significantly. Only about 14.5% of children with normal BMI compared to 27.7 % of obese children were consuming artificial milk. Nearly 63 % of the children consuming 2 snacks per day. The consumption of unhealthy snacks was higher than vegetables and fruits regardless of BMI. Sweets & ships where consumed on daily basis by about 2/3 of the studied students. **Conclusions:** High BMI predisposes children to many of the medical complications of obesity found in adults, in particular components of insulin resistance syndrome: High HOMA –IR, dyslipidemia, and impaired glucose metabolism. As these children age, the obesity epidemic will lead to epidemics of diabetes and CVD. Health care providers of overweight children need to pursue efficient screening procedures earlier in the progression of overweight in order to prevent children from developing type 2 DM and cardiovascular diseases. Future investigations are needed to assess these urgent areas of Egyptian children health status and formulate effective interventions.

PP 195

DIETARY PATTERNS DURING PREGNANCY ARE DETERMINED BY SOCIO-DEMOGRAPHIC FACTORS IN LOWER INCOME BRAZILIAN WOMEN.

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Introduction: To investigate the effect of socio-demographic factors on dietary patterns on pregnant women attending a maternity in Rio de Janeiro metropolitan region. **Methods:** A validated food frequency questionnaire was applied on 329 women with approximately 7 d following delivery and having as time frame the gestational period. Dietary patterns were identified using principal components analysis with Alpha of *Chronbach* index as a measure of internal consistency of the patterns. Multiple linear regression analyses were performed to assess the effect of the socio-demographic determinants (schooling, family income, race, mother’s age, parity and marital status) of the identified dietary patterns during pregnancy. Models were tested with and without adjusted for energy intake. **Results:** Three dietary patterns were identified: i) ‘*health*’ pattern composed by fruits, fruit juice, green vegetables, legumes and other vegetables, beef, poultry, milk and dairy products; ii) ‘*mixed*’ pattern with high loadings for eggs, pasta, lasagna and pizza, meats, fats, cake and biscuits, butter, industrialized foods, candy and soda; and iii) ‘*traditional*’ pattern with rice, beans, bread, flour, roots and potatoes, sugar and coffee. The ‘*healthy*’ dietary pattern was positively associated with family income ($\beta=0.0003$; $p=0.009$; 95% CI: 0.0001 – 0.0005) and negatively with parity ($\beta= -0.1134$; $p=0.025$; 95% CI: -0.2123 – -0.0145). ‘*Mixed*’ dietary pattern was negatively associated with mother’s age (-0.0217 ; $p=0.048$; 95% CI: -0.0431 – -0.0002); and ‘*traditional*’ pattern presented a positively associated with parity ($\beta = 0.1657$; $p<0.001$; 95% CI: 0.0752 – 0.2562), and negatively associated with mother’s age ($\beta = -0.0346$; $p = 0.003$; 95% CI: -0.0571 – -0.0121) and negatively borderline associated with family income ($\beta= -0.0002$; $p=0.075$; 95% CI: -0.0004 – -0.00002). With ou without energy adjustment results are materialy unchanged. **Conclusion:** Dietary patterns were associated with socio-demographic factors such as income, age and parity. These factors should be taken into account for nutrition counseling during pregnancy.

PP 196

DIETARY INTAKE AND SLEEP DURATION IN THE HISPANIC COMMUNITY HEALTH STUDY/STUDY OF LATINOS

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Introduction: The association of sleep duration with dietary intake among Hispanic-Americans has received limited attention. Hispanic-Americans are at increased risk for obesity, diabetes and stroke. In this study we characterize the relationship of sleep and diet in the Hispanic Community Health Study/Study of Latinos (HCHS/SOL). **Methods:** HCHS/SOL enrolled over 16,000 Hispanic/Latino participants aged 18-74 yr in four cities (Miami, Bronx, Chicago, and San Diego). This preliminary analysis describes results from two-thirds of the community sampling who responded to questions regarding sleep duration and completed 24 hour dietary recalls one of which was in-person at baseline and a second which was performed via telephone about five days to three months later. Results were averaged over the two recalls. The University of Minnesota Nutrition Data System for Research was used for data analyses. Habitual sleep duration was taken as the weighted average of self-reported sleep on weekdays and weekends. Participants with sleep apnea or who worked night or irregular work shifts were excluded. All analyses accounted for the sampling design and were adjusted for age and gender. **Results:** Of the 8,853 participants included in this analysis, mean energy, carbohydrate, protein and total fat intakes were as follows: 1816.5 kcal, 238.3 g, 74.9 g and 63.0 g with 52% of calories from carbohydrates, 17% from protein and 30.0% from fats. Short sleepers (< 7 h) constituted 18%, average sleepers (7-8 h) 48%, and long sleepers (> 8 h) 34% of the cohort. Overall dietary intake did not differ substantially by sleep duration with no significant differences in energy, protein, carbohydrate, total fat or saturated fat. No significant differences were observed within ethnic subgroups nor by BMI categories of under-weight, normal weight, overweight and obese. **Conclusion:** No significant differences were seen in dietary intake by sleep duration in this Hispanic cohort. Possible reasons for these results could include measurement error of dietary and sleep self-report and/or other confounding. On-going analyses will focus on stratification by gender, include napping frequency, analyze data from participants with night or irregular work shifts and investigate timing of meals with sleep duration. In addition the impact of depression will be explored.

PP 197

DIETARY PATTERNS IN OLDER INDIVIDUALS REGISTERED IN THE PRIMARY HEALTH CARE NETWORK OF BOTUCATU, SÃO PAULO, BRAZIL

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Introduction: Dietary Patterns are the “set of food groups consumed by a given population”, and they result from cultural, ethnic and environmental heritage. Dietary investigation studies are important in order to monitor and base actions targeted at promoting healthy diets in the population. **Objective:** To identify dietary patterns in a representative sample of older individuals in the city of Botucatu-SP. **Methodology:** This is a cross-sectional study with a representative sample of older individuals selected by stratified sampling in the units comprising the primary health care network. Data were collected from March to June 2011, and a food frequency questionnaire (FFQ) previously validated for the population was used. The FFQ information was used to identify Dietary Patterns through the factor analysis technique (analysis of main components – AMC) by utilizing the SPSS software, 17.0. **Results:** In the analysis of the 66 food items in this study, it was observed that the retention of 6 factors was adequate. The name of each dietary pattern was defined with basis on the nutritional and functional characteristics of food. A typical dietary pattern for this age group was observed, “Pattern 5 – Mild diet”, with food of mild consistency and that could be easily chewed; and “Pattern 6 - Conventional”, with food that was frequently consumed by most of the individuals and reflected the Brazilian population’s basic diet, such as the combination of “rice and beans” and the lettuce-and-tomato salad”. “Pattern 2- Snacks and weekend meals” reflects the existence of a strong correlation between the intake of ready-made and industrialized food types and the tradition to consume pasta with meat, mayonnaise salad and desserts in family meetings on the weekends. Standards “1-healthy” and “4-Light and whole food” characterized the individuals who consumed healthy food. It was also observed that, in this population, there was not a strong correlation between fruit intake (represented by “Pattern 3- Fruit”) with the intake of vegetables and some functional food types, indicating that individuals showing higher fruit intake do not necessarily usually consume other healthy food types. **Conclusion:** The 6 food patterns identified coherently reproduced the different characteristics of older individuals’ diet in the city of Botucatu. Such differentiation was observed through home visits during the field research.

PP 198

OBESITY RELATED EATING BEHAVIOURS IN SWEDISH CHILDREN 1-6 YEARS – FACTORIAL VALIDATION OF THE CHILDREN’S EATING BEHAVIOUR QUESTIONNAIRE

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Background: The Children’s Eating Behaviour Questionnaire (CEBQ) is a multi-dimensional, parent-reported questionnaire measuring children’s eating behaviours related to obesity risk, i.e. 'enjoyment of food', 'food responsiveness', 'slowness in eating' and 'satiety responsiveness'. It has not previously been validated in a Swedish

population, neither on children under the age of 2 years. We examined the factor structure and the reliability of the Swedish version of the CEBQ, for use in an obesity intervention programme targeting preschool children 1-6 years. Further, the associations between eating behaviours and children's age, gender and relative weight (BMI SDS) and parental weight were investigated. **Methods:** Parents to 174 children aged 1-6 years (50% girls, mean age 3.8 years), recruited from five kindergartens in Stockholm, completed the Swedish version of the CEBQ. Data on children's weight and height, parental weight, height and educational level was collected. Children's relative weight was calculated for a subpopulation (mean BMI SDS -0.4, n=47). Factorial validation (Principal Component Analysis) on all CEBQ items was performed. Differences in eating behaviours by age, gender and parental weight were examined. Correlations between eating behaviours and the child's BMI SDS were analysed controlling for age, gender, parental weight and education in linear regression analyses. **Results:** The factor analysis revealed a seven factor solution with good psychometric properties, similar to the original structure. The behaviour scales 'overeating'/food responsiveness', 'enjoyment of food' and 'emotional undereating' decreased with age and 'food fussiness' increased with age. Eating behaviours did not differ between girls and boys. The children's relative weight was unrelated to any of eating behaviours when controlling for age, gender, parental weight and education, and only associated with parental weight status. **Conclusions:** Our results support the use of the CEBQ as a psychometric instrument for assessing children's eating behaviours in Swedish children aged 1-6 years. Measuring obesity related eating behaviours in longitudinal and interventional studies would offer opportunities for studying causal effects of eating behaviours in the development of obesity in children.

PP 199

DOES HIGHER DIET QUALITY PROTECT WEIGHT CHANGE IN ADULTS OVER TIME: A SYSTEMATIC REVIEW OF COHORT STUDIES.

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Background: Diet is a major modifiable risk factor for weight change. Limited studies have examined the relationship between diet quality and weight change longitudinally. **Aim:** To synthesize the best available evidence on the relationship between diet quality, measured by tools that reflect adherence to national healthy eating guidelines, and body weight change in adults. **Methods:** Four electronic databases (MEDLINE, CINAHL, EMBASE , Scopus) were searched for cohort or case control studies published in English from 1970 to February 2011 using the search terms diet quality and weight change. Inclusion criteria were; adults aged ≥ 18 years; diet quality index or score used to evaluate dietary intake; weight change either (absolute weight or categorical) as an outcome. **Result:** Of 2304 studies originally identified, six met all inclusion criteria. These examined the association between overall diet quality and weight change, BMI or obesity incidence and used different methodologies to evaluate dietary patterns. One used diet quality index (DQI), two used the Framingham Nutritional Risk Score (FNRS) and four studies used different scores to assess adherence to the Mediterranean diet score. **Conclusion:** Two studies in adults and one in men only found a significant association between lower diet quality and weight gain. Overall, participants with higher diet quality gained less weight (0.77 to 0.65 kg) compared to those with the lowest diet quality (0.90 to 0.87 kg) over one to two years. Consuming a diet that adheres more closely to national healthy eating guidelines does appear to confer a reduced risk of weight gain.

PP 200

QUALITY OF FOOD AND LIFESTYLE: A STUDY OF CHILDREN ATTENDING PUBLIC SCHOOLS IN VITÓRIA/ES-BRAZIL.

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Introduction: The environment, permeated by the material conditions of life and access to health services and education, determines the characteristic patterns of health. Income, maternal education, among others, interfere the type of participation of families in the production process, reflecting on the acquisition of food, the quality of nutrition and, consequently, the nutritional status of children.

Objectives: To study children's quality of food and its relation to lifestyle and nutritional status.

Methodology: Cross-sectional study in a school-based health regions of Vitoria. We studied children aged 7 to 10 years in six schools. Socioeconomic data were informed by means of questionnaires sent to households. Children were weighed and measured by undergraduate students. To assess the quality of food School Feeding Index (ALES) was used based on frequency of consumption of 15 food items and the habit of eating breakfast. Each was given a food frequency score (positive or negative) based on guidelines for healthy eating according to Ministry of Health then food

was classified into low, intermediate and good quality. We tested the association between diet quality, socioeconomic variables and lifestyle habits.

Results: We studied 205 schoolchildren (59% girls, 67% of socioeconomic class C), 18.4% of children were overweight, 12.9% were obese and 65.7% were eutrophic. About 49% of parents were employed and 39% had less than 8 years of schooling. Approximately 43% of children eat their meals at the table with the family and 48.8% eat their meals while watching television. We found an average value of Ales index of 4.5 ± 3.8 (from -9 to 15). According to the ALES Index, 41.5% had poor diet quality and 37.1% of good quality. Among children with good diet quality, 46.3% watch TV for less than 4 h / day ($p = 0.03$) and 51.7% engage in some kind of sport ($p = 0.01$). There was no association between socioeconomic status, nutritional status and quality of food.

Conclusions: We conclude that the practice of a good quality diet is associated with other healthy lifestyle habits in a region of Vitoria whose social indicators are among the worst in the city.

PP 201

DETERMINANTS OF CHANGE IN DIET QUALITY USING A NEW DIET QUALITY INDEX: A 15-YEAR LONGITUDINAL STUDY IN AUSTRALIAN ADULTS

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Background: Knowledge of longitudinal change in diet quality and associated factors is needed, but it is relatively limited to date. A recently developed diet quality index (Dietary Guideline Index, DGI score) for the Australian population has been reported to be a valid indicator of diet quality, but has not been studied longitudinally.

Objective: We investigated 15 years change in DGI score, and its associations with sociodemographic and lifestyle characteristics.

Methods: We used dietary intake data collected by a food frequency questionnaire (FFQ) in 1992, 1996, and 2007 from a population-based random sample of adults comprising 1511 men and women aged 25–75 years at baseline. We applied generalized estimating equations (GEE) to examine determinants of long-term change in the DGI score. The index consisted of 13 items reflecting the dietary guidelines, including dietary indicators of vegetables and legumes, fruit, cereals, meat and alternatives, dairy, saturated fat, alcoholic beverages, and added sugars. Diet quality was incorporated using indicators relating to whole-grain cereals, lean meat, reduced/low fat dairy, and dietary variety. The DGI had a possible range of 0–130 with a higher score reflecting increased compliance with the dietary guidelines. Information on socio-demographic and lifestyle factors was derived from self-reported questionnaires. Multivariable models, stratified by sex, were adjusted for confounders.

Results: Compliance with dietary guidelines, measured by DGI score, was relatively poor while there was an overall increase in diet quality in both men and women during the follow-up. In men the overall DGI score increased from 71.9 ± 16.9 in 1992 to 73.3 ± 17.2 in 1996, and to 76.2 ± 15.9 in 2007. In women, the corresponding figures were 80.6 ± 16.4 , 80.8 ± 15.8 , and 83.8 ± 15.3 (both P -trend from GEE < 0.05). Scores related to intake of fruit (men only), cereals, and food variety decreased during follow-up.

Younger age, higher occupational level (men only), and low to medium level of physical activity and hormone replacement therapy use in women were independently associated with greater improvement in diet quality over time ($P < 0.05$).

Conclusion: We show that the Dietary Guideline Index is suitable for studying diet quality change longitudinally. Our results identify relevant socioeconomic and lifestyles factors that affect diet quality over time and may help identify stages across the life-course when interventions for improvement of diet quality in the Australian population should be considered.

PP 202

DIETARY PATTERN TRAJECTORIES FROM 6 TO 24 MONTHS AND INTELLIGENCE QUOTIENT AT 8 YEARS OF AGE

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Background: Diet supplies the nutrients needed for the rapid growth and neural development that occurs during early postnatal development. While breastfeeding has been studied extensively, very few studies have examined diet in the first two years of life and none have measured the effect of diet over time on cognitive ability in childhood.

Objective: The aim of this work is to capture a longitudinal measure of diet and then examine the influence of diet on intelligence quotient (IQ) at 8 years of age.

Methods: Dietary patterns were extracted from questionnaires from participants in the Avon Longitudinal Study of Parents and Children at 6 ($n=7052$), 15 ($n=5610$) and 24 ($n=6366$) months of age using principal component analysis.

Scores on similar patterns at 6, 15 and 24 months were combined using random effects models to generate a dietary pattern trajectory. The association between each trajectory and IQ was examined using generalized linear models, with adjustment for potentially confounding variables.

Results: Four dietary patterns were extracted at each age. Based on foods with high loadings, one pattern at each age was mapped onto the following 4 trajectories 1) *Traditional* (characterised by meat and cooked vegetables), 2) *Healthy* (breastfeeding at 6 months, raw fruit and vegetables, cheese, egg and herbs at 15 and 24 months) 3) *Discretionary* (biscuits, chocolate, crisps, soft drinks, sweets) 4) *Ready-to-eat* (use of ready-made baby foods at 6 and 15 months, and biscuits, bread and breakfast cereals at 24 months). After adjustment for potential confounders, the *Healthy* trajectory was positively associated and the *Discretionary* trajectory was negatively associated with IQ at 8 years. There was no association between the slope of the *Traditional* or *Ready-to-eat* trajectories and IQ.

Conclusions: This study captures a longitudinal measure of latent dietary patterns and shows that within the *Healthy* and *Discretionary* trajectories, changes in pattern scores from 6 to 24 months are associated with IQ at 8 years of age.

PP 203

ASSOCIATION BETWEEN DIETARY PATTERNS AND OBESITY IN OLDER INDIVIDUALS IN A MEDIUM-SIZED CITY OF SÃO PAULO, BRAZIL

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Introduction: Studies have investigated dietary behavior as a risk factor for obesity, and one of the ways to evaluate the effect of diet on health outcomes is by using Dietary Patterns, which allow for identifying the synergetic action of food and nutrients on the risk for several chronic diseases.

Objective: To evaluate the association between dietary patterns and the prevalence of obesity in a representative sample of older individuals registered in the primary health care network in the city of Botucatu-SP, Brazil.

Methodology: This is a cross-sectional study on 355 older individuals, which were randomly selected and stratified between the health units. Data were collected from March to June 2011 through the application of a food frequency questionnaire (FFQ) and anthropometric evaluation. The dietary patterns were identified from the FFQ data by factor analysis. By using weight and height data, the individuals were classified as obese when their body mass index was higher than 30kg/m². Chi-square and Student's t test were performed for the "obesity" outcome and variables of interest, which was followed by multiple logistic regression in order to evaluate the effect of the tertiles of the scores of six dietary patterns on obesity in this population, controlling by gender, per capita family income, education and physical activity. Software SAS, v.9.2, and p-value tests were used for the tests.

Results: High prevalence of obesity was observed for both genders (30.20% for females and 15.95% for males). The bivariate analyses, obesity was significantly associated with "gender" (p=0.006) and "education" (p=0.0413), and the highest obesity prevalence was found among females and older individuals who had never attended school. From the six dietary patterns identified (1-Healthy, 2- Weekend snacks and meals, 3-Fruit, 4-Light and whole food, 5-Mild diet, 6-Conventional), only pattern "1-Healthy" had an effect on obesity (p=0.0044). After the introduction of the confounding variables in the logistic model, it was observed that the high adherence (third tertile) to pattern 1- Healthy maintained an inverse and significant association with general obesity, showing to be a protective factor (individuals with high adherence to this pattern reduce their chances of having obesity in 63.3%). It was also observed that living with a partner increased the chance of being obese in 2.18 times, and older age decrease the chance of being obese.

Conclusion: The protective and independent effect of pattern 1-Healthy shows how much diet can influence such high prevalence in this population.

PP 204

STATISTICAL PROCEDURES TO IDENTIFY DIETARY PATTERNS IN OLDER INDIVIDUALS IN A MEDIUM-SIZED CITY OF SÃO PAULO, BRAZIL

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Introduction: Dietary patterns are identified using reduction or aggregation statistical techniques aggregation for components, which can be done from empirical food data for later evaluation (*a posteriori* analysis). It is important to identify these patterns in the population in order to provide a basis for actions that promote healthy diets in the population. **Objectives:** To identify dietary patterns using factor analysis in a representative sample of older individuals registered at the primary health care units and family health strategies in the city of Botucatu –SP, Brazil.

Methodology: This is a cross-sectional study that used a food frequency questionnaire (FFQ) previously validated for this population. To estimate the sample size, we applied the rule that the number of individuals must be at least five times greater than the number of items present in the FFQ. The FFQ was composed of 71 items, then the sample size was, at least, 355 individuals, who were stratified into 16 primary health units of the city. Thus, the data from the FFQ

were analyzed according to factor analysis (principal components analysis – PCA) using SPSS software, v.17.0. The phases of analysis of the principal components were: Evaluation of the applicability of the PCA method using KMO tests and Barlett's sphericity; extraction of a factors set from the correlation matrix; determination of the factors number via Varimax rotation; analysis on the internal consistency of factors and denomination of the dietary patters. **Results:** The food items from the FFQ that did not apply to this type of analysis were removed, then 66 items were analyzed. The requirements for factor analysis were met with the KMO value obtained (0.636) and with the result of Barlett's test ($p < 0.0001$). In the analysis of the original 66 dietary items, it was observed that the retention of six factors located on the biggest slope in the scree plot graph were adequate for data interpretation. The items with a factor loading greater than 0.3 were maintained in the matrix, and those with a negative loading were removed. The name for each dietary pattern was defined with basis on the nutritional and functional characteristics of the food and the characteristic of the items with greater saturation loading. The six dietary patterns were identified: Healthy, Snacks and weekend meals, Fruit, Light and whole-food, Mild diet and Conventional. Cronbach's alpha coefficient was obtained in order to get the internal consistency of factors. It was observed the highest and lowest alpha value for the Healthy and Mild diet, respectively, that indicates the higher and lower variability of consumption of foods, which confirms the diet characteristics of the Brazilian older individuals. The other patterns had moderate consistency. **Conclusion:** The six patterns obtained reproduce coherently the different characteristics of older individuals' diet in the city of Botucatu-SP, Brazil.

PP 205

THE BALTIC SEA DIET SCORE: A TOOL FOR ASSESSING HEALTHY EATING IN NORDIC COUNTRIES

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Due to differences in food cultures, known dietary quality measures (e.g. Healthy Eating Index and the Mediterranean diet score) may not be easily adopted in all countries. Recently, the SYSDIET Study launched a Baltic Sea diet to illustrate a healthy Nordic diet. Based on the Baltic Sea diet, we aimed to create a Baltic Sea Diet Score (BSDS) and to assess whether the BSDS associates with a healthy diet defined by nutrient intakes. We also aimed to examine how different cut-off values impact the results. The population-based cross-sectional study included 4720 Finnish participants (25-74 y) from the National FINRISK 2007 Study. Diet was assessed using a validated food-frequency questionnaire. Nine components were included in the score: Nordic fruits and berries, vegetables, cereals (rye, oat, and barley), ratio of polyunsaturated to saturated and trans fatty acids, low fat milk, fish (Baltic herring and salmon), red and processed meat, total fat (en%), and alcohol (ethanol). We divided each component using both sex-specific consumption quartiles (BSDS-Q) and medians (BSDS-M) as cut-offs. Points were assigned according to the predictable health impact of the component. BSDS-Q ranged from 0 to 25 and BSDS-M from 0 to 9 points. Higher points indicated higher adherence to the diet. In the age- and energy adjusted model, adherence to the diet was associated with higher intake of carbohydrates (en%) and protein (en%), and lower intake of fat (en%) and alcohol (en%) in men and women ($P < 0.001$). The intake of fibre, vitamins and minerals increased due to adherence to the diet in both genders ($P < 0.05$). In the multivariate model, all associations remained ($P < 0.05$).

In conclusion, the BSDS associates with various nutrients. Results in nutrient intakes by adherence to the Baltic Sea diet did not differ between BSDS-Q and BSDS-M. The BSDS seems to be a valid tool to indicate a healthy diet and can be utilized in assessing diet-health relationships in public health surveys in Nordic countries.

PP 206

NUTRITIONAL PROFILE OF PEOPLE LIVING WITH HIV/AIDS FROM DELHI, INDIA

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Importance of good nutrition in maintaining optimal health condition of people living with HIV/AIDS (PLHIV) is well established. However, data regarding the actual intake of nutrients by PLHIV in India is lacking. The objective of present study is to assess the anthropometric profile and actual nutrient intakes by PLHIV in India. The study was performed on 400 adult PLHIV registered at the ART centre in New Delhi, India. 24-hour dietary recall was used to gather information about the nutrient intake and nutrient adequacy ratios were computed. Anthropometric data including height, weight, BMI, waist and hip circumference, WHR, mid arm and calf circumferences were collected. The mean CD4 count for the sample was 291.68 ± 183.81 cells/cumm ranging from 12-1211 cells/cumm. The mean BMI of the sample was 19.73 ± 3.55 kg/m² with 40 percent having BMI < 18.5 kg/m². All anthropometric measurements were found to correlate positively and significantly with CD4 count ($p < 0.05$). The sample could not meet the requirements laid down by ICMR (2010) for energy, protein, calcium, iron, riboflavin, niacin, folic acid, B12, copper and zinc while intake for visible fat, vitamin C, Thiamine and magnesium was adequate. Although, majority of

PLHIV had BMI within normal ranges, poor nutrient intakes over a long period of time could contribute to worsening of the nutritional status. There is a need to develop a database on the nutritional profiles of PLHIV in India and devise necessary interventions to improve their nutritional status.

PP 207

COMPARISON OF DIETARY PATTERNS IN A FFQ AND 3-DAY FOOD RECORD USING REDUCED RANK REGRESSION

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Background: There is growing interest in dietary patterns (DP) derived using reduced rank regression (RRR), as this method integrates a-priori knowledge of diet-disease relationships. However, to our knowledge no studies have examined the comparability of RRR-derived DP using different dietary assessment methods.

Objective: To explore whether an RRR-derived DP observed in a food frequency questionnaire (FFQ) is comparable to that in a 3-d estimated food record (FR), and to assess agreement in DP scores generated by these two methods.

Methods: Participants were adolescents from the Western Australian Pregnancy Cohort (Raine) Study who completed a FFQ and 3-d FR at 14 years of age (n=783). As the outcome of interest was obesity, RRR was used to identify a DP in 46 food groups that would explain the greatest amount of variation in three response variables: dietary energy density (kJ/g food), percentage energy from total fat and fibre density (g/MJ). Separate RRR analyses were run in the FFQ and FR and each participant received a DP z-score for the FFQ and FR. These z-scores were compared using a Pearson correlation coefficient (*r*), weighted Kappa coefficient (*k*), mean difference and 95 % limits of agreement (LOA).

Results: Both the FFQ and FR displayed an energy-dense, high fat, low fibre DP which were characterised by high intakes of processed meat, fried potatoes and sugar-sweetened beverages, and low intakes of fresh fruit, vegetables and high-fibre bread. The FFQ DP explained 58 % of the total variation in the three response variables; the FR DP explained 46 %. There were moderate correlations between DP z-scores from the FFQ and FR (*r*=0.43, *p*<0.001; *k*=0.37, *p*<0.001). The mean difference between scores from the FR and FFQ was close to zero and the 95 % LOA were -2.483 to 2.350.

Conclusion: RRR can generate a comparable energy-dense, high fat, low fibre DP from both a FFQ and 3-d FR in an adolescent cohort.

PP 208

DIETARY PATTERNS AT 10 YEARS OF AGE AND CHANGES IN BODY COMPOSITION BETWEEN 9 AND 11 – THE EFFECTS OF UNDER-REPORTING: RESULTS FROM THE ALSPAC COHORT

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Background: Childhood obesity is a serious public health problem; dietary intake is a modifiable risk factor that plays an important role in the development of obesity. **Objective:** (1) Investigate the association between dietary patterns, obtained through principal components analysis (PCA) of diet diary data collected from children aged 10 years, and gains in fat and lean mass, measured by DXA scans between the ages of 9 and 11. (2) Determine whether any observed associations differed according to under or valid reporting. **Methods:** Dietary patterns were obtained using Principal Components Analysis (PCA) from 3-day diet diaries of 10 year old children taking part in the Avon Longitudinal Study of Parents and Children. Fat and lean mass were assessed at 9 and 11 years using total-body dual-energy X-ray absorptiometry (DXA). Dietary reporting errors were assessed using the method of Touron et al taking into account child age, sex and weight and allowing for moderate activity levels. Multivariable linear regression was used after log transforming fat and lean mass, stratified by gender and by under and valid reporting. 5191 children had complete data. Height, objective measures of physical activity, energy intake, birthweight and menarche in girls, maternal age, smoking, education and pre-pregnancy BMI were included in the models to adjust for potential confounding. **Results:** Three dietary patterns were obtained: 'Health aware', 'Traditional' and 'Packed lunch'. Fat and lean mass were higher on average at both 9 and 11 years in under- compared to valid reporters and all pattern scores were lower on average in under-reporters. In valid reporters after full adjustment, girls demonstrated a 1.2% and a 1.1% decrease in fat mass per 1SD increase in the 'health aware' and 'packed lunch' pattern scores (both *p*=0.049). For lean mass there was a 0.3% increase per 1SD increase in the 'packed lunch' pattern score in valid reporting boys (*p*=0.005). In comparison, the only evidence of any association between pattern scores in under-reporters was for fat mass with the 'health aware' pattern. For each 1SD increase in this score there was a 2.9% (*p*=0.003) and a 2.1% (*p*=0.015) decrease in fat mass in boys and girls respectively **Conclusions:** We observed a small association between dietary pattern scores and change in fat mass in mid-childhood. Although the relative effect sizes are small it is important to consider under-reporting when

examining any potential association between dietary pattern scores and changes in fat or lean mass in mid-childhood. References: Torun B, Davies P, Livingstone MBE, Paolisso M, Sackett R & Spurr G.B. Energy requirements and dietary energy recommendations for children and adolescents 1 to 18 years old. *Eur J Clin Nutr* 1996; 50(Suppl. 1): S37–S81.

PP 209

ASSOCIATIONS BETWEEN PARENTAL AND CHILD DIETARY PATTERNS OBTAINED USING PRINCIPAL COMPONENTS ANALYSIS: RESULTS FROM ALSPAC.

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Background: The development of children's food preferences is primarily influenced by parental control, and may also be affected by parental dietary habits. **Objective:** To assess how much variation in child dietary patterns can be explained by parental dietary patterns, after accounting for other socio-demographic factors. **Methods:** Dietary patterns of parents and children were obtained using Principal Components Analysis (PCA) from FFQ data collected from 4315 parent-singleton child triads from the Avon Longitudinal Study of Parents and Children. Correlations and weighted kappa were calculated to assess associations between child and parental dietary patterns (obtained at 4.5 years and 4 years respectively). General linear models measured the variation in child dietary patterns explained by parental dietary patterns after adjusting for a variety of lifestyle and socio-demographic factors. **Results:** Three dietary patterns were obtained from the children: 'processed' (high-fat processed foods), 'traditional' (meat, potato and vegetables) and 'health conscious' (vegetarian style foods, salad, rice, pasta, fruit and fish). Four patterns were derived from both mothers and fathers. Four patterns were derived for the mothers: 'health conscious' (rice, pasta, salad, fruit), 'processed' (high-fat processed foods), 'confectionery' (high-sugar foods) and 'vegetarian' (vegetarian style foods with negative loadings for meat) for the mothers. The father's patterns differed slightly and were labelled 'health conscious', 'traditional', 'processed/confectionery' and 'Semi-vegetarian' (vegetarian style foods but no negative loadings for meat). The strongest associations were seen between the child 'health conscious' pattern scores and both parental 'health conscious' pattern scores (maternal: $r=0.431$ and $p=0.290$; paternal: $r=0.407$ and $p=0.293$). After adjusting for a number of potential confounding factors, the maternal 'processed' and 'confectionery' patterns explained 7.2% and 7.8% of the variation in the child 'processed' pattern respectively. The maternal 'health conscious' pattern explained the greatest proportion of the variance in both the child 'traditional' pattern (10.0%), and 'health conscious' pattern (15.3%). The father's patterns explained no more than 3% of the variance in the child's patterns scores. None of the socio-demographic and lifestyle factors explained more than 2% of the variation in the child dietary patterns. **Conclusions:** Maternal but not paternal dietary patterns are strongly associated with child dietary patterns and explain a large proportion of the variance. This evidence is strongest for the 'health conscious' pattern and weakest for the 'processed' pattern. Understanding maternal dietary habits is an important factor determining children's dietary patterns, particularly regarding healthful eating habits.

PP 211

DIETARY SOURCES OF NATURALLY OCCURRING PLANT STEROLS IN NORTHERN SWEDEN

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Plant sterols are bioactive compounds present in all vegetable foods at varying concentrations. Plant sterols inhibit the uptake of cholesterol in the small bowel. We have in two epidemiological studies, one using the present data, shown that dietary intake of naturally occurring plant sterols is inversely related to serum cholesterol. Hence, dietary intake of plant sterols could be of importance in primary prevention of and in dietary treatment of hypercholesterolemia. Therefore, it is important to identify which foods that contribute the most to the intake of plant sterols.

The aim of the present study was to investigate what foods co-vary with the intake of plant sterols and to evaluate differences in intake of food groups between groups with high and low energy adjusted intake of plant sterols.

The Västerbotten Intervention Programme began in 1985 and is a population-based study inviting all inhabitants to a health check-up when turning 30, 40, 50 and 60 years. Participants fill in a Food Frequency Questionnaire (FFQ) with 64 or 84 questions. The present analyses include 40,502 visits by women (w) and 37,150 visits by men (m) 1992- 2005. The Pearson correlation coefficients between plant sterol intake (both absolute and energy adjusted) and consumption frequencies of 13 foods and food groups (dairy products; high fat spread; low fat spread; butter; vegetable oil; fruit; vegetables; bread and cereals; potatoes, rice and pasta; sweets; meat, fish and coffee) showed that intake of vegetable oil was highly correlated to both absolute and energy adjusted intake of plant sterols for both women (absolute: 0.498, density: 0.511 $p<0.001$) and men (absolute: 0.5, density: 0.53 $p<0.001$). High significant correlation coefficients ($r=0.3$,

$p < 0.001$) were found for both men and women between absolute intake of plant sterols and frequencies of bread and cereals; potatoes, rice and pasta and vegetables and for women also between energy adjusted plant sterol intake and frequency of vegetables. The highest quintile of energy adjusted plant sterol intake had at least 20% higher consumption frequency of low fat spread; vegetable oil; bread and cereals; vegetables; potatoes, rice and pasta (all both sexes), coffee (w) and butter (m) compared to the lowest quintile, while consumption frequency of high fat spread (both sexes), meat (w) and dairy products (m) was at least 20% lower.

In conclusion, vegetable oil was the most important food source for both absolute and energy adjusted plant sterol intake. Three additional food groups were distinguished as important sources, by both high correlations with absolute plant sterol intake and by significant differences in consumption frequencies between the highest and lowest quartile of energy adjusted plant sterol intake, namely: bread and cereals; vegetables and potatoes, rice and pasta.

PP 212

EVALUATION OF THE BRAZILIAN HEALTHY EATING INDEX REVISED – BHEI_R

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Introduction: The Brazilian Healthy Eating Index (BHEI_R) was revised according to current nutritional recommendations, formed by 12 components based on the Dietary Guidelines for Brazilians. **Objective:** To evaluate validity and reliability of the BHEI_R. **Method:** Cross-sectional population-based study with a sample of 2375 individuals of both sexes, aged 12 and older from the city of São Paulo, who were included in the Health Survey (ISA-São Paulo) performed in 2003. Data of population characteristics were obtained from questionnaire and the dietary intakes were obtained by the 24-hour recall method. The BHEI_R validity was assessed by answering four questions: 1) Does the set of components include the key recommendations from the Dietary Guidelines for Brazilians?; 2) Does it allow to distinguish between groups with differences in diet quality (smokers and nonsmokers)?; 3) Is measured diet quality independent of energy intake?; and 4) Does the index have more than one underlying dimension? The internal consistency was also performed to evaluate the index reliability. The Wald test determined differences in scores between smokers and nonsmokers. Pearson correlation coefficients determined the relationship between energy intake and scores. Principal components analysis (PCA) determined the number of factors that comprise the BHEI_R. Cronbach's alpha coefficient was used to test internal consistency. The analysis was performed using the Stata software version 10.0 ($p < 0.05$) and the results were weighed to consider the sample design. **Results:** The key recommendations of the Dietary Guidelines for Brazilians were captured by the index. All of the BHEI_R components scores showed a weak correlation to energy intake (≤ 0.30). The component SoFAAS (total calories from solid fats, alcohol and added sugar) score was most strongly correlated with the final score of BHEI_R ($r=0.75$), followed by Total Fruit ($r=0.50$) and Whole Fruit ($r=0.48$). When comparing the groups of smokers and nonsmokers the final BHEI_R was 55.4 vs. 56.8 and nine of the 12 components presented a lower score for the smokers group. Cronbach's alpha was 0.7 and PCA revealed the presence of four factors with eigenvalues > 1 . **Conclusion:** The BHEI_R was reliable and structurally valid when used to assess and monitor the quality of the diet of Brazilians.

PP 213

DIETARY QUALITY AND ASSOCIATED FACTORS AMONG ADOLESCENTS LIVING IN THE MUNICIPALITY OF SÃO PAULO, BRAZIL

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¹Nutrition

Introduction. Dietary habits of adolescents are acknowledged factors in predicting adult nutrition status. However, the majority studies generally focus on a single nutrient or food intake, which may be inadequate. In this context, dietary indexes, such as Brazilian Healthy Eating Index_Revised (BHEI_R), emerged as an alternative to capture the complexity and multidimensionality of the diet.

Objective. To assess the associated factors with usual dietary quality, using the BHEI_R.

Methods. Cross-sectional population-based study design in 268 adolescents, aged 15 to 19 years, who were included in the Healthy Survey (ISA2007 - in São Paulo, Brazil). Sociodemographic, anthropometric and lifestyle data were collected by questionnaires. To assess the dietary intake, the adolescents provided one to five 24-hour dietary recalls used to calculate the BHEI_R. The MSM (Multiple Source Method) was applied to assess usual distribution intake of each index component, using a Food Frequency Questionnaire as a covariate. Briefly, the BHEI-R comprises a 12-components system of nine food groups based on recommendations of the Brazilian Dietary Guidelines (2006), which daily portions are expressed on energy density; two nutrients (Sodium and Saturated fat) and SoFAAS (total calories from solid fat, alcohol and added sugar). The total BHEI_R scores range from zero to 100. Multiple logistic regression explored associations between the high BHEI_R score (tertile 3 vs others) and independent variables, such as: age (years); sex (male or female); income level (low (< 1 minimum wage), medium (1-2 minimum wages) or high (> 2

minimum wages)) and; alcoholic beverages frequency (<1x/month, 1-2x/month or \geq 1x/week). This model was weighted, taking into account the complex sampling design. Significance level was set at $p<0.05$.

Results. The mean BHEI_R score was 54.93 (SE=0.54), ranging from 23.94 to 80.03 points. Participants in the highest BHEI_R tertile were more likely to be older (OR age=1.75; $p<0.01$) and medium-income (OR=4.19; $p<0.01$). On the other hand, the high frequency intake of alcoholic beverages (more than once a week) decreased the chances of the adolescent having a dietary quality classified in the highest tertile of the BHEI_R (OR=0.17; $p<0.01$).

Conclusion. The results emphasize the importance of reinforcing and supporting the governmental public policies of the municipality of São Paulo that have been developed to improve diet quality of adolescents

PP 214

EVALUATING THE BRAZILIAN HEALTHY EATING INDEX-REVISED PERFORMANCE IN ASSESSING USUAL DIETARY INTAKE AMONG ADOLESCENTS, LIVING IN SÃO PAULO-BRAZIL.

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¹Nutrition

Introduction. The majority nutritional studies generally focus on a single nutrient or food intake. In this context, diet indexes, like Brazilian Healthy Eating Index_ Revised (BHEI_R), emerged as an alternative to capture the diet complexity and multidimensionality. To assess the dietary quality it's necessary to obtain the habitual dietary intake. For this reason, several methods have been designed, such as the MSM program (Multiple Source Method) that was developed to estimate usual dietary intake of nutrients and food including episodically consumed foods for populations as well as individuals.

Objective. To evaluate the BHEI_R performance in assessing usual dietary quality in Brazilian adolescents.

Methods. Cross-sectional population-based study design in 268 adolescents, aged 15 to 19 years, who were included in the Healthy Survey (ISA2007- in São Paulo, Brazil). Participants provided one to five 24-hour dietary recalls (24HR) and a Food Frequency Questionnaire (FFQ), using as a covariate. The MSM was applied to estimate usual distribution intake of each index component. This process was done in three steps. First, the consumption, via 24HR, of Saturated fat and SoFAAS (calories from solid fat, alcohol and added sugar) was calculated in percentage energy; Sodium was reported as mg/1000kcal; and components based on food groups grounded on Brazilian Dietary Guidelines (2006) were expressed on a per 1,000kcal basis. This step was done separately for each record by each individual. Second, the FFQ food items were classified according to the food groups components of BHEI_R, then frequency of consumption were added according to their respective groups. Consumption frequency of components based on nutrients was defined as 1.0 (daily consumption). Third, the MSM program was applied to provide the usual consumption of each component of each adolescent. Finally, the BHEI_R score was calculated. Pearson correlation was used to verify the ability of BHEI_R to assess usual diet quality independent of energy intake. Principal Components Analysis (PCA) determined the number of factors that comprised the BHEI_R. Internal consistency was tested by Cronbach's a coefficient.

Results. Energy intake was not correlated to BHEI_R score ($r=-0.04$; $p=0.49$). As expected, SoFAAS score was highly correlated to BHEI_R ($r=0.58$; $p<0.001$). PCA provided evidence that no one single liner combination of the BHEI_R components accounted for a substantial proportion of the covariation in dietary patterns. Cronbach's a coefficient was 0.61.

Conclusion. The BHEI_R, based on the usual dietary intake, appears to be useful to assess dietary quality among adolescents, living in São Paulo, Brazil.

PP 215

DIETARY PATTERNS AS PREDICTORS OF CHILDHOOD ADIPOSITY

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How dietary choices drive energy intake and affect adiposity is poorly understood. Traditional nutritional epidemiological methods of assessing the effects of a single, or a few, foods or nutrients on health, are now considered reductionist, since food is mostly consumed in eating episodes (meals), where each episode includes a variety of foods with differing combinations of nutrients that are likely to work cumulatively and synergistically. Dietary pattern analysis facilitates investigation of the effects of overall diet on health by attempting to characterise diets holistically. Cluster analysis classifies subjects into mutually exclusive homogeneous groups, based on individual differences in overall diet. This study characterised children's diets as dietary patterns using k- means cluster analysis and examined their relationships with adiposity.

Data were utilised from 468 children aged 6-8 years participating in the Gateshead Millennium Study; a longitudinal birth cohort study in North East England [1, 2]. Dietary intake was measured by FAST [3] and adiposity as Body Mass Index (BMI) and waist circumference (WC). To facilitate interpretation of clusters, dietary food items were aggregated into 41 food groups and expressed as standardised (z-scores) and non-standardised mean daily number of portions,

energy intake and % total energy intake. To find the most suitable number of clusters, k-means cluster analysis was run several times to identify dietary patterns using 2-8 clusters. A minimum sample size was set, where $\geq 10\%$ of subjects must be present in every dietary pattern identified by each run of cluster analysis. The resulting clusters were then examined for interpretable dietary patterns. Relationships between cluster membership and adiposity were investigated by ANOVA, adjusting for covariates.

Three clusters were identified using standardised % total energy intake/food group, characterised as “healthy”, “processed food” and “breakfast cereals” dietary patterns. BMI and WC were significantly different between “processed food” and “breakfast cereal” clusters. Adiposity of children within the “healthy” cluster did not significantly differ from those in the other clusters. Birth weight, child age, maternal BMI and physical activity were significant covariates. Perhaps counter intuitively, BMI and WC were lowest in the “processed food” cluster and highest in the “breakfast cereals” cluster. This finding might be related to parental misreporting of dietary intake, or parents recognising higher adiposity in their children and adopting healthier dietary patterns prior to data collection. Further analysis is being carried out.

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PP 216

THE DEVELOPMENT OF ETHNIC-SPECIFIC FOOD FREQUENCY QUESTIONNAIRES TO MEASURE DIET OF NON-WESTERN MIGRANTS IN THE NETHERLANDS

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Introduction: The prevalence of cardiovascular disease (CVD) is often higher in non-western migrants compared to the host population. Diet is an important modifiable determinant for CVD. The increasingly ethnically diverse nature of many populations in Europe complicates the assessment of representative dietary intake data. Population based studies of dietary intake often exclude immigrant origin groups due to a lack of validated instruments to estimate the habitual diet of immigrants. In this study we aimed to develop ethnic-specific Food Frequency Questionnaires (FFQs) in order to study the dietary patterns of Surinamese of African and of South Asian origin, Turkish and Moroccan individuals residing in Amsterdam, the Netherlands. The current study is embedded in the HELIUS study, a multi-ethnic cohort in Amsterdam and will include 5.000 individuals per ethnic origin, aged 18-70 years.

Methods: An existing validated Dutch FFQ was used as a basis for the development of the ethnic-specific FFQs and we employed the methodology used by the Dutch-FFQ tool. Food items were selected according to their percentage contribution to, and variance in the nutrient intake of interest (including all macronutrients, dietary fibre, vitamin A, B2, B12, C and D, folate, calcium and iron) based on data from 24 hour recalls collected in studies among non-Western migrants in the Netherlands: the LASER-study (n=156), the SUNSET-study (n=109) and a study by TNO among migrants (n=273). Tests of face-validity and cognitive interviews were performed to pinpoint problems in design and comprehension of the FFQs. A nutrient database was constructed based on data in the Dutch Food Composition Table (Nevo) and will be supplemented with data on ethnic foods based on new analyses and international data.

Results: Three FFQs including approximately 200 food items have been developed to reflect usual intakes of Turkish, Moroccan and Surinamese migrants. Overall the FFQs cover more than 90% of the intake of the nutrients at interest in this study.

Conclusion: The similarity of the FFQs will enable important cross-comparison of the migrant groups with each other and with the ethnic Dutch population. Due to the embedding in the HELIUS study, a major advantage is the possibility to combine biochemical data with dietary intake data derived from the FFQs. This will be the first large scale study in the Netherlands to allow long term research into the main determinants and health consequences of the diet.

PP 217

CAN THE DIETARY GUIDELINE INDEX FOR CHILDREN AND ADOLESCENCE (DGI-CA) DETECT CHANGE IN DIET QUALITY?

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Background: Dietary indexes provide a whole-of-diet measure reflecting the degree of adherence to dietary guidelines or current nutrition knowledge. Dietary indexes are used as a proxy for diet quality and have been associated with micronutrient intake, nutritional biomarkers and disease risk in children. However whether indexes are sensitive enough

to monitor changes in diet quality over time, or detect a change in diet quality in response to an intervention is largely unexplored.

Aim: To determine whether a valid measure of diet quality reflecting adherence with to Australian dietary guidelines is able to detect change.

Method: A 24-wk cluster randomised controlled trial with 93 families of 4-13yo randomly allocated to parental education regarding changing from full fat to reduced-fat dairy foods (n = 76 children) or reducing screen time (n = 69 children). Study measures were collected at weeks 0, 12 (end of intervention), and 24. Parents completed 3x24-hour 3-pass food recalls with a Dietitian (1 face-to-face, 2 via telephone). Food group intake was estimated in Foodworks using AusNut2007. Food intake from two weekdays and one weekend day was averaged and used to calculate a diet quality score using the DGI-CA criteria. The DGI-CA is comprised of 11 components: fruit, vegetables, breads and cereals, meat dairy, extra foods, beverages, proportion of dairy as reduced fat, whole grains, healthy fats and diet variety. The total possible score is 100 with a higher score reflecting greater adherence to guidelines. Group differences in diet quality at weeks 12 and 24 were examined using maximum-likelihood mixed models adjusted for clustering of children within families, baseline measurements, and covariates.

Results: At baseline, there was no group difference in DGI-CA score [mean(SD) 53(13) intervention group, 51(12) comparison group]. Baseline scores on the dairy fat indicator was 0.7/5 and increased by 2.8 (95% CI 2 to 3) points in the intervention group ($P < 0.0001$). In the adjusted analysis, DGI-CA scores were 4.6 points higher in the intervention group than in the comparison group (95% CI -0.3 to +9.4) at week 12. This difference was maintained at week 24 (4.7 95% CI -0.5 to 10.0).

Conclusions: The DGI-CA is sensitive to detecting a change in diet quality. A change from full fat to reduced fat dairy foods would be expected to increase the DGI-CA score by up to 5 points. Diet quality indexes provide a useful way to assess targeted changes in diet (within the context of whole diet).

PP 218

DEVELOPMENT OF A NUTRIENT BASED DIET QUALITY INDEX AND VALIDATION ON NATIONAL FRENCH AND US DIETARY SURVEYS

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BACKGROUND: Existing diet quality indices often show theoretical and methodological limitations, especially with regard to validation.

OBJECTIVES: To develop a diet quality index based on the probability of adequacy for nutrient intakes and validate it using data from French and US populations.

METHODS: The Probability of Adequacy for Nutrient Diet index (PANDiet) was created based on probabilistic calculations, which take into account the estimated usual nutrient intake, day-to-day variability and individual characteristics (Institute of Medicine, 2000). The index is composed of adequacy probabilities for 24 nutrients, divided into two sub-scores according to whether or not the recommendation is a lower limit (e.g. calcium) and/or an upper level (e.g. sodium). The mean of the sub-scores provides the total score. Construct validity was evaluated by comparing scores for population sub-groups with *a priori* differences in diet quality, according to smoking status, energy density and food intakes. Validity was tested on two different implementations of the PANDiet to the French and US cases, using specific national nutritional recommendations and dietary surveys (ENNS 2006-07 and NHANES 2007-08).

RESULTS: Results are based on "acceptable reporters", identified by the methods of Goldberg and Black (French n=1330, American n=2391). The distribution parameters of the PANDiet [mean \pm SE; P05; P95] were respectively [63.25 \pm 0.29; 50.94; 77.09] and [58.73 \pm 0.36; 42.98; 75.83] for the French and US implementations. The PANDiet was not correlated with energy for the French implementation ($r = -0.02$, $P > 0.05$) and correlated at a low level for the US implementation ($r = -0.11$, $P < 0.001$) suggesting the score adequately reflects diet quality. In both implementations, after controlling for age and sex, a higher score was significantly associated with not smoking, consuming a lower-energy-dense diet, consuming higher amounts of fruits, vegetables, fish, milk and yogurts and lower amounts of cheese, pizza, meat and processed meat.

CONCLUSIONS: The PANDiet provides a single score that measures the adequacy of nutrient intake and reflects diet quality with construct validity demonstrated for French and US cases. This is the first index to be easily adaptable for use in different countries, where local nutritional recommendations are proposed. Applications include the assessment and improvement of diet quality at an individual or population level.

PP 219

RELATIONSHIP BETWEEN DIETARY PATTERNS, DIGESTIVE SYMPTOMS AND HEALTH-RELATED QUALITY OF LIFE IN A SAMPLE OF FRENCH WOMEN

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BACKGROUND: Dietary pattern analysis is a useful way to consider the entire diet, rather than individual foods or nutrients, providing an opportunity to take into account interactions and investigate relationships in nutritional epidemiology.

OBJECTIVES: The objective of this analysis was to identify and characterize dietary patterns in a sample of French women reporting minor digestive symptoms, and investigate their associations with digestive symptoms and health-related quality of life (HRQoL).

METHODS: Females aged 18-60yrs with a body mass index between 18-30kg/m², without a clinical diagnosis of digestive disease including any functional bowel disorder were identified from one clinical centre in Northern France. Subjects were screened to include those reporting a bowel movement frequency within the normal range (3-21 stools/week) but minor digestive symptoms in the previous month. Dietary data was collected via telephone by trained dieticians using three non-consecutive multiple-pass 24hr recalls. Data were coded into pre-defined food categories and linked with a food composition database containing over 5000 items. Cluster analysis was undertaken in order to identify dietary patterns. The k-means partitioning method was used to divide the data into a given number (k) of clusters without overlapping, according to three statistical parameters. The frequency of digestive symptoms (abdominal pain, bloating, flatulence and borborygmi) and bowel movements was evaluated over a two week period using a questionnaire. HRQoL was assessed using a validated questionnaire (Guyonnet *et al.*, 2008).

RESULTS: From the 388 subjects initially recruited, data for 308 was analysed due to withdrawal or incomplete data. From these subjects, four clusters of dietary patterns were identified, characterized by a higher consumption of cheese, nuts/appetizers, prepared/complex dishes and alcoholic beverages (Cluster 1, n=58), desserts and starchy foods (e.g. rice, pasta, potatoes) (Cluster 2, n=94), fruit, vegetables, soups, dairy desserts (e.g. yogurt) and coffee/tea (Cluster 3, n=100) and breakfast cereals, milk, salad vegetables and sandwiches (Cluster 4, n=56). The mean age was lower in Cluster 4 (26yrs) and higher in Cluster 3 (38yrs). Stool frequency and physical activity were similar across the clusters. Analysis of the digestive symptoms showed no differences according to cluster, except for the frequency of flatulence (p=0.03) which was more frequent in Clusters 1 and 4. Overall no significant differences were observed according to dietary clusters and HRQoL.

CONCLUSIONS: The results demonstrate that even within a relatively homogeneous sample of French women, distinct dietary patterns can be identified. Results for digestive symptoms should be explored and further research is needed in different age and sex groups and populations with more severe digestive symptoms.

REFERENCES: Guyonnet *et al.* (2008) Public Health Nutr. 11:1163-72.

PP 220

FACTORS THAT INFLUENCE DIETARY ENERGY DENSITY IN US ADULTS

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Background: There has been a growing interest in examining dietary energy density (ED, kcal/g) as a risk factor for obesity and other diseases. Maintaining a diet low in ED has been recommended as a method of disease prevention in the 2010 Dietary Guidelines for Americans, as well as by other agencies. Translating this recommendation into practice, however, is difficult. Several factors may affect dietary energy density. National survey data is an excellent resource for evaluating factors that are important to dietary ED calculation.

Objective: The objective of this study is to evaluate factors that influence dietary ED and describe how these factors modify the relationship between ED and obesity.

Methods: Data from a nationally representative sample of 8,550 adults ≥ 18 y who participated in the 2005-2008 National Health and Nutrition Examination Survey (NHANES) were analyzed in multivariate linear regression models with body mass index (BMI kg/m²) as the dependent variable. Dietary energy density (ED, energy per weight of food, kcal/g) was examined as a continuous and a categorical variable. The present study evaluates all consumed items and defines foods and beverages based on both USDA food codes and how the item was consumed. Results are presented as mean EDs for the different calculation methods stratified by population demographics (e.g. age, sex).

Results: Age, sex, and race all independently influenced the relationship between ED and obesity. Men had significantly higher dietary ED than women (1.97 vs. 1.85, P<0.001); older adults (>70y) had significantly lower ED than all other adults (1.74 vs. 1.98, P<0.001) and current smokers had a significantly higher ED than non-smokers (2.03 vs. 1.85, P<0.0001). Adults who were actively dieting had diets significantly lower in energy density (2.15 vs. 2.27 kcal/g p<0.05) but, as expected, had a significantly higher BMI (mean BMI 30 vs. 27, p<0.0001) than non-dieters.

Conclusion: Several factors including age, gender, race, smoking status and dieting affected dietary ED and the relationship between ED and weight status in adults. When assessing the relationship between ED and weight status in adults, it is important to consider these factors.

PP 221

FACTOR ANALYSIS USING SHORT-TERM DIETARY ASSESSMENT METHODS: ADJUST OR NOT ADJUST FOR THE WITHIN-PERSON VARIATION OF INTAKE?

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Background: Factor analysis is a multivariate statistical method largely used to derive dietary patterns of populations. However, little is known regarding to the effects of the within-person variation in deriving dietary patterns by factor analysis when short-term dietary assessment methods are used. Objectives: To investigate the effects of adjusting for the within-person variation of intake on dietary

patterns derived from factor analysis. Methods: A simulation analysis was performed in a sample comprising 715 subjects of both sexes, aging 19 years and over, evaluated in a cross-sectional study carried out in São Paulo, Southeast of Brazil (Health Survey – ISA-SP 2008). Dietary intake was assessed by two non-consecutive 24-hour dietary recalls applied using the USDA Multiple-Pass

Method. The food items were classified into 34 food groups according to the nutrient profile and representativeness of dietary habits of people living in Southeast of Brazil. The Multiple Source Method (MSM) was used to adjust for the within-person variation of food groups intake without covariates in the model. Principal component factor analysis was performed based on adjusted and not adjusted data. The factors were rotated by orthogonal (VARIMAX) transformation. After rotation, seven factors were retained according to eigenvalues of each factor (eigenvalues>1.25) and the scree plot test. Food groups with factor loadings ≥ 0.30 were considered significant. The Kaiser-Meyer-Olkin (KMO) test was previously conducted to verify the reliability of factor analysis for the sample size. All analyses were performed in Stata 10.0. Results: The total variance explained by the factors was 35.51% (data adjusted) and 33.44% (data not adjusted). The KMO test indicated sufficient reliability of factor analysis (0.59 - adjusted data vs. 0.60 - not adjusted data). The adjustment improved the interpretability of factors and important differences in components retained in each factor were observed. For example, the first factor derived based on adjusted data accounted for 6,1% of total variance explained and was composed of fruits (0.31), vegetables (0.78), condiments (0.80) and dressing for salads (0.60), while the first factor derived based on not adjusted data accounted for 5,5% of total variance and was composed of rice (0.73), red meat (0.41), beans (0.69), and low-fat milk (-0.35). Additionally, three food groups lost statistical significance when adjusting for the within-person variation. Conclusion: The adjustment for the within-person variation can be useful to derive dietary patterns from factor analysis by improving the variance explained and the interpretability of the factors.

PP 222

THE AUSTRALASIAN CHILD AND ADOLESCENT OBESITY RESEARCH NETWORK ONLINE DECISION TOOL TO GUIDE DIETARY INTAKE METHOD SELECTION IN THE CONTEXT OF OBESITY

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The challenges of measuring dietary intake contribute to the limited reporting of dietary intake data within child and adolescent obesity prevention and treatment research. The Food and Nutrition Stream of ACAORN developed an online decision tool with supporting resources, to guide researchers and practitioners in selecting appropriate diet assessment methods within the context of child obesity research and practice. The development of the online tool was informed by a literature review of dietary assessment considerations and recommendations within obesity research. Additionally, a nine item online survey was distributed to nutrition researchers using a snowball technique via existing research and clinical networks (n=69) to gain insights into the content and format preferences of end users of the tool. This data was used to develop a series of web-based resources, located at www.acaorn.org.au/streams/nutrition/index.php. The tool includes a dietary assessment method selection guide, presented as a series of matrices (outcome of interest; practical considerations; population); quick reference guide detailing dietary assessment methodologies; case studies illustrating selection of dietary methods in different research or practice settings; glossary of common terms; frequently asked questions; and a database of validated dietary assessment tools. A practical manuscript to guide the use of the online tools was also published (1). The website has had high utilisation. From March to October 2011 there was an average of 2962 page views per month to the ACAORN website with 1175 views/month to the Food and Nutrition page and 704 and 132 views/month to the assessment methods and validation pages respectively. This high level of access is anticipated to facilitate improvements in the selection and use of dietary methods in research studies in child and

adolescents. Monitoring over time will identify whether there are improvements in the quality of dietary intake assessment methods and reporting within the child and adolescent obesity literature. Future work will focus on development of an online decision guide for conducting validation studies of dietary assessment methods. 1. Magarey A, Watson J, Golley RK, Burrows T, Sutherland R, McNaughton SA, Denney-Wilson E, Campbell K, Collins C. Assessing dietary intake in children and adolescents: considerations and recommendations for obesity research. *Int J Pediatr Obes.* 2011, 6(1), 2-11. Contact author: Clare Collins clare.collins@newcastle.edu.au. Presented on behalf of the Food and Nutrition Stream of the Australasian Child and Adolescent Obesity Research Network. Funding Source: ACAORN grants, National Health and Medical Research Career (NHMRC) Development Fellowship (Collins), NHMRC Post-Doctoral Fellowship (Golley).

PP 223

THE USE OF INDIVIDUAL DIET MODELLING TO OPTIMISE INDIVIDUAL FOOD CHOICES: A FOCUS ON DAIRY PRODUCTS

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The aim of this study was to apply individual diet modelling to analyse the changes in the consumption of dairy products, needed to achieve a whole set of nutrient-based recommendations in a French adult population.

An individual diet model was developed for each adult participating in the French national INCA (Enquête Individuelle et Nationale sur les Consommations Alimentaires) dietary survey (n=1171). From each individual weekly food intake (observed diets), an isocaloric modelled diet was designed by linear programming to simultaneously meet the French nutrient recommendations while deviating the least from the observed individual food intakes. Variations in weight, energy and nutrients in observed and modelled diet were calculated for each food group (n=7), with a focus on dairy products (including 4 subgroups: cheese, milk, fresh dairy products and dairy desserts).

The results indicated that in the modelled diet, the weight of 3 food groups significantly increased: starchy foods (+37%), fruit & vegetables (+62%) and dairy products (+19%). Among these groups, dairy products was the only one which energy contribution was decreased (-225 kcal/week). This was explained by an increase (in weight) of fresh dairy products (+60%) and milk (+17%), a decrease of cheese (-48%), without significant change of dairy desserts. The optimization process decreased the total amounts of SFA, added sugars and sodium in the modelled diets and increased that of calcium. The dairy products group contributed to 24% of the total increase in calcium, to 18.5% of the decrease in SFA and to 20% of the decrease in sodium. Interestingly, the dairy products did not contribute to the decrease in added sugars. The contribution of dairy products to the decrease in SFA and sodium was exclusively due to a decrease in cheese whereas the increase in fresh dairy products and milk led to a small but significant increase in SFA and sodium within these 2 subgroups.

In conclusion, linear programming allows estimating the contribution of the different food groups and subgroups in nutritionally adequate and socially acceptable diets. This method, applied to an adult French population suggests that increasing the intake of the lowest energy-dense dairy products (i.e. fresh dairy products and milk) as well as increasing starchy foods and fruit & vegetables is required to meet a whole set of nutrient-based recommendations. This new individual diet modelling approach could help to revise or precise existing food-based dietary guidelines, in particular among the dairy food group.

PP 224

SAMI DIET AND MORTALITY IN A NORTHERN SWEDISH POPULATION

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The aim of this study was to examine the role of a "traditional Sami" dietary pattern (presented on ICDM7) for mortality in a general northern Swedish population. The Sami are the indigenous people of a 388 350 km² large area of northern Fennoscandia. Sami people generally have a lower risk of death from some cancers. Diabetes and cardiovascular disease, often overly represented in other indigenous populations, are not generally associated with Sami ethnicity in Sweden. This is mainly due to both equal living conditions and access to health care services across ethnic groups in Sweden. But it has also been hypothesized that elements of a traditional Sami diet and lifestyle may reduce the risk to develop chronic diseases such as cancer and CVD.

Methods: We examined 77 319 subjects from the population-based Västerbotten Intervention Program (VIP) cohort. A Sami Diet Score was constructed by adding one point for intake above the median level of red meat, fatty fish, total fat, berries and boiled coffee, and one point for intake below the median level of vegetables, bread and fibre, all calculated separately for sex and FFQ version. Sex-specific hazard ratios (HR) for mortality were calculated by Cox regression.

Results: Increasing Sami Diet Scores were associated with slightly elevated all-cause mortality in men [Multivariate HR per one-point increase in score 1.04 (95% CI 1.01-1.07), P=0.018], but not in women [Multivariate HR 1.03 (95% CI 0.99-1.07), P=0.130]. This increased risk was approximately equally attributable to CVD and cancer, though somewhat

more apparent for CVD mortality in men free from diabetes, hypertension and obesity at baseline [Multivariate HR 1.10 (95% CI 1.01-1.20), P =0.023]. Stratification for physical activity level did not materially affect the results.

Conclusion: This was the first study to examine a “traditional Sami” dietary pattern in relation to any health outcome. Our findings suggest a weak increased all-cause mortality in subjects with higher Sami Diet Scores. Further study of cohorts with more detailed information on dietary and lifestyle items relevant for traditional Sami culture is warranted.

PP 225

VALIDATION OF THE DIET QUALITY INDEX FOR ADOLESCENTS BY COMPARISON WITH BIOMARKERS, NUTRIENT AND FOOD INTAKES: THE HELENA STUDY.
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Introduction: Food Based Dietary Guidelines (FBDG) aim to address the nutritional requirements at population level in order to prevent diseases and promote a healthy lifestyle. Diet quality indices can be used to assess the compliance with these FBDG. This study aimed to investigate whether the newly developed Diet Quality Index for Adolescents (DQI-A) is a good surrogate measure for adherence to the FBDG, and whether adherence to these FBDG effectively leads to better nutrient intakes and nutritional biomarkers in adolescents. **Methods:** Participants were 1752 European adolescents who participated in the HELENA Study. Dietary intake was assessed by two, non-consecutive 24h recalls. A DQI-A score, considering the components dietary quality, diversity and equilibrium, was calculated. Associations between the DQI-A and food and nutrient intakes and concentration biomarkers were investigated using multilevel regression analysis, corrected for centre, age and sex. **Results:** DQI-A scores were associated with food intake in the expected direction: higher intakes of food items with a healthy connotation, such as fruits and vegetables, and inverse associations with energy-dense and low-nutritious foods. Also, the DQI-A was positively related to the intake of water, fiber and most minerals and vitamins, no association was found with total fat intake. Furthermore, a positive association was seen with vitamin D, holo-transcobalamine, and ω -3 fatty acids serum levels. **Conclusions:** This study has shown good validity of the DQI-A and confirmed that the FBDG are effective ‘translations’ of most of the nutrient recommendations. Only for fat intake the findings were not in line with the expectations.

PP 226

EVALUATION AND RELATIVE VALIDATION OF A WEB BASED 24-HOUR DIETARY RECALL IN CHILDREN AGED 9- 11 YEARS - REALITY TM

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Background: Diet is one of the most important modifiable health related behaviours related to chronic disease. There is a need for simple, inexpensive user friendly tools needed to measure energy intake and patterns to effectively measure progress towards government policy targets. This study aims to test the relative validity of a web based 24-hour dietary recall tool in 9-11 year old children.

Methods: Twenty five children from Aberdeenshire Scotland used the REALITYTM web program for 3 days to recall their daily diet. A telephone 24 hr multiple pass recall was also performed on each of these days. The dietary data from each method was compared. Median agreement and correlation of energy and macronutrient intakes were assessed between the two methods. The ranking of individuals into tertiles was also performed while the Bland-Altman method was used to assess agreement.

Results: Higher energy intake was reported in the telephone recall than in REALITY with a median difference of 0.78MJ/d however this difference was not significant. Median intakes of macronutrients between the 2 methods were similar with only significant differences observed in fat, SFA, protein and NSP as energy adjusted grams. A strong correlation was observed between the two methods for energy, sugars, protein and NSP with a corresponding high agreement of subjects classified correctly into the same tertiles. Fat, SFA and carbohydrates as energy adjusted grams and percentage of energy exhibited poor correlation between the methods and had a corresponding low number of subjects classified correctly into the same thirds.

Conclusion: The results confirmed there was good agreement between REALITY™ and the telephone 24hr recall for energy and most macronutrients. The difference in EI was smaller than in a previous pilot validation of the REALITY tool (7 % versus 13% Jackson *et al.* 2009) and high correlations were observed for all macronutrients except for fats, SFA and carbohydrates most likely due to the under-reporting of fat and carbohydrate rich foods although modifications to REALITY could improve these reporting errors. Overall, REALITY was effective at assessing dietary intake at a group level. The improvement in REALITY™ is thought to be due to the extra prompts added to the programming following the pilot validation study (Jackson *et al.* 2009).

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PP 227

MODELLING THE IMPACT OF REDUCING SATURATED FATTY ACID INTAKE FROM MILK AND MILK PRODUCTS IN US NHANES 2008

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Background: Less than 10% of dietary energy from saturated fatty acids (SFA) has been proposed as the target for the population goal for saturated fat. While SFA intakes in the US have been decreasing over time they have stabilised in recent years. Milk and milk products remain a significant contributor to SFA intakes in the US providing 26.2% of the total SFA intake of the total population using NHANES 2008.

Objective: The aim of the current study was to model the impact on SFA and other relevant nutrient intakes when replacing full fat milk and milk products with lower SFA alternatives. As it may not be realistic to assume all consumers would consider such a change, the impact of different probabilities of change occurring was considered.

Methods: NHANES 2008 Two Day survey was used. Males and females aged between 20 and 69 were examined. Those subjects with a BMI less than 20kg/m² were excluded from analysis. Pregnant and lactating females were also excluded as we did not wish to adjust the intakes of these specific groups. All food codes within the FNDDS 4.1 Group 1: Milk and Milk Products were examined for SFA content. Full fat products were matched with suitable similar low fat alternatives. 178 of 603 FNDDS 4.1 food codes had a suitable low fat alternative. Using Creme Food[®] software, the selected food codes were replaced with lower SFA alternatives at 100%, 75% and 35% replacement probability. Nutrient analyses before and after replacement were carried out.

Results: The mean baseline intakes of SFA from the total diet for this specific population subgroup was 11.3% of total energy. This value reduced to 10.1%, 10.5% and 10.9% SFA when replacement was set at 100%, 70% and 35% of consumers respectively. While there was a significant difference observed in the total fat content and cholesterol (both p=0.000) from switching to low fat alternatives, there was no significant difference in other nutrient intakes such as calcium (p=0.2)

Discussion: Using probabilistic food replacement we showed that if even 70% of consumers switched from full fat milk and milk products to lower fat alternatives, the intake of saturated fat would decrease from 11.3% to 10.5%. This would help reach the population target of SFA less than 10%. This could occur without negatively impacting on other nutrient intakes.

PP 228

DIET QUALITY DIFFERENCES AMONG TEMPORAL DIETARY PATTERNS IDENTIFIED USING KERNEL K-MEANS CLUSTERING IN THE ADULT PARTICIPANTS OF NHANES 1999-2004

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Introduction: Temporal dietary patterns, or patterns of energy intake observed by time for a group of individuals, is an emerging area of research and may aid understanding of the relationship of diet to health. Patterns of energy intake over a 24-hour day may vary by individual and may be associated with diet quality. **Objective:** The purpose of this study was to determine whether differences in diet quality were present in the temporal dietary patterns that emerged from novel clustering techniques. **Methods:** Dietary intake was assessed by 24-hour dietary recall and processed using United States Department of Agriculture's Food and Nutrient Database for Dietary Studies. The dietary recall data of the adult participants age 20 to 65 years of the National Health and Nutrition Examination Survey (NHANES) 1999-2004 were used to determine the proportion of energy consumed at a particular hour of the day compared with the total energy consumed for the 24-hour day. Individuals were clustered using kernel k-means clustering with an appropriate distance metric for hourly mean proportion of energy consumed. Four distinct temporal dietary patterns were characterized for the 24-hour time period. A group mean of dietary index quality, such as the Healthy Eating Index 2005 (HEI), were determined for each cluster. These means were then compared using a generalized logit model that

controlled for potential confounders and other covariates. **Results:** Significant differences ($P < 0.0001$) in HEI 2005 were observed among the clusters. The temporal dietary pattern exhibiting a greater proportion of energy consumed during the early evening hours had a significantly greater mean HEI 2005 compared with the three other patterns. **Conclusions:** Temporal dietary patterns determined using kernal k-means clustering exist within the US population and can be used to identify differences in diet quality. Groups of individuals that consume their energy proportionally similarly throughout the day exhibit certain dietary characteristics. These characteristics may be evaluated to determine links to diet and health and may be used to generate public health messages and enhance understanding of the complicated interplay of time and dietary intake.

PP 229

IMPACT OF INDUSTRY FOOD AND BEVERAGE REFORMULATION EFFORTS ON PUBLIC HEALTH: MODELING SHOWS GREAT POTENTIAL

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Background: Among the major global public health concerns are the increasing rates of cardiovascular diseases and obesity. To address these challenges, Unilever is continuously working to improve the nutritional quality of products, and promote activities aimed at behavior change towards a healthier life style. By 2020 Unilever aims to double the proportion of its portfolio that meets the highest nutritional standards, helping hundreds of millions of people achieve a healthier diet. Objective: To develop and apply modeling tools to estimate the potential public health effects of our reformulation efforts. Methods: The used modeling tools are based on existing data on food consumption of certain populations and food composition tables. By modifying the input data on food composition into the aimed reformulation i.e. salt targets, potential reductions on (usual) nutrient intakes of a population can be calculated. These reductions in nutrient intakes can then be linked to change in biochemical risk factors for i.e. cardiovascular disease, which can be quantified to population health impact based on epidemiological evidence. Results: These modeling tools are being used to evaluate our reformulation efforts, for example on salt reduction. Our goal is to help consumers meet the recommended level of 5 gram salt per day based on globally recognized guidelines. The first results on the potential effects on public health of food reformulation will be shared. Conclusion: The use of modeling tools based on existing data on food consumption and composition and epidemiological data enable showing the potential benefit of food reformulation on public health.

PP 230

THE EFFECTS OF FOOD GROUPING IN DIETARY PATTERNS DERIVED FROM FACTOR ANALYSIS

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Background: Analysis of dietary data by dietary patterns is an interesting approach in epidemiological studies because it considers the interaction between nutrients and foods and provides adequate information to establish dietary recommendations for public health. This kind of analysis involves important previous decisions by researcher which includes a set of criteria for grouping foods when short-term dietary assessment methods are used. Objective: To investigate the effects of different food grouping schemes in dietary patterns derived from factor analysis. Methods: Dietary data come from Health Survey – ISA-Capital 2008, a cross-sectional population-based study conducted with a probabilistic sample of residents in the city of São Paulo, Brazil. In this study, 24-hour dietary recalls were applied using the USDA Multiple-Pass Method. In a simulation analysis, dietary data from 941 subjects of both sexes, aging 19 years and over were used to derive dietary patterns from principal component factor analysis. A total of 29 food groups were obtained according to the nutrient profile and representativeness of dietary habits of subjects living in study region. To investigate the effects of different food grouping schemes in derived dietary patterns, we arbitrarily chose the meat consumption and we grouped them in three different ways: a) beef group, pork group, poultry group, fish group, and processed meat group; b) red meat group (beef and pork), white meat group (poultry and fish), and processed meat group; c) red and processed meat group and white meat group. Factors were retained according to eigenvalues (>1.25) and scree plot test. After a VARIMAX rotation, the food groups with factor loadings ≥ 0.30 were considered significant. Results: The total variance explained by the factors was 34.87% in grouping scheme “a”, 35.20% in scheme “b” and 36.28% in scheme “c”. The Kaiser-Meyer-Olkin (KMO) test was 0.57 for all grouping schemes, however two groups had to be excluded from the analysis in grouping “b” (KMO <0.5). All dietary patterns had similar components and factorial loads, but the interpretability was better in grouping scheme “c”. Conclusion: Food grouping is a crucial step to derive dietary patterns when short-term dietary assessment methods are used and must be performed based on theoretical concepts and dietary data collected. Our results suggest that food grouping may influence the interpretability of dietary patterns derived from factor analysis.

PP 231**NUMBER OF SIDE DISHES (FOOD VARIETY) IS ASSOCIATED WITH THE RISK OF OBESITY, ABDOMINAL OBESITY IN MIDDLE-AGED KOREANS**

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The objective of this study is to examine the association between number of side dishes at mealtime, which represents the food variety in Korean diet, and the incidence of obesity (OB, BMI>25) and abdominal obesity (AOB, waist circumference > 90cm for men, >85cm for women) among Koreans. Data from the 4th Korea National Health and Nutrition Examination Survey (KNHANES, 2007-2009) was used in the analysis. Health examination records and dietary intake results of 12,175 adults aged 19-64 were included, excluding those who have changed their diet for weight control. Number of side dishes at mealtime was assessed by 24hr recall method and examined for the association with OB and AOB using odds ratio and trend test. The average number of side dishes at mealtime was divided into 5 categories for analyses. Adjusting for potential confounders, number of side dishes excluding seasonings was inversely associated with both OB and AOB risks. Odds ratio and 95% confidence intervals for the fifth (mean=5.7) compared to the first quintile (mean=1.5) of number of side dishes for OB and AOB, when controlling for age and sex, were 0.73 (0.63-0.86, p for trend=0.001) and 0.76 (0.66-0.86, p for trend=0.002), respectively. These associations were still significant when controlling for age, sex, income, education, smoking status, alcohol intake, physical activity and energy intake, with OR=0.74 (0.63-0.86, p for trend=0.001) for OB and OR=0.73 (0.63-0.86, p for trend=0.001) for AOB. The results support a protective role of the food variety on developing both OB and AOB, especially for the middle-aged Korean men and women.

PP 232**DOES DIETARY PATTERN DERIVED BY CLUSTER ANALYSIS GIVE A BETTER DESCRIPTION OF THE NUTRITIONAL SITUATION IN REFUGEE CAMPS THAN DIET DIVERSITY SCORES?**

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Background: The food intake of Saharawi refugees living in the Algerian desert has been evaluated twice by Diet Diversity Score (DDS), but never by Cluster Analysis (CA) which can be used to describe dietary pattern.

Objective: To compare the two methods by assessing how the different patterns are related to food intake and person characteristics.

Methods: In a cross-sectional nutritional survey in 2008 an extensive seven-day food frequency questionnaire was conducted in 793 women (aged 15-49 years) of 4 refugee camps in Tindouf, Algeria. CA was based on mean number of weekly intake of 33 foods using Ward's method. DDS was determined based on the consumption/non-consumption of 14 food groups during the 7 days.

Results: Five dietary clusters across the refugee camps were identified. The first cluster included 33% of the women and was characterized by the highest consumption of camel milk, processed milk, yoghurt, eggs, fruit and tomato compared to the other clusters. The cluster with the highest local milk and meat intake included 19% of the women, half of them were illiterate. They had also the highest intakes of canned fish, cheese and spaghetti as well as the highest intake of generally distributed potatoes, carrots, onions and fortified flour. The third cluster included 23% of the women and they had the highest intake of lentils, rice and gruel. They had also the highest prevalence of self-reported pneumonia, the lowest prevalence of diarrhea, and the lowest intake of supplements of iron and vitamin A. The fourth cluster included 16% of the women and was characterized by the lowest intake of milk, meat, cereals, vegetables and oil, although 50% of them were breastfeeding. The fifth cluster included 9% of the women and these women drank less tea but more juice, were younger, had fewer children, and more were pregnant and educated. All the differences mentioned above were significant. When the women were divided into groups of low, medium and high DDS, the lowest intakes of all the food items, except gruel and margarine, were found in the low DDS. There were no significant differences between the above background variables and DDS. There were no associations between any of the methods (CA or DDS) and BMI, Hb or marital status.

Conclusion: CA provides a more detailed picture of the situation than DDS, and gives therefore a better basis for developing policies, strategies and activities to improve the nutritional situation.

PP 233**THE CORRELATION BETWEEN THE LEVEL OF KNOWLEDGE AND STREET FOOD CONSUMPTION PATTERNS WITH NUTRITIONAL STATUS OF CHILDREN**

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Street food is one of the food potential in contributing to nutrient intakes for school age children, in the selection of street food consumption required knowledge about healthy snacks. That will eventually influence the nutritional status of children. This study aimed to analyze the correlation between knowledge level and consumption pattern of street food with nutritional status of elementary school children. Analytical observational research with cross sectional design. The study population was the students in grade IV and V Elementary School of Keputran I and III Tegalsari Surabaya. The sampling technique was simple random sampling. Data analyzed by Spearman test. The results showed there was no correlation between the level of knowledge about street food and nutritional status ($p>0.05$), there was a correlation between the level of energy and protein intakes of total food and nutritional status ($p<0.01$), there was no correlation between consumption levels of energy and protein snacks and nutritional status ($p>0.05$), and there was a correlation between energy and protein contribution of street food with low nutritional status ($p<0.05$). The conclusion of this research is to contribute the street food sufficiency level of energy and protein. The child's knowledge about the snacks does not affect nutritional status. The nutritional status of children is not only influenced by the consumption of street food alone but also influenced by the level of consumption of total food consumed daily.

PP 234

BREAKFAST EATING PATTERN OF THAI SCHOOL-AGED CHILDREN

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Introductions: Breakfast has been recognized as the most important meal of the day, which is contribute sustainability to daily nutrient intake and calorie needs, particularly for children. Skipping breakfast cause hypoglycemia by mid-morning and resulted in irritability, weakness and consequently poor performance.

Objectives: This study aims to determine the breakfast eating pattern and breakfast behavior of Thai school-aged children.

Methods: The survey was using questionnaires which consist of 3 parts: general characteristics, breakfast eating pattern and knowledge on breakfast. **Results:** This study was carried out in 902 students who were studying in grade 3-4 in 7 primary schools in Bangkok. Schools were selected from 2 types of administrative commission which was different context. The children aged averaged 9.2 yr and number of boys and girls was no different. The nutritional status of the children was measured by INMU-Thai Growth program. By weight for height, about 70% was normal both private and government schools. But about 23.7% of students in private school was overweight and obese whereas only 16.3% was found in government school students. Students who were study in private school had breakfast regularly more than those governments's students (70.5% compare with 49.6%) for weekday. The reason for not having breakfast during weekday were: not hungry, not have time, and no breakfast preparing at home. The breakfast patterns of children were single plate Thai dishes, rice with side dish and American breakfast, respectively. The most popular breakfast menu were rice porridge (17.6%), fried rice (13.4%), noodle (10.1%), rice with egg dished (9.7%). Most of students (79%) like to eat fruits and vegetables but only half of them had fruits and vegetables for their breakfast. One third of student drank whole milk for breakfast. The places of breakfast eaten were at home (72.6%) and cafeteria in school (17.9%). Average score for knowledge on breakfast test was only 4.9 points out of 10 and no different score between grade 3 and 4.

Summary: The benefit of breakfast to health and learning performance on school-aged children should be promoted especially to the parents since one reason of skipping breakfast was no breakfast preparation at home.

PP 235

EVALUATION OF THE DIET IN DANISH ADULTS USING A DIET QUALITY INDEX

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The aim of the present study was to describe the habitual diet in Danish adults, and to evaluate the overall quality of the diet using a diet quality index based on the National Food-Based Dietary Guidelines (FBDG), which include seven guidelines regarding diet and one regarding physical activity.

Methods: Data from the Danish National Survey of Diet and Physical Activity 2003-08, including 3,354 individuals aged 18-75 years were used. The diet quality index was constructed based on six foods and nutrients, reflecting the dietary guidelines. Individuals were assigned a score according to his/her intake of each of the six foods and nutrients, and the scores were summed resulting in a total score ranging from 0 to 6. Individuals were afterwards divided into groups according to quartiles of the diet quality index, and food and nutrient intakes were evaluated in each of the four groups.

Results: Macronutrient distribution did not meet recommendations, as energy from total fat and especially saturated fat was too high in all of the four groups. A high intake of high-fat milk products, fat on bread and processed meat

contributed to a high intake of total fat and saturated fat. Likewise sugar-sweetened soft drinks contributed to a high intake of added sugars in the group with the lowest value of the diet quality index. Individuals with values above the highest quartile had higher intakes of “healthy foods” such as fish, fruit and vegetables, rye bread, and also a higher consumption of water and wine. Overall, intakes of micronutrients were sufficient in all ranges of the index, except from vitamin D, and iron in women. Conclusion: The diet quality index is a useful tool in assessing food and nutrient intake in individuals with high vs. low degree of compliance towards the dietary guidelines, and provides a valuable tool in future studies investigating variations in dietary intakes in relation to lifestyle, demographic and regional differences in Denmark.

PP 236

THE VALUE OF THE POPULATION-LEVEL MEDITERRANEAN ADEQUACY INDEX (P-MAI): A CONFRONTATION AMONG DATASETS AND METRICS USED IN SEVERAL EU COUNTRIES

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Objective: the purpose of this paper is to assess the value of a population-level Mediterranean Adequacy Index (P-MAI) to support the monitoring of national diets, and more generally, nutrition policies, including emerging nutrition schemes or labelling provisions.

Design: the study evaluates the performance and ability to discriminate among countries of the P-MAI in many European Member States using the EFSA’s Concise European Food Consumption Database (mean and median values) and the FAO-FBS dataset (grams and calories).

Subjects: Selected European countries (19) for which data are available both in EFSA’s Concise European Food Consumption Database and FAO Food Balance Sheets. The age of subjects included in EFSA dataset are adults (16-64 years), while years of reference are those of most recent national food consumption surveys.

Results: While P-MAI allows for clustering of national diets, it is questionable the policy making usefulness of its (relatively low) discriminatory power. Historically, P-MAI scores are relatively stable, although a decrease in P-MAI in Southern Europe is apparent, while some Central or Northern European have obtained gains.

Conclusions: P-MAI seems useful as synthetic indicator for monitoring evolving diets, and to identify sub-regions with similar dietary patterns or changes. However, depending on the database used, there are interesting differences. Furthermore, the average or median values of consumption presents drawbacks when pretending to address “extreme dieting” (and its consequences in terms of health-status), which by its own nature, resides in lower or higher percentiles of the populations.

PP 237

CRITERIA TO CHARACTERIZE EXCESSIVE SATURATED FAT, TRANS-FATTY ACIDS AND ADDED-SUGAR INTAKE IN BRAZIL

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Characterizing the food consumption patterns related with excessive sugar and saturated fat intake is of great value in the definition of food and health policies. The objective was to define clear scientific basis to classify foods as sources of excessive saturated fat (SAFA), trans-fatty acids (TFA) and added sugar (AdS) content. The first nationwide individual dietary survey in Brazil was carried out in 2008-2009 obtaining two food diaries on non-consecutive days of 34,003 individuals over 10 years-old residing in the 13,569 households selected for the study. Nutrient content was estimated using national and foreign food composition tables. The generic and food group specific criteria used to identify the high saturated fat, trans-fat and added sugar foods were based on the standards proposed by the International Choices Programme. The criteria considered the proportion of energy provided by the nutrients based on the 2003 World Health Organization recommendations for TFA (energy from TFA <1% of total energy intake) and AdS (energy intake from AdS <10% of total) and in the 2010 USDA (United States Department of Agriculture) recommendation on SAFA (energy intake from SAFA <7% of total). Energy-based criteria considered the recommendations plus 30%; therefore, foods that provided >9.1% of energy from SAFA, >1.3% of energy from TFA, or >13% of energy from AdS (per 100g of food) were considered as high in saturated fat, trans-fatty acids or added sugar content. Specific criteria were defined for beverages (>20kcal/100ml; SAFA >0.78g/100g; TFA >0.1g/100g), milk and dairy (SAFA>1.4g/100g; TFA >0.1g/100g; AdS>5g/100g), cheeses (SAFA>15g/100g; TFA>0.1g/100g), ready-to-eat cereals (SAFA >0.78g/100g; TFA>0.1g/100g; AdS>20g/100g), and fats and oils (SAFA>30% of total fat; TFA>1.3% of energy). Foods were classified according to each of the described criterion and also by the combination of criteria. Those criteria were not applied for fresh fruits, vegetables, legumes and unprocessed potatoes, roots and tubers. Alcoholic beverages were not classified. Excessive SAFA, TFA, and AdS were observed in 53, 25, and 11% of the foods cited in the food records,

respectively. Moreover, about 45% of the foods cited in the food records were considered allowable. Brazilian traditional foods, like rice and beans, were considered allowable. This work is the first attempt to define a food- and nutrient-based measure to categorize foods in Brazil. The results can indicate foods that should be limited in the diet.

PP 238

THE STABILITY OF DIETARY PATTERNS DERIVED APPLYING REDUCED RANK REGRESSION: THE ZUTPHEN ELDERLY STUDY

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Introduction: A relatively new method to derive dietary patterns is reduced rank regression (RRR) which combines prior knowledge of the diet-disease pathway with a statistical dimension-reducing technique. This method has been applied to assess the stability of dietary patterns in the Zutphen Elderly Study.

Aim: To investigate the stability of dietary patterns –derived using RRR– over a period of five years.

Methods: We used data from 467 men, aged 64-85 years, who participated in the 1985 and the 1990 examination round of the Zutphen Elderly Study. Dietary patterns were derived using intake data from 38 food groups as predictor variables. As markers for the diet-mortality pathway we chose the following response variables to be included in our model body mass index, uric acid, systolic and diastolic blood pressure, and HDL-, total cholesterol levels. The stability of dietary patterns was assessed by comparing median food group intake in 1985 and 1990 and by calculation of the Spearman correlation coefficients between baseline dietary patterns and dietary patterns after five years of follow-up.

Preliminary results: Our preliminary results showed, that the medians in food group intake differed significantly between the two examination years. For both examination years three dietary patterns were derived. Spearman correlation coefficients between the derived patterns at baseline and the derived patterns after five years of follow-up, were low (ranging from $r=0.35$ between the 1st derived pattern in 1985 and 1990 to $r=0.04$ between the 3rd derived pattern in 1985 and 1990). Regarding the two highest factor loadings, pattern 2 derived from the 1985 data loaded on strong alcoholic beverages and high fibre bread whereas pattern 3 derived from the 1985 data loaded on cheese and canned fish. In contrast, pattern 1 derived from the 1990 data loaded on canned fish and beer and pattern 2 from 1990 loaded only high on high fat milk products and ready to eat meals.

The highest correlation was found between the first derived pattern in 1985 and the third derived pattern in 1990 ($r=0.39$). Both patterns included a low intake of fruits and full fat milk products and a high intake of ready to eat meals, beer and strong alcoholic beverages. The first derived pattern in 1985 explained the most variation in uric acid and systolic blood pressure whereas the third pattern derived in 1990 explained the most variation in HDL cholesterol and uric acid.

Conclusion: RRR loadings were different for the dietary patterns derived in 1985 and 1990. Subsequently, Spearman correlation coefficients between the derived patterns of the two examination years were low, indicating a low stability of dietary patterns in the Zutphen Elderly population.

PP 239

ASSESSMENT OF DIETARY PATTERNS OF ELDERLY USING “TEN STEPS TO HEALTHY EATING” IN BRAZIL

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Because foods are not consumed in isolation, analysis of dietary pattern and food combination taking into account the interaction among food components it is a way to evaluate food intake. The objective this study was evaluate of food intake old people living in São Paulo, Brazil using the official guideline “Ten steps to healthy eating”. Methods: Fifty elderly subjects aged ≥ 60 years were evaluated and information on dietary intake over the year before was obtained using 61 item version of the adapted Willet semi quantitative food frequency questionnaire (SFFQ) with 61 items and categorized into 8 food groups based on similarities in food and nutrient composition. The dietary patterns were compared with each step from guideline "Ten steps to healthy eating to elderly" Results: Only a minority of the group daily eats vegetables (14.3%), but the habit to eat the rice and bean is daily in 78,6% of group and is considered healthy to dietary Brazilian pattern. Fruits and fruit juice were observed intake daily (54.8%), but processed fruit juice is more common (75.6%). The daily dairy intake is 26.2% and associated inadequate calcium intake ($p < 0.05$) and the lean products it is frequent in majority. Conclusion: Dietary patterns of older people are healthier than adults probably because have less influence of processed food publicity and purchasing habits before the intense food industrialization.

PP 240

EVALUATION OF AN ADULT FOOD FREQUENCY QUESTIONNAIRE AND ITS ASSOCIATED DIET QUALITY SCORE

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Food frequency questionnaires (FFQs) are the most practical and economic method for assessing dietary intake in large epidemiologic studies. Although FFQs have previously been utilised in Australian adult populations, these FFQs were developed over 20 years ago and do not reflect the current food supply. There has also been increasing focus on diet quality scores because they can be evaluated quickly and appear able to quantify the risk of some health outcomes, including cardiovascular disease.

This study evaluated the 'Australian Eating Survey' (AES), an FFQ for Australian adults. Using data from the same participants, the 'Australian Recommended Food Score' (ARFS), a diet quality score developed from the AES, was evaluated. The ARFS has eight components and is scored zero to seventy-three.

Evaluation of the performance of the 'Australia Eating Survey' (AES) was undertaken using current recommendations for comparative validation. A sample of adults (n=80) aged 42-45 years completed the AES FFQ and 3-day weighed food records. The comparative validity of the AES FFQ was determined by comparing the mean nutrient data collected using the FFQ with 3-day weighed food records. The ARFS was evaluated by comparing the data collected using the FFQ with the ARFS scores calculated.

Spearman's correlations and kappa statistics were used to assess the agreement between the AES and 3-day food records. The nutrient intakes estimated using the AES were higher than those estimated using 3-day food records, with the exception of polyunsaturated fat, thiamin, niacin, folate and sodium. Spearman's correlation coefficients for the unadjusted data ranged from 0.12 (potassium) to 0.68 (alcohol). The kappa statistic ranged from 0.08 (retinol) showing 'slight' agreement to 0.44 (alcohol) showing 'moderate' agreement. When compared with 3-day food records, estimated nutrient intakes were higher using the AES FFQ.

The maximum ARFS was 57, with scores ranging from 8 to 21. Women had significantly higher intakes of fruit than men, $p < 0.04$.

These results are promising and further evaluation with a repeat weighed food record will enable comprehensive evaluation of the validity and reproducibility of the AES to assist in evaluating its suitability for Australian adult populations.

PP 241

DEVELOPMENT OF A DIETARY INDEX TO DETECT A SALTY FOOD PATTERN AND VALIDATION AGAINST 24H URINARY SODIUM EXCRETION

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Background: Cardiovascular disease is the number one cause of death worldwide and non-optimal blood pressure increases the risk of cardiovascular disease. Excessive salt intake is one of the main lifestyle contributors to elevated blood pressure levels. However salt is rarely a component in indexes concerned with the diet quality of individuals. This may be due to the controversy of diet quality and salt intake; high overall diet quality is not necessarily associated with low salt intake, suggesting that high salt intake is either an independent eating pattern or that salt is simply masked/hidden in healthy diets as determined by existing dietary indexes. **Study aims:** To develop a diet index, which categorises individuals according to the saltiness of their eating pattern and to validate it against 24-h urinary sodium excretion. **Methods:** For the present study, 2,504 participants aged 30-60 attending the 3-year follow-up of the Inter99 Study, a population-based intervention study, comprised the study population. A sub-sample of 224 individuals additionally delivered single 24h urine samples for the validation of the index against urinary sodium excretion. The index score was based on self-reported frequency of intake of the following food groups; semi-hard cheese, mould cheese, charcuterie, smoked and tinned fish, fast foods, French fries and salty snacks. The score in each of those components was classified as 1,2 or 3 and summed to the final index score ranging from 7-21. A score of 7-11 was classed as low preference of salty foods, 12-15 as medium preference and 16-21 as high preference. Difference in excreted sodium among the three groups of salt preference was tested by The Kruskal-Wallis test. **Results:** There was a significant difference in mean sodium excretion per 24h ($p=0.0027$) between the three groups. The mean salt intake derived from the excreted sodium was 9.74 g, 10.42 g and 13.27 g per day for the low, medium and high salt preference groups respectively. **Conclusion:** When validated against sodium excretion, the diet index appeared to be an acceptable instrument for classifying individuals of a given population in groups of low, medium and high preference of salty foods.

PP 242**REPRODUCIBILITY AND VALIDITY OF FOOD FREQUENCY QUESTIONNAIRE DEVELOPED FOR KOREA NATIONAL HEALTH AND NUTRITION EXAMINATION SURVEY (KNHANES)**

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Objective: We aimed to examine the validity and reproducibility of an interviewer-administered Food Frequency Questionnaire (FFQ) developed for Korean National Health and Nutrition Examination Survey (KNHANES).

Design: The FFQ with 109 items was administered twice by a trained interviewer in a 1-year interval. We also conducted four seasonal 3-day Dietary Record (DR) as a reference method from July 2009 to April 2010. The raw and energy adjusted data of dietary intake of 13 nutrients from the first FFQ (FFQ1) and the second FFQ (FFQ2), and the average of FFQ1 and FFQ2 (FFQa) were validated against those of 12-d DR.

Setting: Seoul metropolitan area, South Korea.

Subject: 63 men and 63 women aged 20-65 years old, a convenience sample, completed both methods. Pearson correlations, weighted kappa values for the quartile categorization and the Bland-Altman analysis were conducted.

Results: Pearson correlation coefficients for reproducibility ranged from 0.53 (phosphorus) to 0.62 (fat) for raw data and from 0.35 (sodium) to 0.65 (fat) for energy-adjusted data. The Pearson correlation coefficients for validity had a mean 0.42 for all nutrients, and ranged from 0.19 (thiamin) to 0.67 (carbohydrate) for energy-adjusted data between FFQa and 12-d DR. The weighted kappa values for raw and energy-adjusted data ranged from 0.12 (vitamin A) to 0.34 (carbohydrate) and from 0.07 (thiamin) to 0.42 (fat), respectively. On average, 37% of participants were classified into the same quartiles, while 5% of participants were grossly misclassified to the opposite quartiles. Bland-Altman plots showed significant relationships only for 5 nutrients (protein, fat, calcium, potassium, riboflavin) between the average and the difference of the two methods with increasing nutrient intake.

Conclusions: The FFQ has acceptable reproducibility and modest validity over a 1-year period in Seoul metropolitan area.

PP 243**ESTIMATING POLYPHENOL INTAKE VARIABILITY IN THE FRENCH E3N-EPIC COHORT AND REDUCING INTAKE DATA INTO FEWER INDEPENDENT DIMENSIONS**

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Introduction: The beneficial effects of polyphenols in health have been well documented but their dietary intake is still not well characterized. Following the recent development of the Phenol-Explorer database for 502 dietary polyphenols, our objective was to estimate polyphenol intake variability in a large cohort of French women and reduce intake data into fewer dimensions to facilitate future studies on association with health and diseases. **Method:** Using the self-administered diet history questionnaire completed by 73,034 women of the E3N-EPIC cohort in 1993-1995, we built a comprehensive food composition table in polyphenols by matching 208 food and beverage items with the Phenol-Explorer database (www.phenol-explorer.eu). We computed polyphenol usual intake and adjusted for energy intake. Descriptive statistics, a correlation matrix, principal component analysis (PCA) and hierarchical cluster analysis were used to estimate intake levels and identify polyphenols most contributing to intake variability. **Results:** Mean (\pm standard deviation) of total polyphenol intake was 1462 ± 578 mg/d. Out of 343 polyphenols consumed in the E3N cohort, we excluded 108 compounds that were fully correlated to other more largely consumed polyphenols, then retained 235 polyphenols in the PCA. We identified two components accounted for 44 % of total variance. The first pattern was positively correlated with intakes of anthocyanins, dihydroflavonols, stilbenes, hydroxybenzoic acids, catechins, flavanols, theaflavins and lignans and wine and tea consumption. The second pattern was characterized by a low intake of tea polyphenols and a high intake of hydroxycinnamic acids, wine and coffee. From the clustering tree, we identified 13 clusters that we qualified according to their main polyphenol representatives and food determinants. **Conclusion:** Our study suggests that polyphenol intake data could be reduced to a limited number of independent dimensions. Given the high multicollinearity between some phenolic compounds, the identification of best representatives of polyphenol intakes in a Western population will be very helpful for facilitating future epidemiological studies of polyphenols in chronic diseases prevention.

PP 244

OBSERVED DIFFERENCES IN DIETARY INTAKE ON WEEKDAYS VERSUS WEEKENDS IN EUROPEAN CHILDREN

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OBJECTIVE: To examine differences in intake of energy (EI), sugars, and sucrose-rich foods and drinks between weekdays (Monday through Thursday), Fridays and weekends in European children.

METHODS: Twenty-four hour recall data were used for children aged 2-9 years from Belgium, Cyprus, Estonia, Germany, Hungary, Italy, Spain and Sweden, participating in the IDEFICS (Identification and prevention of Dietary- and lifestyle-induced health Effects In children and infantS) study at baseline 2007-2008. Dietary intake was reported by parents and complemented by day-care or school personnel when needed. Children with complete interview days for whom all main meals were known and that had a reported EI between 500-5000 kcal/day were included with one day each. For children with more than one 24-hour recall weekends were chosen over weekdays in order to obtain a balanced distribution of days of week. Regression models adjusted for country, age and sex were performed to investigate differences in EI, sugars (g/day) and sucrose-rich foods and drinks (g/day) on weekdays (Monday through Thursday) versus weekends (n=9339), as well as Fridays versus weekdays and weekends (n=9496), respectively. Models with intake of sugars and sucrose-rich foods and drinks as dependent variables were additionally adjusted for EI. The analysis comparing intake on weekdays versus weekends was stratified by country for Belgium, Cyprus (excluding sugars), Germany, Hungary, Italy, Spain and Sweden.

RESULTS: Intake of energy (t(9338)=4.1, p<0.001), sugars (t(8189)=7.6, p<0.001), and sucrose-rich foods and drinks (t(9338)=6.4, p<0.001) were higher on weekends versus weekdays. Intake on Fridays was a cross between the intakes on weekdays and weekends and did not differ from them, except for intake of sucrose-rich foods and drinks, being lower on Fridays compared with weekends (t(9495)= -2.2, p=0.02). Stratified analyses showed higher EI on weekends versus weekdays in Hungary (t(1532)=7.7, p<0.001). Intake of sugars was higher on weekends versus weekdays in Hungary (t(1532)=5.6, p<0.001), Italy (t(1974)=4.5, p<0.001) and Sweden (t(1224)=6.0, p<0.001), but in Belgium it was lower on weekends versus weekdays (t(372)= -2.0, p=0.04). Intake of sucrose rich foods and drinks was higher on weekends versus weekdays in Cyprus (t(1148)=2.8, p=0.01), Hungary (t(1532)=2.9, p=0.004), Italy (t(1974)=9.0, p<0.001) and Spain (t(623)=3.0, P=0.003).

CONCLUSION: Dietary intake of European children differed on weekdays (Monday through Thursday) versus weekends, and intake on Fridays was a cross between the intakes on these days. The results imply the importance to capture dietary intake of children on both weekdays and weekends when assessing their habitual intake with 24-hour recalls.

PP 245

USING REDUCED RANK REGRESSION METHODS TO IDENTIFY DIETARY PATTERNS AMONG AUSTRALIAN CHILDREN AND ADOLESCENTS

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Background: Analysis of dietary patterns offers an alternative approach to the examination of diet and health. A number of approaches for assessing dietary patterns are available including diet quality scores or indices based on *a priori* knowledge of dietary guidelines or the use of multivariate statistical methods, including reduced rank regression (RRR). Few studies have examined the repeatability and generalisability of reduced rank regression methods.

Methods: Analysis was based on 4523 participants aged 2-16 years participating in the 2007 Australian National Children's Nutrition and Physical Activity Survey. The generalisability of the RRR method was examined to a previous study of dietary patterns, fat mass and adiposity in children aged 5-7 years (Johnson et al, 2008). Dietary intake was measured using 2 non-consecutive, 24-hour recalls and RRR was used to identify the dietary patterns using energy density, fibre density and percentage of energy intake from fat as the intermediate variables. Associations between the resulting dietary patterns and BMI z-scores were examined using linear and logistic regression, adjusted for age, sex, maternal education, physical activity, sedentary behaviour and energy intake.

Results: The first dietary pattern extracted explained 47% of the response variation while the remaining two patterns explained less than 20%. The first dietary pattern was characterized by higher consumption of full-fat milk and cream, low-fibre bread, biscuits and cakes, chocolate and confectionery, processed meat, fried potatoes, crisps and savory snacks, sugar-sweetened beverages, and lower consumption of yoghurt, high-fibre bread and breakfast cereals, rice, pasta and other grains, vegetables, fresh fruit, soups and water as a beverage. Identified dietary patterns were similar between boys and girls, when analysis was stratified by age and following exclusion of under-reporters. No significant associations were found between the RRR dietary pattern score and z-BMI score.

Conclusions: The dietary pattern identified in this study was comparable to that identified in a previous study of dietary patterns using RRR and energy density, fibre density and percentage of energy intake from fat as the intermediate variables. However, no associations were found with BMI in this cross-sectional study of children and adolescents.

PP 246

INCREASED EATING FREQUENCY IS ASSOCIATED WITH A FAVORABLE METABOLIC AND VASCULAR PROFILE IN HEALTHY INDIVIDUALS WITHOUT CARDIOVASCULAR DISEASE

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Background Meal patterns' associations with various biomarkers and disease outcomes have been investigated during the past years. However, data are lacking about their relation with preclinical atherosclerosis. The aim of the present study was to investigate potential associations between eating frequency (EF) and early markers of atherosclerosis

Methods In a cross - sectional study, 164 apparently healthy subjects were recruited. Anthropometric measures, ultrasonographic assessment of endothelial function (flow mediated dilatation, FMD), arterial stiffness (pulse wave velocity, PWV), applanation tonometry, carotid atherosclerosis (common carotid intima-media thickness, IMT and presence of plaques) and biochemical assessment were performed in all healthy volunteers. EF, i.e. the total number of eating episodes per day, was evaluated through 3-day food records.

Results EF was positively associated with energy and macronutrient intake, but with a better metabolic profile in terms of adiposity, glucose tolerance and blood lipids. Aortic diastolic blood pressure (p=0.034), PWV (p=0.032), IMT (p=0.008) and the presence of plaques (p=0.001) were negatively correlated with EF. In multivariate analysis, EF was a significant predictor of IMT (p<0.001) and carotid plaques (p=0.002), after adjusting for markers of adiposity, dietary intake and other potential confounders. Finally, Heartscore, a calculated score of total cardiovascular risk, was significantly negatively associated with the number of meals (p=0.012).

Conclusions High EF was associated with less accelerated atherosclerosis in this population of apparently healthy individuals with risk factors. A simple advice to increase the daily number of eating episodes may have a beneficial effect on preclinical atherosclerosis and cardiovascular risk.

PP 247

NUTRITIONAL QUALITY OF BRAZILIAN ADOLESCENTS' BREAKFAST

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Introduction: Breakfast skipping has been associated to inadequate food intake and excessive weight gain, particularly among adolescents. The frequency of the breakfast consumption is important, however, is also useful to recognize the composition and nutritional quality of this meals among adolescents.

Objective: To evaluate the nutritional quality of adolescents' breakfast.

Methods: The data refer to a baseline study of school-based community trial, involving 747 adolescents (50% boys), 10 to 15 years old, fifth graders from public schools in the metropolitan city of Niteroi, Rio de Janeiro, Brazil, in 2005. The food consumption data were obtained by means of a 24-hour recall (R24h). The evaluation of breakfast quality was

based on the Brazilian Dietary Guidelines recommendations, which suggest an average daily intake of 2000kcal, being 25% provided by the breakfast (500 kcal).

Results: The mean adolescents' age was 11.3 years old (SD: 1.04 years old) and 84% reported the consumption of breakfast. The average energy intake in the breakfast was 468 kcal (18% of total energy intake). The breakfast composition was categorized in three configurations: standard, complete and incomplete. The standard configuration was reported by 52% of the adolescents and included sources of calcium and energy, including jelly, margarine, and butter, providing an average of 803kcal. The complete configuration, which was reported by 13% of the adolescents, provided an average of 459kcal and included sources of calcium, energy and vitamins and other minerals, such as fruits. The incomplete type provided on average 354kcal and was reported by 35% of the adolescents and did not include any source of vitamins and minerals. There were not differences in the consumption of breakfast by sex.

Conclusion: Although the average energy consumption in the breakfast were close to the recommended, it was observed that significant proportion of adolescents reported inadequate energy intake in the breakfast, which was of poor nutritional quality for the majority of the adolescents.

PP 248

USING NATIONAL CONSUMPTION SURVEY DATABASE TO DEVELOP QUANTITATIVE THAI INFANT AND YOUNG CHILDREN FBDGS

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Optimal complementary feeding (CF) recommendation for Thai infant and young child (IYC) was revised by Thai IYC Feeding Guides working group in 2008. **Objective:** This study aimed to develop quantitative FBDGs for Thai IYC, age 6-8, 9-11 and 12-23 months old which meet the new guidelines. **Method:** The Mathematical model was designed to included calculation of macronutrients and concerned micronutrients (Ca, P, Fe, K, Na, Zn, vitamin A, B1, B2 and C) from Thai food composition database, serving size per meal and number of serving per week of regularly consumed food items. The 24 hour dietary recalled from the national consumption survey was used for ranking top ten food items in each main food group and computing the norm consumption size of certain foods for each age group. The food items were grouped to be sub-food group, based on the same consumption size. The reference nutritive value of sub-group was calculated based on weighing by number of consumer for each food item. The actual calorie per serving for the main item of the group should differ from reference values of certain group less than 5%. The excel solver nonlinear programming was used for solving the optimal solution to meet the energy goal. Other nutrient goals ($\geq 70\%$ of CF goals), range of the number of serving per week in each sub-food group, energy density (≤ 1.0 Kcal/g) and optimal range of caloric distribution were the constraints. **Results:** Most of consumption size for IYC was smaller than reference portion in FBDGs for Thai population (over 6 year olds). Almost of all food items was increased consumption size by age, except commercial infant food was reversed direction. Thirty four sub-food groups were set. When the CF combined with breast milk, the energy was $\pm 10\%$ the goal. Most of other nutrient goals, except Zn, were met. The nutrient retention factors had not been included in the model, so some micronutrients might be overestimated. **Conclusions:** Consumption survey database was usefully to identify necessary food patterns for developing quantitative FBDGs, either common be used food items or practical consumption size which graduate increased by age for IYC.

PP 249

KERNEL K-MEANS CLUSTERING FOR TEMPORAL DIETARY PATTERNS IN ADULT PARTICIPANTS OF NHANES 1999-2004

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Introduction: Identification of temporal dietary patterns, or patterns of food/nutrient intake observed by time for a group of individuals, is an emerging area of research and may aid understanding of the relationship of diet to health. For example, patterns of energy intake over a 24-hour day may vary by individual and may be associated with diet quality.

Objective: The purpose of this study was to apply a novel variation of k-means clustering algorithm to elucidate temporal dietary patterns in adult participants of NHANES 1999-2004. "Tight" clusters were found based on the variations in time of eating during a 24 hour period. These clusters emerged through the use of a novel variation of dynamic time warping (DTW) distance measure. "Goodness" of clusters was estimated on a number of intra and inter cluster validity indices such as Dunn's validity index and the Jaccard index. Methods: Dietary intake was assessed by 24-hour dietary recall and processed using United States Department of Agriculture's Food and Nutrient Database for Dietary Studies. The dietary recall data of the adult participants age 20 to 65 years of the National Health and Nutrition Examination Survey (NHANES) 1999-2004 were used to determine the proportion of energy consumed at a particular hour of the day compared with the total energy consumed for the 24-hour day. Individuals were clustered using kernel

k-means clustering with an appropriate distance metric for hourly mean proportion of energy consumed. The optimal number of clusters was determined by estimating various internal and external cluster validity indices. Four clusters were found to be optimal for temporal dietary patterns in the concerned dataset. Further statistical analysis to estimate significant differences in these clusters is performed in a related paper. This analysis showed that these clusters significantly differ in their mean value of the Healthy Eating Index 2005.

Conclusions: Temporal dietary patterns determined using kernal k-means clustering exist within the US population and can be used to identify differences in diet quality. Groups of individuals that consume their energy proportionally similarly throughout the day exhibit certain dietary characteristics. These characteristics may be evaluated to determine links to diet and health and may be used to generate public health messages and enhance understanding of the complicated interplay of time and dietary intake.

PP 250

ADHERENCE TO A MEDITERRANEAN DIETARY PATTERN AND NUTRITIONAL QUALITY IN HEALTHY PREGNANT WOMEN OF THE CANARY ISLANDS

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INTRODUCTION: Nutritional status during pregnancy affects outcomes for both mother and infant. Pregnant women must consume enough calories and nutrients to provide sustenance for both themselves and the developing fetus. Adequate nutrition during pregnancy is important for the development of the placenta, for a healthy delivery and for future lactation. **OBJETIVES:** To describe the adherence to a Mediterranean diet during pregnancy and to estimate the nutritional quality using the Healthy Eating Index (HEI). **METHOD / DESIGN:** Cross-sectional study based on 103 women aged 18-40 years, who gave birth at the University Hospital Materno-Infantil of Gran Canaria. Appropriate institutional ethics committee clearance and participants' informed consent were obtained. Food consumption and macro and micronutrient intake were estimated using a food frequency questionnaire used in the Canary Island Nutrition Survey (ENCA) and the HEI was calculated. This index includes 10 components and the maximum possible score of the index is 100 points. The total Mediterranean- diet score ranged from 0 (minimal adherence to the traditional Mediterranean diet) to 8 (maximal adherence). Ethanol consumption was not considered to build the pattern. The score was divided into three levels: low (0-3), medium (4-5), high (6-8).

RESULTS: The average age for women in the study was 29 ± 4.4 years (mean \pm SD), and the average of weeks of gestation 40 ± 1.3 weeks. The average increase in weight during pregnancy was 13.1kg. The score of the HEI was 54.9. This result remains below the optimum score of ≥ 80 , which is considered good the diet quality of pregnant women in our study population. The average score of the first 5 components of the index showed that cereal consumption was below the daily portions recommended for pregnant women, whereas vegetables, fruit, milk and meat consumption surpassed the recommendations. A low index of adherence (0-3) was found for 34.0% of the sample, 49.5% had intermediate values (4-5) and 16.5% a high index of adherence to the traditional Mediterranean diet (6-8). A significant number of pregnant women did not reach the 50% of the recommendations for iron, folate and vitamin D intake (36.9, 26.2 and 38.8% respectively). At least 30% of the population exceeded 200% of the recommendations for proteins, thiamin, niacin, riboflavin, vitamin C and vitamin A. **CONCLUSIONS:** Dietary advice for improving the diet quality during pregnancy and the supplementation of mainly iron, vitamin D and folate are necessary.

PP 251

PROPOSAL FOR A SHORT FFQ LONGITUDINAL STUDY OF ADULT HEALTH - ELSA-BRAZIL

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Introduction: The food frequency questionnaire (FFQ) is used to meet the usual diet, identifying characteristics of the consumer about the nutritional factors of diet and types of foods commonly consumed by longer periods of time. In the Longitudinal Study of Adult Health - ELSA-Brazil, was used at baseline, a FFQ with 114 items in order to classify participants as to the consumption levels of macro and micronutrients and energy. In subsequent waves of longitudinal studies, short FFQ has been used in order to reduce the possibility of extending the list of food questionnaires, simplifying and facilitating the applicability, understanding and analysis.

Objective: Reduce the list of foods from a semiquantitative food frequency questionnaire of the ELSA-Brazil through different methodological strategies.

Methods: Was used a food frequency questionnaire with 114 food items, answered by 281 participants of both genders (35-74 years) Project ELSA-Brazil. Reduced the list by Pearson correlation, selecting the variables with correlation coefficient positive and significant at $p \leq 0.05$ with $r \geq 0.10$ for entry into the models of stepwise multiple

linear regression. Regression models were tested for energy, macronutrients, iron, calcium and assessed the frequency of consumption items. Were defined as those who consumed foods often had percentages greater than or equal to 50% of consumers used the population. For statistical analysis was used SPSS 17.0. Analysis was performed plausibility of foods included in regressions.

Results: The food included showed a positive regression coefficient with the value of F ($p < 0.001$). To be included in the regression models from the correlation matrix, were selected: 79 foods for energy, 79 for proteins, lipids for 45, 86 for carbohydrates, 52 for iron, 86 for calcium. Regression models with the short list presented R^2 from 0.44 to 0.75 for iron and protein, respectively. 58 foods were selected from among 56 models and often consumed by 50% of participants, some repeated. Taking into account the two criteria, we obtained a list of 82. Were excluded after examination of a food plausibility models and their nutritional composition.

Conclusion: The FFQ list of ELSA-Brazil went from 114 to 71 food items, making a reduction of approximately 40%.

PP 252

MEAL CONSUMPTION PATTERN IS ASSOCIATED WITH EXCESS BODY FAT IN FEMALE ADOLESCENTS

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Introduction: The irregular pattern of meal consumption has been associated with overweight, especially in adolescents. The percentage of body fat is a rather more accurate measure of overweight than estimates based on body mass index, although more sophisticated equipment is necessary for measurement. Objectives: To describe the meal consumption pattern among adolescents from different socioeconomic conditions living in the metropolitan region of Rio de Janeiro and to estimate the magnitude of its association with excessive body fat. Methods: This is the analysis of data from the baseline survey of the Longitudinal Study on Adolescent Nutrition (ELANA), carried out in 2010 with students from 6th to 9th grades at public and private schools in the metropolitan area of Rio de Janeiro. We analyzed 1841 students from 10 and 19 years old (50% girls, 56% from private schools). Information on the meal consumption pattern was obtained by applying a self-administered questionnaire. A score ranging between 0 and 12 points was created to categorize the meal consumption pattern, which was considered satisfactory when the three main meals (breakfast, lunch and dinner) were consumed on a daily basis (score = 2). The percentage of body fat (BF) was estimated by means of the bioelectrical impedance analysis and, body fat values above 25% for boys and 30% for girls were considered excessive. The magnitude of the association between the meal consumption pattern and body fat was estimated by the prevalence ratio (PR) and 95% confidence intervals. Results: The unsatisfactory meal consumption pattern was observed in 43% of adolescents. There was no significant association between the meal consumption pattern and type of school, however, the prevalence of excessive body fat was higher among private school students as compared to students from public schools (36% vs 25%, $p < 0.01$). Excessive body fat prevalence was higher among girls that reported unsatisfactory meal consumption pattern both from public school (PR: 1.64, 95% CI: 1.22, 2.21) and private schools (PR: 1, 50, 95% CI: 1.17, 1.93). For boys, there was a higher frequency of excessive body fat among those from private schools that reported unsatisfactory meal consumption pattern (PR: 1.44, 95% CI: 1.13, 1.83). Conclusion: The prevalence of irregular meal consumption pattern was higher among the adolescents and was associated with excessive body fat, especially in girls.

PP 253

DRINKING HABITS IN HEALTHY PREGNANT WOMEN OF THE CANARY ISLANDS

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INTRODUCTION: Water consumption is critical for metabolism, temperature regulation, transporting nutrients and wastes, and tissue maintenance. During pregnancy and breastfeeding, hydration plays an essential role since an adequate supply of water is essential for meeting the water needs of the body of the mother and the baby. Proper hydration during breastfeeding ensures milk supply.

OBJETIVES: The aims of the present study are to survey the drinking habits of pregnant woman with reference to the consumption of bottled water, since the tap water is not recommended for consumption.

METHOD / DESIGN: cross-sectional study based on 103 women aged 18-40 years, who gave birth at the University Hospital Materno-Infantil of Gran Canaria. Food and beverages consumption will be estimate using a food frequency questionnaire used in the Canary Island Nutrition Survey (ENCA). Energy and nutrient intakes were calculated using the Spanish food composition tables for Mataix et al., which contains detailed data on the energy and nutrients for 121 foods and drinks recorded in the Canary Islands population. For this analysis, beverage group were defined as: 1. Regular dinks: carbonated and uncarbonated sugar drinks, tea, coffee, milk and fruit beverages. 2. Fruit juices: 100%

pure fruit juice. 3. Bottled water: sparkling water and still water. Appropriate institutional ethics committee clearance and participants' informed consent were obtained.

RESULTS: The average age for women in the study was 29 ± 4.4 years (mean \pm SD), and the average of weeks of gestation 40 ± 1.3 weeks. The average increase in weight during pregnancy was 13.1kg. The average consumption of bottled still water was 1357ml/d. Approximately 30% of pregnant women of this study increased consumption of bottled still water during pregnancy. 80% of pregnant women surveyed did not drink bottled sparkling water. 27.2% of pregnant women of this study reduced the coffee intake. The average intake of natural fruit juice, milk, carbonated sugar drinks and uncarbonated sugar drinks was 105ml/d, 203ml/d, 81ml/d and 236ml/d respectively.**CONCLUSIONS:** The pregnant women of this study reach the water intake recommendation from The European Food Safety Authority (EFSA), which recommends 2.3 L as a daily intake of water adequate from all source.

PP 254

OBESITY PREVENTIVE SCORE: A MULTI-DIMENSIONAL ASSESSMENT TOOL OF EATING & LEISURE-TIME BEHAVIOURS IN ASSOCIATION WITH OBESITY AND METABOLIC INDICES

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Background: Childhood and adolescent obesity has been attributed to a variety of environmental factors related to eating and leisure time behaviours. Eating behaviour is a complex entity consisting of multiple behaviours, including food choice, meal patterns as well as conditions preceding, around, and after eating episodes. Leisure time behavior can be spent either on physical activities or more sedentary habits. Most of eating behaviors have been investigated either individually or along with physical activity habits for their effects on overweight and metabolic risk factors in children and adolescents. However, an alternative approach would be to study them by focusing on multifaceted scores, given that they are highly inter-related. For this purpose the aims of the present study were 1) to calculate a score comprising of a series of eating and leisure time behaviors and 2) to investigate how it affects anthropometric and glycemic control markers from childhood to adolescence. **Methods:** An overweight/obesity preventive score comprising of 8 target lifestyle behaviors, based on the recommendations of the Expert Committee of American Academy of Pediatrics, was calculated for all subjects from two cross-sectional pediatric cohorts, GENDAI and TEENAGE. GENDAI included 1138 healthy school-aged children (53% girls; age: 11.2 ± 0.7 years) and TEENAGE 857 adolescents (55.1% females; age: $13.4 \text{ years} \pm 0.9$). Detailed dietary, behavioral, lifestyle, anthropometric and biochemical variables were recorded for participants of both studies. **Results:** Despite the fact that most of factors selected for building the overweight/obesity preventive score individually were not significantly associated with the tested outcomes, in GENDAI, the score was significantly ($p < 0.05$) negatively associated with obesity indices (namely BMI, WC, skinfolds, body fat) and glycemic control variables (namely serum glucose, serum insulin, HOMA-IR index) following adjustment for confounding factors. In TEENAGE, association of overweight/obesity preventive score with the aforementioned obesity markers was significant ($p < 0.05$) only for female adolescents. **Conclusions:** Our study shows that higher adherence to an obesity preventive diet and leisure time pattern is associated with lower values in several obesity and insulin resistance-related biomarkers in children, indicating that an aggregate adoption of healthy eating and activity habits protects children from being overweight and it is also associated with better glucose homeostasis. However, despite similar trends that were observed in an adolescent cohort, most of these associations were significant only for female subjects suggesting a potential gender effect during puberty. **Acknowledgements:** IN has been awarded a research grant HRAKLEITOS-II. GENDAI study was partially funded by Coca-Cola Hellas.

PP 255

ADHERENCE TO THE MEDITERRANEAN DIET AND CANCER RISK IN A US POPULATION

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Background: Adherence to a dietary pattern resembling that of traditional Mediterranean populations has been inversely associated with all-cause mortality, cardiovascular disease, and cancer incidence and mortality. Some studies have shown inverse associations with risks of breast, colorectal, gastric, and upper aerodigestive tract cancers. To our knowledge, no single prospective study has examined adherence to a Mediterranean dietary pattern in relation to multiple cancer sites.

Methods: A US cohort of 491,341 men and women, 50-71 years old at baseline (1995-1996), was followed for a median of 10.5 years, during which time 74,178 cancers were documented. We used a 9-point score to assess adherence to the Mediterranean dietary pattern, with higher scores based on greater intake of vegetables, fruit, nuts, legumes, whole grains, and fish; moderate alcohol consumption; lower intake of red and processed meat; and higher monounsaturated-to-saturated fat ratio. Proportional hazards regression models adjusted for age, race/ethnicity, marital status, education, total energy, body mass index, physical activity, family history of cancer, and smoking were used to evaluate associations with overall and site-specific cancer incidence.

Results: The multivariable hazard ratios for all cancers comparing high to low adherence to the Mediterranean dietary pattern (6-9 versus 0-3 points), were 0.91 (95% confidence interval, 0.89-0.94) in men and 0.93 (95% confidence interval, 0.89-0.96) in women and became weaker after restricting to never smokers (0.95 [0.91-1.00] and 0.97 [0.91-1.03], respectively). Among never-smoking men, we observed inverse associations for risk of multiple myeloma and liver, colorectal, and prostate cancers. Similar, but not statistically significant, inverse associations were observed with risk of multiple myeloma and liver cancer among never-smoking women.

Conclusions: In a US population, greater adherence to a Mediterranean dietary pattern was associated with reduced risk of several types of cancer.

PP 256

ASSESSING ORGANIC FOOD CONSUMPTION IN GIRLS IN CALIFORNIA AND NEW JERSEY

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While there is a growing demand for organic products and a widespread notion that there are generally healthier than conventional foods, there is limited research supporting these claims. Organic food production avoids the use of pesticides, herbicides, synthetic fertilizers, and growth promoters. Because many of these compounds are well known to act as endocrine disruptors, organic food consumption may potentially have an impact on the onset of puberty in girls. We developed a short questionnaire (completed by their biological mothers) to assess organic food consumption among girls participating in two ongoing longitudinal studies of puberty, the CYGNET Study, based in Northern California (n=444; age 6 and 7 yrs.), and the Jersey Girl Study, based in New Jersey, with a large proportion of them coming from the Princeton area (n=165; age 9 and 10 years). At baseline, organic food consumption in general was slightly more prevalent among girls in CA (61.3% vs. 49.7% in NJ), and habitual consumption of organic foods (>40% of the time) was also considerably more common in CA (49% vs. 31% in NJ). Most usual foods consumed organic >40% of the time by girls in both populations were milk (49% in CA vs. 55% in NJ), eggs (50% in CA vs. 54% in NJ), fruit (69% in CA vs. 43% in NJ), and vegetables (67% in CA and 49% in NJ).

We also evaluated selected demographic characteristics according to food preference. As expected, habitual consumption of organic foods were most common among whites, the more educated families, and among girls with normal body mass index. For example, in CA, habitual organic food consumption was reported in 41% of whites, 20% of Hispanics, 25% of African American, and 25% of Asian girls (p<0.001).

Nutrient consumption derived from repeated 24-hour recalls in both populations by organic food preference revealed similar patterns in both population, with girls reporting habitual organic consumption having on average a higher intake of total protein, total fiber, beta-carotene, vitamin C, vitamin D, calcium and iron. Consumption of phytoestrogens was considerably higher in habitual organic eaters in both populations. In NJ, means and SE were 0.69 (0.37), 1.56 (0.45), and 3.10 (0.66) for not organic eaters, organic consumption less than 40% of time and >40% of time, respectively (p<0.01). In the CA population, the corresponding means (SE) were 1.0 (0.58), 1.92 (0.63), and 5.25 (0.64) (p<0.01).

Organic food consumption in two different populations of girls, using the same questionnaires and similar methods, revealed high prevalence of consumption and similar patterns of food consumption and demographic characteristics. In future analyses we plan to assess the impact of organic eating on pubertal onset and other health outcomes, which to our knowledge has not been evaluated.

PP 257

CONSUMPTION OF ORGANIC FOODS AMONG WOMEN NEWLY-DIAGNOSED WITH BREAST CANCER

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There is a general perception that organic foods may be more healthful, as such foods are grown or raised without use of chemical fertilizers, pesticides, hormones, or other synthetic inputs. Despite this perception and interest in organic foods, very few epidemiologic studies have collected information on organic food intake. We assessed organic food consumption in the Pathways Study, an ongoing prospective study of lifestyle and molecular factors and breast cancer prognosis. Women are eligible if they were diagnosed with invasive breast cancer at Kaiser Permanente Northern California hospitals, had no prior cancer, spoke English, Spanish or Chinese, and lived within 65 miles of an

interviewer. A baseline interview was conducted as soon after diagnosis as practical, on average within two months of diagnosis. As part of the interview, we assessed organic food intake using a 14-item questionnaire structured around questions querying the proportion of time that organic foods were consumed, with responses from “never” or “do not eat” to “rarely (<20% of the time)”, “not very often (20-39%)”, “about half of the time (40-59%)”, “more often than not (60-79%)”, and “usually (>80% of the time)”. The first question asked about overall organic food consumption, and the subsequent 13 questions asked about specific foods or food groups consumed in the past six months, among those who ate organic foods. Among the 3,651 women enrolled through July 29, 2011, 2,230 (61.08%) reported eating organic foods. Organic food consumers were divided into two groups: those who reported organic food consumption less than 40% of the time (n=1,497, low organic consumers), and those who reported consumption at least 40% of the time (n=733, high organic consumers). Those who did not eat organic foods had lower educational attainment (24.1% with high school or less), compared to those who ate organic foods (11.3% for low organic consumers, 7.8% for high organic consumers), and were more likely to be of minority background (42.7% vs. 32.3% and 28.0%, respectively). Despite these differences, there were only modest differences by breast cancer characteristics. There was a slight shift to earlier stage at diagnosis among organic food consumers (proportion diagnosed at Stage I was 49.0%, 51.4% and 52.9%, for non-consumers, low consumers, and high consumers, respectively). Other diagnostic characteristics did not differ substantially. These findings suggest substantial demographic differences distinguishing organic food consumers from non-consumers. Determining whether organic food consumption results in different outcomes will need to account for these differences.

PP 259

IMPACT OF AN EDUCATIONAL INTERVENTION TO INCREASE FRUIT AND VEGETABLE INTAKE BY BRAZILIAN COMMUNITY HEALTH AGENTS

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The literature reports that educational group actions performed in primary health care can change participants' dietary intake. Due to their dual condition (community member and health care workers), community health agents can be facilitators in such educational processes as long as they are motivated and trained for that purpose. Supposing that a successful intervention with these professionals would be more likely to also achieve similar results in the community, a pilot study was conducted with the purpose to evaluate the impact of an educational intervention (six group meetings and one culinary workshop) on fruit and vegetable (FV) intake by Brazilian community health agents (CHA). A controlled trial was developed with randomly formed groups: intervention group, 21 agents who participated in six group meetings coordinated by dietitians; control group, 21 non-participant individuals. The main outcome was the total FV intake in grams and in energy %. In order to measure such variables, three 24-hour recalls were performed, referring to two weekdays and to one Sunday, prior to and 90 days after the intervention. The secondary outcome was the community health agents' position in face of the behavioral change stages, according to the Transtheoretical Model. The evaluation of the intervention impact, by means of repeated measures using Tukey's multiple-comparison test, was complemented by the evaluation of the process and of the impact perceived by the agents. Among the main results, the following are noteworthy: of a total of 21 agents who participated in the intervention, only 8 positively changed their behavioral stage in relation to FV intake as compared to 4 of the 21 individuals in the control group; all participants in the intervention group reported that the intervention had positive outcomes, and valuing a healthier diet was the most frequently mentioned (18 agents), followed by increasing their security to address the topic in their visits to families (10 agents). However, no statistically significant differences were identified in FV intake, either in grams or in diet energy percent. The most frequently mentioned obstacles to intake increase were lack of time and the high prices of products. It was concluded that the intervention was not capable of positively changing the community agents' FV intake. Strategies to help them overcome FV intake barriers need to be tested prior to interventions in the community.

PP 260

THE ASSOCIATION BETWEEN SELF REPORTED PHYSICAL ACTIVITY AND ESTIMATED MAXIMAL OXYGEN UPTAKE OF SEDENTARY WOMEN IN A MULTI-ETHNIC POPULATION

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Background: In health evaluations physical activity (PA) and cardiorespiratory fitness (VO_{2max}) are important variables. It is however, not always possible to assess both of them. If the association between self-reported PA and VO_{2max} would be strong, it would be possible to use the information on PA to make assumptions about the VO_{2max} and vice versa. However, the association between both variables is not clear. In particular, little is known about this relation

in women with a high risk profile for cardiovascular disease. Our aim is to study the association between self-reported PA and VO_{2max} in sedentary women in a multi-ethnic population.

Methods: Participants were sampled from an exercise referral program for sedentary women living in a deprived neighbourhood. Self-reported PA was assessed with the SQUASH questionnaire. VO_{2max} was determined with the Siconolfi step test. Linear regression was performed with VO_{2max} as the dependent variable and self-reported PA as the independent variable; confounders were age and BMI. To test the concurrent validity of VO_{2max} and PA data, VO_{2max} was related to age and the PA score was related to educational level and mental well-being score.

Results: 197 female participants (age 40 ± 10) from different ethnic backgrounds were included. No significant linear association was found between VO_{2max} and PA when corrected for age and BMI ($P=0.13$, $R^2=0.60$). A positive association was found between age and VO_{2max} ($P<0.001$, $R^2=0.47$) and a negative one between PA and mental well-being ($P<0.001$, $R^2=0.10$). Women with a low educational level were physically less active than the higher educated ($P<0.001$).

Conclusions: A poor association was found between PA as measured by the SQUASH and estimated VO_{2max} . Hence, an important implication of our study is that PA and VO_{2max} represent two different aspects of health in women with a high risk profile for cardiovascular disease, and cannot be used interchangeably. This should be into account when evaluating health promotion interventions or when making statements about health risks in sedentary women in a multi-ethnic population.

PP 261

DEVELOPMENT AND VALIDATION OF A NEW PHYSICAL ACTIVITY QUESTIONNAIRE FOR USE IN A CLINICAL SETTING (CPAQ): ARE OUR PATIENTS ACTIVE ENOUGH?

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Background: Regular physical activity helps protect against many chronic conditions, yet numerous people fail to meet UK guidelines for minimum physical activity levels. There is currently no quick and accurate tool for use in the clinical setting to determine whether patients are meeting these guidelines, thus often physical activity is not routinely assessed. A new physical activity questionnaire for clinical use (CPAQ) was developed to address this. **Methods:** CPAQ was designed to be one page long and self reported to facilitate data collection. The outcome measure was minutes per typical week across all activity domains to allow direct comparison with UK physical activity guidelines. A single-centre validation study of CPAQ was performed against the short form International Physical Activity Questionnaire (IPAQ). Patients attending the Queens Medical Centre Outpatients department (Nottingham) were asked to complete both questionnaires. These data were used to calculate MET-minutes of activity per week for each patient, for 'moderate', 'vigorous', 'moderate and vigorous' and 'total' physical activity categories. Spearman's Rank Correlations were calculated to assess correlation between the two questionnaires for each of these four activity categories. Similarly, Wilcoxon Signed Rank tests were applied to test the difference in means and Bland-Altman plots were constructed to examine the level of agreement. Qualitative feedback were collected from clinicians and patients. **Results:** 133 people took part in the study (86% response rate). Spearman's Rank Correlation Coefficient was high across all four categories ($r=0.64$; 0.70 ; 0.81 ; 0.72 respectively, $p<0.001$ for all four models). The Wilcoxon Signed Rank test showed no significant differences between the questionnaires for 'moderate and vigorous' activity only ($z=-0.205$; $p=0.838$). The total MET-minutes recorded by each questionnaire demonstrated a negative bias for 'moderate' activity levels (-143.5) and positive bias for 'vigorous' ($+265.0$), 'moderate and vigorous' ($+121.5$) and 'total' ($+1745.6$) in the Bland-Altman plots i.e. lower activity levels recorded in CPAQ for all categories except 'moderate'. Level of agreement was greatest for 'moderate and vigorous' activity (limits of agreement -2654.0 to $+2897.0$). Participants cited the CPAQ as easier and quicker to complete. During data collection the researchers answered significantly more queries regarding completion of the IPAQ (than for CPAQ) and more IPAQ questionnaires were incomplete or completed with impossible figures. **Conclusions:** The CPAQ is short, quick, user friendly, self-administered, reports physical activity in minutes per week, and was popular with clinicians/participants from this study. It demonstrated good comparability with IPAQ in assessing 'moderate and vigorous' physical activity, which are the components that contribute to the UK physical activity recommendations, thus was accurate in assessing whether the patient met the UK guidelines. It should be viewed as a screening tool to aid clinicians to decide whether the patient is insufficiently active and thus at risk of developing health problems as a consequence. A period of trial use of CPAQ in the clinical setting is recommended.

PP 262

ASSESSMENT OF ENERGY EXPENDITURE DUE TO PHYSICAL ACTIVITY USING ACTIHEART IN 1.5 AND 3 YEAR-OLD CHILDREN: AN EVALUATION AGAINST CRITERION METHODS

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Background: According to WHO, childhood obesity is one of the most serious public health challenges for the 21st century. The mechanisms underlying overweight and obesity in young children are largely unknown but lack of physical activity may be one important factor. Further studies in this area are needed but difficult to conduct since evaluations of methods to assess energy expenditure in response to physical activity in young children are lacking. **Specific goal:** To evaluate a procedure, based on Actiheart (a heart rate recorder), designed to assess energy expenditure in response to physical activity in 1.5 and 3-year-old children. **Subjects and methods:** Heart rates were registered using Actiheart during four days in 44 healthy Swedish children aged 1.5 years. Simultaneously, their total energy expenditure (TEE) and sleeping metabolic rate were measured using the doubly labeled water method and indirect calorimetry, respectively. All measurements were repeated at the age of 3 years in 33 of the children. **Results:** At the age of 1.5 years, significant correlations were observed between TEE and a) body weight ($r=0.45$; $p=0.002$) b) mean heart rate ($r=0.39$, $p=0.008$), respectively ($n=44$). Thus, body weight alone explained 20 % of the variation in TEE and by means of multiple regression it was shown that the four days of recording by Actiheart explained another 14 %. The amount of variation explained using recorded heart rates is as good as corresponding results obtained in adults. Data obtained in 3-year-olds are under evaluation and will be presented at the conference. **Conclusion:** Assessments of heart rate has potential to be useful when assessing energy expenditure in response to physical activity in very young children.

PP 263

RELIABILITY OF THE BRAZILIAN VERSION OF THE PHYSICAL ACTIVITY CHECKLIST INTERVIEW IN CHILDREN

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Objective: To assess the reliability of the Lista de Atividades Físicas (Brazilian version of the Physical Activity Checklist Interview) in children.

Méthods: The study is part of a cross-cultural adaptation of the Physical Activity Checklist Interview, conducted with 83 school children aged between seven and ten years, enrolled between the 2nd and 5th grades of primary education in the city of São Paulo, Southeastern Brazil, in 2008. The questionnaire was responded by children through individual interviews. It is comprised of a list of 21 moderate to vigorous physical activities performed on the previous day, it is divided into periods (before, during and after school) and it has a section for interview assessment. This questionnaire enables the quantification of time spent in physical and sedentary activities and the total and weighted metabolic costs. Reliability was assessed by comparing two interviews conducted with a mean interval of three hours. For the interview assessment, data from the first interview and those from an external evaluator were compared. Bland-Altman's proposal, the intraclass correlation coefficient and Lin's concordance correlation coefficient were used to assess reliability.

Results: The intraclass correlation coefficient lower limits for the outcomes analyzed varied from 0.84 to 0.96. Precision and agreement varied between 0.83 and 0.97 and between 0.99 and 1, respectively. The line estimated from the pairs of values obtained in both interviews indicates high data precision. The interview item showing the poorest result was the ability to estimate time (fair in 27.7% of interviews). Interview assessment items showed intraclass correlation coefficients between 0.60 and 0.70, except for level of cooperation (0.46).

Conclusions: The Brazilian version of the Physical Activity Checklist Interview shows high reliability to assess physical and sedentary activity from the previous day in children.

PP 264

VALIDITY STUDY OF THE BRAZILIAN VERSION OF THE PHYSICAL ACTIVITY CHECKLIST IN CHILDREN

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Objective: To assess the validity and operational equivalence of the Lista de Atividades Físicas (Brazilian version of the Physical Activity Checklist Interview) in children. **Methods:** This study is part of a cross-cultural adaptation of the Physical Activity Checklist Interview (PACI), conducted with 118 school children aged between seven and ten years, enrolled from the 2nd and 5th grades of primary education in the city of São Paulo, SP, Brazil, in 2009. The questionnaire enables the quantification of time spent in physical and sedentary activities and the total and weighted metabolic costs.

It was adopted the accelerometer as a criterion measure of physical activity. It was quantified the variables total physical activity (counts / min) and time spent in moderate to vigorous physical activity. The concurrent validity was assessed by Pearson's correlation coefficient while the operational equivalence was assessed by means of data concerning the duration and evaluation of the interview. **Results:** The correlation between the results from the questionnaire and the accelerometer ranged from 0.34 to 0.40. It was found that LAF overestimates time in physical activity when compared to the accelerometer. The average duration of interview was 24 minutes (minimum = 13 min, maximum = 41 min, sd = 5 min). The interview item showing the poorest result was the children's ability to estimate time (poor or fair in 24.8% of interviews). **Conclusions:** In relation to the original version, the questionnaire Lista de Atividades Físicas presents similar indices of concurrent validity and operational equivalence, confirming the fitness of the cross-cultural adaptation.

PP 265

CRITERION VALIDITY OF A 10-CATEGORY SCALE FOR RANKING PHYSICAL ACTIVITY IN NORWEGIAN WOMEN

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Background: Accurate measurement of physical activity (PA) is critical to establish dose-response relationships with various health outcomes. We compared the self-administered PA questionnaire from the Norwegian Women and Cancer Study (NOWAC) with a criterion method in middle-aged Norwegian women. **Methods:** A sample of 177 randomly recruited healthy women attended two clinical visits approximately 4-6 months apart. At each visit, the women completed the NOWAC PA questionnaire (NOPAQ), rating their overall PA level on a 10-category scale (1 being a "very low" and 10 being a "very high" PA level) and performed an 8-minute step-test to estimate aerobic fitness (VO₂max). After each visit, the women wore a combined heart rate and movement sensor for 4 consecutive days of free-living. Measures of PA obtained from the combined heart rate and movement sensor, which were used as criterion, included individually calibrated PA energy expenditure (PAEE), acceleration, and hours/day of moderate-to-vigorous intensity PA (MVPA). These were averaged between visits and compared to NOPAQ scores at visit 2.

Results: Intra-class correlation coefficients for objective measures from both free-living periods were in the range of 0.65-0.87 ($P < 0.001$), compared to 0.62 ($P < 0.001$) for NOPAQ. There was a moderate but significant ($P < 0.001$) Spearman's rank correlation coefficient in the range of 0.36-0.46 between NOPAQ and objective measures of PA (PAEE, MVPA and acceleration). Linear trends for the association between the NOPAQ rating scale with PAEE, hours/day of MVPA and VO₂max ($P < 0.001$) were also demonstrated. **Conclusions:** Self-reported PA level measured on a 10-category scale appears valid to rank PA in a female Norwegian population.

PP 267

PREDICTION OF PHYSICAL ACTIVITY LEVEL BY EVALUATION OF THE GPAQ AGAINST THE ACTIHEART MONITOR

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Self-reported tools to measure PA are widely used since it is non-invasive and inexpensive, however, they have various limitations including suboptimal reliability and validity. The aim of this study was, therefore, to determine the validity of the Global Physical Activity Questionnaire (GPAQ) using the Actiheart® monitor as criterion.

Methods: 210 black and white university female students (18-30 years old) were included in the study. Of this sample complete data of only 90 students were obtained (37 non-athletes, 53 athletes). Demographic information was obtained and anthropometry was done. The average measured metabolic equivalents (METs) derived from the Actiheart® were multiplied with the average time spend on each activity and METs-minutes/day were calculated and compared to METs-minutes/day calculated from the GPAQ. Bland-Altman plots were used to compare the PA obtained from the GPAQ with those directly measured by the Actiheart® monitor. A chi-square test was used to determine how PA category differed between the two methods. Sensitivity and specificity of the GPAQ to discriminate between low and high PA levels were assessed.

Results: The mean difference between the MET-minutes/day calculated from the GPAQ and Actiheart was 1706.3 MET-min/day (95% CI:865-2823.5). There was a positive slope of the regression line of the Bland-Altman plots, indicating an underestimation of PA by the GPAQ at high levels of PA and overestimation at low levels of PA in the total group. The same result was found when separate analyses were done for athletes and non-athletes. Specificity to correctly assign the highly active individuals to the highly active group according to Actiheart measurements was 100%

and sensitivity to correctly assign a low-moderate active individual to the low-moderate activity group was 31.4%. The GPAQ had a high specificity and sensitivity of 100% and 82.8% respectively to assign athletes to the correct PA categories, but low specificity and sensitivity in the non-athlete group.

Conclusion: These results showed a very large difference between the two PA assessment methods. In this population the GPAQ seemed to overestimate the PA level of athletes and underestimate PA in individuals who are sedentary. The specificity of the questionnaire was high in both the total group and athlete group. The sensitivity was only high for the athlete group, which indicates that the use of the GPAQ for classifying PA level would be valid in an athlete group, but would not be valid if used on a mixed population or sedentary individuals only.

PP 268

MONITORING AND ASSESSMENT OF OBESITY PREVENTION POLICIES: AN INDICATOR SET

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Implementation of Health strategies needs systematic monitoring and assessment in order to know its level of development. In Spain, NAOS Strategy is a global strategy of promotion of healthy food, physical activity and obesity prevention.

Objective: to establish a minimum indicator set related to healthy eating, physical exercise and prevention of becoming overweight within the diverse fields of activity of the NAOS Strategy. Develop an efficient collaborative work among public administrations.

Methodology: creation of a working group with representatives of Spanish Agency for Health Safety and Nutrition (AESAN), Health departments of regional governments, the Spanish Sports Council and municipal health representatives.

Requirements for the indicators were settled. Information areas for the indicators were determined, trying to include all important settings.

Existing and potential sources of data were examined.

Indicators were defined as clearly and simply as possible.

The proposed indicators were assessed in several rounds to make they keep the requirements.

Results: 60 indicators were defined in 8 information areas: General framework, School environment (Healthy diet and physical activity), Healthy eating habits and physical activity at work, Health care environment, Urban planning and infrastructures for practicing physical exercise, Food industry and distribution and Hotels and catering sector.

Existing and potential sources were identified, and some new and feasible sources were defined.

Conclusion: monitoring and assessment are compulsory activities to improve the efficiency of actions. Feasible monitoring actions must be planned. Collaborative work among public administrations gives positive results in monitoring and assessment.

PP 269

CROSS-CULTURAL VALIDATION OF THE “SHORT QUESTIONNAIRE TO ASSESS HEALTH ENHANCING PHYSICAL ACTIVITY” (SQUASH) IN THE HELIUS COHORT.

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Background: Physical inactivity is one of the biggest public health problems of the 21st century. It is an important risk factor for cardiovascular disease and diabetes mellitus. In the Netherlands only 61% of the population meets the minimum recommendation of 30 minutes moderate intensity physical activity daily. In ethnic minorities this percentage is much lower, e.g. only 18% of Turkish Dutch meet this recommendation. Self-report questionnaires are often used to assess physical activity in epidemiological studies. In the Netherlands, the SQUASH (short questionnaire to assess health enhancing physical activity) is often used. The SQUASH has been validated among the ethnic Dutch population but it is not known whether it provides reliable information about the physical activity level in ethnic minorities. **Aim:** To cross-culturally validate the SQUASH among four main ethnic minority groups in the Netherlands. **Methods:** Prospective validation study including 500 participants: 100 persons (50 males and 50 females) from 5 different ethnic groups: ethnic Dutch, Turkish, Moroccan, Surinamese Hindustani and Surinamese Creole. All participants will complete the SQUASH twice, once at baseline and the second time a month later. The SQUASH will be extended with a physical inactivity section to provide physical inactivity patterns of the diverse populations. The occurrence of social desirability will be tested using the shortened version of the Marlowe-Crowne scale. After completion of the baseline questionnaire participants will receive a combined accelerometer and heart rate monitor device (Actiheart) that will be worn for a week (construct validity). This accelerometer will be individually calibrated based on a short aerobic fitness test (Astrand test). To obtain insight in content validity, the occurrence of bias and encountered difficulties of the

questionnaire, cognitive interviews will be carried out in sub-populations (up to 15 persons per group). The SQUASH will be revised on the basis of these cognitive interviews and the actiheart data. The revised version will again be validated among a randomly chosen group of 20 new participants (5 Turks, 5 Moroccan, 5 Surinamese Hindustani, 5 Surinamese Creole). The same protocol as described above will be followed. Discussion: The SQUASH questionnaire has already proven its utility for research on physical activity in the ethnic Dutch population. This study will validate this widely used tool for the assessment of self-reported physical activity among ethnic minority groups and thus contribute to our understanding of ethnic differences in physical activity and health.

PP 270

CALIBRATION OF ACTIGRAPH GT3X+ FOR ASSESSMENT OF PHYSICAL ACTIVITY AMONG CHILDREN 2 YEARS OF AGE

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Background: For studies of children's sedentary and physical activity behavior, there is a need for objective measures such as accelerometry. The ActiGraph GT3X+ accelerometer has not been calibrated on children 0-3 years of age. The aim of this study is to calibrate the ActiGraph GT3X+ accelerometer for assessing physical activity and sedentary behaviors among children 2 years old.

Method: The recruitment was conducted at four preschools within Stockholm County. Children aged 1-3 years were included. Weight and height was assessed using standardized measures. The included children were observed and videotaped during structured indoor activities (watching a cartoon and sitting and drawing with crayons) and during free play outdoors while wearing an ActiGraph GT3X+ accelerometer on the wrist. Physical activity intensity was classified in five categories according to Children's Activity Rating Scale. Coding was performed by watching the video material and recording intensity for each 15 second interval on a study specific protocol. Start and stop times for every activity was recorded in order to apply it to the corresponding accelerometer data. Accelerometer Vector Magnitude (VM) and vertical axis (Y-axis) counts per 15 seconds were derived, corresponding to the structured activity-intervals.

Descriptive data on accelerometer based physical activity are presented as mean and standard deviation (SD). Classification accuracy will be evaluated via weighted Kappa statistics and area under the receiver operator characteristics curve (ROC-AUC).

Results: Here we present accelerometer data for the structured and free activities. Final data will be presented at the conference. In total 31 children were included in the study (18 boys, 13 girls). The age was an average 25 months (range 15-36). Participating children had a BMI of 17.3 (range 14.0-22.3).

Mean counts for watching a cartoon was 560 (SD 512) VM/15 sec and 290 (SD 298) for counts on Y-axis/15 sec. Mean counts for drawing with crayons was 932 (SD 342) VM/15 sec and 445 (SD 189) for counts on Y-axis/15 sec. Mean counts for free activities outdoors was 1427 (SD 553) VM/15 sec and 879 (SD 364) for counts on Y-axis/15 sec.

Conclusion: There was a large variation in activity counts among children performing structured activities. Hence, we suggest that structured activities alone, is not suitable as a measure of physical activity in small children. Data from this calibration study will yield important information for further research on preschool children's physical activity and sedentary behaviors.

PP 271

COMPARISON OF THE DANISH STEPTEST AND THE WATTMAX TEST FOR ESTIMATION OF MAXIMAL OXYGEN UPTAKE. THE HEALTH2008 STUDY.

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Introduction: Cardio respiratory fitness is inversely associated with cardiovascular morbidity and mortality. Direct measurement of maximal oxygen consumption (V02 max) is considered the gold standard for measuring aerobic capacity, but the method is not feasible in large study populations. The Danish steptest (1) may be a simple alternative for estimation of V02 max epidemiological studies. Aim: To compare 'the Danish Steptest' to an indirect maximal test 'the Wattmax test' for estimation of V02 max. Methods: For the population-based Health2008 Study, 2,218 men and women between 30-60 years were invited. Altogether 795 eligible participants (response rate 35.8%) performed the Wattmax and the Step test. Correlation and agreement between the two V02 max test results was explored by Pearson's rho, Bland Altman plots, KappaW and Gamma coefficients. Results: The correlation between V02 max (ml•kg⁻¹•min⁻¹) estimated by the two tests was moderate to high (men: r=0.69, p<0.0001; women: r=0.77, p<0.0001). The Step test slightly overestimated V02 max compared to the Wattmax test, more so in women than in men. Agreement between the two tests when V02 max was classified in five levels was gamma=0.77, KappaW=0.42 in women, and gamma=0.64, KappaW=0.37 in men. Conclusion: The Danish Step test is a reasonably valid, safe and feasible alternative to more

time-consuming and expensive methods for estimation of V02 max in large adult population-based studies. Reference 1. <http://www.health-calc.com/fitness-tests/the-danish-step-test>

PP 272

VALIDITY OF THE SC-STEPMX Pedometer DURING Treadmill Walking and Running

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Introduction: Pedometers are used in a variety of settings to measure physical activity levels. The SC-StepMX™ is a new generation pedometer that uses SC-StepMX electric accelerometer technology. The purpose of this study was to examine the performance of the SC-StepMX™ pedometer in accurately measuring step counts at different treadmill speeds in a group of individuals of various ages, body masses and leg lengths. **Methods:** A convenience sample of 40 participants wore 4 SC-StepMX™ pedometers, 2 Yamax Digi-Walker™ pedometers and 2 Actical™ accelerometers around their waist during treadmill walking and running at 4 different speeds (range: 0.9–8.8 mph): 50%, 100%, 180% and 250% of each participant's self-paced walking speed (SPW). Absolute percent error was calculated at each speed for each monitor using manually counted steps from two observers as the criterion measure. The impact of age, sex, body mass index, leg length and treadmill speed on measurement accuracy was tested. Measurement bias was assessed using Bland-Altman analysis. **Results:** The SC-StepMX demonstrated lower average absolute percent error (-0.2%) compared to the Digiwalker (-20.5%) and the Actical (-26.1%). Mean bias was lower for the monitor (0.1 ± 9.1 ; 95% CI = -17.8 to 18.0 steps·min⁻¹) when compared to both the Digiwalker (-15.9 ± 23.3 ; 95% CI = -61.6 to 29.7 steps·min⁻¹) and the Actical (-22.0 ± 36.3 ; 95% CI = -93.1 to 49.1 steps·min⁻¹). As treadmill speed increased, the strength of the correlation (R²) between actual and measured steps increased for all monitors with the SC-StepMX showing the highest overall co-efficient of determination of the 3 monitors (0.97 versus 0.95 and 0.85 for the Digiwalker and Actical, respectively). Treadmill speed was associated with measurement error in the Digiwalker and Actical (both $p < .0001$) but not in the SC-StepMX. Age, sex, body mass index and leg length were not associated with measurement error in any of the monitors. **Conclusion:** This study demonstrates that the SC-StepMX has good measurement accuracy for treadmill walking and running in a group of individuals of various ages, body masses and leg lengths. A unique strength of the SC-StepMX appears to be its ability to accurately measure steps at slow walking speeds. This feature may allow the SC-StepMX to be useful in measuring steps in populations that are less active (e.g., sedentary individuals, elderly or those with a chronic illness). **Note:** This research was funded by Diabeters Incorporated.

PP 273

AGREEMENT BETWEEN PHYSICAL ACTIVITY MEASUREMENT TOOLS IN THE ASSESSMENT OF OLDER MEN IN A RESISTANCE EXERCISE INTERVENTION STUDY

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Accurate and reliable assessment of physical activity remains a challenge. Measures used fall into three categories: direct observation; subjective reports (including self-reports); and portable monitors such as the accelerometer which measures body movement in terms of acceleration. The aim of this study was to assess the agreement between three measures of physical activity in 119 elderly men aged 55 to 80 years. Subjects undertook either resistance exercise (RE) or walking (WA) programmes. At baseline there was no difference between groups in age, BMI or measures of physical activity. The level of physical activity and changes in physical fitness between baseline and 1-year were assessed by IPAQ self-report questionnaire, 7-day accelerometry-based physical activity monitor and 6-minute walk test.

IPAQ showed no significant changes in activity levels between groups over time, however, the activity monitor detected changes between groups with the WA group having higher levels of sedentary activity ($p < 0.05$) compared to the RE group who had higher levels of moderate activity (not significant). The 6-Minute walk test time decreased significantly for the RE group ($13.0 \pm 13.4\%$ $p < 0.05$) as compared to the walking group ($4.6 \pm 11.1\%$ $p < 0.05$) confirming a greater increase in physical fitness in the RE group and therefore intensity of physical activity and amount of physical activity than the walking group.

Agreement between the three measures of physical activity was undertaken by Spearman's ranked correlation and by computing the level of agreement (kappa). Assessment of the baseline group using Spearman's showed little agreement between the three measures. Analysis by group at 12 months showed improved correlation but still low level of agreement between the physical activity measures. However at 12 months there was agreement between measurement for total sedentary counts and IPAQ ($p < 0.05$) for both groups. This increased correlation and level of sensitivity of measurement when subjects are split into their exercise group and at differing time-points, despite the reduced power of the sample, needs further exploration. Kappa between tertiles between the three measures of physical activity ranged from 0.012 to 0.350, indicating a lack of agreement.

Measurement method appears to have a significant impact on the observed levels of physical activity. Agreement between the measurement tools used to assess levels of physical activity was dependent on the group the subjects were assigned to and the time point of measurement, possibly due to the Hawthorne effect therefore indicating possible problems with the reliance of self-reporting measures.

PP 275

SEDENTARY BEHAVIOR AND CARDIO RESPIRATORY FITNESS IN ADOLESCENTS FROM PUBLIC SCHOOLS OF METROPOLITAN REGION FROM RIO DE JANEIRO, BRAZIL

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Objectives: To describe the frequency of sedentary behaviors (watching television and using computer and video game), the frequency of practice of regular activity and performance in cardio respiratory fitness test in adolescents.

Methods: Cross-sectional study developed with a probabilistic sample of 493 students from 14 to 19 years old from 13 public schools in the metropolitan region of Rio de Janeiro, Brazil evaluated in 2008 and 2009. Sedentary behaviors and regular physical activity in the last six months were investigated by self-report questionnaire. Cardiorespiratory fitness was assessed by run / walk 9 minutes test (T9). The adolescents were classified as excellent, very good, good, weak and very weak performance. The association between the frequencies of the variables was evaluated by chi-square test and between continuous variables by Spearman correlation (hours watching television and hours using computer and video game with the distance running in meters in the T9), assuming $p < 0.05$ for statistical significance

Results: Seventy-two percent and 48% of adolescents reported watching television and using computer and video game more than 2 hours per day, respectively, with a daily average of 4.5 hours watching TV and 3.3 hours playing video games or using computer. Watching TV was most frequently mentioned as a leisure activity over the weekend. On the other hand, 64.1% reported performing regular exercise in the last six months, being the most accomplished soccer activity (59.4%), followed by walking (26.3%) and dance (26%) frequently two to three times a week between 30 and 60 minutes for all these activities; 88.6% of adolescents were classified as performing weak or very weak in the T9, although no association was observed between sedentary practices and performance in this test ($r = 0.020$, $p = 0.626$ for hours of TV and $r = 0.048$, $p = 0.249$ for hours on the computer and video game with the distance running in T9).

Conclusions: Although about two thirds of adolescents reporting regular practice of physical activity, it is likely that the long time spent on sedentary activities like watching TV and using computer and video game reflected in high prevalence of adolescents classified as weak or very weak in the cardio respiratory fitness test suggesting that this test can be used as a *proxy* for physical inactivity among adolescents, although the absence of correlation between these variables still unsure on this issue

PP 276

PHYSICAL ACTIVITY ASSESSMENT IN GROUP OF ADULT PEOPLE: COMPARISON BETWEEN TWO METHODS

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PURPOSE: Regular exercise reduces risk of CVD, hypertension, diabetes type 2, colon cancer, breast cancer and depression. Physical activity represents a not negligible component of the energy expenditure and for this reason is fundamental for the body weight control. Global, international and national public health strategies to encourage an active lifestyle are based on the widely used recommendation of at least 30 minutes of physical activity on at least moderate intensity on most, preferably all, days per week.

The aim of this study is to evaluate the physical activity level in a sample of Italian population aged 20-65yrs and therefore the adherence to international recommendation on physical activity. Secondary outcome is the comparison between two methods utilized for the assessment of physical activity: the International Physical Activity Questionnaire – long version (IPAQ-L) and the accelerometer Actigraph GT1M.

METHODS: 220 volunteers have been recruited (105 males and 115 females) living in Centre and South of Italy. All subjects worn an accelerometer for 7 consecutive days and at the end of this week we asked them to administrate the IPAQ-L questionnaire together with a life style questionnaire containing questions regarding physical exercise, smoking habits, alcohol consumption and demographic data (sex, age, etc). Moreover according to standard procedure height (cm) and weight (kg) measures have been collected, and BMI has been calculated (kg/m^2).

RESULTS:

IPAQ-L shows that 91% of volunteers are sufficiently or very active. There is a positive although weak correlation between total physical activity assessed using accelerometers and IPAQ-L questionnaire; however the Altman and

Bland analysis shows differences between two tools in moderate and vigorous physical activity (minutes/day) have been found and these differences increase as the time spent in these activities raises.

CONCLUSION:

on the base of IPAQ-L scores our sample follows the minimum physical activity recommendations hence this group doesn't seem to be sedentary. When compared with accelerometers data those from IPAQ-L shows an overestimation mostly for moderate and vigorous activities, determining a misclassification for an half of the sample.

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PP 277

DEVELOPMENT AND VERIFICATION OF VALIDITY AND RELIABILITY OF THE INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE -TAIWAN SHOWCARD VERSION

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Background: It is widely confirmed that physical active can bring people health benefits. This study anticipates developing a physical activity showcard through the use of images, allowing an understanding of underlying semantics, enhancing answering fun as well as breaking through cultural and linguistic limitations and barriers between countries.

Methods: This study's questionnaire used visual communication elements and iconic signs constitution elements in the developing period of the International Physical Activity Questionnaire (IPAQ) -Taiwan Showcard Version. We added some types of physical activity in this questionnaire. Through field study, we got the responses to the showcard version among subject. The consensus of physical activity images of people were confirmed by expert validity. After review by experts, the IPAQ Taiwan Showcard Version entered the test period. Face-to-face interviews were conducted to test one hundred subjects aged 18-65. The subjective IPAQ Taiwan Showcard Version and IPAQ Self-Administered Short Version were used to monitor the amount of physical activity in the previous seven days. The single-axis accelerometer (Actical) was used to monitor the amount of physical activity for coming seven days. The subjective IPAQ Taiwan Showcard Version and IPAQ Self-Administered Short Version were done in posttest when returning Actical. SPSS 17.0 was used to analyze its reliability and validity. **Results:** The index of content validity (CVI) of the development period of IPAQ Taiwan Showcard Version is 0.95. The concurrent pretest and posttest validities of health-enhancing physical activity (HEPA) of the test period of IPAQ Taiwan Showcard Version are 0.916-0.960 and 0.916-0.998; the retested reliability is 0.478-0.683; and the criterion-related validity of Actical is 0.192- 0.405. There are no significant differences from the IPAQ Self-Administered Short Version by Z test. The time of completing IPAQ Taiwan Showcard Version and IPAQ Self-Administered Short Version are on average 4.8±1.6 and 7.3±2.6 minutes respectively and the value of paired t-test is -8.29 which indicates that the average time to complete the IPAQ Taiwan Showcard Version is shorter than IPAQ Self-Administered Short Version. **Conclusions:** After the reliability and validity test with the IPAQ Taiwan Showcard Version developed by this study, there are no differences from the IPAQ Self-Administered Short Version. Yet, there are physical activity types in the showcard version which can accurately present actual physical activity conditions. It is recommended to be used in large sample surveys and extended to study various populations for validation and application to increase the applicability of the IPAQ Taiwan Showcard Version.

PP 278

THE CUTTING POINTS OF EIGHT MEASUREMENTS OF PHYSICAL ACTIVITY TO PREDICT METABOLIC SYNDROME

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Background: metabolic syndrome is a global concern identified as a seminal cause of cardiovascular disease and type 2 diabetes. It has been found a stronger association between regular physical activity and lower prevalence or incidence of metabolic syndrome. Physical activity is good predictor of the metabolic syndrome in adults. But the sensitive cut point for metabolic syndrome of various measurements of physical activity is unknown.

Methods: Investigators collected 251 subjects come from a community by systemic and household sampling. Participants were instructed to wear a RT3 accelerometer and completed IPAQ-Taiwan (self-administration long and short version as well as telephone interview short version), GPAQ, 7-D PAR, diary and MOSPA. The definition of

metabolic syndrome is based on the criteria of the Department of Health in *Taiwan*; it is similar with Adult Treatment Panel III. However, waist circumference modified to ≥ 90 cm in men and ≥ 80 cm in women.

Results: The participants have 59 % female, 73.8 % more than 9 years education. Their physical activity level is low (35.0%), middle (31.4%), and high (33.6%). We used the ROC to establish the cutting point of healthy enhancing physical activity including vigorous and moderate intensive. Using 50% sensitivity and most near 50% 1-specificity as criteria, the cutting point in IPAQ_LS, IPAQ_SS, IPAQ_ST, GPAQ, 7-D PAR, diary, MOSPA and RT3 accelerometer is 1069, 922, 572, 1005, 808, 1984, 1494 and 1114 Kcal/week.

Discussions: Different measurements of physical activity have different approach and assumption. The recall period is various, the IPAQ, GPAQ, 7D_PAR are past seven days. The MOSPA need recall past one year, the subjects take more memory bias. The data of diary is coming seven days then participants take the risk of the Hawthorne Effect to increase the report or behavior of physical activity to fit social norm, let their data twice than the recall tools. The telephone interview tool need more clear guide to conduct comprehensive memory.

Conclusion: Physical activity is good predictor of **metabolic syndrome**. The cutting point for metabolic syndrome is around one thousand Kcal/week in the most tools of physical activity. It can be help health professionals to make precious decisions in care process to high risk person with **metabolic syndrome**.

PP 279

PROSPECTIVE STUDY OF RECREATIONAL AND OCCUPATIONAL PHYSICAL ACTIVITY AND RISK OF SKIN CANCER, AUSTRALIA

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Background. The relationship between physical activity and risk of skin cancer is unknown and difficult to investigate due to confounding by sun exposure. The very few population-based studies on recreational or occupational physical activity and skin cancer incidence are confined to melanoma or the two main types of keratinocyte (non-melanoma) cancers combined, cutaneous squamous cell carcinoma (SCC), and basal cell carcinoma (BCC). We have prospectively examined the association of recreational and occupational physical activity and incidence of SCC alone, accounting for photoaging and other risk factors.

Methods. We used standard self-reports of physical activity from the Australian population-based Nambour Skin Cancer Study comprising 1,171 adults aged 25–75 years at baseline (1992). In sex-stratified analyses (person-based and tumor-based) we estimated the associations between type of activity and subsequent incidence of SCC to 2007. Activities examined included hrs/week of walking, moderate activity, and vigorous activity, summed to total recreational activity (hrs/week or MET-hrs/week), and occupational activity (sedentary, standing or manual) based on main lifetime occupations (job titles).

Results. During 16 years of follow-up, 98 men and 90 women newly developed SCC. We found no significant association between recreational activity measures and SCC after controlling for potential confounding factors including indicators of sun exposure. In men, the observed risk pattern was however suggestive of elevated risk with increasing total hours of recreational activity (compared to inactive men, RR (95%CI) 0.89 (0.54, 1.46) for ≤ 1.5 hrs/wk; 1.29 (0.82, 2.04) for ≤ 4.0 hrs/wk; 1.33 (0.86, 2.05) > 4.0 hrs/wk). Among women, higher level of occupational activity (standing and manual versus sedentary work activities) was associated with a reduced incidence of SCC tumours (P trend=0.03).

Conclusions. Despite some suggestion that recreational activity in men and occupational activity in women are related to occurrence of SCC, there is no firm support for a role of physical activity in the development of cutaneous SCC.

PP 280

EVALUATION ON PREGNANT WOMEN'S PHYSICAL ACTIVITY: CROSS-SECTIONAL STUDY IN A SOUTHEASTERN BRAZILIAN CITY

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Objective: to evaluate physical activity performed by pregnant women assisted at primary health care services.

Methods: cross-sectional study conducted in 2010, in Botucatu, a city with approximately 120,000 inhabitants and located in southeastern Brazil. Two hundred and fifty-six adult pregnant women were studied in their second pregnancy trimester. Multiple pregnancy and medical contraindication to physical activity performance were exclusion criteria. The sample was randomly selected proportionally to the number of pregnant women assisted at each of the 14 primary care units in the urban area. Information concerning physical activity was collected by an adapted version of the PPAQ questionnaire and by estimating the time and intensity of occupational physical activity related to locomotion, household and leisure activities in METs/day. Based on total daily MET, the pregnant women were classified according to physical activity level. Weekly leisure physical activity time was evaluated by adopting ≥ 150 minutes as

a recommendation. Data on the weekly frequency of healthy and unhealthy food intake were obtained (non-quantitative FFQ) and expressed in scores ranging from 0 to 3. The highest the score, the more frequent the intake. **Results:** the majority of pregnant women were classified as sedentary/low active (77.7%); 12.5% were moderately active/active, and 9.8% were vigorously active. There was a predominance of household (10.70 ± 6.02 METs/day), locomotion (8.75 ± 6.68 METs/day) and occupational (6.38 ± 6.42 METs/day) physical activities over leisure (0.31 ± 0.65 METs/day) activities, and the mean total daily energy expenditure was equal to 22.15 ± 9.50 METs/day. Only 10.2% achieved 150 weekly minutes of leisure physical activities, and walking was the only modality performed. Sedentary/low active and active pregnant women showed different medians for the healthy eating score, which were respectively 2.0 and 2.7 (p=0.002).

Conclusions: Sedentariness/low physical activity is a risk factor to maternal-child health that is widely present in Brazilian pregnant women assisted by primary health care services, and their daily expenditure on leisure physical activities is very low. In insufficiently active pregnant women, the intake of healthy foods was lower, which suggests an accumulation of risk factors. Such results support multidisciplinary interventions involving physical activity promotion and orientation and healthy diets in prenatal care.

Key words: pregnant women, physical exertion, cross-sectional studies, prenatal, epidemiology

PP 281

WAIST-HEIGHT RATIO AND METABOLIC RISK IN YOUTH

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Background: Abdominal obesity is a strong predictor for metabolic complications and adverse health effects. Waist-height ratio (Whtr) is a simple and alternative method to waist circumference as a potential indicator of harmful effects of central obesity. The aims of this study was to analyze the associations of Whtr and metabolic risk in a sample of Portuguese youth **Methods:** This study comprised 779 adolescents (472 girls), aged from 12 to 18 years. WHtR was calculated as the ratio of waist (cm) and height (cm). The blood pressure [BP], fasting total cholesterol [TC], low density lipoprotein-cholesterol [LDL-C], high density lipoprotein-cholesterol [HDL-C], triglycerides [TG], glucose, and a metabolic risk score (MRS) were also examined. CRF was predicted by maximal multistage 20m shuttle-run test. **Results:** Using the WHtR, the prevalence abdominal obesity was 21.3% (23.5% girls and 17.9% boys; p=0,062). Regardless of gender, participants who belonged to the WHtR risk group had significantly (p=0.05) lower CRF scores than the WHtR non-risk group. Logistic regression analysis showed that girls belonging to WHtR risk group (OR: 2.3 ; 1.1 - 4.8; p=0.031) were more likely to be classified as having metabolic risk than their normal peers even after adjustments for age and maturational status. However no statistical significant associations were found for boys. **Conclusion:** This study highlights the Whtr as a potential indicator of metabolic risk in girls but not in boys. Possible explanations for this gender differences should be further discussed.

PP 282

SEDENTARY TIME INCREASES MORTALITY RATE IN OLDER US ADULTS: INDEPENDENT EFFECT OR DISPLACEMENT OF ACTIVITY TIME?

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Introduction: Sedentary behavior may be a risk factor for morbidity and mortality. A major question concerning this possibility is whether effects of sedentary behavior arise through independent physiological consequences or because sedentary time displaces time spent in physical activity. However, traditional analytic methods cannot distinguish between the ‘displacement’ and ‘independent effect’ hypotheses. We used partition and isothermal substitution models to test for displacement and independent effects of sedentary time on mortality in US adults.

Methods: We analyzed accelerometer data and all-cause mortality from the date of examination through December 31, 2006 of 1906 participants aged 50+ with at least one valid day of 10+ hours of accelerometer data from the U.S. National Health and Nutrition Examination Survey 2003-2004. We fit Cox proportional hazards models with gender, age, smoking status, alcohol use, BMI and several health conditions as covariates and time in various activity intensities as independent variables. Activity was divided into three categories defined by accelerometer counts (AC): Sedentary (AC < 100), Light (100 ≤ AC < 760), Moderate or higher (Mod+) (AC ≥ 760). Partition models estimate the effect of adding time in one activity, holding the other activities constant. Substitution models estimate effects of substituting one activity for another.

Results Over an average follow-up of 2.8 years, there were 145 deaths reported. Sedentary time was positively associated with mortality (OR = 0.026, p = 0.0035), after adjusting for other covariates, but not physical activity. In the partition model, sedentary time was no longer associated with mortality (OR = 0.01, p = 0.21) after adjusting for light (OR

= -0.05, $p = 0.06$) and Mod+ ($\beta = -0.16$, $p = 0.04$) activity, both of which had inverse associations with mortality. In the substitution models, displacing moderate activity time with sedentary time ($\beta = 0.17$, $p = 0.03$) or light activity ($\beta = 0.11$, $p = 0.22$) was associated with higher mortality rates. Replacing sedentary time with light ($\beta = -0.06$, $p = 0.03$) or Mod+ activity ($\beta = -0.17$, $p = 0.03$) reduced mortality rates.

Conclusions: These results support the hypothesis that sedentary behavior influences mortality rate in older adults by displacing active time, rather than through independent physiological effects. Replacing active time with sedentary/light active time was associated with increased risk and replacing sedentary time with light/Mod+ activity was associated with reduced risk. One limitation of the present study is lack of information about the entire 24 hour day.

PP 283

TIME ALLOCATION OR 24H ACTIVITY RECALL QUESTIONNAIRES OVERESTIMATE ENERGY EXPENDITURE IN ADULTS. A POPULATION-BASED STUDY IN NITERÓI, RIO DE JANEIRO,

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Measurement of physical activity and energy expenditure (EE) is still a challenge in epidemiological studies. Questionnaires are the primary method used in such studies but their validity varies considerably depending on the questionnaire and the population. The purpose of the present study was to compare EE obtained from two questionnaires with measured EE. A sub-sample of 204 adults (≥ 20 years of age) from the Nutrition, Physical Activity and Health Survey (PNAFS), a household survey conducted in Niterói, state of Rio de Janeiro, Brazil in 2003 participated in the study. Each subject (115 women) responded a modified version of the MONICA Optional study of Physical Activity (MOSPA) questionnaire and worn a heart monitor during 24h after which a 24h activity recall (24hR) was conducted in their houses. The activity information was expressed in EE using the Compendium of Physical Activities MET-codes and totaled to 24h. EE was measured by the Flex-HR method in every subject. The subjects came to the laboratory twice for the: 1) measurement of resting metabolic rate and 2) measurement of EE and heart rate (HR) during an incremental walking test on a treadmill. Resting and walking EE were measured by indirect calorimetry and HR was monitored using POLAR S-610 units. Total 24h EE was extrapolated from 24h HR data using the EE values obtained in the laboratory (the Flex-HR method). Sample weights were calculated and calibrated according to the 2000 Census information and used in the analysis (SUDAAN, 9.01) to represent the adult population of Niterói (324,671 adults). Median values of EE assessed by MOSPA, 24hR and Flex-HR for men were 2804.7, 2831.3, and 2261.3 kcal/day, respectively, and 2319.9, 2462.6, 1589.5 for women. EE estimated by the questionnaires was similar, particularly in men (0.9% difference). However, EE was overestimated by the questionnaires both in men (21.5%) and women (43.1%). It is concluded that the MOSPA questionnaire and a 24h activity recall yield similar median values of EE but they substantially overestimate EE in adults from Niterói, Rio de Janeiro, Brazil. Part of this overestimation may be due to the inadequate universal value of MET (3.5 mL O₂ / kg / min) in this population.

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PP 284

THE REPEATABILITY AND VALIDITY OF QUESTIONNAIRES ASSESSING OCCUPATIONAL PHYSICAL ACTIVITY – A SYSTEMATIC REVIEW

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Introduction: To date, little is known regarding the health effects of occupational physical activity, as few studies have adequately examined the contribution of occupational physical activity, when studying the health benefits of physical activity. Moreover, available data is providing conflicting information. As these contradictory findings could be due to unreliable and invalid questionnaires, a review of the repeatability and validity of questionnaires measuring occupational physical activity is needed. **Aim:** The study aimed to review systematically the repeatability and validity of questionnaires used to assess occupational physical activity among healthy adults. **Methods:** We searched PUBMED and EMBASE using occupational, work-related, job-related, physical activity, motor activity and questionnaires as keywords. Article selection, data extraction and quality assessment was performed by two independent reviewers. The methodological quality and results of the studies was evaluated based on an existing checklist. The level of evidence and repeatability, criterion and construct validity were rated. **Results:** We included 31 papers describing 30 questionnaires in the review. Repeatability was assessed in 22 studies, 11 used appropriate measures to assess 12 questionnaires. Intra-class correlation coefficients and weighted Cohen's kappa ranged between 0.43–0.95. Six studies

used appropriate measures to assess criterion validity of 13 questionnaires. One questionnaire, the Tecumseh Self Administered Occupational Physical Activity Questionnaire (TOQ), showed good criterion validity against a physical activity record. Eighteen studies used appropriate measures to assess the construct validity of 23 questionnaires. Comparison included those against accelerometers, maximal oxygen uptake, questionnaires, and body composition measures. None showed good construct validity.

Discussion: Our results indicated that few questionnaires were examined for repeatability and/or validity in more than one study and often inadequate measures were used to determine the repeatability or validity. In our opinion, future studies are needed to test the reliability and/or validity of existing questionnaires. Moreover, in order to enhance the quality of occupational research with respect to physical work exposures and health, more insight is needed into optimal comparison methods for validation and optimal ways of assessing occupational PA, by using both self-reported and objective measures.

PP 285

MEASUREMENT ERROR IN A 24 HOUR PHYSICAL ACTIVITY RECALL INSTRUMENT: DESCRIPTIVE RESULTS FROM THE PHYSICAL ACTIVITY MEASUREMENT SURVEY (PAMS) PROJECT.

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A better understanding of measurement error is needed to improve the utility of physical activity recall (PAR) instruments. The Physical Activity Measurement Survey (PAMS) was designed to evaluate statistical procedures to model, quantify and adjust for measurement error in a commonly used and accepted physical activity recall instrument (a 24 hour physical activity recall – 24PAR). A representative sample of 1468 adults (ages 21-70 years old) wore a SenseWear Mini Armband (SWA) for a randomly assigned day (24 hours including sleep time).

The following day participants completed a 24PAR survey administered by a trained interviewer using a computerized telephone system. Participants completed a second trial but the present study examined agreement between the objective and subjective assessments for Trial 1. A total of 1426 participants (593 males and 833 females) met the criteria of 99% SWA wear time and were included in the analyses. Standard measurement agreement techniques were used, but the large sample made it possible to examine differences in measurement agreement for gender, age and BMI subgroups. Pearson product correlation coefficients between the SWA and 24PAR were moderate for both men ($r = .66$) and women ($r = .59$). A 3 way (gender x age group x BMI group) ANOVA was used to examine differences in EE estimates (kcal/day) derived from monitored and recalled physical activity. The overall differences (monitored – recalled) were large and significant with participants reported EE being significantly higher than monitored. The gender main effect was significant ($F=5.18$, $p = .02$) with males having slightly smaller differences than females (-525 +/- 967 kcal and -614 +/- 725 kcal, respectively). However, the effect of BMI group was also significant ($p < .001$). Post hoc analyses revealed small differences in EE estimates for normal weight individuals (males: -6.7 kcal; females: -55.9 kcal), moderate differences for overweight individuals (males: -380 kcal; females: -367 kcal) and large differences for obese individuals (males: -865 kcal; females: -1091 kcal).

The results demonstrate that weight status has a major influence on the agreement between reported and monitored measures of physical activity and energy expenditure. A variety of other factors may also influence agreement so more complex measurement error models are needed to improve precision for use in population research. The models developed from the PAMS study will contribute new information about measurement error approaches for physical activity assessment.

PP 286

ESTIMATING THE PROBABILITY OF COMPLIANCE WITH PHYSICAL ACTIVITY GUIDELINES FROM A BAYESIAN PERSPECTIVE

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There is heightened interest surrounding the physical activity levels of individuals, in particular given ballooning rates of obesity worldwide. Currently, the Center for Disease Control (CDC) in the United States issues guidelines with recommended levels of physical activity for children, adults, and older adults. In light of the current obesity levels in America, it is hypothesized that compliance with these guidelines is low. The objective of this work is to estimate the proportion of individuals in a population with usual (or long-run average) physical activity levels that meet the CDC guidelines. We use data from the Physical Activity Measurement Survey (PAMS) that were recently collected in Iowa (NIH Grant HL091024), and adopt Bayesian methods to model physical activity. Our approach integrates the complex design of the PAMS and classical Bayesian methods to extend the results beyond the sample. In addition to estimating the proportion of adult Iowans who comply with the CDC guidelines we also explore individual attributes that may be associated with the probability of compliance.

Keywords: Physical Activity, Compliance, Bayesian Methods, Survey Design

PP 287

THE ASSOCIATION OF DOMAIN-SPECIFIC PHYSICAL ACTIVITY AND SITTING WITH HAND GRIP STRENGTH IN A MULTI-ETHNIC POPULATION

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BACKGROUND AIMS: Numerous clinical and epidemiological studies have shown that low grip strength predicts morbidity and mortality in healthy adults and is associated with increased risk of functional limitations and disability in healthy older adults. As public health recommendations encourage participation in physical activity in all life contexts, this study examined which of the physical activity domains best explained the variability in handgrip strength in two populations that differ fundamentally in their physical activity patterns.

METHODS: A population sample of 961 Palestinians and 701 Israelis from east and west Jerusalem underwent an examination that included handgrip strength using a hydraulic hand dynamometer, and detailed interviews on health-related behaviours including the usual week all-domain physical activity using the Cross-Cultural Activity Participation Study questionnaire. Multivariable linear regression models were used to determine the domains that were significantly associated with hand strength.

RESULTS: Sex, age, ethnicity, work status, education, self-rated health status and measured BMI explained 60.6% of the variability in handgrip strength. Hours spent in moderate and vigorous physical activity (MVPA) at work, home, transport and leisure, all were significantly associated with handgrip but together explained only 1% of the variance in handgrip strength. There were significant sex interactions with hours spent sitting ($p=0.001$), and MVPA at leisure ($p=0.012$) and at work ($p=0.045$). Sex-specific models revealed that among men neither leisure MVPA nor sitting were associated with handgrip strength. MVPA at work ($p=0.001$) and home ($p=0.016$) were positively associated with handgrip strength whereas travel-related walking was inversely associated with handgrip strength ($p=0.044$). There were no significant ethnic differences among men for any domain. Among women hours spent sitting was negatively associated with handgrip strength ($P=0.002$) and MVPA during leisure was the only physical activity domain that was significantly and positively associated with handgrip strength ($P<0.001$), however, the later was only apparent among Israeli women ($p=0.002$ for interaction of ethnicity and leisure).

CONCLUSION: In this cross-sectional analysis, most of the variability in handgrip was explained by socio-demographic and health factors. Lifestyle physical activity contributed significantly but modestly to the variability in handgrip strength. The use of handgrip as a simple clinical predictor of health largely reflects factors other than lifestyle physical activity. Household chores (indoor and outdoor) and caring for others comprises 65% of total time spent on moderate to vigorous physical activity (MVPA), among Palestinian women's whereas among Palestinian men 39% and 24% of the total time spent in MVPA were attributed to job-related activity and household chores, respectively. After accounting for age, gender, work status, self-rated health and BMI

PP 288

HOUSEWIVES AND UNEMPLOYED FEMALE OWN WORSE PATTERNS OF HEALTHY ENHANCING PHYSICAL ACTIVITY COMPARISON WITH WORKERS ACROSS THE LIFE SPAN IN TAIWAN.

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Purpose: To explore the levels of physical activity among female and figure out the influence factors of them. **Method:** The Taiwan representative sample of 2931 female (13-92 years old, mean =39.1) is selected by the Computer Assisted Telephone Interviewing System and household sampling in Taiwan national physical activity surveillance system. The International Physical Activity Questionnaire was applied to get data. Multiple Classification Analysis (MCA) was chosen for data analysis. **Result:** The percentage of people meeting the recommended standard of vigorous-intensity physical activity (VPA) (60 minutes/week), for improving the cardiopulmonary function is 23.8%; the percentage of people meeting the recommended standard of moderate-intensity physical activity (MPA) (150 minutes/week), for preventing chronic diseases is 48.8%. The percentage of those having insufficient physical activities is 38.7%. The VPA among housewives and unemployed is decreasing as their age, but the VPA of workers dramatically rebounded after retiring age. Worker's MPA increases as the age rising, but housewives and unemployed were not. These are reasons why workers owned more active life than housewives and unemployed in the senior age. MCA was further applied to identify the important factors by model establishment. The result revealed that VPA was strong associated with the occupation and numbers of bicycle. In the MPA, the numbers of bicycle, the occupation, and marriage status were

important. The well-maintained sidewalks in people's neighborhood, the occupation, and marriage status were influential factors for walking time. **Conclusion:** The occupational status is the determinant to the levels of physical activity among females in Taiwan. When workers are free from duty, they will engage more VPA and MPA, which is good for health. But housewives and unemployed people are not free from duty at all. These results suggest that health professionals should design some tailored strategies for housewives and unemployed female.

Keywords: female, physical activity, occupation, International Physical Activity Questionnaire (IPAQ), Multiple Classification Analysis (MCA)

PP 289.

THE DETERMINANTS OF LTPA OF THE DISABLED FROM RURAL AREAS IN POLAND

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Introduction: Disability is a widespread phenomenon and affects all countries and all communities. It is estimated that in Poland there are approximately 6 million people (15% of population) with disability. Studies of many authors indicate that the disabled by the mere fact of having specific dysfunctions are in the vast majority outside of the mainstream of social and economic life and their physical activity, especially leisure time physical activity. The study presents selected results from the research conducted among a randomly selected group of people with disabilities, residing in rural areas of Poland which were finished on December 2011.

Aims: The aims of this study was to search:

- relation between SES of people with disabilities residing in rural areas in Poland and their participation in LTPA;
- for the major barriers to the participation of disabled people in LTPA;
- for results concerning the relationship between participation in LTPA and types or degree of disability.

Methods: In our study the research diagnostic survey method was used, and the research material was collected using a questionnaire, which was conducted among people with disabilities residing in rural areas of Poland. The selection of the sample was made using the method of **Stratified Random Sampling**, with the following main strata: region, place of residence, gender, education, type and degree of disability. The association between variables and participations in LTPA was assessed by **logistic regression** using Statistica program.

Results: The results have shown that the participation in LTPA depends mainly on the gender and the level of education of respondents. The main barriers hindering participation in LTPA is low SES and type of disability. The most frequent form of physical activity implemented by disabled people are walking. A little less work on the plot and in the garden. The least frequent LTPA undertaken by the disabled are the various forms of sports and active tourism.

Conclusions: The results indicate that in order to increase the participation of the disabled in the LTPA should be taken actions to change the neighbourhood in the direction too more walkability for making possibility to take the simplest forms of physical activity such as walking, riding in a wheelchair or to enable working on the plot and garden. An equally important actions should be to strive to improve SES of persons with disabilities.

Keywords: disability, rural areas, life activity, LTPA, SES,

PP 290

INTERACTIVE LEARNING TOOL FOR PORTION SIZE ESTIMATION: A PILOT STUDY

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Rationale: Several dietary assessment methods exist, each with its own benefits and limitations. The promise of overcoming some of the drawbacks of traditional assessment methods is an important motivator for experimenting with computers, the Internet, and personal digital assistants in the realm of dietary assessment. **Objectives:** To develop an innovative public education tool for dietary portion size estimation using interactive technology. **Process:** The design concept for the learning object or tool was to provide a visual image of a mixed-food dish and enable learners to actively estimate the portions of component food items by food group. Through viewing their estimations on a virtual plate and receiving feedback on the accuracy of responses, learners would gain familiarity with food guide portion sizes. The tool was developed and benefited from input by design students on layout, instructions and interactivity. The final tool was developed using Macromedia Flash. **Project Summary:** A prototype learning tool was developed. Learners are presented with a screen showing a food guide on the left and, on the right, an empty plate and below it a plate containing a photographic image of a mixed food dish. Using "click" and "drag", learners move photographic images of single portions of foods from their respective food groups within the guide across to the empty plate. The

single food portion is “dropped” on the plate and the mixed dish progressively assembled. By clicking on the dish they are assembling, learners are told if their portion estimates are correct.

Recommendations and Conclusions: This innovative tool for portion size estimation engages learners and hence has cognitive advantages over traditional methods for assessing dietary intake and teaching the concept of portion size.

PP 291

ASSESSMENT OF ADULTS’ DIETARY INTAKE, USING A WEB-BASED 24-HOUR DIETARY RECALL METHOD, IN ONLINE RESEARCH.

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The online environment may be an unparalleled source in which to conduct research interventions. Collection of high-quality dietary data is a priority when conducting online nutrition and health research. The objective of the study was to assess dietary intake, utilizing a web-based 24-hour dietary recall, in adults participating in an online research study. A convenience sample of adults was surveyed utilizing an online learning management system. The United States National Institutes of Health, National Cancer Institute’s automated self-administered 24-hour dietary recall (ASA24) was used to assess dietary intake. Additionally, anthropometrics, health and demographic data were collected. Results showed that participants (n=101) were 76% female, and 24% male with a mean (\pm SD) age of 39 ± 10 years. The participants’ mean BMI indicated that they were overweight (BMI ≥ 28 kg/m²). Participants completed six 24-hour dietary recalls, over 15 weeks for a total of 606 used for this analysis. In all 90% of the participants completed approximately 4 dietary recalls from weekdays and 2 dietary recalls from the weekend. Males and females on average (\pm SD) reported consuming 14 ± 5 and 15 ± 5 foods per dietary recall. Mean (\pm SD) daily energy intake was 1622 ± 701 kcals. The mean % of energy intake from protein, carbohydrate and fat was 18%, 47% and 35%, respectively. A web-based, self-administered, 24-hour dietary recall method is a feasible tool utilized to collect dietary intake of adults participating in online research.

PP 292

CAN A PRICE DATABASE LINKED TO FOOD INTAKE PRODUCE AN ACCURATE ESTIMATED COST OF FOOD PURCHASED?: A VALIDATION STUDY

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Background Diet cost is thought to influence dietary patterns which could have potential health consequences. The use of average price databases to estimate diet costs is increasingly common, yet there is scant literature validating such databases. This study aims to show whether a price database linked to food composition in the Diet and Nutrition Tool for Evaluation (the ‘DANTE cost database’) produces an accurate estimated cost of diet. **Methods** The DANTE database was populated with food cost information from supermarket websites. Till receipts were collected alongside food diaries in two independent studies. Agreement between the daily food diary costs calculated by the database and the daily expenditure recorded by till receipts was compared using Bland Altman plots. **Results** The average daily food cost estimated by DANTE for the first sample was £2.88. The average daily till receipt expenditure was £2.71. The Bland Altman showed a mean difference of £0.10 with 95% limits of agreement of £2.88 and -£3.08. For the second sample, the average daily cost given by DANTE was £3.96. The mean daily till receipt expenditure was £3.75. The mean difference was £0.21; 95% limits of agreement were £3.22 and -£2.80. **Conclusion** The mean difference between the two methods was as little as £0.10 suggesting that the database could be useful in estimating diet costs of larger samples. However, it could over- or under-estimate the daily diet cost for an individual by up to £3.22. Therefore, the DANTE cost database was judged suitable for assigning costs to habitual diet in population research.

PP 293

ADAPTING THE ASA24 FOR USE IN CANADA

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Background The ASA24 is a freely available Web-based tool developed by the National Cancer Institute (NCI) that enables automated self-administered 24-hour recalls. By eliminating the need for trained interviews it reduces the cost of collecting dietary intake information in large scale studies. The U.S. version of the ASA24 has already been used in Canadian research, but there is a need for a Canadian version to increase data quality. Work is underway to modify the food list terms (FLT), food probes, and nutrient database to improve its application for Canada.

Methods and Materials Participants of two Canadian studies using the U.S. version of the ASA24 were asked to evaluate the tool. This evaluation helped identify which foods participants were unable to find. The data collected was used to add to the Food List Term (FLT) and to outline which food categories needed to be modified to better reflect the Canadian market. Modifications applied to the Automated Multiple Pass Method (AMPM) tool, which had been used in the Canadian Community Health Survey (Nutrition-2004), were considered when modifying the ASA24. Nielsen marketing data was also used to verify brand name availability and popularity in Canada.

Results To make this tool relevant for Canadian food consumption surveys, over 450 foods were added and approximately 800 foods were deleted from the FLT, mainly in the burger, butter/margarine, cake, cereals, cookies, crackers, and sandwich categories. Most of these changes reflected differences with fast food restaurants and brand name items. Metric measurements were added for foods and beverages commonly consumed in standard size containers such as water, soda, beer and yogurt.

Next steps The Canadian version of the ASA24 will be made available shortly on the NCI website. The ASA24 data is presently coded to U.S. nutrient values. Work is underway to map the data to the Canadian Nutrient File (CNF) and a Canadian recipe database used for surveys. This modified version will provide Canadian researchers with a simplified tool to collect Canadian dietary intake data.

PP 294

“MY MEAL MATE” (MMM) A NEW SMARTPHONE APPLICATION FOR WEIGHT LOSS: EVALUATION OF ITS POTENTIAL AS A DIETARY ASSESSMENT TOOL.

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Background: There is a growing interest in developing innovative approaches for dietary assessment due to the established limitations of current methodology. The University of Leeds has developed a new smartphone application, “My Meal Mate” (MMM) to facilitate weight loss. The tool incorporates a large branded food item database and its development has been informed by qualitative research with potential system users and benchmarking against similar commercially available devices. A smartphone application which permits self monitoring of food and drink intake offers promise as a convenient and cost effective dietary assessment tool. This study aimed to validate the diet measures recorded on MMM against a reference measure of 24 hour dietary recalls.

Method: Fifty volunteers from the University of Leeds recorded their food and drink intake on MMM for seven days. During this time, two telephone 24 hour dietary recalls were also conducted as a dietary reference measure.

Results: Energy (kcal) recorded on MMM correlated well with the recalls (Day 1: $r=0.77$ (95% CI: 0.62-0.86), day 2: $r=0.85$) (95% CI: 0.75-0.9) and had a small mean difference (MMM-recall: day 1: -16, 95% CI: -132 to 100 kcal/d; day 2: -105, 95% CI: -204 to -7 kcal/d). Bland Altman analysis (figure 1 below) showed wide limits of agreement between the methods (-807 to 775 kcal/d on day 1). 78% stated that they liked using MMM and reported an average 7 (95% CI 6-9) minutes to enter a meal and an average 22 (95% CI 19-26) minutes to input a day’s intake.

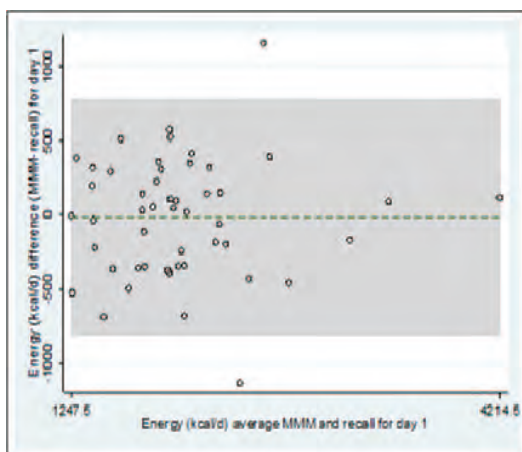


Figure 1: Bland Altman analysis of agreement for day 1 of recording on MMM and recall

Conclusion: Although the limits of agreement are wide at the individual level, MMM has potential as a dietary assessment tool at the group level.

PP 295**THE INFLUENCE OF FOOD LITERACY ON THE EVERYDAY PRACTICALITIES OF MEETING NUTRITION RECOMMENDATIONS**H. Vidgen¹, D. Gallegos¹, M. Caraher²¹Queensland University of Technology, ²City Univeristy

Contemporary nutrition policies and plans call for focussing efforts to improve nutrition through a closer connection with food and the everyday practicalities of how people live and eat. Various words have been used to articulate what this might mean in practice. More recently, the term “food literacy” has emerged to explain this gap between the policy aims the (in)ability of people to know, understand and use food to meet nutrition recommendations. Despite its increasing use, there is no common understanding of this term or its components. Once established, food literacy could be measured in order to examine its association with nutritional outcomes.

A Delphi study of 43 Australian food experts from diverse sectors and settings explored their understanding of the term “food literacy”, the likely components and possible relationship with nutrition. The three round Delphi study began with a semi-structured telephone interview and was followed by two online surveys. Constructivist grounded theory was used to analyse data, from which a conceptual model of the relationship between food literacy and nutrition was developed. The model was then tested and refined following a phenomenological study of 37 young people aged 16-25 years who were responsible for feeding themselves. They were interviewed about their food intake, day-to-day food decision making, the knowledge and skills used and their perceptions of someone who is “good with food”.

Analysis from the Delphi study identified, eighty components of food literacy and these were grouped into eight domains: 1)access, 2)planning and management, 3)selection, 4)knowing where food comes from, 5)preparation, 6)eating, 7)nutrition and 8)food related language. When these were compared to results of the Young People’s study it was found that while specific components of food literacy were largely contextual, the importance of all eight domains continued to be relevant.

The results of these qualitative studies have set the boundaries and scope of meaning of food literacy and will be used to inform the development of measurable variables to be tested in a quantitative cross-sectional study. This prospective study will examine the relationship between food literacy and nutrition. This research is useful in guiding government strategy and investment, and informing the planning, implementation and evaluation of interventions by practitioners.

PP 296**PORTABLE TECHNOLOGIES USED IN DIETARY ASSESSMENT: A SYSTEMATIC REVIEW**L. Gemming¹, C. Ni Mhurchu², J. Utter³¹Clinical Trials Research Unit, University of Auckland, ²Clinicals Trials Research Unit, University of Auckland, ³Epidemiology & Biostatistics, University of Auckland

Background: Recent advances in handheld-computer technologies have opened up possibilities for new methods of dietary assessment. Digital cameras, wireless data transmission, touch screen devices and software for automated image analysis have great potential to improve dietary assessment. Therefore a review was conducted to explore the range of portable technologies available and their validity/reliability for assessing dietary intake.

Aims: To identify portable technologies used in dietary assessment and examine the validity and reliability of the identified methods where data available.

Methods: A systematic search of peer-reviewed literature was conducted to identify all relevant English language publications from January 2000 to November 2011. All study designs and technical articles were eligible for inclusion. Obsolete and non-digital technologies, such as photographic film and dictaphones were excluded.

Results: 18 publications were identified that described four portable technologies (digital cameras, PDAs, mobile phones and a custom device). Ten different methods of portable technology-assisted dietary assessment were described in studies conducted in the United States of America, Japan, Australia, Denmark and the United Kingdom. Seven methods used digital photos as the primary source for dietary intake information. Three methods used portable technologies to enhance traditional methods: electronic food records, food records with photos, and an image-assisted 24h recall. The criterion validity of an image-based method (Remote Food Photography Method) to estimate energy intake has been demonstrated using weighed meals. However, limitations of other image-based methods in free-living conditions were evident as the variety and complexity of foods made accurate image analysis difficult. The criterion validity of two PDA electronic food record software packages has also been demonstrated using an observed weighed lunch (DietMatePro) and doubly labelled water (Balance Log). All other methods have only been tested in small pilot or feasibility studies.

Conclusions: Use of photos captured from portable technologies to assess dietary intake is a growing trend but the accurate analysis of images captured in free-living conditions is a major challenge for these new methods. The development of semi-automated food record systems may provide objectivity lacking in current methods. However, these systems are still under development and are yet to be validated.

PP 297**“BRAZILIAN ADOLESCENTS” FOOD AND BEVERAGES CHOICES DURING SCHOOL BREAK: SCHOOL MEAL PROGRAM OR OTHER ESTABLISHMENTS?”**A. C. Leme¹, S. Tucunduva Philippi¹, E. Toassa¹¹Department of Nutrition

Background: The consumption of food and beverages at school falls into two main categories: the National School Meal Program and the competitive foods (which replace the balanced school meal). Objective: To identify the adolescents' food preferences: the Brazilian School Meal Program or competitive foods through a qualitative method. Methods: This was a qualitative cross-sectional study with 83 adolescents from a public school in the city of São Paulo. The participants answered the following question: During the school break do you usually eat or drink something? Please justify your answer. The adolescents' answers were analyzed by a Brazilian qualitative method called Discourse of the Collective Subject based on the Theory of the Social Representations. It consists of the collection of all the subjects' speeches which are clustered in same, similar or complementary ideas. These ideas generate a discourse in the first person of the singular that represents the ideas of a collectivity. In this technique each individual answer generate methodological figures - key expressions and central ideas - that result in the Discourse of the Collective Subject. Results: The Discourse of the Collective Subject generated 4 following ideas: School Meal Program (36.2%), don't eat anything (26.7%), bring food and beverages from other establishments (20.1%) and just drink water or juices (17.1%). The adolescents who chose the School Meal Program claimed they had no other alternatives. On the other hand, the participants who refused the meal offered by the school did so because they disliked it and as a result brought snacks from home or food markets. Furthermore, they stated that a typical Brazilian lunch (rice and beans) was inadequately served in the middle of the morning. Their general preferences were: cookies, chips, hot dogs, fried and baked finger foods, candies and sodas. Conclusion: Most of the adolescents' claimed they have an inadequate diet. At the same time the school environment can have an important influence on their food choices. So our study suggests that changes should be made in the school meal program offering healthy and palatable options.

Key Words: Adolescents, food choices, School Meal Program, Competitive foods, qualitative research.

PP 298**A SELF MANAGEMENT IPHONE APPLICATION FOR RECORDING FOOD INTAKE, BODY WEIGHT AND ENERGY BALANCE**N. King¹, F. Loewenich¹, A. Hills², R. Wood¹, N. Byrne¹¹Institute of Health and Biomedical Innovation, Queensland University of Technology, ²Mater Research Institute

Food intake is traditionally measured using self-record food diaries which involve logistical and compliance issues. Recently a range of electronic and automated techniques have been developed to improve the accuracy and validity of recording food intake. The aim of this ongoing project is to develop a smart-phone application to facilitate the self-recording of food intake and monitoring energy balance in research and clinical populations. The application could also be used as a self-management tool for preventing and treating chronic diseases.

We have developed a Dietary and Weight Management application (app) for the Apple iPhone. The app includes features with the capacity for individuals to record their body weight, food intake and monitor their energy balance. The app has the potential to provide continuous feedback about energy, macronutrient, vitamin and mineral intake. The application utilizes the iPhone's built-in camera as a barcode reader for EAN, UPC, and other popular barcode formats to identify foods. A custom 2D barcode reader is also available to produce unique barcodes for foods that do not have barcodes. Portion size (g or ml) is currently entered manually by the individual, however, we are working on a wireless portable weighing scale as an alternative method of automatically recording portion size. Once the food type and portion size are entered, the energy and nutrient information are automatically retrieved from a nutrition database (AUSNUT 2007), and displayed on the screen. The data are time and date stamped, and automatically recorded in a secure database. The app provides an accumulative measure of total daily energy intake and expresses it relative to individual energy requirements. This information is constantly displayed as an analogue bar showing the proportion of calories required to maintain energy balance. If the individual eats less, or more than their energy requirements (i.e., energy required to maintain energy balance), the daily deficit or surfeit is automatically factored into the next day's requirements. The app has the capacity for a researcher or clinician to provide automatic feedback and prompts – via SMS or phone – as reminders of when, and specifically how to alter dietary intake. Therefore, the app could be used as an intervention tool to manage and improve dietary intake.

This app provides a novel platform for improving the measurement of food intake, which could have various implications for the self-management of health behaviours and chronic diseases, including a weight management tool for reducing obesity

PP 299

ASSESSMENT OF THE RELATIVE VALIDITY OF REALITYMALTA™, A NEW INTERNET-BASED DIETARY ASSESSMENT TOOL, IN MALTESE SCHOOLCHILDREN.

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Background: The prevalence of childhood obesity is increasing in most countries, including Malta. The school environment could offer a suitable setting for the use of these new dietary assessment methods. In this study we compared nutrient intakes obtained from RealityMalta, an internet-based dietary assessment tool for children aged 9-11 years, with results from a single 24-hour multiple pass recall (24-h MPR) as the reference method.

Aims: To modify the tool RealityMalta and adapt it for use in Maltese children and to assess its validity for measuring diets of Maltese children aged 9-11 years.

Methods: A convenience sample of 6 elementary schools, located in different areas on the island of Malta, were chosen and asked to participate through request letters. 50 children (22 boys, 28 girls), average age 10.2 years, were recruited following receipt of parent consents. They first used RealityMalta, then were interviewed by the researcher to provide details on their previous day's food and drink intake at their school. Results for both RealityMalta and the 24-h MPR were first categorised into 21 food groups and then compared using Spearman correlations and Wilcoxon signed-rank tests. Total energy and macronutrient intakes were then computed and results obtained from both methods were compared using t-tests or Wilcoxon signed-rank tests as appropriate. The Bland-Altman method was used to assess the limits of agreement for energy and macronutrients.

Results: Using RealityMalta, the children underestimated their intake of bread, savoury snacks and dairy foods (all $p < 0.05$) but overestimated their intake of milk ($p < 0.05$). There were statistically non-significant differences for all other food counts. The correlations between MPR and RealityMalta were significant for most food categories except for sugar, nuts and seeds. Energy and fat intakes were significantly lower by RealityMalta than by the 24-h MPR ($p < 0.001$) but intake of total sugars and non-milk extrinsic (NME) sugars expressed as a % of total energy, was not significantly different by the two methods, though the 95% CI for the limits of agreement were wide.

Conclusions: In Maltese schoolchildren, a single day's dietary recall using RealityMalta provides valid information on total sugars and NME sugars as % total energy on a group, but not individual, basis.

PP 300

DEVELOPING INTERNET-BASED TOOLS TO ASSESS DIET ADHERENCE AND PROVIDE FEEDBACK IN CKD IV

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Successfully changing patients' dietary behavior is a challenging problem in the management of chronic kidney disease (CKD). Focus groups were used to develop a physician friendly dietary report format. This was then applied in a clinic environment on patients diagnosed with stage IV CKD (pre-dialysis stage). To test the feasibility and acceptability of an internet-based, self-administered, dietary assessment tool equipped with instructional feedback, aimed at facilitating patient dietary change and reducing resource burdens on providers, 12 patients diagnosed with stage IV CKD (pre-dialysis stage) were recruited. Multiple validated questionnaires, gauging nutritional education, importance in CKD management and patients' compliance to required dietary guidelines were applied. Results show that 25-30% of the patients were severely non-compliant to the requirement guidelines for each nutrient. Awareness about the role of diet in CKD management was found among 0%-58% of population varying over different nutrients. All of the patients successfully completed the web based dietary assessment. Patients and physicians differed considerably in their perception of the use of the report. Dietary knowledge and adherence to KDOQI guidelines is suboptimal among CKD patients, however, interest and motivation is high. Web based tools are well-accepted among CKD patients as an aid to assessing dietary adherence to KDOQI guidelines and may pose a cost effective approach to bridging the adherence gap.

PP 301

TWO WEB BASED 24 HOUR RECALLS PROVIDE VALID PROTEIN AND POTASSIUM INTAKE REPORTS FOR AFRICAN AMERICANS AND CAUCASIANS IN THE ENERGETICS STUDY

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Web based recalls offer an inexpensive and widely accessible dietary assessment alternative. Their validity for protein and potassium intake assessment was tested among African Americans (AA) and Caucasians (C) and compared with

National Cancer Institute Dietary History-food frequency Questionnaire (NCI-DHQ) results in the Energetics study. On two independent days, subsequent to 24 hour urine collections, a multipass, food image-based, computerized tool (DietDay) was conducted among 244 Caucasians and African Americans. The validity of the 24 hour protein reports in AA is higher compared to that of the C. The log-transformed Pearson's correlation adjusted for age, gender and BMI between mean urinary protein and the corresponding mean of 2 DietDays protein intake was 0.37 among African Americans (AA) and 0.29 among Caucasians.(C). For the DHQ, adjusted log correlations for protein were much lower with correlations of -.05 for AA and .16 for C. Potassium validity also differed by race. The log-transformed Pearson's correlation adjusted for age, gender and BMI between mean urinary potassium and the corresponding mean of 2 DietDays potassium intake was 0.29 among African Americans (AA) and 0.38 among Caucasians.(C). For the DHQ, adjusted log correlations for potassium were much lower with correlations of .15 for AA and .06 for C. These findings suggest that web based DietDay dietary recalls offer an inexpensive and widely accessible dietary assessment alternative, whose validity is strong among AA as among C adults. Web administered recall validity was superior to this paper-pencil administered Food Frequency Questionnaire (FFQ) for protein and potassium. Supported by NIH R01CA1050.

PP 302

SOURCES OF SATURATED FAT AND SUGAR IN BRAZILIAN DIET: DATA FROM THE BRAZILIAN NATIONAL DIETARY SURVEY 2008-2009.

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Background: Dietary Guidelines are the basis of food and nutrition policies. Identifying the food groups that contribute to healthy or unhealthy eating is an important step to translate nutritional recommendations into food-based guidelines.

Objectives: To describe the food groups that most contribute to the intake of saturated fat and free-sugar in Brazilian diet.

Methods: A total of 34,003 subjects aged 10 years old or more participated in the first Brazilian Individual Dietary Survey, conducted in a subsample of the 2008-2009 Household Budget Survey. The present analyses were based on the first day of food record and considered 23 food groups. Groups considered as healthy eating in the Brazilian guidelines included: rice, beans, vegetables, fruits, and low fat milk as well as food groups that are advised to be eaten in specific amounts because their content in proteins, vitamins and minerals (meat and poultry) or fiber (manioc flour and whole bread). Analysis also included food groups which should be restricted in a habitual diet, such as crackers, cookies, filled cookies, processed meats, cakes, desserts, soft drinks, sandwiches, pizza, deep-fried and baked snacks, savory snacks, breads, fruit juices and flavored beverages. Saturated fat and free-sugar intakes were expressed related to energy intake density (grams per 1000kcal) and compared according to the report of selected food groups for male and female adolescents (10-19yo), adults (20-59yo) and elderly (60yo+) and for quartiles of family monthly per capita income. The analyses took into account the sample weights and design effect.

Results: The mean energy intake was 1921kcal/day and the contribution of saturated fat and free-sugar to energy intake was 9% and 13%, respectively. Women reported higher intake of saturated fat (9.4 vs. 9.1%) and free-sugar (14.0 vs. 12.50%) than men. Consumption of traditional Brazilian foods such as, rice and beans, manioc flour and fruits were related to the lowest participation of energy from saturated fat (7.5%) and free-sugar (10.2%). Conversely, the intake of filled cookies, soft drinks, desserts, savory snacks and pizza were associated with the highest averages of energy coming from saturated fat (12.1%) and free-sugar (19.8%). These findings were similar across all sex-age groups and income categories.

Conclusion: Combining food groups and nutrients provides a comprehensive picture of the national food intake and indicates diet quality markers that can be used in nutritional surveillance surveys as well as in food-oriented guidelines to promote healthy food habits.

PP 303

DEVELOPMENT AND EVALUATION OF A GERMAN SIMPLIFIED WEB-BASED 24H-DIETARY RECALL

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Background: Currently, the most promising approach to dietary assessment in large scale epidemiological studies is the combined use of different dietary assessment instruments to estimate usual food intake. To minimize participants' burden, a simplified 24hour recall (short-24HR) that can be administered repeatedly via the web was developed to

provide accurate and easy to collect information to estimate frequency of food intake. Methods: Recent national survey data provided by the National Nutrition Survey II (n=12502) were analyzed by linear regression on nutrient or food group intake to identify food items characteristic for the German diet and to generate a food list for the short-24HR. 481 individuals of 5 German study centers located in Augsburg, Berlin-South, Freiburg, Kiel and Regensburg were invited to test the web-based instrument. Study participants were randomly prompted three times over a period of 3 months to complete the short-24HR and an evaluation form. Results: The short-24HR consists of 71 questions inquiring about intake (yes/no) of a list of 247 foods on the previous day in an easy to complete drop-down menu. These 247 food items reflected at least 70% of variation in intake of 27 nutrients. Overall, 69% of individuals invited completed the short-24HR. Lack of internet access was the primary reason for refusal (70%). The median duration of completing the short-24HR was 9 minutes. On the evaluation form, 95% of participants indicated their willingness to complete the web-based form again. Conclusion: The short-24HR was shown to be largely accepted, easy to be administered and suitable for application in large-scale cohorts. It is a promising new instrument for the use of dietary assessment methods in combination e.g. with a FFQ to estimate usual food intake in large scale settings.

PP 304

A NEW 'FLOWER LEAF' APPROACH FOR FOOD FREQUENCY QUESTIONNAIRES

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Food frequency questionnaires (FFQ) are commonly used in epidemiological studies to assess dietary intake. As a comprehensive assessment may result in a long burdensome FFQ, we developed a FFQ for a 5-year study, using a new approach consisting of a combination of 1 main and 3 complementary questionnaires, all with a reference period of 1 month. The 4 questionnaires can be filled out at different moments during the study period, and combined cover usual intake. We called it the 'flower leaf' approach. The main 'flower heart' FFQ (110 food-items) was developed to estimate intakes of total energy, fat, carbohydrates, protein, and alcohol. It asks the frequency of consumption of the major food groups. The 3 complementary 'flower leaf' FFQs consist of questions to estimate the intakes of specific foods or nutrients. Leaf 1 aims to assess the intakes of the types of fatty acids, and caffeine containing foods (59 food-items), leaf 2 assesses vitamins B2, B6, B11, B12, calcium, and soy foods (61 food-items), and leaf 3 assesses retinol equivalents, vitamins C, E, and dietary fibre (64 food-items). Questions in these three specific FFQs only ask whether a food-item from the main FFQ is used or not, and if it is used, how often specific types of this food-item are used. Also questions about dietary supplements are added. The source for generating the food lists was the Dutch National Food Consumption Survey (DNFCS 1998). In combination, the FFQs cover more than 96% of the absolute level of intake, and explain more than 93% of the between-person variability of each nutrient as assessed in the DNFCS by two-day food records (n=4789). To calculate the intake of specific nutrients assessed by the leaf FFQs, we first derive the number of servings of the major food reported in the heart FFQ (e.g. rice) and then use the information about the specific type reported in the leaf FFQ (e.g. white rice). Time estimated to fill out the flower leaf questionnaires is 75 minutes, of which 30 minutes for the heart, and 15 for each of the leaves. A comparable comprehensive FFQ (200 food-items) takes 45-60 minutes. Although total time needed for the new approach is longer, the possibility of the flower leaf approach to divide needed time over 4 time-points offers the possibility to assess usual comprehensive food intake in a for participants more convenient way.

PP 305

OPTIMISING FFQS FOR MULTIPLE NUTRIENTS BY SELECTION OF FOOD ITEMS USING MIXED INTEGER LINEAR PROGRAMMING

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Currently, the selection of the most informative food items to be included in Food Frequency Questionnaires (FFQs) is to a large extent done manually. Although the selection procedure is done by experts it could be made more transparent, and less time-consuming. Especially in case of multiple nutrients it is hard to obtain sufficient information on all nutrients of interest within a limited number of food items. Therefore, we present a Mixed Integer Linear Programming (MILP) model to support the selection of food items for FFQs. The model helps to select items in such a way that the amount of information on all relevant nutrients is maximised while the food list is as short as possible.

The selection of food items was based on the food consumption data collected with a 2 d food record of 3524 adults aged 25-65 years who participated in the Dutch National Food Consumption Survey of 1997/1998. To demonstrate the methodology we used the MILP model to select food items for an FFQ with interest in energy and nine nutrients. Three different quantities are used to optimize the selection of food items, namely MOM1, MOM2, and R2. In order to evaluate the performance of the methodology the generated food lists are evaluated with respect to the length of the

questionnaire, the percentage of intake and the explained variance. The percentage intake is defined as the sum of the reported intake of all food items in the food list of all subjects divided by the total sum of the reported nutrient. It takes 60 items to obtain a food list in which all nutrients and energy have an explained variance of 80% or more. The percentage intake of the nutrients varies between 92.7% and 98.0%. Results also show that MOM2 is the best quantity to optimize food lists of less than 20 items, and MOM1 is the best quantity for food list of more than 70 items. For intermediate lengths of the food list, none of the three quantities is constantly better than the others. In addition, a comparison was made with the ValNed FFQ, which was generated by identifying the food items for each nutrient separately using MOM2. The MILP model can obtain a similar R² as ValNed in substantially fewer items. In conclusion, the MILP-model makes the selection of items standardised and transparent, and is especially helpful in coping with multiple nutrients.

PP 306

VALIDITY OF A BRIEF QUESTIONNAIRE FOR DETERMINING USUAL EATING PATTERNS: THE UEPQ

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Background: Eating patterns such as eating frequency, snacking and breakfast skipping have been suggested to play a role in obesity and chronic disease risk. However, methods for assessing eating patterns are not standardized. Food records and 24h recall methods were developed primarily to determine nutrient intakes but not eating patterns. Furthermore, those approaches are subject to reporting bias, particularly underreporting of energy intake, which may in part be due to underestimation of eating frequency.

Objectives: We assessed the validity of a brief questionnaire designed to determine usual eating patterns (UEPQ) in a sample of individuals who plausibly reported energy intakes (Huang et al 2005) from multiple pass 24h recalls. We hypothesized there would be no significant difference in eating patterns assessed by the two methods.

Methods: We used data from n= 61 healthy, nonsmoking, weight-stable adults (aged 18-58 y; BMI 19-36 kg/m²) who participated in an ongoing study on diet and chronic disease risk at Purdue University and whose 3-day mean energy intake from multiple pass 24h recalls was plausibly reported (within ±30% of predicted energy requirement (IOM 2005)). The UEPQ was a modification of the meal pattern grid designed by Bertéus Forslund et al for use in a Swedish population (2005). We modified the grid to include American food examples, a specific question about breakfast, and separate assessment of weekday and weekends over the past month. Frequencies over 3 days of all eating occasions, meals only, breakfasts, and snacks were calculated from the UEPQ and 24h recalls, weighted for the ratio of weekdays to weekend days. Eating pattern variables were not normally distributed; therefore the data were analyzed using nonparametric statistics.

Results: Based on 24h recalls, snacking and skipping breakfast and lunch were common: over 3 days, 35% of subjects snacked >6 times, and on ≥1 day 31% skipped breakfast, 31% skipped lunch, but only 5% skipped dinner. Median frequencies of total eating occasions, all meals, breakfast only, and snacks did not differ significantly by method (24h recalls: 15.0, 8.0, 3.0, and 7.0 /3d vs. UEPQ: 15.4, 9.0, 3.0, and 6.8/3d). Between-method Spearman correlations were medium in magnitude for all eating patterns examined: total eating frequency (r=0.57; p<0.0001), meal frequency (r=0.38; p=0.003), breakfast frequency (r=0.41; p=0.001) and snack frequency (r=0.58; p<0.0001).

Conclusion: The UEPQ may be a valid tool to assess eating patterns in adults. Additional studies with larger sample sizes are needed to confirm these findings. [Funding: R01DK075862]

PP 307

SIMPLIFIED 24-H-RECALLS – A NOVEL APPROACH TO IMPROVE DIETARY ASSESSMENT IN LARGE COHORT STUDIES

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Introduction: The Food Frequency Questionnaire (FFQ) has been evaluated in validation studies during the past years with the conclusion that misclassification compared to objective methods for dietary assessment are large and that short term methods such as food records or 24-h-recalls provide less biased data. Thus, it was suggested that short term methods should form the next generation of dietary assessment tools for epidemiological studies and that FFQs should be used to identify habitual use or non-use of specific foods. However, the precision to estimate individual diet depends on the number of days and about 4 to 6 days are necessary to properly reflect the diet of the individual. In population based large scale epidemiological studies, the conduct of this number of interviewer administered 24-h-recalls would be

cost and time consuming. Also, the alternative to ask the study participants to fill in several web-based self-administered 24-h-recalls seem to be a rarely applied due to unknown validity and complexity of the programs.

Method: We propose to use 3 to 6 24-h-recalls tailored to the estimation of the probability of intake together with a questionnaire asking for the habitual use of specific foods and food groups. The idea is to restrict the collection of information to the question of use or non-use of a specific food at a specific day. The quantitative daily amounts of foods consumed will be derived from interviewer conducted 24-h-recalls performed in a sub sample of the study population. In order to increase precision, covariate adjusted daily amount values should be taken. In this study we investigated the impact of individual versus standardized quantification of daily amounts of foods on the overall estimation of habitual food intake of individuals.

Results: Using 12 24-h-recalls from 134 individuals, initial data analysis of 37 foods indicate that intake of foods derived from estimates of individual probabilities and standardized daily amounts still correlate with about 0.7 to intake estimates using individual probabilities and individual daily amounts. The correlations between individual daily amounts and standardized amounts themselves showed a high variation from about zero up to nearly 1. We observed that the use of standardized daily amounts compared with individual amounts was associated with reduced variation.

Conclusions: The use of simplified 24-h-recalls appears to be an interesting alternative to assess dietary intake in large scale epidemiological studies compared to the traditional FFQ methodology.

PP 308

VALIDATION OF A DIETARY ASSESSMENT TOOL TO ACCURATELY ASSESS POLYUNSATURATED FATTY ACID INTAKES IN THE NEW ZEALAND POPULATION

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Background: The health benefits of long chain omega-3 polyunsaturated fatty acids (LC n-3 PUFA) are well established. Current intakes of these fatty acids and foods contributing to polyunsaturated fatty acid (PUFA) status in New Zealand (NZ) cannot be assessed accurately as there is no valid dietary assessment tool or a complete fatty acid food composition database available to assess PUFA intakes in NZ.

Aim: This validation study aimed to develop, validate and test the reproducibility of a NZ-specific food frequency questionnaire to assess dietary intakes of polyunsaturated fatty acids (NZ PUFA FFQ).

Methods: A 36-item, semi-quantitative NZ PUFA FFQ was developed based on a validated Australian PUFA FFQ. The Australian fatty acid database was adapted to include NZ-specific fatty acid values for 86% of the major sources of PUFA. Healthy subjects ($n=48$) from Auckland, NZ provided fasting blood samples for biomarker (erythrocyte PUFA) analysis, completed the NZ PUFA FFQ and a 3-day weighed food record (WFR) (validation), and repeated the NZ PUFA FFQ ($n=41$) three months later (reproducibility). The method of triads was used to assess the triangular relationship between the NZ PUFA FFQ, WFR and erythrocyte PUFA for eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA) and total LC n-3 PUFA. Validity for alpha linolenic acid (ALA), linoleic acid, arachidonic acid, total omega-6, total omega-3 and total PUFA was determined by assessing agreement between NZ PUFA FFQ and WFR intakes using a cascade of statistical tests.

Results: The NZ PUFA FFQ effectively estimated dietary intakes with strong validity coefficients for EPA (0.72 [95% CI 0.49, 0.89]), DHA (0.72 [95% CI 0.53, 0.95]) and total LC n-3 PUFA (0.68 [95% CI 0.47, 0.89]) intakes. The NZ PUFA FFQ was comparable to the WFR for all PUFA except DPA. There were significant correlations between repeated implementations for all PUFA intakes except ALA, with correlation coefficients ranging from 0.44 to 0.76.

Conclusion: The NZ PUFA FFQ is a valid and reliable tool to measure PUFA intakes in healthy NZ adults. Using this tool to assess PUFA intakes can provide direction for public health strategies, and will be useful in nutritional research and clinical settings.

PP 309

SCRAN24 – SELF COMPLETED RECALL AND ANALYSIS OF NUTRITION

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Novel methods of assessing dietary intake are required to reduce the burden of participating in dietary surveys, improve participation rates and the representativeness of the sample. Such methods could also minimise the impact of measuring dietary intake on subject's food intake during the recording period.

The use of a computerised 24hr recall has the potential not only to engage the user and make the task less onerous but also to reduce the amount of researcher time required, improve the consistency of coding and reduce the potential for data entry errors.

IPSAS (Interactive Portion Size Assessment Software) is an interviewer led computer based portion size assessment tool for use with children. Using IPSAS children of 11 years and over were found to be as accurate and precise as their parents in estimating portion size.

IPSAS was further developed into a self completed computerised 24hr recall, modelled on the multiple pass method, for use with children aged 11-16 years (SCRAN24).

The development of SCRAN24 was informed by an extensive literature review, a series of focus groups and usability testing. Initial focus groups used paper-based activities to simulate a range of tasks. Software development focus groups examined the usability and performance of prototypes of the system, assessed comprehension of tasks required and identified further development requirements. Final testing assessed the usability of the system and measured success rates of finding foods and time taken to complete the recall.

Small scale validation was conducted with 39 children and parents. Parents kept a 24 hr weighed food diary for their child. The child completed a 24 hr recall using SCRAN24 the following day. Food and drink items reported using SCRAN24 were classified as an exact match, an approximate match, an omission or an intrusion. Accuracy and precision of estimates of energy and nutrient intake using SCRAN24 were assessed.

SCRAN24 was very well received by the young people taking part in the study, it was relatively quick to complete and worked well in both the home and the school environment. The level of matches, omissions and intrusions were similar to those reported during a dietitian administered 24hr recall but energy intakes reported using SCRAN24 were low compared with the weighed food diary.

With further development to improve both the usability and accuracy of SCRAN24 could facilitate the rapid collection of dietary data from large numbers of children in a school setting.

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PP 310

THE RESEARCHER WEBSITE FOR THE AUTOMATED SELF-ADMINISTERED 24-HOUR RECALL (ASA24) SYSTEM: AN INNOVATIVE RESEARCH TOOL.

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The Automated Self-Administered 24-hour dietary recall (ASA24) is a web-based tool that provides an affordable means of collecting high-quality dietary data. ASA24 can be used for surveillance, epidemiology, and intervention research, as well as by clinicians and educators. ASA24 consists of a Respondent website used by participants to complete recalls and a Researcher website used by researchers, clinicians, and educators to register and manage studies. The Researcher site provides options for study-specific configuration of the Respondent site, including tailored welcome and thank you text, and study logos to be displayed to participants. Researchers can opt to include modules querying where meals were consumed, who meals were eaten with, TV and computer use during meals, and supplement intake. Studies can be configured as 'scheduled' or 'unscheduled.' If 'scheduled,' researchers are required to upload recall completion dates for each participant and recall. This facilitates unannounced recalls by restricting participant access to the Respondent website to assigned reporting dates. The 'unscheduled' option permits respondent access at any time and requires researchers to assign recall dates outside of the ASA24 system. In either case, tracking of participant progress is essential to the success of a study and is facilitated by Researcher site reports on complete, incomplete, and upcoming recalls. Once data collection is underway, researchers can obtain up to eight data files that include food and supplement codes and nutrient and food group estimates for each individual per recall day. To assist in assessing data quality, files include flags to indicate whether a recall was completed up to the last question and whether any data (e.g., portion size) are missing. The Researcher site produces reports with data for all participants as well as instant reports for a particular individual. Beta versions of the Respondent and Researcher sites were released in August 2009 and, as of December 2011, had been used by over 175 researchers to collect over 40,000 recalls. Among registered studies or classes, the number of participants ranges from fewer than 10 to 2500, and several multiple year studies have been initiated. Version 1 of ASA24, which offers improved functionality and new features compared to the Beta version, was released in September 2012. As researchers continue sharing their experiences and begin publishing data from ASA24, the Researcher site will be further developed to ensure that it supports the collection of high-quality recall data.

PP 311

CONTRIBUTIONS OF COMMONLY UNDER-REPORTED FOODS AND INTAKES AT UNEXPECTED EATING TIMES TO REPORTED ENERGY INTAKES AMONG ADULTS USING AN IMAGE-BASED DIE

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Background: Traditional methods of dietary assessment are fraught with error associated with self-report. Contributions to error in self-reported dietary intakes may include reporting certain foods less frequently or in smaller portions than actually consumed. Foods thought to be under-reported among adults include beverages, desserts and candies, and condiments. Image-based methods of dietary assessment are being designed to reduce the user burden of reporting

eating events and portions consumed in an effort to improve measures of dietary intakes. Objectives: First, to quantify commonly under-reported foods in images captured by adults over 3 non-consecutive days. Second, to quantify the contribution of energy provided by foods captured in images taken at unexpected eating times (i.e., between 22:00 and 05:59). Methods: Twelve adults (aged 20-58 y; 5 women, 7 men) participated in this study. Participants' heights and weights were measured by research staff. All meals and snacks were provided in excess of the participants' estimated energy requirements (EER). Using an application running on a mobile telephone, participants captured images of all eating occasions on each of three non-consecutive days, and were encouraged to take images of any foods or beverages they consumed that were not provided to them. Before and after images taken by participants were reviewed by research staff, and portions of foods in each image were estimated for reported energy intakes (rEI) using standard protocols. Foods were categorized according to the 16 AMPM major food groups (MFG). The metadata time stamp was used to assign each image to a time of day quadrant defined as A) 06:00-10:59, B) 11:00-16:59, C) 17:00-21:59, D) 22:00-05:59. Results: A total of 754 foods were recorded in images. Of these, 109 (14%) were beverages not provided to the participants (e.g., coffee, sodas, beer, water). The largest proportion of mean rEI (18%) came from breads and sweet breads. Beverages contributed a mean 13% of total rEI. Foods categorized as beverages, candy, syrups, sweeteners, desserts, snacks and condiments (i.e., commonly under-reported foods) accounted for 51% of the reported number of foods and a mean 44% of rEI. Foods consumed during time quadrant D, represented 13% (min: 0; max: 23%) of total rEI across 3 recording days. Significance: These results provide evidence that image-based dietary assessment methods hold promise for capturing many commonly under-reported foods. Additionally, it may be easier to simply take an image with a mobile device than to write down foods consumed throughout the 24-hour day. The possibility exists that the image capture process using a mobile device is so effortless that the time and opportunity to dwell on social desirability is abated, thus contributing to improved measures of dietary intakes. However, we can't rule out that our distribution of candy bars and other commonly under-reported foods may have attenuated the motivation for social desirability. Larger studies with more diverse sample populations among which biomarkers are used will be needed to confirm these results for generalizing to choices of dietary assessment methods.

PP 312

THE USE OF AN INDICATOR VARIABLE RATHER THAN AN FFQ CAN BE USED TO ESTIMATE USUAL INTAKE OF FOOD EPISODICALLY CONSUMED

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Introduction: the information about frequency of consumption, from a food frequency questionnaire (FFQ) can improve the prediction of statistical models that estimate usual intake using 24-hour recalls (24HR). The FFQ as covariate is used to identify usual consumers and non consumers of a given food. However, some individuals are subject to report no consumption from an FFQ and also report consumption greater than zero in a 24HR. Then, the use of a variable that identify usual consumers and non consumer would be helpful. Objective: to verify the performance of the FFQ and an indicator variable as covariate to estimate habitual food intake. Methods: A sample of 716 individuals answered one R24HR and one FFQ. A subsample (93%) answered a second 24HR. the usual dark green vegetable intake was estimated using the National Cancer Institute method. Participants who were non-consumers of a food according to the FFQ and who did not report consumption of this food in the 24HR were defined as true non-consumers. Then, it was created an indicator variable (usual consumer yes or no) for each food. The models to estimate the food intakes were: a) null model; b) with FFQ as covariate; c) with FFQ and the indicator variable; and d) only the indicator variable. Results: In all analyzed foods, the inclusion of the FFQ was not able to distinguish consumers and non consumers. When the indicator variable was included together the FFQ, the prediction was better. It should be noted that the inclusion of the indicator variable alone estimated similar results compared to the model with the FFQ and indicator variable. When the analyzed food was not consumed almost every day for everyone, inclusion of neither FFQ nor the indicator variable consisted in improvement in the prediction. Conclusion: These results showed that the inclusion of an indicator variable per se it enough to reach a good estimate. This implies in cost and time saving when data are collected.

PP 313

THE USE OF QUANTILE REGRESSION TO ASSES RELATIONSHIP BETWEEN DIET-DISEASE: A TOOL FOR THE NUTRITIONAL EPIDEMIOLOGY

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Introduction: The relationship between fruits and vegetables (FV) and serum homocysteine (hcy) is sometime non significant. The studies usually are based on food frequency questionnaire (FFQ) or mean of few 24-hour recalls (24hr); both contain an expressive measurement error. Estimating intake adjusting for the within-person variance can result in a more accurate distribution of usual intake. Besides, we have a hypothesis that some relationships depend on

the level of exposure and outcome. Then, using quantile regression makes us able to detect this association through percentiles of serum hcy. Objective: To verify association between estimated FV intake and serum hcy using a quantile regression. Methods: We collected two 24hr and one food frequency questionnaire of 514 individuals from a population based survey of residents of the city of São Paulo-Brazil. Habitual intake of FV was estimated via NCI method with covariates: FFQ, sex, and age group. Individual usual intake was estimated using INDIVINT macro for SAS. To verify the association between FV intake and serum homocysteine (hcy) a simultaneous quantile regression model was done. The dependent variable was the serum hcy and independent was estimated individual usual FV intake, sex, age, serum vitamin B12, serum vitamin B6, synthetic folate. It was estimated one coefficient and confidence interval (95%) for each 5 percentiles of serum hcy. The standard errors were calculated using a 400 bootstrap. Further, the same model was performed but using the observed intake (not adjusted) rather the estimated usual intake. Results: FV usual intake was inversely significant with serum hcy at percentiles 10 and 15, and from 40 up to 90. However, the magnitude of this effect was not the same at all level of serum hcy. At percentile 75, for example, the coefficient was twofold the coefficient at percentile 50. Using the observed intake none of the coefficients was significant. Conclusion: The quantile regression using intake adjusted for within-person variance was able to detect relationship between FV and serum hcy, and suggested us that its magnitude varies according to the level of hcy.

PP 314

THE BRAZILIAN PYRAMID AND FUNCTIONAL FOODS: A PRACTICAL APPROACH TO BE USED IN CLINICAL AND EPIDEMIOLOGICAL FIELDS

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Background: Functional foods are to be consumed as part of the normal diet. They contain biologically active components which can promote health and/or reduce the risk of disease, in accordance with the Brazilian food guide pyramid recommendation. Objective: to highlight the main functional foods incorporated in the Food Pyramid in accordance to the Brazilian eating habits. Results: The 8 food groups, the calorie equivalents and portion sizes were maintained. However, the functional foods and their components were highlighted in this guide for better food choices. The foods that are in the base of the pyramid should have a higher consumption and the ones on the top a lower consumption, as follows: whole wheat bread and pasta, brown rice, potato and cassava (fiber), barley and oat (b-glucan) - in the rice, bread, pasta, potato and cassava group - ; grape (flavonoids), guava (lycopene), papaya (b-carotene), citrus fruits (vitamins A,C,E and b-carotene), berries (polyphenols and lignans) and avocado (monounsaturated fat – omega 9) - in the fruits group -; cruciferous as broccoli and cauliflower (flavonoids and polyphenols), carrot (b-carotene), tomato (lycopene), garlic and onion (inulin) - in the vegetables group -; milk and cheese (calcium) and fermented milk and yogurt (probiotics) in milk, cheese and yogurt group; fish (unsaturated fat - omega 3) in the meat, eggs and fish group; beans(folic acid), soy (isoflavone), Brazilian nut (selenium, zinc, magnesium and vitamin E), flaxseed (unsaturated fat - omega 3) and quinoa (flavonoids and polyphenols) - in the beans group -; olive (unsaturated fat – omega 9) canola and vegetable oils (phytosterols and unsaturated fat - omega 6) - in the oil and fat group -; and finally dark chocolate (polyphenols) - in the sugar and sweets group. Conclusion: The Brazilian Pyramid was developed to help people make healthy food choices and it highlights the importance of not omitting any group. It can also be easily used by dietitians and other health professional in their practice to ensure people's healthy diet.

Key-words: food pyramid, functional foods, eating habits, Food choices.

PP 315

VALIDITY AND REPRODUCIBILITY FOOD FREQUENCY QUESTIONNAIRE FOR ADOLESCENTS BASED ON THE GROUPS OF THE BRAZILIAN FOOD PYRAMID

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Background: Adolescents' diet is inadequate and can lead to obesity and chronic noncommunicable diseases when reaching adulthood. Food frequency questionnaires are instruments widely accept in epidemiological and clinical practice to evaluate individuals' diet, but before their use validity and reproducibility process and studies are need it. Objective: To access the validity and reproducibility of a food frequency questionnaire for adolescents based on the Brazilian food pyramid. Methods: This was a validity and reproducibility study with 109 high school adolescents from a public school of the city of São Paulo during the first semester of 2010. The Food Frequency Questionnaire was completed twice (FFQ1 and FFQ2) at an interval of 90 days, along with four 24hour recalls. A list of 50 items (42 foods and 8 beverages) constituted the FFQ. Validity was evaluated by comparing the average of the four 24hour recalls with the FFQ2. Reproducibility was evaluated by comparing FFQ1 and FFQ2. Statistical

descriptive analyses were used to verify energy, nutrients and portions sizes consumed on both dietetic instruments. Meanwhile, the validity and reproducibility were accessed through Pearson correlations coefficients and kappa statistics. Results: The Pearson correlations, after being adjusted for energy, presented the highest variability for the following groups of the pyramid: rice, bread, pasta, potato and cassava (0.88), meat and eggs (0.82) and sweet and sugars (0.82). The highest value for reproducibility was in the sweet and sugar group (0.72). On average both dietary instruments presented 54.5% and 51.4% of agreement for validity and reproducibility, respectively. The kappa values for validity ranges between 0.15 and 0.57 and for reproducibility between 0.13 and 0.51. Conclusion: The food frequency questionnaire based on the Brazilian Food Pyramid was validated and reproduced for a range of nutrients in epidemiological research and public health interventions for adolescents.

Key words: Adolescent, validity, reproducibility, food intake, dietary instruments.

PP 316

MEAL-Q – A MODERN DIETARY ASSESSMENT METHOD

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The Food Frequency Questionnaire (FFQ) has been a frequently used dietary assessment method in epidemiological studies since the 80s. However, much has happened during the last 30 years and it is therefore relevant to update the FFQ methodology. We have developed an interactive web- and meal-based FFQ called Meal-Q. Meal-Q is available in different versions, such as age-specific versions for pre-school children, school children, teenagers, as well as two versions for adults, a short (126 food items) and a long (174 food items) version. Besides questions about intake of food items, Meal-Q includes questions about portion size, meal patterns and behaviors, use of dietary supplements, and intake of alcoholic beverages (for adults). Meal-Q for small children also includes questions about introduction of specific foods, food allergy, and breast-feeding.

All versions of Meal-Q are based on pilot studies where commonly eaten food items and dishes in the Swedish population were identified for each specific age group. In addition, all versions have been, or are currently being, validated against food records and/or biomarkers.

Features in all versions of Meal-Q are an interactive design with extensive skip- and follow-up patterns, automatic controls for missing answers for selected questions and pre-defined answering options. Together, these features minimize the time spent answering the questionnaires, which decreases the participant burden and drop-out rates. Thus, most Meal-Q versions take less than 10 minutes to fill out. When Meal-Q for adults and a traditional non-interactive FFQ were evaluated in a validation study, Meal-Q yielded higher total intake of energy and nutrients, and equal or higher validity for most nutrients than the traditional FFQ. Also, the participants considered Meal-Q to be easier to fill out than the FFQ, even though Meal-Q includes twice as many food items than FFQ.

In summary, Meal-Q is a modern and user-friendly dietary assessment method for assessing habitual food habits. Different versions of Meal-Q are currently being used in four large-scale epidemiological studies, together aiming at recruiting several hundred thousands of participants.

PP 317

VALIDATION OF A MODEL TO ESTIMATE INDIVIDUAL FOOD CONSUMPTION FROM HOUSEHOLD-PURCHASES

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Background. Household-purchase data can be used to estimate individual consumption of foods. A prerequisite is that households are of varying composition and the individual food consumption is dependent on individual characteristics such as gender and age. Models have been developed for nutrient intake, but not for food consumption.

Method. To estimate consumption of dairy foods (yoghurt and custard), which are not eaten on all days by all persons, we applied the 'Chesher model' developed for nutrient intake. The application is validated by comparing simulated true individual values with estimates derived from household-level data. This simulation model was set up to mimic consumption using analysis results of both household-purchase data and individual food consumption survey data.

Results and conclusion. The results of the validation show that estimation of individual dairy consumption from household-level data is possible, although with limited accuracy. Increasing the number of households in the household-purchase surveys will improve the accuracy.

PP 318**DEVELOPMENT OF A FOOD FREQUENCY QUESTIONNAIRE FOR ADOLESCENTS BASED ON THE BRAZILIAN FOOD GUIDE**S. Tucunduva Philippi¹, M. Flores Martinez¹, G. Vieiro da Silva Leal¹, C. Estima¹, E. Lie Araki¹, A. C. Barco Leme¹¹Nutrition

Background: Inadequate eating habits are common among adolescents and this can lead to chronic noncommunicable diseases and obesity when reaching adulthood. Taking into consideration the daily food variability and the quick change in the youth eating habits, the development of instruments able to measure accurately the habitual diet of the adolescents represents an important methodological challenge. Furthermore, it should be considered that people in this age group demonstrate a lack of interest in answering huge questionnaires to evaluate their eating habits. Objective: this study was conducted to design a food frequency questionnaire for adolescents based on the Brazilian food guide. Methods: This study was carried out with 109 high school adolescents from public schools in the city of São Paulo, Brazil. A list of foods was selected through the results of an epidemiological study conducted with same age group in a town on the Coast in the state of São Paulo. The main sources of energy, macronutrients and micronutrients were identified from the 24h recalls applied. The frequency of consumption, average and median portion were defined. Results: The Food Frequency investigated the frequency of adolescents' consumption of 50 items (42 foods and 8 beverages) which represents 97.7% of total calories, 93.2% of carbohydrates, 90.6% of protein, 92.4% of total fat and 90.8% of saturated fat. The foods that most contributed in terms of energy were: snack chips (8.4%), pizza (7%), fried and baked finger foods (6.9%) and meat (5%). The final list of foods and beverages was developed based on the 8 groups of the Brazilian Pyramid. The food frequency was defined in 7 categories: never, < 1x/month, 1-3x/ month, 1x/week, 2-4x/week, 1x/day, ≥2x/day. Conclusion: The food frequency questionnaire proved to be useful in epidemiological studies to evaluate the adolescents' diet over extended periods, making it possible to identify their dietary habits and to evaluate the association between diet and nutritional status.

Key words: Adolescent, nutrition assessment, diet survey, food intake, epidemiological studies.

PP 319**MONITORING HEALTH, NUTRITION AND SCHOOL FEEDING SYSTEM (NUTRISIM): COMPUTER PROGRAM FOR NUTRITIONAL EPIDEMIOLOGY USE**S. M. Voci¹, B. Ferri¹, C. Borges¹, B. L. Januario¹, J. F. Ramos¹, W. L. Conde¹, B. S. Villar¹¹Nutrition

Introduction. Increasingly, computer systems and digital media are being enhanced in the field of health research. Information can be transferred simultaneously into a digital circuit, thus enabling the development of programs of primary health promotion and the monitoring of the individuals diet.. Objective. To develop a computerized system for data collection, evaluation and monitoring of health and nutritional status of school children. Methods. the questionnaires used in NUTRISIM were based on validated questionnaires and were subsequently revised, resulting in 11 interfaces, including: characterization and identification of the school children; anthropometry; sexual maturation, school feeding, socioeconomic profile, nutrition and food security, physical activity, domestic violence, drug use, smoking and alcohol and food consumption. For the structured 24-hour (R24) recall, a photographic atlas of food portion sizes was developed for visual aid. The R24 was pre-tested on the computerized version and its usability was evaluated, both with students and with information technology professionals. NUTRISIM was designed in order for the students to answer the questionnaires directly into the system. Therefore, the user interface used colors, fonts and images to attract attention without missing the purpose of the instrument. The system also contains two virtual environments called "administrator" and "researcher". The filling can be performed in online mode when there is internet access. Otherwise, it can be filled out offline for later synchronization and routing based. Results. The software was able to generate databases without apparent inconsistencies and in a format compatible with all major statistical software, in addition to allowing the exportation and consolidation of a single database, which could be integrated into other databases. The generated data are related to the forms and/or variables chosen by the researcher (number of individuals surveyed, daily food consumption expressed in energy and nutrients). The administrator module allows creating surveys, register and enable access to researchers and all the management functions of the system. The researcher environment allows the registration of surveys under his or her coordination and of school units to be surveyed. Conclusion. It is an instrument that could support epidemiological studies, including large surveys and multicenter studies, as it produces a generic base that can be adapted according to the objectives of each study. The instrument developed allowed an approximation between the nutritional epidemiology and the information technology, expediting procedures such as data transmission, generation of database simultaneously to data collection, and optimization of human and financial resources.

PP 320**THE ZERO-INFLATED MIXED GAMMA REGRESSION FOR FITTING USUAL FOOD INTAKE**

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We propose the zero-inflated Gamma regression mixed model as a novel approach for fitting usual food intake. In this model, zero observations happen with probability p and non-zero observations are modeled by a Gamma distribution with probability $1-p$ as in a mixture model. The mean of the Gamma distribution and the probability p are modeled as a function of fixed and random effects; the fixed effects are not necessarily the same. The random effects account for the heterogeneity due to the repeated measurements of each individual. We achieve a fully Bayesian inference by adopting a Metropolis algorithm within a Gibbs sampler. We use the proposed methodology to fit data from a population study from the city of São Paulo, Brazil, in order to know what variables affect the usual food intake and to estimate the heterogeneity among the individuals. In particular, we model the amount (in grams) of fruit and vegetables intake according to sex, age, drinking and smoking habits, as well as nutritional status. To estimate the heterogeneity among individuals it has been considered two records per individual, measured within 24 hours. The novelty of this model is that it preserves the natural state of the data by fitting zero observations and by avoiding transformations.

PP 321**ESTIMATING SALT INTAKE IN A CAUCASIAN POPULATION: CAN SPOT URINE REPLACE 24 H URINE SAMPLES?**

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Estimating salt intake in a Caucasian population: Can spot urine replace 24 h urine samples?

The gold standard for estimating sodium intake is (repeated) 24-hour urine collection. However, this method is cumbersome, and a simple and valid method to estimate populational 24-h urinary sodium excretion from a casual spot urine sample would be desirable. A method has been developed by Tanaka et al (J Hum Hypert 2002;16:97-103) but the validity of this method in a Caucasian population remains to be established.

Aim: To assess the validity of the predicted 24h urinary sodium excretion using spot urine and two different prediction methods in a Danish population. Overall 473 Danish individuals provided a complete 24h urine collection (validated by the PABA method) and a spot urine sample. Data were collected in the Danthyr study (248 women aged 25-30 years and 60-65 years) and the Inter99 study (102 men and 113 women aged 30-60 years), respectively. The measured 24h urine sodium excretion was compared with the predicted 24 h sodium excretion from a casual urine specimen, using the Tanaka prediction method. Furthermore, using the same approach as Tanaka et al, we fitted a prediction model, based on data from the Danish population.

Results: The median 24 h sodium excretion (median [5 and 95 percentile]), mmol/day was as follows:

Measured 24h sodium excretion: ? : 195 [110; 360]; ? : 139[61; 258].

Predicted 24h sodium excretion by the Tanaka model: ? : 171[117; 222]; ? : 153[92; 228].

Predicted 24h sodium excretion by the Danish model: ? : 207[146; 258]; ? : 134[103; 163].

The residual (measured minus predicted 24 h sodium excretion, mmol/day) was: For the Tanaka model: ? : 37.7 [-43; 185]; ? : -13.1[-100; 92].

For the Danish model: ? : 7.1 [-80; 146]; ? : 4.9[-70; 116].

The correlation (Spearman) between predicted and measured 24 h sodium excretion was 0.47 for men and 0.33 for women for the Tanaka method, and 0.48 and 0.33, respectively for the Danish model.

For both prediction models the proportion of individuals classified in the same or adjacent quintile was 74% for men and 64% for women. Bland-Altman plots showed a tendency of an underestimation of the sodium excretion for excretions above 250 mmol per day (~14 gram salt per day).

Conclusion: Both prediction models gave a reasonable classification of individuals according to their sodium excretion. However, the median daily sodium intake was estimated more precisely by the Danish model, especially among men. Sodium intake was found to be underestimated for individuals with a high sodium intake (>14 gram salt/day).

PP 322**FOOD RECORDS AIDED BY DIGITAL CAMERA SHOW GOOD REPRODUCIBILITY BUT UNDERESTIMATE ENERGY INTAKE IN CHILDREN WHO ARE OVERWEIGHT AND OBESE**

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OBJECTIVE: The objective of this study was to evaluate the validity and reproducibility of a food record (FR) aided by

digital camera regarding the methods ability to estimate energy intake (EI) of children who are overweight and obese compared with total energy expenditure (TEE) registered with the SenseWear Armband (SWA).

METHODS: In total, 73 children, aged 8-12 years at inclusion, used the method 7 times at regular intervals during a 2-year period. They were instructed to use a digital camera to take pictures of everything they ate and drank during the day, and in the evening to note in a food diary together with a parent what and how much had been consumed with the help of the photographs taken. On the same days as recording their food intake their TEE was registered with SWA.

RESULTS: The difference between reported EI and registered TEE was -2.8 (2.4) MJ/d on the first assessment occasion ($t(72) = -10.0$, CI: -3.3,-2.3). Mixed model analysis showed no difference in reporting accuracy between the 7 assessment occasions ($F=1.60$, $p=0.15$). Variables negatively associated with reporting accuracy relative to TEE were age ($b= -0.04$, CI: -0.07, -0.01) and BMI z-score ($b= -0.12$, CI: -0.18, -0.06). Further, reporting accuracy relative to TEE was higher for boys than girls ($b= 0.07$, CI: 0.01, 0.14) and higher with a weekend day included in the record ($b=0.04$, CI: 0.001, 0.08).

CONCLUSION: FR aided by a digital camera showed good reproducibility over a 2-year period, but underestimated EI in overweight and obese children.

PP 323

DEVELOPMENT OF A RECIPE-BASED DATABASE FOR THE ASSESSMENT OF DIETARY INTAKE IN JAPANESE POPULATIONS: PART I – FRAMEWORK AND STRATEGY

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Background/objective: Assessment of dietary exposure to determine disease associations in epidemiological studies is generally done using food frequency questionnaires (FFQs). However, dietary estimates by FFQ for Asian populations are less accurate than those for Western populations. In particular, the variety of mixed dishes consumed in Asia is challenging, and recipes for the same mixed dish may vary depending on age, sex, residential area, and other unknown factors. A representative database of recipes for mixed dishes among a population would be beneficial in studies using the recipe-based dietary assessment method. Hence, we developed a recipe database which consists of recipe names, ingredients, and ingredient weights based on observed dietary data among Japanese.

Methods: Our strategy was to collect existing dietary data obtained in observational studies among widely differing Japanese populations. The data included recipe names, and ingredient foods and their weights, collected by means of dietary records. Recipes are aggregated by name, and grouped into three classes, i.e. large, middle and small classes. Foods that are used in recipes will be linked with a Japanese food composition table for nutrient calculation.

Results: We collected dietary data from four different populations, namely 1) Iwate: 1-day dietary record data of middle-aged to elderly women from Iwate Prefecture, Tohoku (north-eastern area of Japan; age 38-86 years, 25 males and 262 females); 2) JPHC (Japan Public Health Center-based Prospective Cohort Study) areas: 28-day dietary records (7 days in 4 season) of middle-age to elderly men and women from five different areas of Japan (Ibaraki, Niigata, Osaka, Nagasaki, Okinawa; age 40-69 years, 174 males and 176 females); 3) Tokyo: 4-day dietary records of cancer-screening recipients living in a metropolitan area of Tokyo (age 40-69 years, 69 males and 74 females); 4) Nagoya: 3-day dietary records of men and women living in Nagoya, Aichi Prefecture (central area of Japan; age 40-79 years, 556 males and 515 females). The total frequency of mixed dishes and foods from all areas was 240,303.

Conclusion: Collected data included dietary data from both sexes and a variety of areas. Age was limited to middle-age to elderly populations.

Implication of the research: We plan to expand the database to particularly include younger generations.

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PP 324

DEVELOPMENT OF A RECIPE-BASED DATABASE FOR THE ASSESSMENT OF DIETARY INTAKE IN JAPANESE POPULATIONS: PART II – BASIC RESULTS

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Objectives: We developed a recipe database which consists of recipe names, ingredients, and ingredient weights based on observed dietary data among Japanese. The database will provide representative recipes for mixed dishes when used for recipe-based dietary assessment among Japanese populations. Here, we present the basic results of data collection.

Methods: We collected existing dietary record data from four different populations in Japan (Iwate, JPHC area, Tokyo,

and Nagoya; database details were presented in Part I). Data included names of mixed dishes or food names for single foods, ingredient foods, and their weights. All mixed dishes and single foods were categorized and coded according their names, and then grouped into three classes, i.e. large, middle and small classes. Taking “cooked brown rice” as an example, the large class was “rice and rice cakes”, middle class was “plain rice” (as opposed to salted and seasoned rice), and the small class was brown rice (as opposed to white rice). The small class was used when only necessary.

Results: A total of 240,303 dishes (7,495 in Iwate, 141,226 in the JPHC areas, 11,061 in Tokyo, and 67,532 in Nagoya) were categorized by name into 7,037 types of dishes and foods (1,200 in Iwate, 5,011 in JPHC areas, 2,619 in Tokyo, and 1,863 in Nagoya). After types of dishes were aggregated into small and middle classes, they were integrated into 64 categories of large class. Among all large-class categories, the three most frequently consumed categories were single foods, namely rice and rice cakes, tea and water, and fruits. Among mixed dishes, “salad” was most frequently consumed, and also had most types. Other mixed dishes that were frequently consumed included stewed vegetable dishes (vegetable ni-mono), tofu dishes, egg dishes, mixed-sauce dishes (ae-mono), stir-fried dishes, and so on. Frequency of consumption of mixed dishes was approximately 40% in each database, but types of mixed dishes among total types of foods and dishes varied from 62% to 75% depending on the database.

Conclusion: We identified a number of mixed dishes that require inclusion in the recipe database. We also identified mixed dishes that were frequently consumed, and had a variety of types. We will further investigate the ingredients of these frequently consumed dishes to develop a food composition table for a representative recipes database.

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PP 325

OPTIMIZED E-DIARY TO INCREASE ACCURACY AND ACCEPTABILITY OF DIETARY SURVEYS

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Context: Despite various existing methodologies, it remains difficult to evaluate food intake with accuracy. Evaluating fluid intake is even more challenging because of numerous acts of consumption within a day. In order to improve recording, we used an optimized online tool (MXS-Epidemio, MXS, Paris, France), with specific controls to track fluid intakes.

Objectives: To compare (i) dietary and nutritional intakes obtained with a 7-d paper food diary versus a 7-d web-based food diary and (ii) user’s acceptability towards both methods.

Methods: A cross-over study design was used and completed by 246 French subjects aged 18 to 60. Each subject self-reported their food and fluid intake using both methods (7-d each) with a one week washout period. At the end of the study subjects completed a questionnaire designed to assess their acceptability of the two methods.

Results: Results showed (1) no difference between methods in terms of Energy intake: 1824 ± 39 vs 1836 ± 41 kcal/day for online and paper methods, respectively, (2) that reporting of total water intake from fluids was significantly higher with the optimized online method compared with the paper-method (1348 ± 36 vs 1219 ± 34 mL, $p < 0.0001$), respectively, (3) that reporting of plain water is also higher with the online method: 609 ± 29 vs 532 ± 25 mL ($p = 0.004$), respectively and (4) 77% of subjects preferred the online method.

Conclusion: The quality of reporting using this online method was comparable for food and better for fluid in comparison with the paper-version. In addition, the online method facilitates data management and induces cost and time savings. It can be a relevant alternative to the paper method, especially to record fluid intake in population surveys.

PP 326

COMPARISON OF PERCEPTIONS REGARDING THE USE OF THE MOBILE TELEPHONE FOOD RECORD AMONG ADULTS IN CONTROLLED FEEDING AND FREE-LIVING CONDITIONS

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BACKGROUND: Mobile telephones offer promise to improving the accuracy of dietary intake data. Theoretical models recommend tools be designed with features that will lead to adoption. To create tools for adoption, developers iteratively test devices under controlled conditions among target groups prior to testing among free-living individuals. Information that would support this process would aid the development of these tools to market.

OBJECTIVE: To compare the perceptions regarding the use of a mobile telephone food record (mpFR) between two samples of adults (21-65 yr) under controlled feeding and free-living conditions.

METHODS: Participants ($n = 57$, 32% men) in the controlled conditions were recruited through community channels to attend a meal session in a metabolic kitchen. They received instruction for the mpFR and used the mpFR to take before

and after images of a large meal. Trained staff monitored the sessions. Adults (n=46, 33% men) in the free-living conditions were recruited similarly and received comparable training.

They used the mpFR to take before and after images of all eating occasions over 7 days. Both groups completed a questionnaire about perceptions after training and after using the mpFR, i.e., after one meal or after 7 days.

RESULTS: The two groups responded the same to “remembering to take an image before my meals would be easy” whether asked before or after use of the mpFR. For this same question, but with “snacks,” the groups differed significantly with the free-living participants adopting a more favorable response after 7 days. For taking an image before a snack, 67% of the free-living reported “easy” just after training which increased to 90% after 7 days compared to 50% in controlled condition. Similar results occurred for ease of taking an image after a snack. With regard to carrying and using the fiducial marker (a small credit card size item used for color correction and volume) both groups responded favorably ranging from 91% among the controlled group to 98% among the free-living.

SIGNIFICANCE: These results support the iterative process of controlled testing followed by free-living studies. Systematic, iterative testing under controlled conditions that informs evidence-based changes may explain the more ideal responses of the participants in the free-living situation. Responses of participants under controlled conditions can't be assumed to be the same or better than free-living. Whereas, reactions to traditional dietary assessment methods start to wane after several days, the free-living responses about the mpFR did not follow this trend.

PP 327

USING THE SPEARS-DIETARY ASSESSMENT TOOL TO DETERMINE DIETARY IMPACT OF BREAKFAST CONSUMPTION BEHAVIOR AMONG 9 TO 10 YEAR OLD CHILDREN

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Aim: To evaluate the dietary impact of breakfast consumption behavior among 9 to 10 year old children.

Background: Several studies have explored the effect of skipping breakfast on childhood obesity, but few have compared the number of breakfasts consumed during a given time period. It is unclear if children adjust their intake related to their breakfast consumption pattern.

Method: Subjects were 4th graders (9 to 10 years of age) attending a school in Reno, Nevada, USA (n=25) of whom 80% were White-Hispanic/Latino and 40% were overweight or obese. The estimated daily intake from school breakfast and lunch, as recorded by the new Spears-Dietary Assessment Tool (Spears-DAT), was combined with reported dietary consumption outside of school using two multi-pass 24-hour recalls. Staff operating the Spears-DAT weighed and scanned, by bar-code, each food/beverage item selected by the child at school breakfast and lunch before and after the meal. Breakfast intake at or before school for 9 school days was used to classify a child's consumption pattern. A breakfast skipper, a single breakfast eater and a multiple breakfast eater consumed ≤ 4 days breakfast, ≥ 4 days one breakfast, and ≥ 4 days two or more breakfasts, respectively. Welch t-tests were conducted to determine the difference of means between breakfast intake categories for kilocalories, carbohydrates, protein, total fat, calcium and iron intake.

Results: No breakfast skippers were in the study sample. Multiple breakfast eaters consumed significantly more kilocalories (2475 kcal vs. 1886 kcal, $p = 0.04$), carbohydrate (337g vs. 244g, $p = 0.05$), and calcium (1452 mg vs. 967 mg, $p = 0.001$) than did single breakfast eaters. No significant differences were found between the groups for protein (92g vs. 82g, $p=0.43$), total fat (88g vs. 68g, $p=0.13$) and iron intake (19.5mg vs. 14.3 mg, $p=0.06$).

Implications: Findings suggest that 9-10 year old children who consume multiple breakfasts do not adjust their kilocalorie intake over the remainder of the day. Multiple breakfast eaters consumed significantly more total kilocalories than single breakfast eaters, which exceeded kilocalories that are recommended by the Institutes of Medicine Dietary Reference Intakes for moderate active 9-13 years old children (range 1,600 kcal to 2,200 kcal). On a positive note, calcium intake exceeded the 1,300 mg/day recommendation. Studies with a larger sample size that include breakfast skippers are needed to confirm these results. Generalization of results is limited, since the majority of the children were White-Hispanic/Latino and from low-income households.

PP 328

UK ON-LINE 24H DIETARY RECALL TOOL FOR LARGE SCALE POPULATION STUDIES: DEVELOPMENT, VALIDATION AND PRACTICAL APPLICATION

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Reliable assessment of the association between diet and health requires accurate and repeated measurements of diet in large prospective cohort studies. Incorporation of an internet based 24hr recall into such studies may substantially advance our understanding of the nutritional determinants of disease. Existing tools, such as food frequency questionnaires, are limited in scope, and do not lend themselves to easy adaptation for different population groups due to their reliance on previously defined food lists. Presently, there is no on-line 24hr dietary recall tool available in the UK based on the principles of the Automated Multiple Pass Method (AMPM), which is suitable for use by groups from different ethnicities and of different socio-economic classes. We have obtained funding from the Medical Research Council (UK) to develop, validate and apply this tool in practice; this work will be undertaken between 2012 and 2015. This project has three main components:

(1) Development of a UK on-line 24hr dietary recall. Existing online tools from the US and France (ASA24, DietDay, Nutrinet Santé) will be compared using focus groups, 30 potential users will be divided into 3 groups according to age: adolescent; adult; elderly (post-retirement). Following this the new UK tool will be developed based on the ASA24 as template

(2) Validation of foods and nutrients measured by this new on-line tool. Foods and nutrients assessed by the new tool will be compared to those obtained using an interviewer-administered AMPM recall; independent biomarkers of nutrients: specifically urinary N (for protein); potassium; sucrose and fructose; and a measure of total energy expenditure. 200 participants will provide repeated measurements over 6 months. The primary analysis will assess differences in agreement between the urinary N biomarker and protein intakes as assessed by comparing the measurements from both the on-line and the AMPM interviewer-administered recalls.

(3) Pilot study for practical application of the on-line 24hr dietary recall in two different epidemiological cohorts. A subgroup of 200 older women in the UK Women's Cohort plus their adult children and adolescent grandchildren will be asked to complete 3 on-line recalls over a 6 month period. 100 participants from a new cohort to be established at Imperial College London (a clinic based cohort with mixed population characteristics) will be asked to do the same.

Dissemination of the tool is key and open access vital. We intend to provide the software free of charge to other UK researchers.

PP 329

EFFECT OF SCHOOL BREAKFAST PROGRAM (SBP) INTAKE ON NATIONAL SCHOOL LUNCH PROGRAM (NSLP) CONSUMPTION USING THE SPEARS-DIETARY ASSESSMENT TOOL

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Aim: To examine the effect of School Breakfast Program (SBP) intake on National School Lunch Program (NSLP) consumption using the Spears-Dietary Assessment Tool (Spears-DAT).

Background: In 2010, 11.6 million American children participated daily in the federally subsidized SBP, and 31.7 million daily in the NSLP. The interaction between these two programs has not been examined. The Spears-DAT is a new automated weighed dietary assessment instrument.

Method: Study sample was 157 students 5 to 12 years old attending a school in Reno, Nevada, USA. Breakfast and lunch dietary intakes were measured for 9 consecutive days at 3 time points during the 2007/2008 school year using the new Spears-DAT. The Spears-DAT assigned barcode numbers to students, service trays and food items. The barcodes were scanned and food items weighed before and after consumption, estimating a student's meal energy and nutrient intake. The subject do not need to recall or record any information; making this tool especially suitable for young children and persons with low literacy skills. Potential confounders included age, sex, body mass index percentile, race, appetite rating, and breakfast consumption away from school. General linear statistical modeling was conducted.

Results: A total of 31,322 weighed transactions were collected over 27 days (4,767 SBP and 26,755 NSLP). Eating school breakfast significantly impacted lunch program consumption. Intakes decreased in kcalorie intake ($p=0.03$) and increased in Vitamin C ($p=0.04$), carbohydrate ($p=0.05$) and calcium ($p=0.02$) intake; but there was no significant impact on intakes of total fat ($p=0.06$), iron ($p=0.15$) and protein ($p=0.2$) after adjusting for confounders. However, those who switched from SBP skippers to SBP consumers did not exhibit a significant change in NSLP intake (kcalorie, calcium, carbohydrate, protein, vitamin C and fat) (all $p>0.3$). An unexpected finding emerged. Both energy and nutrient intakes were significantly affected by the time lapse between school breakfast and school lunch ($p<0.0001$). The longer this time period, the greater was the reduction in students' energy and nutrient intakes, even after adjusting for the potential confounders.

Implications: Potential interactions should be considered when exploring modifications in the SBP and NSLP. The Spears-DAT can offer another means to evaluate diet intake in congregate meal setting such as an elementary school.

PP 330

TESTING THE AUTOMATED SELF ADMINISTERED 24-HOUR RECALL (ASA24) IN A SAMPLE OF MULTIETHNIC ELDERLY AMERICANS

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Background: The 24-hour dietary recall is often used to collect dietary data. The ASA24 is a web application developed by the U.S. National Cancer Institute to collect self-administered recalls, thus reducing interviewer costs. There has been a paucity of research conducted regarding the feasibility of using the ASA24 in elderly and multiethnic adults. **Objective:** Evaluate the feasibility of using the ASA24 for collection of dietary data among multiethnic, elderly adults. **Materials and Methods:** The Multiethnic Cohort Study (MEC), based on the prospective follow-up of over 215,000 adults, provided the opportunity to test the ASA24. Selected persons from the cohort were part of a calibration study where three-24hr telephone-administered diet recalls were completed. During the first screening call, respondents who reported ready access to a computer with internet capability were asked their willingness to complete the ASA24 and respond to a questionnaire. After completion of the main study components, they were sent instructions to access the ASA24. Also included was a questionnaire designed to evaluate their experience with the ASA24. They were given two weeks to complete a one day recall using the ASA24 and return the questionnaire. Phone numbers were provided for help; however staff provided no reminders to complete these additional activities. Categorical variables were compared using chi-square or exact tests.

Results: Mean age for the 77 respondents (46% men, 54% women) returning the questionnaire was 67±4.6 (SD), and the ethnic distribution was non-Hispanic White (32%), Japanese (29%), Hawaiian (20%), Black (13%), and Hispanic (6%). Successful access of the ASA24 was achieved by 44 individuals, one of whom did not return a questionnaire. Older participants were less likely to access the ASA24: 44% of the 66-78 y compared to 70% of the 59-65 y ($\chi^2 = 5.1$, $df=1$, $P=.024$). Of the 44 entries, 37 (84%) generated nutrient values, of which 27 were considered reasonable, i.e., energy ≥ 1200 kcal. Among those accessing the ASA24, the majority agreed that the website was easy to understand (28/42, 67%); however, many preferred the in-person interview (19/42, 45%). The individuals with reasonable energy results were more likely to agree that the website was easy to understand, compared to the misreporters ($\chi^2 = 7.3$, $df=2$, $P=.022$).

Significance: Technology is steadily permeating all aspects of life. However, older adults who have little experience with technology may require extensive training on computers and on the use of computer applications to achieve certain tasks; in this case, to complete a dietary recall. Although the much older adults in the study were less likely to access the ASA24, their younger counterparts were successful in accessing and utilizing the web application, and even indicated the site was easy to use; furthermore, they expressed a preference for utilizing a web recall. Misreporting, although commonplace in dietary recall data, may have been attributed to the difficulties experienced in accessing, utilizing and understanding the application. Further research regarding the adoption of technology for nutrition assessment in older adults should be undertaken.

PP 331

DEVELOPMENT OF A NEW COMPUTER PROGRAM TO ASSESS FOOD CONSUMPTION IN PORTUGUESE SCHOOL-AGE CHILDREN: A QUALITATIVE APPROACH FOR IDENTIFYING FOOD ITEMS.

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Introduction: Food and nutrition are important determinants of non-communicable diseases such as childhood obesity. Understanding how to prevent this major public health problem remains a research question and the design of potentially effective interventions is hampered by the general lack of good-quality data. There is no validated method available to assess food and nutrition intake in school age Portuguese children. A new engaging method for assessing food and nutrition intake of school age Portuguese children (7-10 years old) is currently being developed, based on a self-administered computerized 24-Hour Recall questionnaire. The purpose of this study was to select and identify questionnaire food items through a qualitative approach. **Methods:** 21 Focus Group were conducted in seven primary schools from the seven geographic regions of Portugal. The focus group were homogeneous for age (7 years, n=70; 8 years, n= 61; 9 years; n=73) and area of residence but heterogeneous for sex, social-economic and nutritional status. Children participated in focus group after parent's written informed consent and school authorization. The focus group were moderated by Nutritionists and/or Psychologists. Topics for discussion were: (a) food consumption on the previous day; (b) problems regarding to the reporting consumption on the previous day; (c) comprehension of some food items; (d) food preferences. Focus group were audio-recorded and transcribed. The content analysis followed a thematic coding process. **Results:** Main meals, such as breakfast, lunch and dinner were generally easier to remember than secondary meals such as snacks. Children tended to underreport the consumption of candies (either due to social desirability or to recall bias) and seem to remind better the consumption of this type of foods when there was a recall

link between previous-day activities and food exposure/consumption. Overall, 4172 food items were identified and grouped into the following groups: 1) Grains (1147), 2) Dairy (631), 3) Meat/seafood/eggs (578), 4) Drinks (451), 5) Vegetables (383), 6) Fruits (308), 7) Fats (150), 8) Beans and peas (25) and 9) Others (499). Regarding to drinks, 61.4% of the items correspond to soft drinks. **Conclusion:** This study proved the utility of the focus group methodology to obtain qualitative data about dietary intakes of children in the immediate past (24 hours). The identified items included both items that were part of previous checklists from other countries and many new items that are local-context specific. This pool of items will be used for building up the self-administered computerized 24-Hour Recall questionnaire.

PP 332

EVALUATION OF AN ELECTRONIC FOOD FREQUENCY QUESTIONNAIRE FOR BRITISH & IRISH ADULTS

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Background: Historically, paper-based semi-quantitative Food Frequency Questionnaires (p-FFQ) have assessed habitual diet in medium and large scale epidemiological studies. Often the questionnaires are distributed to large numbers of participants, by post, at relatively low cost and labour requirements to researchers. However, paper-based FFQs are known to have some limitations including poor response rates and incomplete questionnaires (Willet 1998). With the evolution of web-based technology an electronic version of the FFQ has been developed as an alternative to paper questionnaire. Our hypothesis is that the e-FFQ could improve participant response, quality of completion and reduce researcher costs during large scale diet disease risk trials. Before realising the e-FFQ for application in studies of diet and disease it is important to evaluate the reproducibility, acceptability and usability of the e-FFQ compared to the p-FFQ for adults www.foodfrequency.org

Methods: Male and female participants, aged 18-64 y completed a randomised cross-over study. Subjects were divided into two groups. Group 1 completed the p-FFQ first, while group 2 completed the e-FFQ and an e-FFQ usability questionnaire first. A minimum of one week then past before participants crossed over and completed the alternative version of the FFQ. Nutrient intakes were calculated and levels of intakes ranked for both versions of FFQ, both differences and categorisation were then assessed. A subset of subjects completed Think Aloud interviews to assess acceptability and usability of the FFQs whilst completing the questionnaires.

Results: Good agreement and reproducibility was observed between the questionnaires for dietary nutrient intake. Correlation coefficients ranged from 0.5 to 0.8 for vitamin C and energy intake respectively ($p < 0.01$). Cross classification and weighted kappa data values reflected this agreement. Acceptability and usability assessment of the FFQs were comparable, while the think aloud interviews indicated the majority of participants rated the e-FFQ an 'easy-to-use' dietary assessment tool. Think-out loud interviews highlighted similar issues between the paper and electronically based questionnaires, including 'not reading completion instructions'.

Conclusion: The e-FFQ and p-FFQ had good agreement and repeatability. Participants' indicated the e-FFQ was acceptable and usable, demonstrating the electronic FFQ can be utilised, as an alternative to p-FFQ in nutritional epidemiological studies.

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PP 333

A GENETIC ALGORITHM APPROACH TO OPTIMIZE PLANNING OF FOOD FORTIFICATION PROGRAMS AUTHORS: DAVE

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Methods for reliably estimating the distributions of usual (long-run average) daily nutrient intakes have been proposed (National Research Council, 1986; Nusser et. al. 1996). These estimates are utilized by epidemiologists and food policy makers for evaluating the adequacy of nutrient intake in sub-populations and for the development of interventions such as food fortification. In a typical fortification program, one or more nutrients are added to food vehicles in order to increase the supply of the nutrient in the population. The goal of food fortification is to reduce the proportion of the population with inadequate nutrient consumption, at a reasonable cost. We propose a method to select the optimal amount of a nutrient to add to a set of promising vehicles so that a target prevalence of inadequacy in the population can be met. The approach we propose relies on the methodology for estimating usual nutrient distributions proposed by Nusser et al., and uses a genetic algorithm to minimize the analytically untractable optimization function. The goal of the methodology is not to deliver a single, universal "best" food fortification plan, but rather a "best" plan under a variety of objectives and constraints - such as cost. We illustrate the method by planning vitamin A intakes of Ugandan children aged 6-24 months.

Keywords: Genetic algorithm, optimization, nutrition, food fortification, measurement error

PP 334

USING COMPUTER-ADMINISTRATION, COMPLEX SKIP PATTERNS AND PORTION SIZE GRAPHICS TO IMPROVE FOOD FREQUENCY QUESTIONNAIRES: EVALUATION OF THE GRAPHICAL

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The Graphical Food Frequency System (GraFFS) is an algorithm-driven, computer-delivered dietary questionnaire, based on the paper food frequency questionnaire (FFQ) used in the Women's Health Initiative (WHI).

GraFFS was developed to address key limitations of paper FFQs: (1) common response errors, such as skipped questions; (2) infeasibility of implementing complex skip patterns; and (3) restrictions in the range and descriptions of portion sizes. GraFFS collects data on intake frequencies of 156 food items or groups, with portion size based on 3-6 pictures; when required it also captures preparation, formulations and added condiments. This study assessed inter-method reliability and bias, as well as test-retest reliability, using 6, telephone-administered 24-hr recalls as the criterion measure of food intake. Analyses are from 74 men and women, ages 18-69, who completed a baseline GRAFFS, ≥ 4 of 6 bi-weekly recalls, and a repeat GraFFS. Bias (mean difference GraFFS - recalls) for percentage energy from macronutrients ranged from -1.6 to 2.0. With the exceptions of folate, calcium and B-vitamins, energy-adjusted micronutrients were significantly higher from GraFFS (10%--30%). Pearson correlations between energy-adjusted GRAFFS and recalls were 0.63, 0.68, 0.44, 0.62, 0.62, 0.67 and 0.54 for total, saturated, monounsaturated and polyunsaturated fats, docosahexanoic + eicosapentaenoic acids, carbohydrate and protein, respectively; after deattenuation for error in 24-hr recalls these increased to 0.82, 0.84, 0.67, 0.85, 0.89, 0.79 and 0.67. Deattenuated correlations for most micronutrients were ≥ 0.60 , with the exception of zinc, iron, thiamin and vitamin D. Test-retest correlations for macronutrients were ≥ 0.60 , and tended to be somewhat higher for most micronutrients. In conclusion, in this first and limited evaluation of GraFFS, the bias and test-retest reliabilities were similar to those reported from paper FFQs. However, inter-method reliability (often called validity) was substantially higher. Compared to the paper WHI questionnaire and using comparable study designs, the inter-method reliabilities of macronutrients from GraFFS were substantially larger than those reported for the paper-based WHI FFQ; for example 0.82 vs. 0.64 for total fat. The inter-method reliabilities for most micronutrients were also higher, often dramatically; for example 0.37 vs. 0.66 for vitamin C. More rigorous evaluations are needed before concluding that GraFFS yields data superior to those from paper-based FFQs, however results suggest that some or all of the unique aspects of GraFFS, including multiple portion size pictures, incorporation of complex skip patterns, and elimination of missing responses, can improve dietary assessment using a FFQ approach.

PP 335

A COMPARISON OF DIETARY PATTERNS IN INDIAN AND PAKISTANI CHILDREN LIVING IN THE UK

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Introduction: South Asian population is the largest minority ethnic group in the UK, and the largest South Asian migrant groups are Indian and Pakistani. It has been reported that depending on the part of the subcontinent from which people originated, these groups have various diet and food choices, and may eat meals and dishes that clearly vary in the method of cooking. As a result of increased risk of diet related diseases in South Asians and the possible relation between the diet and disease of adulthood, the diet of young people have recently received high attention. In addition, the food choices children make during these crucial years of development can shape the food habits in their later life. **Objective:** To gather information on the food consumption patterns and nutrient intake of Indian and Pakistani children living in UK. **Methods:** A cross sectional study of 47 Indian and 64 Pakistani (n=111, 65 boys and 46 girls) aged 4-11 years was conducted. Parents/guardians completed three multiple pass 24-hour recalls on non-consecutive days including one weekend. Food portion sizes were estimated using household measurements and newly developed South Asian Photographic Booklet. Dietary intakes of macro-and micronutrients were calculated (as a mean of three multiple pass 24 hour recalls). Nutrient contents were calculated using COMP-EAT software and newly generated South Asian foods composition ⁽¹⁾. These data were then analysed using the Statistical Package for Social Science (SPSS). Ethical approval for this study was obtained from University of Leeds. **Results:** A total of 333 multiple pass 24 hour recalls were assessed to identify main food groups and their contribution towards energy, fat, carbohydrate and protein (Table.1), mean energy intake of Indian and Pakistani children was 1659 and 1571 kcal/d, respectively. There were no significant differences for mean energy intake. Compared with Pakistani group, Indian had higher intake of total fat and carbohydrate and lower intake of protein. Cereal and cereal products including rice and chapatti were the main source of energy (%) in both groups. Meat and meat products were the main group contributor for protein of Pakistani children, whereas, milk and milk products for Indian children.

Table 1 Macronutrient intake of South Asian children and main food group contribution

Macronutrient	Indian	Main contributing food groups	Pakistani	Main contributing food groups	Sig.
Energy (kcal)	1659	Cereal and cereal products	1571	Cereal and cereal products	.243
Total fat (g)	63.5	Cereal and cereal products	61.9	Milk and milk products	.668
% Energy Fat	34.0		35.1		.279
Carbohydrate (g)	230.5	Cereal and cereal products	207.1	Cereal and cereal products	.023*
% Energy Carbohydrate	52.3		49.6		.006*
Protein (g)	55.6	Milk and milk products	58.2	Meat and meat products	.381
% Energy Protein	13.4		14.9		.000*

Conclusion: Finding showed that Indian and Pakistani migrants have some differences regarding their dietary patterns for 4-11 years old children living in UK.

References:

1. European Food Information Resource Network (EuroFIR) WP2.3.2. (2010) Final report on ethnic foods. Available upon request.

PP 336

A COMPARISON BETWEEN DIETARY PATTERNS OF SOUTH ASIAN CHILDREN AND THE UK NATIONAL DIET AND NUTRITION SURVEY (NDNS) THE NEW ROLLING PROGRAMME (2008/2009)

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Background: The risks associated with nutrient inadequacies during childhood are high, therefore there is great attention on the quality of children's diets and the possible relation between their diets and health outcomes. In the case of South Asian children this becomes even more important because South Asians are reported to be at a higher risk of developing nutrition-related non-communicable diseases which may implicate on children's health. Although South Asian children living in the UK are a vulnerable group, little is known about what they eat or how efficiently their nutrient intake meets dietary recommendations. **Objectives:** The aim of this cross-sectional study is to assess the nutritional adequacy of the diet of South Asian children (1y-3y) living in West Yorkshire as compared with national recommendations and the new rolling programme for the NDNS (2008/2009). **Methods:** Ethical approval for the study was obtained from the University of Leeds. Children's parents (n=80) completed 240 multiple pass 24-hour recalls on non-consecutive days, including one weekend. Household measurements and newly developed food photograph booklet for South Asian food were used with 24-hour recalls. All foods were analysed for nutrient composition using the latest available data on South Asian foods generated by the FSA and European Food Information Resource Network (EuroFIR, 2010) as well as the WinDiets computer software (Wise 2005). **Results:** Average daily energy intake in both South Asian children (1081.6 kcal/d) and Caucasians (1136 kcal per day) were below the recommended energy intake (1198 kcal/d). South Asian children had lower intake of carbohydrate, protein, vitamin A, Fe and zinc when compared with Caucasians. The delay of weaning practices which lead to low consumption of fruit and vegetable and meat among these children may explain this phenomenon. Total fat intake was higher among South Asian children but average intakes for Ca and vitamin C were significantly higher than the RNI in both groups. This might be due to high consumption of full fat milk and fruit juices in case of South Asians children. Average intake of vitamin D was significantly low in both South Asian children (1.2µg/d) and Caucasians (2µg/d) than their RNI (7µg/d). **Conclusions:** The study showed differences in some nutrients intake between South Asian children and Caucasians. Inadequate intake of vitamin D, A, zinc and Fe may present a concern in these children.

Reference: - European Food Information Resource Network (EuroFIR) WP2.3.2. (2010) Final report on ethnic foods. Available upon request.

PP 337

DEVELOPMENT OF THE U.S. HEALTHY FOOD DIVERSITY INDEX: A MEASURE OF DIETARY VARIETY, QUALITY, AND PROPORTIONALITY

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Introduction: Current dietary variety assessment methods do not account for dietary quality and proportionality. These methodological limitations fail to distinguish between individuals who consume a number of healthful foods versus a number of less healthful foods and may contribute to inconsistencies in the literature examining dietary variety and

body adiposity. The objective of the current study was to generate the U.S. Healthy Food Diversity (HFD) index, which measures total variety (i.e. total number of foods consumed) as well as dietary quality and proportionality as described in the 2010 Dietary Guidelines for Americans (DGA). Methods: To develop the U.S. HFD, single 24-hour dietary recall data from the 2003-2004 National Health and Nutrition Examination Survey (NHANES) were merged with the My Pyramid Equivalent (MPED) 2.0 database to obtain food-group level data. The U.S. HFD was generated using the equation $HFD = (1 - \sum s_i) * hv$ whereby s_i = share by volume of each food in the total diet and hv = health value of the total diet. As a proxy for dietary quality, hv was assessed by using the quantitative and qualitative recommendations of the 2010 DGA to assign health scores to 17 food groups based on the recommended proportion of each food group by volume in the total diet. The U.S. HFD is bounded between 0 and 1-1/n, with a maximum score (~1) achieved by consuming a variety of foods in the proportions recommended by the 2010 DGA. Descriptive statistics using appropriate sample weights were generated. Results: Dietary data from 4,808 non-pregnant adults ages 20 years and older were analyzed. U.S. HFD scores ranged from 0-0.18 (mean 0.09). Adults consumed an average of 17.9 foods and ~2350 calories per day. They consumed an average of 1.1 cups of fruits and 1.8 cups of vegetables along with 0.44 cups (21 teaspoons) of added sugar and 0.21 cups (10 teaspoons) of solid fat per day. Discussion: U.S. HFD scores are low in this cross-sectional sample of the U.S. population as estimated by single 24-hour recalls in 2003-2004 NHANES. This may be explained by: 1) insufficient representation of total variety with only a single dietary recall; 2) poor overall diet quality; and 3) limited variety within healthful food groups. Future research will investigate factors influencing the low scores in the U.S. population before using the score to examine associations with adiposity and other chronic diseases.

PP 338

THE ASSOCIATION BETWEEN DIETARY DIVERSITY AND NUTRITIONAL STATUS AND THE EFFECT OF SEASONALITY

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Introduction: Conventional methods for assessing the quality of diets are time consuming, costly and often difficult or even impossible to conduct in resource poor settings. Dietary diversity however, is shown to be a very useful indicator of mean probability of adequate micronutrient intake (MPA) and is relatively easy to measure. Dietary diversity is usually assessed during a single period and little is known about the effect of seasonal variation on DDS. This study will reveal whether dietary diversity is influenced by the seasonal availability of foods.

Materials and Methods: Data from a cross-sectional study conducted on the same children in three periods: base-line (October 2010), intervention (April 2011) and final (May 2011), were collected and analysed. The sample consisted of 241, 60 and 228 children at base-line, intervention and at final measurements respectively. Based on thirteen food groups, a food group was given a score of one (1) if a child consumed a food item belonging to that food group. The DDS were then aggregated to get total scores for each child. Differences in mean DDS between the different periods were compared using one-way analysis of variance. Pearson's correlation coefficients between DDS and different components of nutritional status were conducted for base-line data and data collected after the intervention. Linear regression models with interaction were used to study the effect of seasonality and the effect of intervention on the association between DDS and nutritional status.

Results: Mean DDS was higher during the intervention period (6.4 ± 0.1) and during the final measurement (6.5 ± 0.1) compared to the base-line measurement (5.9 ± 0.9). The differences between DDS at base-line and DDS at final measurement were significant ($P = 0.00$). No statistically difference was observed in mean DDS during intervention and mean DDS at final measurement ($P = 0.913$). According to the Pearson's correlation coefficients no clear association between nutritional status on and DDS was found. Treatment influenced Hb levels, children from the green group had significant higher Hb levels after the intervention.

Conclusion: DDS after the intervention was higher than DDS at base-line, just after harvest. No association could be found between DDS and nutritional status. Nutritional status in terms of Hb levels, weight and height changed during the study period. Whether this can be ascribed to seasonality should be further investigated.

PP 339

GENETIC VARIATION IN FADS MODIFIES THE ASSOCIATION BETWEEN DIETARY POLYUNSATURATED FATTY ACIDS AND INCIDENCE OF CARDIOVASCULAR DISEASE

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The link between intake of polyunsaturated fatty acids (PUFA) and risk of cardiovascular disease (CVD) is unclear and might be explained by studies not taking into account the genetic variation between individuals. Minor alleles of single nucleotide polymorphisms in the Δ -5 fatty acid desaturase (*FADS1*) gene have been associated with lower concentrations of long-chain PUFA, indicating a decreased enzyme activity. Therefore, the aim of this study was to

examine if genetic variation in the *FADS1* gene modifies the association between intakes of different PUFA and the risk of CVD.

We included 24,032 individuals (62% females, 44-74 years) without a history of coronary event, stroke and diabetes from the Swedish population-based Malmö Diet and Cancer cohort. All participants were genotyped for the *FADS1* polymorphism rs174546 (45% had CC, 44% had CT and 11% had TT). The different PUFA intakes, (alpha-linolenic acid [ALA], long-chain n-3 PUFA, total n-3 PUFA, linoleic acid [LA], total n-6 PUFA, ALA:LA ratio [ALA/LA], and n-3:n:6 PUFA ratio) expressed as energy percentage E%, were divided into quintiles. In total, 2,751 CVD cases (coronary and stroke events) were identified during a mean follow-up time of 13 years. Diet was assessed by a modified diet history method, combining a 168-item dietary questionnaire, a 7-day registration of cooked meals and cold beverages, and a 1-h diet history interview. Cox proportional hazard regression, adjusted for potential confounders was used.

We did not observe any statistical significant association between intake of any of the specific PUFAs and risk of CVD. However, there was a significant interaction between ALA/LA and *FADS* genotype on incidence of CVD ($p=0.04$) as well as a borderline significant interaction between intake of ALA and *FADS* genotype on incidence of CVD ($p=0.08$). Both ALA/LA- and ALA intakes were inversely associated with risk of CVD only among individuals homozygote for the minor T-allele of rs174546 (expected to have the lowest *FADS1* activity). Among the TT genotype carriers, the highest versus lowest quintile of ALA/LA- and ALA intakes were associated with 31% (95% CI: 1-53%) and 33% (95% CI: 4-53%) decreased incidence of CVD, respectively.

Genetic variation in *FADS1* modifies the association between the intake of PUFA and the risk of CVD. Our epidemiological prospective study indicates that for the 11% of the population homozygous for the allele that associates with lower Δ^5 fatty acid desaturase activity, a high ALA and/or ALA/LA may be preferable in prevention of CVD.

PP 340

INFLUENCE OF NUTRIENT INTAKE AND SOCIOECONOMIC BACKGROUND ON THE FOOD VARIETY AND DIETARY DIVERSITY SCORES IN SELECTED RURAL AREAS OF MALAYSIA

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The purpose of this study was to analyse the associations between food variety score (FVS) and dietary diversity score (DDS) with selected nutrients and socio economic characteristics among lower income households in rural Malaysia. Stratified random sampling method for location of the study and systematic random sampling was used to choose households (284). Food frequency questionnaire was developed and adapted from the Malaysian Adult Nutrition Survey (2003) with 126 food items included in this study. The FVS was on a score ranging from 0-833. The DDS was calculated based on the number of food groups consumed within a week. The head of households completed a 2-day dietary recall including 1 weekday and 1 weekend day to get the nutrient information. The nutrient intake was analysed using the Nutritionist ProTM Nutrition Analysis Software (First Data Bank, USA, 2003) that consists of Malaysian Foods Composition Table, while multiple regression was used to determine the association of FVS and DDS with selected nutrients and households' socio economic backgrounds. The results show that overall mean of FVS was 170.0 ± 90.3 with a range of 37-749 and majority of households (81.8%) had low FVS. The highest mean FVS were fat, oils, sugar and salt groups (43.0 ± 27.4), and fish, poultry, meat and legume groups (35.0 ± 24.0). Ninety-nine per cent of households had a high DDS, with weekly mean intake of 5.5 ± 0.8 . Total food expenditure ($p<0.01$) and energy intake ($p<0.05$) of households were associated with FVS. Meanwhile sex of head of households ($p<0.05$) and energy intake ($p<0.01$) were associated with DDS. In conclusion, the higher DDS shows that even though the households consumed food from all food groups, their diets lacked variety. Total food expenditure, sex of head of households, and energy intake were the main factors that influence FVS and DDS among lower income households in rural areas of Malaysia.

PP 341

AMARANTHUS TRICOLOR AND A. HYPOCHONDRIACUS LEAVES: CHARACTERIZATION OF BIOACTIVE COMPOUNDS AND PHENOL CONTENTS

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Amaranth is a versatile but underutilized crop which is highly adaptable to new environment even in presence of huge biotic and abiotic stresses. The leaves of amaranth are eaten as vegetables while the seeds are used as cereals. *Amaranthus tricolor*, is the main vegetable type of amaranth having attractive leaf colors and important sources of bioactive compounds. *Amaranthus hypochondriacus* L. are grown as grain crops or ornamental plants. Here we studied

on the leaf pigments, phenolic compositions, phenolic acids and flavonoides of the two amaranth species. We raised 4 cultivars of each of these amaranth species at Gifu field science centre, Gifu University, Gifu, Japan from July to August 2011. Leaf color measured by colorimeter, chlorophyll and betalain content were determined using spectrophotometer whereas phenolic acids such as hydroxybenzoic acids, hydroxycinnamic acids and flavonoides were determined by HPLC- UV-VIS detector. Identification of compounds were achieved by comparing their retention times and UV-Vis spectra with those of the standards. Among the *A. tricolor* cultivars Rocto alta showed the highest redness value and betalain content. Almost similar chlorophyll content contained was observed in all of the cultivars. New Aztec, a cultivar of *A. hypochondriacus* showed the highest total flavonoid content whereas Baromashi of *A. tricolor* had the maximum total polyphenol content. Vanilic acid, salicylic acid and gallic acid were the most abundant in all the cultivars however, *A. hypochondriacus* leaves were found to be rich in ellagic acids and sinapic acids. Isoquercetin, the most common flavonoid frequently occurred in all of the cultivars. We observed hyperoside and rutin only in New Aztec. Thus, the present study recommends that the leaves of both *A. tricolor* and *A. hypochodriacus* are the potential sources of phenolic antioxidants. In addition, the total polyphenol index in New Aztec and all the cultivars of *A. hypochondriacus* were found significantly higher which dignifies these leaves as the potential sources of natural antioxidants.

Key words: Leaf pigments, betacyanin, phenolic compositions, HPLC, Amaranth

PP 342

MODIFICATION OF THE US NATIONAL CANCER INSTITUTE'S (NCI) DIET HISTORY QUESTIONNAIRE II (DHQII) FOR USE IN CANADIAN POPULATIONS

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Epidemiologic studies continue to rely on cost-efficient tools such as food frequency questionnaires (FFQ), either exclusively or in combination with other methods of dietary assessment, to estimate usual dietary intake. These tools generally include questions about foods that are major contributors to nutrient intakes within the populations for which they are intended. Associated nutrient and food group databases used to calculate total intakes should therefore reflect the content of the current food supply. Although many aspects of the US and Canadian diets are similar, enough differences exist both in foods consumed and nutrient content (e.g. the countries have different fortification policies), that it is necessary to adapt dietary tools developed in one country if they are to be used for the other. Described are methods used to modify the US NCI's FFQ (DHQII) for a Canadian adult population based on 24-hour dietary intake recalls reported in the Canadian Community Health Survey-Nutrition, Cycle 2.2 (CCHS), collected in 2004 from 20,159 adults – the most recent and comprehensive dietary survey conducted in Canada. The goal was to identify changes to the food list and portion sizes that are important to creating a Canadian DHQII. More than 4500 individual foods reported in CCHS were grouped into 360 categories comprising foods with similar nutrient composition and usage. The food categories were evaluated for their contribution to total population intakes of key nutrients: energy, protein, carbohydrate, fat, percent energy from fat, dietary fibre, calcium, iron, folate and vitamins A, C and D. New questions were designed and existing questions were modified to include those foods that captured up to 90% of total CCHS nutrient intakes. One hundred and fifty-three food questions were identified for FFQ inclusion. Gram weight portion sizes were estimated for food categories linked to questions and three portion sizes were identified: small (<25th percentile), medium (25th to 75th percentiles), and large (>75th percentiles), consistent with methods used for the US DHQII. Of 143 food questions with portion size queries, 53 required modification from US values. Based on specific concerns and interests of collaborators, other foods and supplements were added and text was modified to reflect Canadian vernacular. English and French paper versions of the Canadian DHQII are now available and the development of web-based English and French versions are currently in progress. This FFQ provides investigators with an up-to-date, cost-efficient, freely available tool for use in adult Canadian populations.

PP 343

"DIVERSITY OF THE BRAZILIAN DIET WAS RELATED TO CHANGES IN EATING HABITS OF MIGRANT WOMEN FROM EASTERN EUROPE."

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Introduction: It is considered a habitual pattern for the immigrants to gradually adopt the foods and dietary practices of the host country. This change in eating habits may be associated with increased or decreased risk of developing non-communicable diseases, since the diet constitutes a factor that either prevents or triggers these diseases.

Objective: The aim of this study was to identify changes in eating habits of women from Eastern Europe who migrated to Brazil in the first half of the XX century.

Method: This is a cross-sectional study developed in Rio de Janeiro, Brazil, involving 43 Ashkenazi Jewish women over 60 years old, who were born in Eastern Europe and migrated to Brazil in childhood or adolescence, or were born in Brazil to migrants from this region. Data was collected through questionnaires with semi-open questions related to changes in eating habits. For the classification of fat intake in childhood/adolescence (in Europe) and adulthood (in Brazil), it was created a "score of fat intake". The following foods were considered significant sources of fat: eggs, milk, red meat, apparent fat meat, chicken skin, and melted fat from chicken skin used as butter and fried food. We applied the Wilcoxon test to evaluate changes in eating habits over time, considering a significance level of $p < 0.05$.

Results: This study found that, between childhood/adolescence and adulthood, there was an increase in fish consumption ($p = 0.01$) and reduction in consumption of whole milk, apparent fat meat, chicken skin, and melted chicken skin ($p < 0.05$). The frequency of high consumption of fat sources was lower in adult age (in Brazil) than in childhood/adolescence (in Europe) (19% vs 91%, $p < 0.01$). Most of the respondents (74%) reported that changes in eating habits occurred due to the diversity in food availability in Brazil.

Conclusion: The diversity of the traditional Brazilian diet led to positive changes in the eating habits of women from Eastern Europe who migrated to Brazil.

Key Words: Migration, Eating Habits, Food Consumption, Dietary Fat.

PP 344

ESTIMATION OF ISOFLAVONE INTAKE AND ITS FOOD SOURCES OF KOREAN USING THE FOURTH KOREAN NATIONAL HEALTH AND NUTRITION EXAMINATION SURVEY, 2007~2009

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Isoflavone is a class of phytochemical compounds, mainly found in soybean and soy products. Due to its similar structure with estrogen, isoflavone is considered to have a protective effect on the breast cancer, osteoporosis and cardiovascular diseases. Korea has high consumption of soy and its products however data of isoflavone intake is limited because isoflavone database is rare for Korean food. This study estimated isoflavone intake and its food source using fourth Korean National Health and Nutrition Examination Survey, 2007~2009 with isoflavone DB established by Park MK, compilation of analytic data of Korean foods. Mean daily total Isoflavone intake of Korean was 17.4 mg. Compared by age groups, intake of 50~64 years, 23.5 mg was higher than other age groups. This age group also shows the highest intake of energy adjusted isoflavone intake, 12.6 mg/1000kcal. Men has higher isoflavone intake than women, which was 19.7 mg for men and 15.1 mg for women. However when it was adjusted by energy intake, women has higher. Regarding components of isoflavone, mean intake of genistein and diadzein was 7.8 mg and 7.7 mg respectively. Intake of genistein and diadzein show similar trends with total isoflavone by age and gender, except energy adjusted genistein intake was highest in age group of 65 years and over. Tofu was most important food source of total isoflavone. Total isoflavone from tofu was 3.5 mg/day and it comprises 20% of total isoflavone intake. Following tofu, *Seoritae bean*, soybean paste, arrow root and soybean sprout was identified as major food sources of total isoflavone. Including tofu, they account for 72% of total isoflavone intake. Biggest food source of diadzein and genistein was arrow root and *Seoritae bean*. By age groups, soy milk was largest food source of isoflavone in the age group of 1~5 years. For the age group of over 50 years, *Seoritae bean* was largest food source. Since Korean national health and nutrition examination survey use one day 24 hour recall to collect dietary data, it is needed further research to evaluate usual intake of isoflavone in Korea.

PP 345

DIET DIVERSITY SCORE, DIETARY FREQUENCY INDEX AND SCHOOL CHILDREN NUTRITION STATUS IN THE PROVINCE OF KENITRA, NORTH-WESTERN MOROCCO

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Morocco is still suffering from a heavy burden of many micronutrient deficiencies and child stunting. This parameter reflects chronic under nutrition and nutritional insecurity. The purpose of the study was to assess dietary diversity by comparing a dietary diversity score (DDS) and a weekly food frequency score (WFFS) and study their relationship to stunting in school-age children in the province of Kenitra (Morocco). The study was carried out in urban and rural areas of Kenitra. After administrative authorizations, parents' clearance and children's consent the team surveyed seven different schools in Kenitra province. A structured questionnaire composed of different items - Household demographic data, socio-economic data, anthropometric measurements, food and nutrition evaluation - was used to collect data. A stratified random sample of 263 pupils with average age of 13 years was recruited. A health team assessed the anthropometric status. Dietary diversity was appraised with two types of indices: a dietary diversity score (DDS) based on the number of food categories consumed over a week, and a weekly food frequency score (WFFS). The DDS was significantly higher in rural than in urban children, whereas the WFFS was lower in rural children, owing primarily to

less frequent intake of fruits and vegetables, than in the urban children. Maternal level of instruction was also positively associated with a higher consumption of fruits and vegetables and milk, and with a higher WFFS. Both indices were significantly associated with stunting. The study suggested that diet quality is associated with height status and food diversity indices, that take food frequency into account, which may provide a better reflection of diet quality.

PP 346

MEASURING WHAT KIDS ARE EATING ACROSS EUROPE – A NOVEL PAN-EUROPEAN APPROACH

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Aim: Given the wide variation in prevalence of obesity in European children, this study examines food selections across countries that are generally believed or recommended to promote or protect against obesity. **Methods:** A multicenter cohort study about identification and prevention of dietary- and lifestyle-induced health effects in children and infants (IDEFICS study) was conducted between 2007 and 2011. Centres in eight European countries (Belgium, Cyprus, Estonia, Germany, Hungary, Italy, Spain and Sweden) included over 16000 children between the age of 2 and 9 years. A qualitative food frequency section in a Children's Eating Habits Questionnaire (FFQ-CEHQ) with 43 food items was completed by the parents at baseline 2007/2008. Those who had more than 50% of food items missing were excluded. The present study included a sample of 14996 children. Mean frequencies of selected food intakes were calculated on food item or food group level. **Results:** The average consumption frequency of vegetables and fruits was between 14 and 22 times/week. Very few children (2% in Belgium and 14% in Sweden) reached the recommended five times/day. The intake of sweet beverages (including sweet milk) was five times as large in Germany (3 times/day) compared to Sweden. In Hungary, Estonia and Cyprus the mean intake of pizza and hamburger was more than 10 times as high as in Belgium (once/month). Fried food was most common in Spain (once/day) and least common in the other Mediterranean countries Italy and Cyprus. Sweden was the country with the highest proportion of whole meal bread, reduced fat spread and semi skimmed/skimmed milk while Hungary had the highest proportion of semi skimmed/skimmed yoghurt. Children in the different countries preferred various types of sweet and salty snacks. Even the average frequency of intake of all snacks varied, Italian, Estonian, Cypriot and German children had snacks on average two times/day whereas the Swedish and Spanish children only once/day. **Conclusion:** Despite the trend towards a unification of brands and eating habits over Europe we can still see large differences in food intake patterns between countries. Recommendations to reach five a day for vegetables and fruits should be promoted far more given the very low proportion of children reaching this uniform goal. Every country should be aware of the unique weaknesses and risks in children's dietary patterns. Therefore it is necessary to make national recommendations in order to target dietary intervention in the appropriate areas.

PP 347

INSECTS AS A FOOD ALTERNATIVE FOR DESERTED AREAS IN MEXICO

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Mexico's biological diversity reflects in the feeding habits of its population. However, climate variation and non sustainable exploitation has had an unfavorable impact on some species. As a consequence, the reduction of biological diversity has greatly affected the nutritional sources of some traditional communities whose livelihood is highly dependent of such diversity. Adaptation is unavoidable; hence the need for empowering these groups with knowledge of other options that can be a good source of nutrients, such as those from edible insects that can thrive in the deserts of Mexico. The Mexican biological diversity of these regions has led us to promote the use of insects as food supplements to improve the nutritional value of their diet. The aim of this paper is to detect the edible insects from an arid zone of the State of Hidalgo, assess their macronutrient value and deliver that information to the local population. A longitudinal conventional study throughout 2010 was performed. Data was obtained from three species of maguety cactus (*agave spp.*): white maguety grub, *Aegiale hesperiaris k*; red maguety grub, *Comadia redtenbacheri H* and botija, *Scyphophorus acupunctatus*. Also from three species of nopal cactus (*Opuntia spp.*): Nopal grubs *Laniifera cyclades D*, *Metamastus spinolae V* and black bee, *Polybia parvulina R*. Also edible on larva stage, we found honey ant, *Myrmecosistus melliger L.* and Escamoles (ant eggs) from *Liometopum apiculatum M*. Both species are subterranean. Also Xavis, *Pachilis gigas B.* adults were found thriving on the huizache bush, *Acacia farnesiana*. Analyzed for

macronutrients, they ranged as follows: proteins from 9.85% to 4.52%; lipids from 5.85% to 55.85%, minerals from 2.95% to 4.52%; fiber from 1.32% to 5.14% and soluble carbohydrates from 2.84% to 77.16%.

That is, insects have good nutritional values. Their reproduction is seasonal but some species can be found all year long and hence represent a good alternative to increase the nutritional value of traditional foods.

Edible insects have a good nutritional balance and can be consumed either by themselves or combined with other foodstuff.

PP 348

DIETARY DIVERSITY IN CHILDREN 1-8 MONTHS FROM THE MALNUTRITION-ENTERIC DISEASE (MAL-ED) BIRTH COHORT STUDY

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After controlling for socioeconomic and demographic factors, dietary diversity (DD) is a strong proximal indicator for dietary adequacy, quality and child nutritional status, (Arimond & Ruel et al , 2000). Following procedures used by Arimond & Ruel et al (2002) in Latin America and Ethiopia, we created standardized dietary diversity scales/indices to compare variation in diets across the 8 MAL-ED study sites (4 urban: Bangladesh, Brazil, India, and Nepal, 1 rural/perurban: South Africa, and 3 rural: Peru, Pakistan, and Tanzania). Monthly qualitative assessment captures 24 hour food consumption of enrolled children from 1 to 8 months of age. Indices were calculated for two age ranges: 1-5 months and 6-8 months. For months 1-5, the dietary index was a factor of breastfeeding (0 or 1), infant formula and other liquid consumption (0 or 1), and demonstrated quality of optimum feeding (0 or 1) for a maximum score of 3 on this index. For 6-8 months, the index was based on breastfeeding, formula feeding, frequency of feeding and consumption of a variety of food groups including grains (rice, porridge, bread, noodles), tubers (potatoes, yams, manioc), orange vegetables (carrots, squash, sweet potatoes), dark leafy vegetables (spinach), legumes (beans, lentils, peas, corn, ground nuts), orange / yellow fruits (mangos, papayas), other fruits, organ meat (liver, kidney, heart), animal protein (chicken, beef, lamb, goat, duck, fish, shellfish), dairy (cheese, yogurt, milk), sugary foods (pastries, biscuits, cakes) and other commercially available foods. Results showed that the Tanzanian site had the highest diversity score in both indices when compared to all eight sites. South Africa shows the lowest diversity score, perhaps reflecting limitations on choice when purchased foods rather than grown foods are relied on. The 4 south Asian countries showed high diversity throughout the first eight months of life. It is important to note that urban-rural context plays a large role in the availability of foods, and thus the diversity in these sites.

PP 349

DIETARY DIVERSITY OF HOUSEHOLD MEMBERS: CAN CHILD DIET DIVERSITY BE USED AS PROXY INDICATOR FOR MOTHER DIET DIVERSITY?

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BACKGROUND: Through its nutrition policy (draft October 2011), WFP is committed to developing a sound nutrition problem analysis that defines the nutritional needs of vulnerable groups. WFP systematically collects data on household food consumption but understanding the dietary diversity of the most vulnerable household members could provide additional evidence of the importance of food as part of the solution to address malnutrition. As highlighted in the WFP Household Food Security and Nutrition Conceptual Framework, individual diet is determined by household food access but also by knowledge, education and cultural factors (e.g. food taboos) that play an important role in food distribution within the household. Such factors could lead to poor dietary diversity of individuals even in households with secure access to food, or individual specific food protection in food insecure environments. Information provided by WFP analysis will help countries to identify possible interventions, define the most cost-effective response and allow for effective targeting.

However, especially in emergency situations obtaining rapid results of assessments is critical. The use of proxy indicators, whilst recognising that they only provide partial information, can be a good compromise when direct measurements may be costly, time consuming and technically challenging. It is essential to determine the reliability of these proxies and the importance of the information we are losing when they're used.

The potential impact of behaviour on food consumption is more pronounced during periods when individual specific nutrient requirements are higher such as in pregnancy, lactation and weaning with greater consequences on malnutrition.

OBJECTIVE: Test if child diet diversity is a good proxy indicator of mother diet diversity.

METHODOLOGY: Diet diversity of mothers and 6-35 months old children and its adequacy is calculated from 24 hours recall consumption. WHO Infant and Young Child Feeding indicators and those of KPC 2000 will be used.

Differences between mother and child diet diversity will be calculated, as well as sensitivity and specificity of mother diet diversity adequacy with respect to that of the child. Food groups with the highest mother and child differences will be identified.

EXPECTED RESULTS: Results will indicate which percentage of error and misclassification occurs when children diet diversity, in absolute and adequacy terms, is used as estimation of mother one. According to these results it is expected to evaluate the usefulness of children food consumption diversity as a proxy for that of the mother. For programming, results will estimate to what extent lactating women nutrition requirements will be covered when their needs are inferred from those of children.

PP 350

COMPARISON OF TWO PHYSICAL ACTIVITY CLASSIFICATION METHODS AND ASSOCIATIONS WITH CANCER MORTALITY IN THE THIRD NATIONAL HEALTH AND NUTRITION EXAMINATION SURVEY

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Introduction: Physical activity (PA) is categorized inconsistently in studies and may generate differing results when evaluated in relation with disease outcomes. **Methods:** We investigated the longitudinal associations of cancer mortality and PA using two different commonly used definitions to categorize level of PA. Seventeen questions querying PA were self-reported in the Third National Health and Nutrition Examination Survey (NHANES III;1988-1994). In the first method standard metabolic equivalent (MET) cut-offs were used to classify PA (<3 METS=low-intensity;3-6 METS=moderate;>6 METS=vigorous). In the second method, PA was categorized using age and gender specific MET cut-offs. Among men, moderate activity was defined as >1.26-3 METS depending on age, with lower values used as cutoffs for older men (80+ years) and higher values for younger individuals (20-39 years). Among women, moderate activity ranged from >1.25-2.5 METS. Vigorous activity was defined as >3-7.2 METS for men and >1.5-5.2 for women. PA categories ('sedentary', 'moderate' and 'vigorous') created using both methods were cross-classified using a Chi-squared test. The Cohen's Kappa statistic was used to assess agreement between the two methods. NHANES III weights were applied in all analyses. Next, the associations of PA (both definitions) and cancer mortality were evaluated using Cox Proportional regression models. **Results:** The Chi-squared test suggested that 22%, 20% and 7% (total of 49%) of the individuals were classified in the 'sedentary', 'moderate' and 'vigorous' categories respectively, regardless of the method used ($p<0.001$). An unweighted Kappa of 0.26 and weighted Kappa of 0.33 showed that the agreement was fair according to the Landis and Koch criteria. In the analyses with PA categorized using standard MET cut-offs, associations were insignificantly protective for moderate activity (HR:0.92;95%CI:0.69-1.21) and vigorous activity (HR:0.66;95%CI:0.39-1.13) after adjusting for race, sex and smoking status. In the analyses with PA categorized using gender- and age-specific MET cut-offs, persons were 18%(HR:0.82; 95%CI:0.65-1.03) and 16%(HR:0.84;95%CI:0.68-1.04) less likely to die of cancer if they engaged in moderate and vigorous activities. **Conclusions:** The classification of individuals into 'sedentary', 'moderate', and 'vigorous' activity levels differed based on the definition of PA used. However the associations in relation with cancer mortality did not vary in this dataset. A consensus definition of PA is warranted to improve comparison across epidemiologic studies.

PP 351

HOW WELL DO THE MET VALUES FOR WALKING REFLECT THE ENERGY COST OF WALKING?

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Metabolic equivalents (METs) are often used as a means of estimating energy expenditure of physical activities. We have previously shown that the 1-MET value of 1 kcal/kg/h overestimates resting energy expenditure by 20%. Furthermore, energy cost of walking at 5.6 km/h was on average 4.6 ± 0.5 kcal/kg/h, 22% higher than the theoretical energy cost of 3.8 kcal/kg/h (based on the *Compendium of Physical Activities* published in 2000). However we demonstrated that accounting for an individual's resting metabolic rate can improve estimates of the energy cost of moderate intensity walking when using the 2000 Compendium MET values. In 2011 an updated version of the Compendium was published, noting our proposed individualised correction approach, but also providing new MET values for a range of physical activities including walking. We undertook the current study to [1] investigate the variance in the measured energy cost of walking at a variety of walking speeds in a heterogeneous cohort of 180 adults, and [2] compare the measured energy cost of walking with the previous 2000, and the new 2011, Compendium MET values.

180 adults (M=94, F=126; 21 – 64 yrs; 48 – 133 kg; 18 – 43 kg/m²) were recruited via stratification in 2 sex (male, female), 4 age (20-34.9, 35-44.9, 45-54.9, 55-65 yrs), and 3 BMI (normal weight: 18-24.9 kg/m²; overweight: 25-29.9 kg/m²; obese: 30-45 kg/m²) groups. Self-paced walking (SPW), defined as the speed corresponding with 'walking for

pleasure' pace, was measured twice over 2 km walking on a 400m track. Energy cost walking was then determined at four speeds (SPW-1.2 kph, SPW-0.6 kph, SPW, SPW+0.6kph) on a treadmill via indirect calorimetry.

While there was no influence of age on SPW speed ($P=0.86$) in this cohort, SPW decreased with BMI in females ($P<0.001$) but not in males ($P=0.15$). After adjusting for SPW speed, the influence of BMI on energy cost of walking (kcal/kg/h) at SPW speed was largely accounted for. At each of the speeds tested, the measured energy cost of walking was statistically ($P<0.001$) higher than both the 2000 and 2011 Compendium values; however the underestimation was statistically smaller using the 2011 MET values. The average error from the 2011 MET values was only -0.21 kcal/kg/h (95% CI: -0.26 to -0.17 kcal/kg/h). The magnitude of error increased with walking speed, age and resting VO_2 . Therefore while individual variability remains, the new 2011 MET values provide an improved estimate of the energy costs of moderate-intensity walking.

PP 352

VARYING PERSPECTIVES OF RELIABILITY IN ACCELEROMETER RESEARCH

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Reliability coefficients in physical activity research are often reported using classical test theory, where measurement error is a singular undifferentiated term. Generalizability (G) theory offers a novel approach to report reliability when multiple sources of error exist; however, the utility of this approach in physical activity research is unclear. Purpose: The purpose of this study is to partition and quantify total variance in accelerometer-derived levels of moderate-to-vigorous physical activity (≤ 3600 counts/min) according to: a) participant (P) differences, b) inconsistencies across days (D), c) variation between occasions (O), and d) interactions among variables. A secondary purpose is to compare variance estimates and reliability coefficients between a two factor (P x D) and three factor (P x D x O) design. Methods: Participants enrolled in the Study of Early Child Care and Human Development with accelerometer data from seven consecutive monitoring days during 5th and 6th grade were included in this fully crossed design (P x D x O) ($n=87$; 41% male). Variance component estimates were calculated for all terms in the fully crossed design (G study phase) and these estimates were then used to derive variance components for a P x D design, assuming n occasions = 1. Universe score variance, relative error variance, and G (reliability) coefficients were derived in the decision (D) study phase for both designs under the assumption that n days = 7 and n occasions = 1. The 'occasion' term was considered random in the P x D x O design and fixed in the P x D design. Results: Total variance in MVPA was partitioned in the following manner using the three factor design [P (27.7%), D (1.5%), O (1.9%), P x D (6.4%), P x O (11.9%), D x O (0%), and P x D x O (50.6%)] and two factor design [P (40.4%), D (1.5%), and P x D (58.1%)]. Compared to the P x D design, the P x D x O design resulted in a lower amount of universe score variance (164.88 vs 235.79), higher amount of relative variance (119.31 vs 48.40), and a lower G (reliability) coefficient (0.58 vs 0.83). Conclusions: Within the P x D design, the occasion term is hidden and therefore the universe of generalization is confined to a single array of days. G theory expands the perspective of reliability and allows researchers to make informed decisions regarding study design.

PP 353

DESIGNING MEASUREMENT ERROR INVESTIGATIONS OF SELF-REPORTED AND OBJECTIVELY MONITORED PHYSICAL ACTIVITY: THE IDATA STUDY AND MEASURE

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Uncertainty about error inherent in physical activity (PA) measurement hinders research to assess the links between PA and health. We designed the Interactive Diet and Activity Tracking in AARP (IDATA) Study to investigate the measurement error structure of self-reported and objectively measured PA against reference biomarkers. A secondary aim is to evaluate approaches for combining self-reported and objective data to better characterize PA. The IDATA Study will be conducted with a target sample of 760 male and female AARP members, 50-74 years of age, residing in Pittsburgh, Pennsylvania. The target sample includes participants in the NIH-AARP Diet and Health Cohort Study. IDATA participants will provide clinical measures at three study center visits; other data collection activities will be completed at home each month for twelve months. Doubly labeled water (DLW) will be used to measure energy expenditure and indirect calorimetry will be used to measure resting metabolic rate (RMR). One-quarter of participants will complete DLW and RMR measurements in each season; 50 participants will repeat DLW and RMR protocols after six months to assess within-person random error. The Modified Canadian Aerobic Fitness Test will be used to estimate cardiorespiratory fitness. Seven self-report PA instruments will be administered: a 24-hour activity recall (ACT24), past year recalls (AARP, Harvard cohort questionnaires), past month recalls (CHAMPS, BRFS questionnaires), a past week recall (sedentary behavior questionnaire), and a screener (Stanford). ACT24 will be administered six times bi-monthly. AARP, CHAMPS, BRFS, sedentary behavior, and Stanford questionnaires will be administered twice, six months apart. The Harvard questionnaire will be administered once. An ActiGraph GT3X accelerometer and activPAL

inclinometer will be worn concurrently for seven days on two occasions, six months apart. A subsample of 50 adults will wear an Actiheart-4 heart rate monitor while wearing the ActiGraph and activPAL. The timing of the ACT24 administrations relative to the monitor wear occasions will allow ACT24 to be evaluated as a measure of both short- and long-term PA. The IDATA Study is one of three cohort studies participating in the Multi-cohort Eating and Activity Study for Understanding Reporting Error (MEASURE). The MEASURE coordinating center developed standard quality control protocols, constructed a web-based study management system to coordinate access to instruments and data, and is creating rules for data harmonization across studies. The IDATA Study and MEASURE are the most comprehensive efforts to date to evaluate the measurement error structure of PA data, an understudied area in measurement science.

PP 354

A SYSTEMATIC REVIEW ON THE VALUE OF METABOLIC EQUIVALENT (MET) TO ESTIMATE ENERGY EXPENDITURE AND ACTIVITY INTENSITY

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The metabolic equivalent (MET) is widely used to estimate energy expenditure (EE) in clinical and research settings both in the sports science and public health areas even though its origin is still uncertain. Notwithstanding the controversy over its origin, it is generally assumed that it represents the O₂ consumption of a person sitting quietly (RO₂). However, its accuracy in exercise prescription and EE determination has been recently questioned. Thus, the purpose of this study was to systematically review the biomedical literature to verify the validity of using the conventionally-accepted value of MET (=3.5 mL O₂/kg/min). A search was done in Pubmed in July 2011 with the term “metabolic equivalent” as a word for the publications before July 8, 2008 and as a keyword thereafter. No limits have been established in relation to age and gender of the subjects and the date of publication but the search was limited to the English language. A total of 292 citations were found, their abstracts were retrieved and read. If the abstract indicated that RO₂ and body mass (BM) were measured the citation was selected. A total of 22 papers met the criteria and the reported values of RO₂, BM and age were retrieved. Most of the studies (15 or 68%) measured RO₂ with the subjects lying even though their stated purpose was to measure the MET. Two studies were done in adolescents and three studies were done in either para or tetraplegic subjects. Most studies reporting MET values of adults in the seated position had very few subjects (24 at most). Only one study assessed more than 80 subjects per gender. In general, measured RO₂ values were higher in males and younger adults. Mean values of RO₂ values were correlated with mean age ($r = 0.772$; $p < 0.001$) and BM ($r = 0.669$; $p < 0.001$). Due to the very limited information on the validity of the MET value, researchers and clinicians should use the conventionally accepted value of MET with caution if they want to estimate the EE or the intensity of activities. It would be best to measure RO₂ until reliable values of MET are well-established using standardized methods.

PP 355

COMPARISON OF THE ENVIRONMENTAL COST OF PROTEIN FOOD SOURCES

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Rationale: Dietary patterns featuring increased amounts of animal protein, more specifically red meat, have been evolving in developing nations over the past few decades in parallel to increases in national wealth and the shift towards urbanization. This is of great concern since the agriculture sector produces about 22% of global total greenhouse gas emissions and livestock production is responsible for approximately 80% of the sector's emissions. McMichael (2005) has predicted that the current production and consumption of animal-based foods is not sustainable in the context of current rates of population growth and increased meat consumption in developing countries, and, suggests that an international contraction and convergence strategy be considered to reduce climate change and improve health outcomes. *Objective:* To investigate the environmental impact of producing one kilogram (kg) of edible protein from two plant and three animal protein sources. *Design:* Primary source data were collected and applied to commodity production statistics to calculate the indices to compare the environmental impact of producing 1 kg of edible protein from beans, almonds, eggs, chicken and beef. Inputs included land and water for raising animals and growing animal feed, total fuel, and, total fertilizer and pesticide for growing the plant commodities and animal feed. Animal waste generated was computed for the animal commodities.

Results: An 18 and 9-fold greater requirement was found for beef versus beans for land and water usage, respectively. For fertilizer, beef was found to have a ~4-fold greater requirement versus beans, a 1.5-fold increased requirement versus chicken and almonds, and, a ~2.5-fold increased requirement versus eggs. Beef and almonds were found to have similar fuel requirements, which are ~2-fold greater than beans and chicken, and, ~3.5-fold greater than eggs. Lastly, beef was shown to generate a 5 to 6-fold greater amount of waste as compared to eggs and chicken.

Conclusions: The substitution of beef with beans, eggs and chicken in meal patterns will significantly reduce the environmental footprint worldwide and should also be encouraged to reduce the prevalence of non-communicable chronic diseases. Societies must work together to change the perception that beef (e.g., red meat) is the mainstay of an affluent diet.

PP 356

GREENHOUSE GAS EMISSIONS AND FOOD CONSUMPTION: A STUDY OF SUSTAINABLE FOOD HABITS IN SWEDEN

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Climate change is one of the most urgent global issues and is constantly gaining increased political importance. In the EU, food consumption contributes to almost one third of the total greenhouse gas (GHG) emissions, which is more than the entire transport sector. There is great variation in emissions associated with different foods. Foods from animal origin, particularly beef and lamb, give rise to the largest emissions whereas plant based foods such as pulses, cereals, fruits and vegetables leads to lower emissions. To reach the 2°C climate target with high level of certainty, global emissions have to decrease by 80 % until 2050, and studies are therefore needed to explore potential reduction in all sectors. The objective of this study is to use dietary information collected from 180 participants to estimate GHG emissions associated with dietary intake in Sweden. A simulated study will also investigate how altered food consumption patterns (e.g. replacement of 1/3 of the beef with pulses) may reduce GHG emissions and how the nutritional profile will change due to the altered food consumption. Assessment of dietary intake was done using food records where the intake of foods and drinks was weighted and registered for one week. Each food item in the record has been assigned a CO₂-eq value according to a list of compiled lifecycle assessment data from published reports. The mean CO₂-eq emissions at baseline and after simulated replacements will be analyzed on individual- and group level as well as the intake of some selected nutrients. The contribution from single items (e.g. beef) to the total emission will also be investigated.

PP 357

USING LINEAR PROGRAMMING TO CHARACTERISE SUSTAINABLE DIETS: BALANCING HEALTH AND ENVIRONMENTAL SUSTAINABILITY IN THE DIET.

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Background: Defining a sustainable diet is complex, not least because it is multifaceted encompassing environmental, health, social and economic issues. Nutritionists are mainly concerned with the health benefits of the diet, but with the increasing awareness of the impact of food choices on other things (e.g. climate change), dietary advice needs to embrace a broader definition of sustainability. The challenge is to balance different elements of sustainability whilst creating a realistic and acceptable diet. One approach is to use mathematical modelling techniques, such as linear programming. Linear programming is used for determining the choices that achieve the best outcome (e.g. minimise climate change) subject to a list of requirements (e.g. energy and nutrient requirements, acceptability constraints), represented as linear relationships.

Methods: Linear programming was used to explore the compatibility of the dietary recommendations for health with environmental sustainability. In this study the focus for environmental sustainability was climate change, expressed in terms of greenhouse gas emissions (GHGE). A maximally sustainable diet was derived, based on the energy and nutrient requirements (protein, fat, saturated fatty acids, carbohydrate, non-milk extrinsic sugar, fibre, sodium, zinc, iron, calcium, vitamin B12, folate) for an adult woman. This generated a list of foods which achieved the energy and nutrient constraints, whilst minimising the GHGE. The database used in the model comprised 82 food groups. The nutrient composition data and the GHGE data in the database had to be adjusted so they both represent the food groups in the form 'as eaten' (e.g. cooked, edible portions).

Results: The first diet generated by the model met all the dietary requirements and achieved a 90% reduction in GHGE, but only included eight foods in unrealistic quantities. Additional constraints were added to the model to construct a more realistic and acceptable diet. These were termed 'acceptability' constraints, where upper and lower limits were placed on the amount of each food group. This limited the amount of any individual food in the diet and forced some foods, such as meat that has high GHGE and would not otherwise be selected, into the diet. This created more complete and realistic diet, with a much greater variety (52 foods) but this was at the expense of a smaller reduction in GHGE (36%).

Conclusion: Linear programming provides a useful tool to balance the different elements of sustainability and can be adapted to nutrient requirements of other groups and incorporate additional constraint (e.g. cost, preferences).

PP 358**CURRENT STATUS OF ALKYLRESORCINOLS AS BIOMARKERS OF WHOLEGRAIN INTAKE**A. Ross¹¹Nestec SA

Since 2001, alkylresorcinols have been suggested as potential biomarkers of wholegrain wheat and rye intake, and many steps have been taken towards validating their use as such. Alkylresorcinols are stable during food processing and well absorbed, and can be measured in plasma, while their main metabolites can be easily measured in both urine and plasma. Many studies have now demonstrated that they are clearly associated with different measures of wholegrain intake in both intervention and free-living situations, though inter-subject variability is wide. In this talk, latest results from both intervention and free-living studies from both the literature and our laboratory will be presented and the issue of whether current data supports alkylresorcinols as suitable biomarkers of wholegrain intake, and as compliance in intervention studies will be discussed.

PP 359**DIETARY MERCURY (HG) INTAKE ASSESSED BY A FOOD FREQUENCY QUESTIONNAIRE; A CALIBRATION STUDY WITH TOENAIL HG CONCENTRATIONS.**J. Warnberg¹, J. Perez¹, M. Alva¹, R. Cueto¹, F. J. Baron¹, E. Gomez-Gracia¹, J. Fernandez-Crehuet¹¹Preventive Medicine & Public Health. University of Malaga.

Background: Assessment of dietary Mercury (Hg) exposure can be estimated by Food Frequency Questionnaires (FFQ) to study diet-disease relationships, but few studies validate the instrument against biological markers. Objectives: To estimate Hg intakes with a FFQ and to validate the dietary exposure estimates with toenail concentrations.

Methods: An estimation of dietary Hg exposure was calculated with a 136 items FFQ and data on Hg food concentrations from the Catalanian Total Diet study (2004). Validity of Hg dietary exposure estimation was determined through toenail Hg concentrations from 70 asymptomatic, high cardiovascular risk Spanish men and women (aged 55-80 years). Toenail Hg was assessed by neutron-activation analysis. The associations of estimated dietary Hg intake with toenail Hg concentrations were analysed using Spearman's correlation coefficient (r). Results: FFQ estimates of Hg intake did not correlated with toenail Hg concentrations ($r=-0.057$; $p>0.05$). Conclusions: Our FFQ is not a valid tool to estimate dietary Hg exposure as shown in this preliminary study done in a rather small sample. The correlations can improve if we repeat the analyses when a larger dataset is available, and/or by updating our data on Hg food concentrations.

PP 360**LONG-TERM STABILITY AND VALIDITY OF FOOD FREQUENCY QUESTIONNAIRE-BASED ESTIMATES OF LONG-CHAIN N-3 FATTY ACID INTAKE IN SWEDISH WOMEN**A. Wallin¹, D. Di Giuseppe¹, A. Wolk¹¹Division of Nutritional Epidemiology, Institute of Environmental Medicine, Karolinska Institutet

Dietary intake of long-chain n-3 fatty acids has been associated with several cardiometabolic risk factors and disease outcomes. To further investigate the effects of these fatty acids in epidemiological studies, reliable assessment of intake is of major interest. We evaluated long-term stability and validity of food frequency questionnaire (FFQ)-derived long-chain n-3 fatty acid intake by comparing estimates from two FFQs (completed on average 6.3 years apart) and adipose tissue (AT) content in a subgroup of the population-based Swedish Mammography Cohort (SMC). In 2003-2004, 235 women aged 55-75 years reported their average frequency of consumption of 96 food items during the preceding year. A subcutaneous fat aspirate was obtained on average 1.8 months (range: 0-6.1 months) after completion of the FFQ. All participants had previously returned an identical questionnaire as a part of the SMC in 1997. The mean relative intake (% of total fat) of long-chain n-3 fatty acids (eicosapentaenoic acid, docosapentaenoic acid and docosahexaenoic acid) had increased by 25% from 1997 to 2003-2004 (from 0.68 to 0.85%). The mean relative AT content in 2003-2004 was 0.95%. Long-term stability, assessed by Spearman rank correlation between the two FFQ-based estimates, was 0.37 ($p<0.0001$). Validity, in terms of Spearman correlation between FFQ-estimated intake and AT content in 2003-2004, was 0.36 ($p<0.0001$). AT content was also significantly correlated with FFQ-estimated intake in the long-term retrospect (1997 FFQ; $r=0.28$). Excluding users of fish oil supplements ($n=29$ in 2003-2004 FFQ) did not substantially alter the correlations. These data indicate that the FFQ has good validity in the measurement of long-chain n-3 fatty acid intake. Further, despite a substantial increase in the mean intake of long-chain n-3 fatty acids over the course of 6 years in this population, ranking of the study participants according to intake level was relatively consistent.

PP 361

INVESTIGATION OF MEASUREMENT ERROR IN FFQ AND 7-DAY-DIARY MEASUREMENTS OF SUGAR INTAKE IN EPIC NORFOLK USING A VALIDATED URINE BIOMARKER

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Sugar intake is an important risk factor for chronic diseases such as cancer and diabetes. The ratio of urinary sucrose and fructose has been developed and validated as a predictive biomarker of sugar intake^{2,3}, and this biomarker has now been applied to several studies. Previous studies comparing self-reported dietary and biomarker data have shown considerable underreporting of sugar intake, in particular by obese subjects¹. Tasevska *et al.*⁴ have investigated the measurement error structure of self-reported sugar intake in 484 participants of the OPEN (Observing Protein and Energy Nutrient) study, and found significant error in measurements from both FFQ and repeated 24h dietary recall with attenuation factors between 0.3 and 0.4.

In contrast to OPEN, most observational studies have only spot urine samples available which require an adjustment for daily urine volume. In this study, we have investigated the error in self-reported dietary measurements using biomarker and dietary data from EPIC Norfolk. Spot urine samples collected at baseline (n=7,000) and after three years (n=200) and biomarker concentrations were determined using a newly developed analytical method⁵. Dietary data were obtained from FFQ, 24h dietary recall and 7-day diary at both time-points. One or more self-reported measurements are available for over 25,000 men and women. We will present a detailed measurement error structure analysis of different dietary assessment instruments in a large observational study.

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4 Tasevska, N. a. *et al.* Cancer Epidemiology Biomarkers & Prevention 20, 490-500, (2011).

5 Kuhnle, G. G. *et al.* Rapid Commun Mass Spectrom 22, 279-282, (2008).

PP 362

VALIDATION OF ESTIMATED FOOD RECORDS USING OBJECTIVE MEASURES FOR ENERGY AND PROTEIN INTAKE IN A 2-YEAR RANDOMIZED DIETARY INTERVENTION STUDY

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Background: Two major sources of error in dietary intervention studies are underreporting of energy intake and non-adherence to the prescribed diet. These ought to be addressed in order to make relevant conclusions. **Objective:** To compare validity of reported dietary intake of energy and protein and adherence to prescribed diet using objective measures. **Design:** Seventy-one obese women were randomized to either a Paleolithic-type diet (PD) or a diet according to the Nordic Nutrition Recommendations (NNR-diet) for two years. Energy (EI) and protein (nitrogen) intake (NI) were assessed at baseline, 6- and 24-months by food records and compared against total energy expenditure (TEE) and urinary nitrogen excretion (NU). **Results:** The mean energy difference (\pm 95% CI) at baseline between EI and TEE in the PD and NNR groups was -1.42 (-2.02 to -0.84) and -1.19 (-1.83 to -0.57) MJ/d, respectively, corresponding to a 14% and 11% lower EI. The mean nitrogen difference (\pm 95% CI) at baseline was -2.17 (-3.02 to -1.32) and -1.92 (-2.73 to -1.12) g/d, respectively, corresponding to an underestimation of NI (adjusted for extra-renal losses) by 15% and 14%. Forty-three % of the whole study population was classified as underreporters of EI and 20 % of NI but with no differences between groups. There was a significant 15-20% decrease in reported EI from baseline to 6- and 24-months, followed by a weight loss. Despite the intention to double the protein intake in the PD group, NU was unchanged compared to baseline in this group. **Conclusion:** The reported energy and protein intake was underestimated by 14% and 11% as well as 15% and 14% for PD and NNR-diet group respectively, and did not differ between the dietary groups. Both study groups reported a lowered intake of energy over time. The PD group was unable to reach the prescribed goal of protein intake.

PP 363**PLASMA VARIATIONS OF OXIDIZED LDL-CHOLESTEROL AND CHRONIC INFLAMMATION BIOMARKERS, AND ASSOCIATIONS WITH DIET**E. Wirfält¹, U. Ericson¹, S. Hellstrand¹, I. Drake¹, E. Sonestedt¹, B. Gullberg¹¹Lund university, Clinical Sciences in Malmö,

Modern reproductive patterns, obesity and alcohol are established risk factors of postmenopausal breast cancer. Sedentary lifestyle and westernized diets may contribute to enhanced breast cancer risk, and are considered major contributors to oxidative stress and inflammation. Lipid peroxidation causes damage to cell membranes and release of toxic metabolites, which seriously may damage DNA and hinder DNA repair. Oxidized LDL-cholesterol (oxLDL) in plasma is considered a stable marker of oxidative stress and enables strong epidemiological studies. The Malmö Diet and Cancer (MDC) cohort (n=28098, women=17 035) that conducted baseline examinations in 1991-1996 among men and women aged 45-73 years, have unique dietary data of high relative validity and a well-maintained bio-bank. Previous reports from the MDC suggests that women with low-fiber-high-fat diets (especially high in vegetable oil-margarines), and consuming food products manufactured at high temperatures, may be at an increased breast cancer risk.

During the spring of 2011 we examined the variation of oxLDL and inflammation markers (in fasting and non-fasting blood) in a small sub-sample from the cohort (n=95) to determine the intraclass correlation coefficients (ICC) of the plasma concentrations of oxLDL and chronic inflammation bio-markers (i.e., IL-1b, IL-6, IL-8, TNF-a).

Study participants donated blood at 6 occasions; 3 samples in a fasting state and 3 samples in a non-fasting state during a 6 week period. A four-day registration method assessed dietary intakes at the beginning of the blood sampling period. The plasma concentrations of oxLDL and inflammation bio-markers IL-1b, IL-6, IL-8 and TNF-a were analysed at the Lund University Clinical Research Center in Malmö.

The within-subject and between-subject variations (coefficient of variations, CV) and the ICC of the plasma concentrations of oxLDL and inflammation bio-markers will be determined separately for fasting and non-fasting blood samples. Previous research indicates that in order to be useful for epidemiological studies, the ICC needs to be sufficiently large. It has been suggested that relative risks in the range of 1.5-2.5 would be substantially attenuated if ICC is less than 0.65. The associations between diet and oxLDL and inflammation biomarkers will be examined. More data will be presented and discussed.

PP 364**PREVALENCE OF CARDIOVASCULAR RISK FACTORS IN CHILDREN AGED 7 TO 10 YEARS IN VITORIA-ES-BRAZIL.**B. H. Fiorin¹, G. G. Torres¹, J. H. Siqueira¹, J. R. Andrade¹, M. Cattafesta¹, P. R. Oliosia¹, R. P. Silva¹, R. S. Matos¹, G. M. Lomeu¹, J. T. B. Ferreira¹, L. B. Salaroli¹¹Federal University of Espirito Santo

Introduction: In recent decades, the processes of demographic and epidemiological transition have been observed, further studies since 1975 show changes in food intake and nutritional profile on the population called nutrition transition, characterized by a steady decrease in cases of malnutrition and accelerated growth of overweight and obesity. These observed changes contribute greatly to the occurrence of diseases in the world population and the increasing prevalence of chronic noncommunicable diseases (NCDs), especially cardiovascular disease. Studies show that children already have present overweight, obesity and high blood pressure in early age, inadequate eating habits and lifestyle that may be associated with the emergence of risk factors in childhood and adolescence to NCDs. Objectives: To identify the prevalence of cardiovascular risk factors in children 7 to 10 years old in the region of Maruípe, Vitória-ES. Methodology: Cross-sectional study in a school-based health region of Vitoria. We studied children aged 7 to 10 years in six schools. Socioeconomic data were informed by means of questionnaires sent to households. We also collected anthropometric data (weight and height) and measured blood pressure. Risk factors considered were: hypertension, overweight, poor diet quality and sedentary leisure greater than or equal 4 hours daily. Results: We studied 347 schoolchildren, 202 (58.2%) girls and 145 (41.8%) boys. Only 100 (31, 6%) children practiced some kind of sport, 258 (75%) considered themselves as not Caucasian and 135 (38%) of their parents had less than 8 years of school education. The prevalence of risk factors found were: 32.5% overweight, 11.6% hypertension, 56.9% and 41.7% sedentary leisure supply of low quality. Conclusion: We conclude that it is necessary to implement intervention measures to prevent the emergence of cardiovascular risk factors in childhood that can cause serious problems along their life.

PP 367**SERUM B12 AND PLASMA B6 STATUS IN A BRAZILIAN POPULATION: HEALTH SURVEY – SÃO PAULO (ISA2008 – SP)**N. K. Simoni¹, A. N. Previdelli¹, E. Verly¹, R. Fisberg¹, D. Marchioni¹¹Nutrition

Introduction. The literature has been hypothesized that B6 and B12 vitamins might reduce the risk of cardiovascular diseases because adequate levels of these vitamins are related to lower homocysteine levels. **Objective.** To investigate the B6 and B12 status in a population living in the municipality of São Paulo, Brazil. **Methods.** Cross-sectional population-based study that comprised 153 adolescents (aged 12 to 18 years old) and 333 adults (aged 18 to 60 years), from both sexes, who were included in the Healthy Survey (ISA2008 – in São Paulo, Brazil). Sociodemographic data were assessed using questionnaires. Serum B12 was estimated by electrochemiluminescence immunoassay method and plasma B6 by HPLC-Analytik system. Analyses of results were performed calculating the prevalence of deficiency of vitamin B6 and B12, according to age and gender. Vitamin B6 deficiency was defined when plasma concentration was < 12 nmol/L (for individuals from 12 to 17 years old), < 28 nmol/L (for men older than 18 years old) and < 08 nmol/L (for women older than 18 years). Vitamin B12 deficiency was defined when serum concentration was < 93 pg/mL (for men older than 18 years) and < 116 pg/mL (for women older than 18 years). Since there are no reference values for vitamin B12 deficiency for people younger than 18 years, these results were not presented. Data analyses considering complex sampling design were performed using Stata. Significance level was set at $p < 0.05$. **Results.** The mean and standard error values for plasma B6 were: 61.9 (2.0) (for individuals from 12 to 17 years old), 68.8 (3.1) (for men older than 18 years) and 50.7 (1.5) (for women older than 18 years old). For serum B12 the values were: 292.1 (12.0) (for men older than 18 years) and 317.6 (13.1) (for women older than 18 years). A total of 1.0% individuals presented deficiency in B6 vitamin, all of them being male. Deficiency of B12 vitamin was found in 0.6% of the study population, all of them being women older than 18 years. The serum concentration of B12 vitamin was significantly higher for women (318.0 (9.7 pg/mL)) than for men (293.7 (9.4 pg/mL)). **Conclusion.** The prevalence of vitamin B12 and vitamin B6 deficiency in this population is low. However, further studies are necessary to investigate the status of other nutrients important for this metabolic cycle.

PP 368**LONG-TERM REPRODUCIBILITY OF PLASMA ALKYLRESORCINOLS WITHIN A SWEDISH COHORT**R. Landberg¹, P. Åman¹, G. Hallmans², I. Johansson²¹Department of Food Science, Swedish University of Agricultural Sciences, ²Nutrition Research, Department of Public Health and Clinical Medicine

Alkylresorcinols (AR) have been suggested as specific biomarkers of whole grain and bran intake from wheat and rye. Before using plasma AR as biomarkers in prospective cohort studies, the long-term reproducibility needs to be determined in order to judge how well AR reflect whole grain intake.

The objective of the present study was to estimate the reproducibility of plasma AR concentrations over 1-3 years. The concentrations of AR homologues were analyzed in plasma samples, drawn > 8 h since last meal, donated by 74 participants in the Swedish prospective Västerbotten Intervention Project cohort. Reproducibility was estimated by calculating the intra class correlation coefficient (ICC). Fasting plasma AR concentrations were similar between the first and second measurements. The ICC for total AR was 0.54 [95% CI = 0.38-0.69] overall, 0.34 [95% CI = 0.13-0.64] for men and 0.73 [95% CI = 0.56-0.85] for women, respectively. Somewhat higher ICCs were obtained for shorter AR homologues. Adjusting for differences in time between blood samples (<1.5 y, ≤ 1.5 to 2 y, ≥ 2 y) did not substantially change ICC for any of the homologues.

In summary, the reproducibility of total AR and individual homologues over 1-3 years was high for women and moderate for men within this population, suggesting that this biomarker is useful for objective assessment of long-term whole grain wheat and rye intake in populations where the intake range is wide and where it is stable and frequent within individuals. Plasma AR concentrations do not appear to be affected by lipoprotein concentration or BMI.

PP 369**N-6:N-3 POLYUNSATURATED FATTY ACID RATIO, N-6 AND LONG-CHAIN N-3 POLYUNSATURATED FATTY ACIDS, AND PLASMA EXTRACELLULAR SUPEROXIDE DISMUTASE ACTIVITY**J. Zheng¹, A. Wolk¹¹Unit of Nutritional Epidemiology, Institute of Environmental Medicine, Karolinska Institutet

Background: Omega-3 polyunsaturated fatty acids (n-3 PUFA) may have anti-inflammatory effects, while omega-6 (n-6) PUFA and high n-6:n-3 PUFA ratio may have pro-inflammatory effects and increase generation of reactive oxygen species and influence expression of endogenous antioxidants.

Objective: To assess the associations of n-6:n-3 PUFA ratio (implicating high intake of n-6 PUFA and low intake of n-3 PUFA), n-6 PUFA and specifically long-chain n-3 PUFA with an endogenous antioxidant biomarker, plasma extracellular superoxide dismutase (EC-SOD) activity, in “healthy” and “non-healthy” women.

Design: Cross-sectional study including 58 “healthy” women (no history of cardiovascular disease, diabetes or cancer, never smokers and non-obese, BMI<30) and 101 “non-healthy” women (including one or more of the following: history of cardiovascular disease, diabetes, smoking and obesity), aged 55-74 years, from the Swedish Mammography Cohort – Clinical. Adipose tissue and blood samples were collected in 2003-2004. Biomarkers of fatty acid intake were measured in adipose tissue (reflecting long-term PUFA intake, up to 2 years) with gas-liquid chromatography. Plasma EC-SOD activity was analyzed by an indirect spectrophotometric method. Spearman correlation coefficients were calculated for all associations and adjusted for age and BMI (r_{adj}).

Results: The median (25th-75th percentile) n-6:n-3 PUFA ratio was 5.3 (4.9-5.8) in “healthy” women and 5.7 (4.9-6.1) in “non-healthy” women. The median (25th-75th percentile) plasma EC-SOD activity was 6.0 (5.2-6.8) U/mL in “healthy” women and 6.4 (5.4-7.5) U/mL in “non-healthy” women. In “healthy” women, n-6:n-3 PUFA ratio ($r_{adj}=0.38$, $P=0.004$) and n-6 PUFA ($r_{adj}=0.33$, $P=0.01$) were statistically significantly positively correlated with EC-SOD activity and long-chain n-3 PUFA was significantly inversely correlated with plasma EC-SOD activity ($r_{adj}=-0.27$, $P=0.045$). In contrast, we did not observe any statistically significant associations in “non-healthy” women.

Conclusions: In this study, “healthy” women had lower median n-6:n-3 PUFA ratio and lower plasma EC-SOD activity compared to “non-healthy” women. Our results indicate a role of the PUFAs in regulation of endogenous antioxidants in “healthy” women. The lack of association in “non-healthy” women (with potentially higher levels of inflammation and reactive oxygen species) suggests a different interplay between these PUFAs and plasma EC-SOD activity in health and disease.

PP 370

NATURAL AND SYNTHETIC FOLATE INTAKE DIFFERENTLY AFFECTS PLASMA HOMOCYSTEINE ACCORDING TO GENE VARIANTS? POPULATION-BASED STUDY IN SAO PAULO-BRAZIL

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Introduction: B vitamins, especially folate, have been associated with decreased hiperhomocysteinemia, an independent risk factor for adverse events. Several countries, including Brazil, adopted food fortification with folic acid (synthetic folate) as public policy to reduce neural tube defects. The purpose of this study was assessed the relationship between natural and synthetic folate with plasma homocysteine concentration according to methylenetetrahydrofolate reductase (MTHFR) gene variants C677T and A1298C. **Methods:** A cross-sectional population-based survey was conducted in the Sao Paulo-Brazil. Blood sample and diet assessment were performed in 691 men and women aged 12 and over. Dietary intake was measured using 24-hour dietary recall, and the folate intake (natural folate, synthetic folate and dietary folate equivalents) was obtained using the software program Nutrition Data System for Research. Plasma homocysteine (hcy) was analyzed using Immulite chemiluminescent kit. DNA was isolated and the genotype for C677T was done with an allele-specific polymerase chain reaction. A generalized linear model to homocysteine was constructed to assess the association with natural and synthetic folate intake according to sex, age, vitamins B6 and B12 intakes, and C677T polymorphism (CC and T-carriers) and A1298C (AA and C-carriers) polymorphism interaction. **Results:** The prevalence of T-carriers (C677T) and C-carriers (A1298C) genotypes in the population was 54.1% and 41.4%, respectively. The mean plasma homocysteine concentration for C677T polymorphism was 9.32 $\mu\text{mol/L}$ [95%CI 8.88-9.76] among CC genotype and 10.76 $\mu\text{mol/L}$ [95%CI 9.92-11.59] among T carrier, and for A1298C polymorphism, was 10.46 $\mu\text{mol/L}$ [95%CI 9.67-11.24] among AA genotype and 9.62 $\mu\text{mol/L}$ [95%CI 9.16-10.08] among C-carrier. Significant effects of males ($p<0.001$) and age ($p<0.001$) were found in both polymorphisms' models. In MTHFR C677T polymorphism' models, there was no interaction effect of natural folate ($p=0.48$) or synthetic folate ($p=0.93$).

The same no interaction effect was observed in A1298C polymorphism' models, natural folate ($p=0.64$) and synthetic folate ($p=0.88$), adjusting for potencial confounders (sex, age, vitamins B6 and B12). **Conclusion:** Homocysteine concentrations are influenced by vitamin status and genetics, especially several polymorphisms in folate-metabolizing genes. However, natural folate and synthetic folate intake was not associated with higher plasma homocysteine in MTHFR gene variants C677T and A1298C.

PP 371**DIETARY BETAINE AND CHOLINE AND PLASMA HOMOCYSTEINE: HEALTH SURVEY OF SÃO PAULO, BRAZIL**R. M. Fisberg¹, R. C. V. Lopes¹, M. A. Castro¹, V. T. Baltar¹, D. M. L. Marchioni¹¹Department of Nutrition - School of Public Health - University of São Paulo

Background: Elevated plasma homocysteine (Hcy) concentrations have been associated with the increase risk or cardiovascular diseases. Hcy can be converted to methionine through remethylation pathways that use folate or betaine as methyl radical donors. Betaine can be obtained directly from the diet or from oxidation of choline. Objectives: Evaluate betaine and choline intake and investigate their relation to Hcy in residents of the city of São Paulo. Methods: Data of 372 adults and elderly of both sexes, from a population-based cross-sectional study called Health Survey-São Paulo (ISA-SP 2008) was used. The median values of plasma homocysteine were analyzed according to tertiles of choline as well as of betaine intakes and also a linear trend test was performed. Results: The prevalence of hyperhomocysteinemia was higher in men (29%), in elderly (24%), in individuals with lower per capita family income (26%), and in smokers (28%). About 51% of individuals with hyperhomocysteinemia showed folate deficiency (<7.5 nmol/L) and 46% of individuals showed vitamin B12 deficiency (<200 pmol/L). There was a decrease in Hcy medians as betaine intake tertiles increased for all studied variables, except for those of individuals who were not normal-weight, who smoked and who consumed alcohol. We observed that choline showed a relation to plasma homocysteine levels in women, in individuals whose per capita family income was greater than one minimum wage, and in individuals who did not consume alcohol. Conclusion: Our study suggests the importance of betaine intake and its inverse association with homocysteine levels in elderly residents of the city of São Paulo.

PP 372**PLASMA HOMOCYSTEINE LEVELS ACCORDING TO METHYLENETETRAHYDROFOLATE POLYMORPHISMS AND SERUM FOLATE LEVELS IN A POPULATION-BASED STUDY IN SÃO PAULO**V. T. Baltar¹, J. Steluti¹, A. Mendes¹, G. F. Gattás², R. M. Fisberg¹, D. M. L. Marchioni¹¹Department of Nutrition, ²Department of Legal Medicine, Bioethics and Occupational Health

Background and Aims: Hyperhomocysteinemia is recognized as a risk factor of cardiovascular and other degenerative diseases. Homocysteine remethylation requires vitamin B12, vitamin B6, folate and methylenetetrahydrofolate reductase (MTHFR) enzyme. Both TT homozygosis of the C677T and the CC of A1298C in the MTHFR gene have been associated with reduced MTHFR activity. This study aims to assess the impact of serum levels of folate on plasma homocysteine considering C677T and A1298C polymorphism in a Brazilian sample. All models controlling for sex, age, serum vitamins B6 and B12. Methods: Serum vitamins B12, B6, folate, and plasma homocysteine of 726 participants from a population-based survey in São Paulo were used. The genotypes were done with an allele-specific polymerase chain reaction. Generalized linear models with gamma distribution and link identity were applied to model homocysteine according to sex, age, vitamin B12, vitamin B6, folate and both polymorphism (C677T: non-TT and TT; A1298C: non-CC and CC) in addition to folate and polymorphisms interactions. Results: Significant effects of males (p<0.01), age (p<0.01) vitamin B12 (p=0.001) and vitamin B6 (p=0.001) were found. An interaction between C677T and folate was found (p<0.01) whereas between A1298C and folate was not significant. Excluding the effect folate and A1298C polymorphism interaction, we did not find a significant effect of A1298C (p=0.080) and we found a significant effect of the interaction between folate and C677T (p=0.001). Subjects with TT homozygote for C677T genotype presented average of homocysteine levels 3.8 umol/L higher than non-TT (p<0.001). An increase of one ng/ml in folate was associated with and reduction of 0.16 umol/L (p<0.001) and 0.45 umol/L (p<0.001) in homocysteine levels for non-TT and TT polymorphism respectively. Conclusion: Lower levels of folate are associated with higher levels of homocysteine, but in the presence of TT homozygote for C677T genotype this association is even higher.

PP 373**FATTY ACIDS IN ERYTHROCYTES AS BIOMARKERS OF DAIRY INTAKE**M. Carlsen¹, A. Carlsen¹, R. Blomhoff¹, L. F. Andersen¹¹Department of Nutrition, University of Oslo

Studying diet related disease require accurate assessment of dietary intake. Fatty acids (FA) in adipose tissue and plasma have been shown to be biomarkers for intake of fatty acids and also been used in validation studies as biomarkers of dairy intake. A few studies have explored the FAs in erythrocytes with respect to dietary intake. For dairy intakes C15:0 and C17:0 is the most often measured biomarkers. Here we present the associations between the FAs C15:0, C17:0 and C23:0 measured in erythrocytes and intakes of dairy products estimated from a food frequency questionnaire (FFQ) and 7 days weighed food records (WFR), in free-living subjects.

Study population and method: The study was designed to include a representative sample of the Norwegian adult population. A total of 214 men (n=91) and women (n=123) filled in the 220 items FFQ at home and an overnight fasting blood sample was collected approximately 3 weeks later. The WFRs (n=95) were conducted 4 weeks after blood sampling. FAs in erythrocytes were expressed as percentages of total fatty acids. Spearman correlations were calculated.

Results: significant correlations were observed between C15:0 and yoghurt and cheese (r=0.26 and 0.21 respectively), C17:0 showed significant correlation (r=0.20) with intake of whole milk (3.9g fat/100g) and C23:0 showed significant correlations with intakes of semi-skimmed milk and total milk intakes (r=0.19 and 0.25, respectively), all intakes estimated from the FFQ. When intakes were estimated from the WFR both C15:0 and C17:0 showed significant correlations with cheese and whole milk (r between 0.22 and 0.28). Moreover, C23:0 showed significant correlations with intakes of cheese and semi-skimmed milk (r=0.21 and 0.27, respectively).

We also observed gender differences; in men only C15:0 showed significant correlations with intakes of whole milk and yoghurt intakes from the FFQ. In women however, C15:0 showed significant correlations with semi-skimmed milk, yoghurt, cheese and total dairy intake (r=0.30, 0.26, 0.26 and 0.25, respectively). Moreover, in women C17:0 showed significant correlation with total milk intake and C23:0 showed significant correlations with intakes of semi-skimmed milk, total milk intake and total dairy intake (r= 0.31, 0.25 and 0.27, respectively), all intakes estimated from the FFQ.

These results suggest that erythrocyte C23:0, in addition to C15:0 and C17:0, may be used as biomarker of dairy intake. Further statistical analyses will be conducted in a sub-sample of the study population using the method of Triads including intake from the FFQ, WFR and fatty acid measurements.

PP 374

URINARY SUCROSE AND FRUCTOSE ASSOCIATIONS WITH SELF-REPORTED INTAKE: THE INFLUENCE OF PLAUSIBILITY OF REPORTED ENERGY INTAKE AND EATING OCCASION

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Background/Aim: Foods that are high in fat and/or sugar are thought to be underreported in dietary assessment. Urinary sugars (sucrose and fructose) serve as “predictive biomarkers” of sugars intake and therefore provide objective assessment of the relative intake of dietary sugars among individuals. We examined associations of urinary sugars with reported total energy and sugar intakes and with reported energy intake from different eating occasions among adults recruited for a study on diet and chronic disease risk. Our hypothesis was that urinary sugars would be positively associated with energy and sugars intakes among all participants, but these associations would be stronger when the analyses were limited to plausible energy intake reporters.

Methods: Healthy, non-smoking, weight-stable adults (n=76) performed 3x24h urine collections (UC) and completed 3 multiple pass 24h dietary recalls over 10d. Results are shown for those (n=67; aged 18-58y, BMI 19-36kg/m²) who had ≥1 complete UC (based on urinary PABA recovery ≥85%). Urinary sugars were measured by an enzymatic kit (Roche) and mean daily amounts calculated. 3d mean intakes of total energy, sucrose, fructose and added sugars, and energy from eating occasions (breakfast, lunch, dinner and snacks) were computed with *Nutrition Data System for Research* (v.10/11). Plausible (n=52) and implausible EI reporters (n=15) were identified (Huang et al, 2005).

Results: Mean(±SEM) urinary sucrose and fructose were 28±2 and 38±4 mg/d, respectively. Reported intakes were 56±5 (sucrose), 25±2 (fructose), and 84±7 (added sugars) g/d. Pearson correlations showed that urinary sucrose was significantly associated with dietary sucrose in the plausible sample (r=0.36; p=0.008) and non-significantly in the total sample (r=0.19; p=0.12). A similar pattern was seen for urinary sucrose and added sugars intake. Urinary fructose and sugars intake had statistically non-significant associations (r=-0.07-0.17, p=0.24-0.80). Concerning analysis by eating occasion, energy at the different meals was weakly associated with urinary sugars in both the total and plausible samples, and these associations ranged from inverse to weakly positive (total: r=-0.15-0.04, p=0.25-0.92; plausible r=-0.26-0.03, p=0.06-0.98). Energy from snacks, however, was positively associated with urinary sugars in the total sample (r=0.02-0.26, p=0.04-0.90), and more strongly associated in the plausible sample (r=0.23-0.30, p=0.03-0.10).

Conclusion: These data may provide evidence that foods containing sucrose and added sugars are underreported, and that many of these foods may be consumed during snack eating occasions. [Funding: R01DK075862 and Purdue University]

PP 375**APPLICATION OF METABOLOMICS IN THE SU.VI.MAX2 COHORT TO IDENTIFY NEW BIOMARKERS OF FRUIT AND VEGETABLE INTAKE**

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Metabolomics has emerged as a promising approach for the discovery of biomarkers of food intake. Metabolomics allows the simultaneous analysis of hundreds of low-molecular-weight metabolites present in biofluids. The so-called metabolome includes the “Food metabolome” part which encompasses all metabolites coming directly from the digestion and metabolism of food components. Any given plant food contains hundreds of phytochemicals from different chemical families, which are absorbed to various extents and transformed in the body to a number of metabolites by intestinal and hepatic enzymes, as well as by the microbiota. Our hypothesis is that the comparison of the Food metabolome of individuals consuming or not a specific plant food can lead to the discovery of new biomarkers of intake. We obtained very encouraging results in an initial study (ANR Agruvasc), in which we clearly discriminated the urine metabolomes of subjects consuming Citrus juices, either as part of a fully controlled diet or with their regular diet. Phytochemical metabolites reflecting citrus intake could be identified. Some were expected but others had not been recognized before. To speed up the process of biomarker discovery for a large range of foods we evaluated the option of applying the metabolomic approach directly to samples from a cohort study. We showed that analysis of the urine metabolomes of 40 low and 40 high Citrus consumers in the SUVIMAX2 cohort was an effective way of finding the same candidate biomarkers as previously identified in controlled intervention studies. In a new project (ANR PhenoMeNEp), two groups of SU.VI.MAX2 subjects were selected according to their F&V intake assessed by a FFQ (2009) and six 24-hr recalls (1994-2002). Low and high consumers (66 and 144 subjects, respectively) declared a median intake of 305 and 974 g/d F&V, respectively. Morning urines were analyzed with high-resolution mass spectrometry. Univariate and multivariate statistical analyses of all detected signals showed a clear discrimination of the groups with > 350 discriminatory ions. Identification of these markers of low and high F&V diets is in progress using spectral data interpretation, querying of online and in-house databases, and laboratory expertise on phytochemical metabolism. Furthermore the metabolomes of low and high consumers of 15 selected F&V and phytochemical-rich foods (apple, banana, berries, cruciferous vegetables, leafy vegetables, root vegetables, onions, legumes, tomato, potato, green beans, red wine, coffee, tea, cocoa) were compared. Candidate biomarkers for the intake of these foods will be presented.

Fundings: ANR PhenoMeNEp ALIA2010.

PP 376**PLASMA CONCENTRATION OF FOLATE AS A BIOMARKER FOR INTAKE OF DARK GREEN LEAFY VEGETABLES IN TAIWANESE MALES**

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Introduction: Nutritional biomarkers, when used to assess dietary exposure, are less prone to errors typically associated with self-reported data. Taiwan is a country with a wide variety of dark green leafy vegetables, many of which are indigenous, and the population typically consumes vegetables in much higher quantities than in most western countries. Dark green leafy vegetables are excellent sources of many vitamins, minerals and phytochemicals, and may have beneficial effect toward prevention of chronic diseases commonly looked into in epidemiological studies. We have examined whether plasma folate could be a biomarker for certain food groups, especially certain types of vegetables, in a sub-study of Tzu Chi Health Study (TCHS), a new cohort in Taiwan. **Methods:** In addition to a complete health examination and interviewer administered lifestyle and food frequency (FFQ) questionnaire, a sub-study of 1528 participants from the TCHS had fasting plasma folate examined. Spearman's correlation coefficient and agreement in percentage of quartile distribution of plasma folate and dietary data from the FFQ were examined. **Results:** In the 1528 participants, 580 used supplements that contained folic acid. Among non-supplement users, plasma folate level is moderately correlated to consumption of leafy green vegetables (LGV, $r = 0.28$), and to a lesser degree with total vegetables (TV, $r = 0.18$), total fruits (TF, $r = 0.14$), total fruits and vegetables combined (TFV, $r = 0.19$), and negatively correlated with intake of meat ($r = -0.33$) and fish ($r = -0.24$). When further categorizing participants by gender, we found that plasma folate may be a better indicator for intake of LGV in males ($r = 0.30$) than in females ($r = 0.14$). Similar results were also found for TF, TV, and TFV. When comparing agreement in quartile distribution, about 30% were in exact quartile agreement and $\leq 10\%$ were misclassified into extreme quartile for all of LGV, TV, TF, and TFV. **Conclusion:** Similar to other previous studies, our study suggested that plasma folate level may be a potential biomarker for fruits and vegetable consumption among non-supplement users in countries without folic acid supplementation. Among different types and combinations of vegetables and fruits, we found the correlation is the highest for dark green leafy vegetables, particularly in male participants.

PP 377**FOOD PREDICTORS OF PLASMA CAROTENOIDS**S. J. Hendrickson¹, B. A. Rosner², W. C. Willett¹, A. H. Eliassen²¹Nutrition and Epidemiology, Harvard School of Public Health, ²Channing Laboratory, Department of Medicine, Brigham and Women's Hospital and Harvard Medical School

Background: Empirical prediction models that weight food frequency questionnaire food items by their relation to nutrient biomarker concentrations may estimate nutrient exposure better than nutrient intakes derived from food composition databases. Carotenoids may especially benefit because contributing foods vary in bioavailability and assessment validity.

Objective: To develop empirical prediction models for the major plasma carotenoids and total carotenoids and evaluate their validity compared with intakes calculated using standard food composition tables.

Design: 4180 nonsmoking women in the Nurses' Health Study cohort who previously provided blood samples were randomly divided into training (n=2787) and testing (n=1393) subsets. Empirical prediction models were developed in the training subset by stepwise selection from foods contributing $\geq 0.5\%$ to total intake of the relevant carotenoid. The correlation between predicted and measured plasma concentrations was compared to the correlation between dietary intake and measured plasma concentrations for each carotenoid.

Results: Three to 12 foods were selected for the alpha-carotene, beta-carotene, beta-cryptoxanthin, lutein/zeaxanthin, lycopene, and total carotenoids empirical prediction models. In the testing subset, correlations with measured plasma concentrations for the predicted plasma concentrations and dietary intakes, respectively, were 0.36 and 0.32 for alpha-carotene, 0.28 and 0.29 for beta-carotene, 0.39 and 0.36 for beta-cryptoxanthin, 0.30 and 0.27 for lutein/zeaxanthin, 0.24 and 0.28 for lycopene, and 0.26 and 0.24 for total carotenoids. The two correlations were not significantly different for any carotenoid.

Conclusion: Despite the potential for differences in bioavailability, values from published food composition data appear to adequately represent bioavailable carotenoids.

PP 378**MEASUREMENT ERROR CORRECTION OF DIETARY INTAKE IN SURVIVAL ANALYSIS - USE OF MC-SIMEX FOR CATEGORICAL DATA**D. Di Giuseppe¹, M. Bottai¹, A. Wolk¹¹Institute of Environmental Medicine, Karolinska Institutet

Measurement error is a well-known problem in nutritional epidemiology. There are some methods available in traditional statistical packages but they are appropriate only for continuous variables. The simulation extrapolation method (SIMEX) and its extension for categorical variables (MC-SIMEX) can be a useful tool for correcting risk estimates in the presence of systematic additive measurement error. The MC-SIMEX method was applied to data from the Swedish Mammography Cohort (SMC), a cohort of Swedish women aged 54-89 years who received a food-frequency questionnaire (FFQ) in 1997. The method, implemented in R software, was used to correct relative risk (RR) as incidence rate ratio (calculated with Poisson regression) of developing rheumatoid arthritis (RA) according to 4 categories of alcohol consumption. To identify the misclassification matrix for each category, a validation study of the FFQ was used (fourteen 24-h recall interviews). The uncorrected multivariable adjusted relative risk of developing RA among women drinking more than 4 glasses of alcohol per week compared to women drinking less than 1 glass or never drinking was 0.65 (95% confidence interval (CI): 0.43-0.99). After correcting for measurement error using the MC-SIMEX method, the corresponding value was 0.49 (95% CI: 0.24-0.98). The MC-SIMEX method is easy to use even for unskilled R users but requires some assumptions and, as all methods based on validation data, it is strongly dependent on the quality of the validation study. In conclusion, the MC-SIMEX is an easily implementable tool to correct for measurement error in nutritional epidemiological studies that can be applied to prospective cohort data when the exposure is categorical.

PP 379**MEASUREMENT ISSUE FOR 25-HYDROXYVITAMIN D ASSESSMENT**A. Burgaz¹, K. Michaelsson², A. Wolk¹¹Karolinska Institutet, ²Uppsala Universitet

Background: There are substantial discrepancies in between methods used for measuring circulating 25-hydroxyvitamin D concentrations. Differences in the measurement of a standard reference sample (from vitamin D External Quality Assessment Scheme, DEQAS) may vary up to 65%. Still, there is a lack of consensus regarding recommendations which analytical method should be used for measuring circulating 25(OH)D concentrations.

Methods: Serum samples from 90 middle aged to elderly Swedish women were analyzed for 25-hydroxyvitamin D with two different methods and by two different laboratories: Immunodiagnostic Systems Limited OCTEIA 25-hydroxyvitamin D enzyme immunoassay (IDS OCTEIA) and liquid chromatography coupled with tandem mass spectrometry (LC-MS/MS). IDS OCTEIA analyses were performed by a research laboratory at the Karolinska Institute and the LC-MS/MS method by the University Hospital laboratory, Malmö.

Results: The results of the analyses showed a correlation of 0.88 ($p=0.0001$) between the two methods. The mean serum 25(OH)D concentration was 69 nmol/L (± 23 for IDS OCTEIA and ± 19 for LC MS/MS) for both methods and the median was 65 nmol/L (range 35-147) for IDS OCTEIA and 69 nmol/L (range 33-123) for the LC-MS/MS method. Concentrations >90 nmol/L varied most and were consistently higher for the IDS OCTEIA method compared to the LC MS/MS method.

Conclusion: Differences in measuring 25(OH)D concentrations between methods may have important implications for the determination of cut-of levels for an optimal vitamin D status and the resulting public health messages. For the future a sustainable long-term solution to the problem of 25(OH)D assays' heterogeneity will require method standardization. The best solution would be to have a consensus on which method should be used, and to use only that method in the future studies.

PP 380

THE MEASUREMENT ERROR WEBINAR SERIES: AN ONLINE RESOURCE FOR NUTRITIONISTS, EPIDEMIOLOGISTS, AND STATISTICIANS

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The concept of usual or long-term average daily intake is important because dietary recommendations are intended to be met over time and diet-health hypotheses are based on dietary intakes over the long term. However, measurement error in self-report intake data poses a challenge to capturing usual intakes. The Measurement Error Webinar Series, organized by collaborators from the U.S. National Cancer Institute, the Office of Dietary Supplements, the U.S. Department of Agriculture, the Gertner Institute for Epidemiology, Texas A&M University, and Wake Forest University, provides an in-depth examination of the latest concepts and methods related to measurement error in intake data. The overall goal of the 12-part series is to provide participants with an understanding of the sources and magnitudes of dietary measurement errors, how they may affect estimates of usual dietary intake distributions and analyses of diet-health relationships, and how their effects may be mitigated. An introductory session addresses the concept of usual intake and types of measurement error in detail. Many of the subsequent sessions focus on either dietary components that are consumed nearly daily by nearly all persons or episodically-consumed components, recognizing the particular challenges that the latter pose to statistical modeling. Two webinars focus on estimating usual intake distributions with applications to survey data, while three sessions are dedicated to understanding and reducing error when examining diet-health relationships with a food frequency questionnaire as the main instrument. Concepts related to accounting for complex survey methods, estimating total intakes from diet and supplements, and estimating multivariate dietary constructs (e.g., diet quality indices) are also covered. The final sessions focus on advanced and emerging approaches, including combining multiple assessment instruments and combining self-report and biomarker data to reduce measurement error. The series concludes with the discussion of an analytic method proposed for future diet-health studies in which short-term instruments such as recalls are the main instrument, a scenario made feasible by technologic advances such as automated web-based tools. Webinar recordings, slide sets, and notes are freely available online (riskfactor.cancer.gov/measurementerror/), along with supporting materials including recommended resources and a glossary. Macros for some applications covered in the series are also available online, and additional macros will be shared as they become available. Through this series and associated resources, the collaborators aim to improve the capacity of the field to monitor intakes and to understand diet-health associations by using analytic techniques and data collection strategies that minimize error.

PP 381

THE RELATIONSHIP BETWEEN COGNITIVE PERFORMANCE AND THE ASSESSMENT OF ENERGY-INTAKE USING A 3-DAY FOOD RECORD IN ELDERLY PEOPLE

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Introduction Older people may not always be able to respond to dietary assessment methods, such as to recalls or records. This could lead to underreporting of energy-intake. Frequently, ageing goes together with diminished functionality and cognitive decline. Cognitive function can be assessed by the Mini-Mental State Examination (MMSE), so we hypothesized that this score is related to the extent of underreporting in food records.

Aim To determine the relationship of cognition with the assessment of energy-intake using a 3-day food record in an older population.

Methods As part of an intervention trial, 126 pre-frail and frail elderly people (>65 year) completed a 3-day estimated food record at baseline to assess energy-intake. The extent of underreporting was calculated by reported energy-intake (EI)/ Basal Metabolic Rate (BMR). Basal Metabolic Rate was calculated by the gender-specific Schofield equation using measured bodyweight and height. The MMSE, consisting of 20 items including orientation in time and place, concentration, arithmetic and memory, was used to assess cognitive impairment. Physical Activity Level (PAL) of the elderly was sedentary, so we used the Goldberg cut-off value of 1.35 to classify the participants into under-reporters and acceptable-reporters. To test whether the mean MMSE-score was different between under- and acceptable-reporters, we used an independent T-test. We determined Pearson correlation coefficients between EI/BMR and MMSE-score or age, separately.

Results Median EI/BMR of all reporters was 1.32 (range 0.76-2.61). Mean reported MMSE-score of the under-reporters was 0.2 points (95% CI -1.0, 0.6) lower than that of the acceptable reporters. MMSE-score was not significantly correlated to EI/BMR ($r = -0.021$, $p=0.4$), but a significant inverse correlation between the EI/BMR and age ($r = -0.149$ $p=0.048$) was found.

Discussion We did not find a significant difference in MMSE-score between both groups, although a higher age was related to the extent of underreporting. This might be attributed by the general character of the MMSE which includes several aspects of cognitive function, of which some, for example memory, may not be related to response errors in reports by a food record. Separated cognitive functions might be correlated to the rate of underreporting. In addition, the number of under-reporters may be underestimated, because the actual physical activity levels of participants were not specified. We conclude that the performance of reports by food records seems not to be related to cognitive function, but other functional aspects related to age may be important to be considered in an older population.

PP 382

A NEW APPROACH FOR ESTIMATING THE DISTRIBUTION OF USUAL INTAKE OF NUTRIENTS

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One of the main interests of researchers in the field of nutrition is to check the inadequacy of food intake (according to an existing standard reference) from a group population. In these cases, the statistical modeling represents a challenge because the central feature of food consumption is the variability of the diet, which have both between and within-person variance. In the literature, models with measurement errors are proposed to overcome this variability and estimate usual dietary intake of foods and nutrients of a group population. The basic assumption of these models is that the response variable follow a normal distribution. When this assumption failure, an appropriate transformation of the data for this assumption is done (usually Box-Cox-type), but in practice, it is noted that for datasets in which the distributions are highly asymmetric, it is not always possible to normalize them, so that it could find a incorrect probability of inadequate food intake. In the literature, the comparison among data with asymmetry and empirical values ??was little bit explored, and previous studies do not incorporate the issue of within-person variance. Thus, the present study aims, through Generalized Additive Models for Location, Scale and Shape (GAMLSS), propose a new approach to obtain the distribution of nutrient intake data from a population with high asymmetry, trying to incorporate a factor in the model that considers within-person variance. The choice of the models GAMLSS was due to the flexibility of distributions in relation to the response variable so that food consumption can take many proposals for non-symmetric distributions. Moreover, the linear predictors can incorporate a considerable range of options, including a random term, which may represent the within-person variance of each individual. Thus, the study presents a model with repeated measures in GAMLSS structure, which incorporates a random effect in the linear predictor of the average in order to consider the within-person variance of individuals. In addition, a model considers between-person variance. These models were applied to a consumption data obtained from three 24-hour recalls of 351 older people of Botucatu city, São Paulo, Brazil. Nutrient intakes were obtained using the NDSR (Nutrition Data System for Research) software. The intake of some nutrients that showed very asymmetric distributions were adjusted and, using the Akaike criteria, the GAMLSS approach presented lower values than the ones in classical models with measurement errors. It was concluded that the GAMLSS can be an useful approach to estimate the distribution of consumption in a more adequately way to data with highly asymmetry.

PP 383

BASAL METABOLIC RATE: VALIDATION OF A POPULATION-SPECIFIC EQUATION FOR BRAZILIAN WOMEN

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Estimation of energy requirements (ER) depends on reliable values of basal metabolic rate (BMR). Internationally recommended BMR prediction equations have been shown to be inadequate for groups of Brazilians living in the country or abroad. The purpose of the present study was to validate a population-based specific equation to estimate

BMR in women developed for the Brazilian population (BRA) against measured BMR and the values obtained from the WHO-recommended Schofield predictive equations (SCHO) in a sample of adult women (age ≥ 20 years) living in Niterói, Rio de Janeiro, Brazil. A total of 89 women participated in the study. BMR was measured early in the morning with the subject having fasted for 12 hours. Anthropometric (body mass and stature) and body composition (percent body fat – %BF) information were obtained following the BMR measurements using a bioelectrical impedance scale (OMRON BF-500). Estimated BMR was calculated with the SCHO and the BRA equations: $8.95(\text{BM}) + 8.87(\text{S}) - 0.70(\text{Age}) - 814.3$. Average (\pm SD) age was 36.7 ± 14.5 years, ranging from 20.1 to 70.6 years. Mean body mass index was $25.0 \pm 5.2 \text{ kg/m}^2$ and %BF was 36.9 ± 8.0 . Measured BMR ($1153.0 \pm 164.6 \text{ kcal/day}$) was significantly lower than SCHO ($1384.5 \pm 124.9 \text{ kcal/day}$) but not different from BMR estimated by BRA ($10.1 \pm 124.8 \text{ kcal/day}$, representing only $1.8 \pm 10.8\%$). Individual accuracy was greater for BRA (66.3% of women had predicted values within $\pm 10\%$ of measured BMR) than SCHO equations (16.9%). The data on BMR indicate that WHO internationally recommended predictive equations (SCHO) are not appropriate for the Brazilian women living in Niterói, RJ. The reported equation for BMR estimation can be used to accurately determine ER.

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PP 384

WEBDASC: A WEB-BASED DIETARY ASSESSMENT SOFTWARE FOR 8-11 YEAR OLD DANISH CHILDREN

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Background/Aim: When we rely on children's self-report to obtain information about dietary intake, the assessment tools we use should foster participants' cooperativeness by being intuitive, easy and fast to complete, flexible in the choices it offers, non-intrusive, engaging, and age-appropriate. The challenge is to engage children in the process and to obtain accurate report while minimizing respondent bias. The aim of this study was to develop and evaluate a Web-based Dietary Assessment Software for Children (WebDASC) created as part of the OPUS[1] project ("Optimal well-being, development and health for Danish children through a healthy New Nordic Diet") to measure dietary change after a school-based intervention.

Methods: WebDASC is a self-administered tool that can be used by 8-11 year old children with or without parent's aid. The development of WebDASC followed a prototyping approach: focus groups, informal interviews, literature review, and usability tests preceded its release. Special consideration was given to age-appropriate design issues, e.g. the avatar is an animated armadillo who guides respondents through six daily eating occasions and helps them report foods and beverages previously consumed; the report of amount consumed is aided by food photography: children are prompted to select the best match among four digital images depicting child-appropriate portion sizes. WebDASC is powered by a database of 1300 food list items based on food intakes from the Danish National Survey of Diet and Physical Activity among children. A type-in format is also available for foods that children are unable to find by either category browse or text search. Respondent's acceptability was measured by a qualitative questionnaire administered to eighty one 8-11 year old participants in the OPUS pilot study who had completed seven consecutive days of dietary assessment using the WebDASC.

Results: 74 participants returned the qualitative questionnaire. 95 % of the children received more or less help from parents to complete WebDASC. 80% found the recording duration acceptable. 88% found the task of finding and reporting foods more or less easy. Children preferred the category browse search, whereas parents preferred the free text search. 85% found the digital images to estimate portion sizes more or less easy to use. 98% liked the user interface design. Open answers indicated that the flexibility could be improved.

Conclusion: Qualitative testing demonstrated that WebDASC was well accepted among children and their parents.

[1] The OPUS project is supported by a grant from the Nordea Foundation.

PP 385

A CHECKLIST FOR EVALUATING THE METHODOLOGICAL QUALITY OF VALIDATION STUDIES ON SELF-REPORT INSTRUMENTS FOR PHYSICAL ACTIVITY AND SEDENTARY BEHAVIOR

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Introduction: Assessing physical activity is important for prevalence estimates, establishing trends in physical activity levels and sedentary behaviors over time, establishing the link between different aspects of physical activity, sedentary behavior and health and for evaluation of behavior change as part of a physical activity or lifestyle intervention program. Valid and reliable methods are needed as poor assessment of physical activity may lead to inadequate conclusions. Multiple physical activity and sedentary behavior self-report instruments have been developed and are found in the literature. The overall quality of the methodological papers assessing measurement properties of physical activity and sedentary behavior instruments needs improvement. Checklists are useful to assess the quality of studies designed to validate physical activity survey measures.

Aim: The aim was to propose a checklist to assess key methodological quality criteria for physical activity and sedentary behavior self-report validation studies.

Methods: A Medline/PubMed search was performed to identify published guidelines or standards for evaluating the methodological quality of validation studies on self-report measures of physical activity and sedentary behavior. Based upon the literature a checklist was developed. The checklist consisting of 21 items with three subscales: 1) Quality of the Reported Data (9 items: Assess whether the reported information is sufficient to make an unbiased assessment of the findings). 2) External Validity of the Results (3 items: Assess the extent to which the findings are generalizable). 3) Internal Validity of the Study (9 items: Assess the rigor of the study design). The checklist was tested for inter-rater reliability and feasibility with six raters.

Results: Raters viewed the checklist as helpful for reviewing studies. They suggested minor wording changes for 8 items to clarify intent. One item was divided into two items for a total of 22 items.

Discussion: Checklists may be useful to assess the quality of studies designed to validate physical activity instruments. Future research should test checklist internal consistency, test-retest reliability, and criterion validity.

PP 386

COMPARING SELF-REPORTED AND DIRECTLY MEASURED PHYSICAL ACTIVITY, SEDENTARY BEHAVIOUR AND SLEEP IN CANADIAN ADULTS AND THEIR ASSOCIATION WITH HEALTH

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Introduction: As new and objective physical activity measurement devices become available, the differences between these and self-report measures must be examined. Social desirability bias and recall difficulties impact self-reported estimates of lifestyle behaviours. This study examined the associations, alone or in combination, of self-reported and directly measured (by accelerometer) physical activity, sedentary behavior and sleep with selected health outcomes in teens and adults aged 12-79 years.

Methods: This sample of teens and adults (n = 3,562) was from the 2007 to 2009 Canadian Health Measures Survey (CHMS), a nationally representative direct health measures survey. Moderate- to vigorous-intensity physical activity (MVPA), sedentary behaviour and sleep were assessed using both accelerometry and a questionnaire. Regression analysis was used to assess the association between self-reported and directly-measured MVPA, sedentary behaviour and sleep with selected health outcomes. Body mass index (BMI) was derived from directly measured height and weight ($\text{kg} \cdot \text{m}^{-2}$), waist circumference was measured by a trained examiner and blood pressure was measured using an automated monitor.

Results: According to self-report, the teens (12 to 19 years old) in this study had an energy expenditure average of 3.2 METs per hour for their leisure-time physical activity (LTPA), or 63 minutes of walking equivalent, an average of 3.5 hours a day of sedentary time and 8.3 hours per day of sleep. According to accelerometer measures, teens accumulated 48 minutes of MVPA, 9.2 hours of sedentary time and 9.1 hours of sleep per day. For adults (20 to 79 years old), self-reported energy expenditure from LTPA was 1.5 METs per hour, or 30 minutes of walking equivalent, sedentary time was 3.1 hours a day and sleep time was 7.1 hours a day compared to 24 minutes a day of MVPA, 9.7 hours a day of sedentary time and 8.5 hours a day of sleep when using accelerometer results. In a full model (accounting for MVPA, sedentary time and sleep), both directly-measured MVPA and self-reported LTPA were significantly associated with BMI and waist circumference. Self-reported sedentary time was significantly associated with BMI, waist circumference and blood pressure.

Conclusions: Both self-reported and directly-measured movement variables are associated, to varying degrees, with health outcomes in teens and adults aged 12 to 79 years old. The differences in estimates of MVPA, sedentary behaviour and sleep between measurement modalities are substantive and have implications with respect to understanding how these behaviours relate to health.

PP 387**EFFECTS OF SOME INDIGENOUS GREEN LEAFY VEGETABLES, CNIDOSCOLUS ACONITIFOLUS, TELFAIRA OCCIDENTALIS AND PSYCHOTRIA SPP. ON HAEMATOLOGICAL INDICES IN RA**G. T. Otitoju¹, N. Ene-Obong², O. Otitoju³¹Home science, Nutrition and Dietetics, university of Nigeria, Nsukka, ²Department of Biochemistry, university of calabar, ³Department of Biochemistry, University of Uyo

The effects of diet preparation of some lesser known vegetables (*Cnidoscopus aconitifolus*, *Telfaira occidentalis* and *Psychotria* spp.) on some hematological indices were carried out using forty nine male albino rats. The animals divided into nine groups including control and were fed for three weeks on diets specially formulated to contain 5% and 10% each of *Cnidoscopus aconitifolus*, *Telfaira occidentalis* and *Psychotria* spp. The results showed a dose dependent ($p < 0.05$) increase in all the measured haematological indices (packed cell volume (PCV), haemoglobin concentration (HB), platelet counts (PL), red and white blood cell counts (RBC and WBC)) when compared with the control group fed with normal rat chow. This result confirms that *Cnidoscopus aconitifolus* and *Psychotria* spp possess haematopoietic property as claimed by the local consumers. Hence could be use in the treatment of anemia.

Key words: vegetables, anemia, haematopoietic property, haematological indices.

PP 388**COMPARATIVE EFFECTS OF MOIST AND DRY HEAT ON NUTRIENT POTENTIALS OF TETRACARPIDIUM CONOPHORUM NUT IN RATS**C. G. Nkwonta¹, O. Okafor², I. Obizoba³¹Biotechnology Centre, University of Nigeria, Nsukka, ²Department of Biochemistry, University of Nigeria, Nsukka, ³Department of Home Science, Nutrition and Dietetics, University of Nigeria, Nsukka

The nutritional potential of moist and dry heat treated *Tetracarpidium conophorum* nut was evaluated using male albino rats (45-55g). Twenty-four (24) weanling rats were divided into four groups of six rats each on the basis of body weight. These rats were fed for thirty-five (35) days. Caesin (CAS), boiled *T. conophorum* (BTC), roasted *T. conophorum* (RTC) and nitrogen –free diets (NFD) were fed these four (4) groups of rats respectively. All chemicals and statistical analysis were based on modern techniques. *In vivo* bioassay revealed that growth food and nitrogen intakes and protein efficiency ratio (PER) were higher in rats fed the RTC diet than in rats fed the BTC diet. However, rats fed the BTC diet gained more weight than those fed the RTC diet. The rats fed the RTC diet had higher food and nitrogen intakes, faecal digested and retained nitrogen, biological value (BV), and net protein utilization (NPU) than rats fed the BTC diet. Rats fed the test diets – RTC and BTC- had more than 95% N intake, digested and retained nitrogen. The results indicate that dry-heat treatment improved N availability in *T. conophorum* than moist-heat.

KEY WORDS: Biological value, protein efficiency ratio, net protein utilization, *Tetracarpidium conophorum*, digested and retained nitrogen.

PP 389**CONTENT OF TRACE METALS IN DIFFERENT KINDS OF TEA AND THEIR INFUSIONS**A. Pekal¹, K. Pyrzyńska¹¹Faculty of Chemistry, University of Warsaw,

Tea is one of the most consumed beverages in the world. It is a rich source of polyphenol compounds, which exhibit high antioxidative properties. Moreover, tea could be potentially a rich source of some dietary metals which are essential for the general well being of humans. Thus, the regular consumption of tea may contribute to the daily requirements of these trace metals.

Five metals (Cu, Fe, Zn, Cr and Co) were determined in three kinds of commonly consumed bagged teas such as black, green and fruit. Microwave-assisted acid digestion procedure was used for dissolution of the samples and metal contents were determined by ICP-MS. The levels of metals varied between tea types. The highest content of Cu, Cr, Fe and Co was found in black tea leaves, while fruit tea was a good source of Zn. To study the effectiveness of metal transfer from dry tea matter to infusion, different kind of water (deionised, tap and spring) were used for brewing. The efficiency of extraction using tap water was the lowest for Cu and Zn, but the highest for Fe and Cr (only from black tea). Natural water extracted the highest percentage of Cu and Zn from all studied teas.

PP 390

COMPARISON OF CALCULATED AMINO ACID CONTENTS OF DIETS WITH CHEMICAL ANALYSIS IN DUPLICATE PORTIONS.

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Introduction

The amount and type of protein and amino acids in a diet may play an important role in human health issues, such as weight management, blood pressure. Research on those issues requires information on contents of amino acids in foods, which is lacking in the Dutch food composition database. Therefore, we extended the database 2006 with analyzed data on amino acids from McCance and Widdowson's First supplement(1980). We corrected contents of all amino acids of interest in foods (grains, milk, eggs, meat, fish, vegetables, fruits, nuts and miscellaneous) for total protein. Subsequently, contents of amino acids corrected for protein of remaining single foods and of recipes were estimated based on those of analyzed foods.

Aim

To gain insight in the validity of the amino acid food table by comparing results of calculations with those of chemical analyses of duplicate diets.

Methods

Four different diets (1 normal diet with 15 energy% of protein, and 3 protein-rich diets with 20 energy% of protein and a main protein source of either dairy, meat, or grain) were provided to volunteers during a controlled feeding trial. We limited comparisons to the essential amino acids (isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, valine, histidine) and glutamic acid. Ten duplicate diets were sampled (1 of the normal diet and 3 of each of the protein-rich diets), homogenized and analyzed for amino acids by ionchromatografie and HPLC (TRIS/AZA, JEOL AminoTac JLC/500-V, Japan).

The mean calculated contents of amino acids of the diets were compared to those of the respective duplicate portion.

Results

%	ile	leu	lys	met	fen	thr	trp	val	his	glu
Normal	109.0	105.5	107.8	104.3	111.2	108.9	107.4	113.6	113.7	108.1
Dairy	100.5	98.4	92.6	88.9	97.9	103.7	100.2	102.3	99.0	78.8
Meat	108.1	101.5	111.0	103.4	114.9	106.1	105.5	108.4	111.9	113.0
Grain	100.9	105.4	103.5	89.3	107.1	102.0	135.8	103.3	106.1	95.9
Mean all 4 diets	104.6	102.7	103.7	96.5	107.8	105.2	112.2	106.9	107.6	98.9

Calculated data of 2 out of 10 amino acids were overestimated ($\geq 110\%$) in the normal diet, of 4 in the meat diet and of 1 in the grain diet. Calculations of 2 out of 10 amino acids were underestimated ($\leq 90\%$) in the dairy diet, and of 1 in the grain diet.

Discussion and conclusion

Inaccurate estimations of amino acids using data from food composition databases may be due to errors in the method of analysis or to variations in contents of foods. Calculations of diets of a free-living population may show larger inaccurate estimations than found in our test diets. However, as for most amino acids the differences between calculated and actual contents in our study were $\leq \pm 10\%$ we conclude that the extended Dutch food composition database 2006 is suitable to calculate composition of essential amino acids and glutamic acid in planned diets.

PP 391

MEAT CONSUMPTION AND OESOPHAGEAL ADENOCARCINOMA RISK IN THE EPIC COHORT

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BACKGROUND: Evidence suggests that red and processed meat could increase oesophageal cancer risk. Previous analysis from our group based on only 65 oesophageal adenocarcinomas cancer (OAC) cases suggest a positive association with processed meat and an unexpected positive association with poultry. Very little information is available regarding different types of meat intake and OAC in prospective studies. **OBJECTIVE:** To assess the association between meat intake (red, white and processed meat) and oesophageal adenocarcinoma. To test alternative hypothesis we estimated the substitution effect of different types of meat. **METHODS:** The European Prospective Investigation in Cancer and Nutrition (EPIC) is a study designed to investigate the relationships between diet, lifestyle, and environmental factors and the incidence of cancer carried-out in 23 centres from 10 European countries. Meat intake (red, processed and white) was estimated based on country-specific food questionnaires. The hazard ratios (HRs) and their corresponding 95% confidence intervals (CIs) for the development of OAC cancer will be estimated using the

Cox proportional hazards regression model. Meat intake is presented as 25 grams per 2000 kcal. All models were adjusted for BMI, sex, smoking status, educational level, total fruits and vegetables consumption, alcohol and energy intake. Additive model was constructed to evaluate: 1. additive effect (the risk associated with to adding the amount of red meat while white meat remains constant). 2. Substitution effect (the effect of substitution red meat for white meat while keeping total meat intake constant). RESULTS: After a mean follow-up of 11 years 142 OAC were identified. The association between total meat intake and OAC was statistically significant (HR: 1.16, 95%CI=1.07-1.27). Additive models shows a positive significant effect of white meat (HR: 1.22, 95%CI=1.03- 1.45) and processed meat (HR: 1.18, 95%CI= 1.02-1.37) but not for red meat (HR: 1.12, 95%CI=0.97-1.29). None substitution effect were found for any meat-type. CONCLUSION: Similar to our previous findings, we have found a positive significant association between processed meat intake and OAC and a non significant association with red meat intake. An unexpected statically significant increase of the risk due to white meat intake was observed. Further studies with large sample size are needed in order to clarify these findings.

PP 392

IRON INTAKE AND GASTRIC AND OESOPHAGEAL ADENOCARCINOMA RISK IN THE EPIC COHORT*

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Background: Even though recent studies suggest that a high intake of heme iron is associated with several types of cancer, epidemiological studies in relation to oesophageal (EA) and gastric adenocarcinoma (GA) are lacking. Aim: we investigated the association between heme iron intake and EA and GA risk in the European Prospective Investigation into Cancer and Nutrition (EURGAST-EPIC). Material and Methods: dietary intake was assessed by validated centre-specific questionnaires. Heme iron was calculated as a type-specific percentage of the total iron content of meat intake, derived from the literature. Antibodies of *Helicobacter pylori* (*Hp*) infection and vitamin C levels were measured in a sub-sample of cases and matched controls included in a nested case-control within the cohort. Cox proportional hazard were used to examine association between heme iron and the risk of EA and GA adjusted by known risk factors. Result: During the mean follow-up of 11 years, 444 GA and 142 EA were diagnosed. We observed a statistically significant association between heme iron intake and GC risk 1.67 95% CI: 1.20-2.34 for the highest vs. lowest intake). Associations were stronger for non cardia site and intestinal sub-type. EA was statistically significant associated with heme iron intake (Highest vs. lowest intake: HR 1.59, 95 %CI: 1.00-2.54, p trend 0.003). Iron intake from all dietary sources was not significantly associated with risk of either cancer. In substitution models with total iron constant, an equal decrease of 1mg (per 2000 Kcal) of heme iron offset by an equal increase of 1mg of non heme iron was associated with a significant reduced risk of EA (34 %). Conclusion: we found that high dietary intake of heme iron could increase the risk of GA and EA.

PP 393

RELATION BETWEEN DIETARY CADMIUM INTAKE ASSESSED WITH TWO DIFFERENT METHODS AND A BIOMARKER OF CADMIUM EXPOSURE

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Cadmium is a widespread food contaminant with adverse effects on kidneys and bone, but with insufficiently elucidated public health consequences. The diet is the main source of exposure in non-smokers. Urinary cadmium is considered a valid biomarker of lifetime kidney accumulation from overall cadmium exposure and thus used in the assessment of cadmium-induced health effects. We aimed to assess the relationship between dietary cadmium exposure and cadmium concentrations in urine, taking the toxicokinetics of cadmium into consideration. We used data from two study populations to assess the correlation between urinary cadmium and dietary intakes: 1) Duplicate food portions, 2) FFQ-based dietary cadmium estimates, 3) Urinary cadmium concentration predicted from each of the two dietary intake assessment methods using a one-compartment toxicokinetic model. Duplicate food portions were collected by 57 non-smoking Swedish women aged 20-50 years with individual data on iron status (a proxy of the gastrointestinal cadmium absorption). The FFQ was completed in 1987 by a subsample of 680 non-smoking women, 56-70 years of age, from the population-based prospective Swedish Mammography Cohort (SMC). **Within the duplicate portion study**, the mean concentration of cadmium in urine was 0.18 (range 0.02-0.59) µg/g creatinine and the model-predicted urinary cadmium concentration was 0.19 (range 0.03-0.76) µg/g creatinine. In the FFQ study, the corresponding means were 0.34 (range 0.09-1.2) µg/g creatinine and 0.19 (range 0.09-0.53) µg/g creatinine, respectively. The partial Pearson correlation between analyzed dietary cadmium intake and urinary cadmium concentration was r=0.4 in the duplicate portion study. It increased to r=0.5 when using a one-compartment model with individual gastrointestinal cadmium absorption coefficients based on the women's iron status. The partial Pearson correlation between FFQ-estimated

dietary cadmium intake and urinary cadmium concentration was $r=0.1$ when accounting for within-person variation in the FFQ-based estimates and increased to $r=0.2$ when using a one-compartment model with a common coefficient for the gastrointestinal cadmium absorption. Our results indicate that FFQ-estimated dietary cadmium intake predicts biomarkers of long-term kidney accumulation (urine) less precisely, corresponding to about 25% of that observed in a study with measured (duplicate portions) cadmium intake. By using a toxicokinetic model, thus taking the exponential shape of the elimination rate of cadmium into account, the correlation coefficients increased. The improvement was even stronger when taking individual data on the iron status into account.

PP 394

DIETARY CADMIUM EXPOSURE AND RISK OF POSTMENOPAUSAL BREAST CANCER: A POPULATION-BASED PROSPECTIVE COHORT STUDY

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The ubiquitous food contaminant cadmium has estrogenic properties that may promote the development of estrogen-dependent cancers. Cadmium accumulates in the kidney with increasing age, thus urinary cadmium is a biomarker of lifetime body accumulation and used for assessment of health effects of cadmium exposure. As this strongly limits the size of the study population, alternative exposure assessment methods are needed. The food frequency questionnaire (FFQ) enables prospective assessment of associations between long-term exposure via food and disease risk in large populations, but misclassification of the exposure is inevitable. We created a large database on cadmium content in all foods. We estimated the average daily exposure to dietary cadmium by multiplying the frequency of consumption by the age-specific portion sizes and the average cadmium content in each food item based on national screening data. We examined the association between FFQ-based dietary cadmium exposure and the risk of overall and estrogen receptor defined breast cancer within a population-based prospective cohort of 55 987 postmenopausal women. In addition, we quantified the likely effect of the estimated exposure misclassification based on cross-classification between the FFQ-estimated and urinary cadmium. We handled missing values by multiple imputation. During an average of 12.2 years of follow-up, 2112 incident cases of invasive breast cancer were ascertained. The multivariable-adjusted relative risk of breast cancer was 1.21 (95% confidence interval (CI): 1.07-1.36) for the highest versus the lowest tertile of dietary cadmium intake ($P_{\text{trend}}=0.02$). Among lean and normal weight women, statistically significant associations were observed for all tumors (RR 1.27; 95% CI: 1.07-1.50) and for ER+ (RR 1.23; 95% CI: 1.02-1.49) and similar, but not statistically significant associations for ER- tumors (RR 1.23; 95% CI: 0.78-1.93). The risk of breast cancer increased independently with increasing cadmium exposure and decreasing whole grain/vegetable consumption (pinteraction = 0.73), foods that contribute to about 40% of the dietary cadmium exposure, but that also contain phytochemicals with proposed anticarcinogenic properties. When quantifying exposure misclassification, we observed a median rate ratio of 1.72 (95% simulation limits 1.34 and 5.81) for overall breast cancer comparing the highest tertile with lowest. The results indicate that the observed associations are likely biased towards the null, so that the true association is even stronger. In conclusion, we found a positive association between dietary cadmium exposure and risk of postmenopausal breast cancer incidence.

PP 395

THE NEED FOR EXPANDED DATABASES FOR NON-NUTRITIVE DIETARY COMPONENTS: COMPOUNDS RELATED TO FOOD PREPARATION AS AN EXAMPLE.

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Beyond nutrients, diets contain other components that may be detrimental or beneficial for health. However, intake of non-nutritive components cannot be estimated using standard food composition databases. In order to evaluate relationships with disease risk, several different research groups have independently developed databases of non-nutritive dietary components using published and/or measured values derived from limited food sources. Predictably, there is little consensus in findings across epidemiologic studies, possibly due to the limited capabilities of existing databases and/or assessment methods. Using such databases to estimate intake presents a number of disadvantages that could lead to a greater degree of measurement error and/or misclassification bias. By nature, values derived from the literature cannot keep up with the ever-changing food supply. To accurately capture representative intake, databases must be regularly updated to reflect the relevant time period of exposure and/or geographic location. On the other hand, using a database based on measured-values from selected food sources (generally items known to contain high-levels of the components of interest) is likely to result in inflated and skewed intake estimates. Despite these limitations, researchers have uncovered some provocative findings. However, to move the etiologic evidence to the next level we need a more systematic and centralized approach to develop national databases of non-nutritive dietary components.

Creating a comprehensive and nationally representative database of non-nutritive food components could be invaluable to clarify the mechanisms involved in diet and disease associations. Even with a limited database, Computerized Heterocyclic Amines Resource for Research in Epidemiology of Disease (CHARRED), we have found compounds related to meat cooking methods (e.g., heterocyclic amines and polycyclic aromatic hydrocarbons) to be positively associated with certain cancers. However, there is little data available for other biologically-active, non-nutritive dietary components associated with food preparation, such as advanced glycation end products, N-nitroso compounds, acrylamide, herbs and spices, to name a few. To enable comparability across studies, foods collected through the USDA Nutrient Data Lab, nationwide multistage sampling, or any nationally representative sampling scheme, could provide an important centralized tool to facilitate investigations of non-nutritive dietary components. A centralized system could optimize the cost and effort associated with creating, updating, and validating such comprehensive databases. Continued expansion of dietary data to include non-nutritive components is likely to further our understanding of the complexities and mechanisms involved in diet-disease associations, which are urgently needed to move the field forward.

PP 396

VALIDATION OF A FOOD FREQUENCY QUESTIONNAIRE FOR DIETARY PCB EXPOSURE ASSESSMENT

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Diet, and especially fatty fish, is the major source of exposure to polychlorinated biphenyls (PCBs). Fatty fish is also a major source of long-chain polyunsaturated fatty acids, vitamin D and selenium. Although exposure to PCBs, a group of persistent and bioaccumulating chemicals, has been associated with a wide range of health effects, including cardiovascular disease and cancer, there is very limited knowledge of possible health consequences of low-level PCB exposure via food as well as the risk-benefits associated with fish consumption. To enhance our understanding of the relationship between dietary exposure to PCBs and health effects, taking into account the beneficial effects of fish consumption, we validated past and concurrent dietary PCB exposure, estimated via food frequency questionnaires (FFQs) against biomarkers of PCBs. We used PCB153, an indicator of PCB exposure, and created two large recipe-based food concentration databases based on more than 1,200 food samples analyzed between 1992 and 2009. The concentrations were extrapolated with 8% per year, reflecting the yearly decline of PCB153 concentrations observed in food and in human breast milk, to mirror the concentrations of PCB153 in food during the years of completions of the FFQs (1997 and 2004). Serum concentrations of PCBs, including PCB153; were analyzed in 201 women (56–85 years of age) from the population-based prospective Swedish Mammography Cohort who had completed the FFQs in 1997 and 2004. To account for within-person variation in FFQ-based PCB153 exposure, intra-class correlation coefficient was estimated from a reproducibility analysis based on a subsample of 165 of the women who had completed two identical FFQs one year apart. The validity, i.e., the Spearman correlation coefficient between FFQ-based PCB153 exposure (expressed as ng/kg body weight) and serum PCB153 concentrations (adjusted for serum lipids and age, accounting for the within-person variation) was 0.37 ($p < 0.001$) for concurrent exposure assessment (2004 - 06) and 0.32 ($p < 0.05$) for past exposure assessment (1997). The Spearman correlation between concurrent exposure of PCB153 and other serum PCB congeners (118, 138, 156, 170 and 180) ranged from 0.26 to 0.45 (95% CI; 0.06-0.62). Similar results were obtained for past exposure assessment. We conclude that FFQ-based dietary PCB153 exposure assessed up to nine years earlier, shows reasonable validity in relation to PCB biomarkers, justifying its use in large scale epidemiological studies.

PP 397

BEYOND GLYCEMIC INDEX: NEW FOOD INSULIN INDEX

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Objective: Develop a database of food insulin index (FII) values for a semi-quantitative food frequency questionnaire and investigate relation to blood lipids. Background and Methods: The recently developed food insulin index (FII) directly quantifies the postprandial insulin secretion of a food. It is calculated by feeding 1000 kilojoules of a food and measuring the area under the insulin response curve following sequential blood draws, using white bread (FII = 100%) or glucose (FII = 75%) as the reference food. FII was analyzed for approximately 100 foods. FII values were imputed, calculated, or recipe-derived from analyzed values for some 600 foods and breakfast cereals. Specific algorithms were developed for assigning different food groups and include adjustment for carbohydrate per 1000 kilojoules (grains, cereals, baked goods, dairy products), dry weight and fiber ratios (fruits, vegetables), and direct imputation (fats, beef, poultry, fish). FII values for mixed dishes were derived using an automated recipe program. Individual average insulinogenic load (IL) (defined as calories*FII/100) during the past year was estimated from FFQs by multiplying the FII of each food by its energy content and the consumption frequency and summing over all reported food items. The

average dietary Dietary Insulin Index (DII) was calculated by dividing the average IL by the total daily energy intake. 3,743 participants from Health Professional's Follow-up Study and Nurses' Health Study, were included in the analysis of blood lipids. None of the men or women included had previously diagnosed cancer, cardiovascular disease, or diabetes at the time of blood collection. Results: FII varied greatly among foods depending on the type and amount of carbohydrate, protein, and fat. In multivariate adjusted regression models, dietary II and IL were not significantly associated with plasma C-peptide. Participants in the highest quintiles of both II or IL had 26% higher triacylglycerol concentrations than participants in the lowest quintiles (ptrend <0.0001). The positive associations between II and IL and plasma triacylglycerol were strongest in obese (BMI =30 kg/m²) participants (difference highest versus lowest quintile in II = 72%, ptrend=0.01). An inverse association between DII and HDL cholesterol was observed among obese participants (difference = -22%, ptrend=0.01 for II). DII and IL were not associated with LDL cholesterol, CRP or IL-6. Significance: DII and IL were not associated with markers of glycemic control, at least in the fasting state, but may be physiologically relevant to plasma lipids, especially in the obese.

PP 398

IMPACTS OF GLOBALISATION AND FOOD COMPANIES ON NUTRIENT INTAKES IN THE PACIFIC ISLANDS

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Food supply chains in most parts of the world are changing rapidly due to the globalisation of food markets and the increasing availability and use of processed foods. In the Pacific Islands, while few countries manufacture foods on a commercial scale, most are heavily reliant on food imports, with the bulk of these imports being processed foods. The source and content of these processed foods is therefore of considerable relevance to health.

Method: Data was collected in 5 key Pacific Island countries, which were considered to represent the majority of the food supply in the region, due to shared shipping links and intra-regional exports. Data was collected on the processed foods sold in each country, capturing that detailed on the labels.

Findings: The diversity of products varied considerably by country from 2151 to 235. The levels of consumer choice were not consistently related to population size, nor with percentage urbanisation. The most urbanised had the smallest dataset, while the largest country had the second largest diversity. Processed foods from across the globe were identified, with 0-21% sourced from within each country. 94% had some nutritional information on the label, although there was considerable variation in the extent of the data. Within similar product categories extensive differences in nutrient content were found, although there was no clear relationship with the country of origin.

Discussion: The variation in the number of products sold in the region was considerable, and is likely influenced by a range of factors including market size, income, urbanisation, marketing strategies and the influence of external companies. Overall, the products sold are mostly not manufactured in the region, and indicate the reach of globalisation. Consumers who are informed can make choices based on declared nutritional information, and this could have significant impact on the salt, sugar and fat content of diets. Work is needed to educate consumers and also importers and retailers regarding label reading and healthier choices.

PP 399

ESTIMATION OF HABITUAL TOTAL IODINE INTAKE IN THE NETHERLANDS, USING A 'SHRINK THEN ADD' APPROACH FOR INTAKE FROM DIFFERENT SOURCES

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Background: A problem estimating the habitual total iodine intake is the lack of detailed data about the discretionary use of iodized salt and, in the Netherlands, the iodization of industrially processed foods. Previous work showed that combining deterministic and probabilistic techniques help to tackle those challenges. It was also shown that the estimation of total micronutrient intake from foods and

dietary supplements benefits from a 'first shrink then add' approach in statistical modeling of the habitual intake from short-term measurements, as heterogeneous variances and potential multimodality may occur. To estimate the total iodine intake 4 potential sources should be taken into account (i.e. natural iodine, discretionary used salt, use of iodized salt by industry, dietary supplements) for which it might also be important to apply a 'first shrink then add' approach.

Objective: To develop a methodology for the estimation of the distribution of total iodine intake from different sources.

Method: Data from the Dutch national food consumption survey 2007-2010 and an updated version of the Dutch food composition database 2011 were used to estimate habitual total iodine intakes. The consumption of foods and dietary supplements were measured with 2 non-consecutive 24-h recalls. General information on the consumption frequency of types of dietary supplements, and about the discretionary use of (iodized) salt in part of the study population was available. For each of the different

iodine sources the habitual intake was estimated separately using SPADE. These four intake distributions were combined to estimate the habitual total iodine intake distribution. To take into account uncertainties related to which persons are actually discretionary using iodized salt and what industrially processed foods are iodized a probabilistic approach was applied for these sources.

Results: Heterogeneous variances and differences in the transformation parameter (λ) were observed for the different iodine sources. The habitual total iodine intake distribution was generally narrower with the 'first shrink then add' approach compared to the 'first add then shrink' approach. The median total iodine intake ranged from 145-223 mg/d, increased with age and was higher for men compared to women. Less than 5% of the population had iodine intakes below the EAR or above the UL.

Conclusion: The total iodine intake is currently adequate in the Dutch population (7-69 yr). Heterogeneous variances and differences in λ underline the importance of the 'first shrink then add' approach in estimation of total iodine intake. As iodine and sodium are partly connected, this model can also be used to estimate the habitual total sodium intake.

PP 400

ASSOCIATION BETWEEN FLAVONOID AND LIGNAN INTAKES AND RISK OF GASTRIC ADENOCARCINOMA IN THE EUROPEAN PROSPECTIVE INVESTIGATION INTO CANCER AND NUTRITIO

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Introduction. Case-control studies suggested that some flavonoids may play a role in preventing gastric cancer, although no evidence exists from old cohort studies. The assessment methods used in these studies have been quite heterogeneous and some used old food composition databases (FCDB), which may explain some of these inconsistencies. Therefore, we aimed to explore the association between flavonoid intake and gastric adenocarcinoma (GC) in the EPIC study using the most updated FCDBs.

Design. The study included 477,386 subjects (29.8% men) aged 35-70 years from 10 European countries. Both lifestyle and dietary questionnaires were collected at enrollment. An ad hoc FCDB on flavonoids and lignans was compiled using data from U.S. Department of Agriculture and Phenol-Explorer databases and was expanded using recipes, and estimations for missing values. The final FCDB contained 1877 food items and only 10% of missing values.

Results. After a mean follow-up of 11 years, 683 validated incident GC cases were identified and included in the analysis. After stratification by centre and sex and adjustment for recognized GC risk factors, quartile 4 compared with quartile 1 of total flavonoid intake was associated with a significant reduction in GC risk in women (HR: 0.49; 95% CI: 0.30, 0.80; *P* for trend: 0.003), but not in men (HR: 0.97; 95% CI: 0.67, 1.41; *P* for trend: 0.995). Similar inverse significant associations were also observed for some flavonoid subclasses such as anthocyanidins, flavonols, flavones and flavanols. For males, flavanones were only related to GC. After stratification by smoking status, ever smoker women maintained the inverse significant association between total dietary flavonoids and GC risk, but not the non smoker women.

Conclusions. This is the first large prospective cohort study to suggest that dietary flavonoid intake, measured by dietary questionnaires and using the most updated FCDBs, is associated with a decreased risk of GC in women, particularly in ever smokers.

PP 401

DEVELOPMENT AND EVALUATION OF A EUROPEAN FOOD PROPENSITY QUESTIONNAIRE AS A COMPLEMENTARY TOOL FOR THE 24-H DIETARY RECALL METHOD (EPIC-SOFT®)

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Introduction: The open-ended 24-h dietary recall (24-HDR) method (EPIC-Soft®) has been successfully used to collect standardized quantitative dietary intake in diverse populations across Europe. However, incomplete recovery of episodically consumed foods may hamper data comparability and validity, especially at individual-level. A complementary, non-quantitative questionnaire on usual consumption (food propensity questionnaire/FPQ) is a promising tool to improve the dietary assessment, but requires a number of methodological considerations. *Objective:* To present the stepwise methodological approach followed to conceptualize a standardized FPQ as a complement to EPIC-Soft® as well as preliminary evaluation results. *Methods:* The stepwise approach was determined as a result of a methodological inventory of FPQs and other advanced methods to enhance the

assessment of dietary intakes. This included findings from a recent European project (IDAMES/Innovative Dietary Assessment Methods in Epidemiological studies and Public Health), where a standardized FPQ has been tested as web- and paper-based version in a small multi-centric pilot study in 5 European countries (n=261, aged 19-75y, 2009). In addition, evaluation/simulation analyses were performed, using data from the European Prospective Investigation into Cancer and Nutrition (EPIC)-calibration-study. In this study, a single 24-HDR using EPIC-Soft® was applied in the calibration sample of the EPIC-cohort (n=36,994, aged 20-84y at baseline, 1995-2000). Methodological steps were generally formulated to be useful for designing other cultural-sensitive FPQs in Non-European populations. Results: The steps relevant to develop a complementary FPQ for EPIC-Soft® include the purpose (e.g. to distinguish between true and occasional non-consumers of episodically consumed foods in 24-HDR-measurements), identify design requisites, which are related to the methodology (e.g. level for harmonized aggregation, frequency-of-consumption-scale), applicability (e.g. self- or interview-administered, computerized-, web- or paper-based tool) and technical requirements for use in specific population groups (e.g. elderly). Next, appropriate data source(s) need to be determined for identifying and evaluating food item selection criteria (e.g. based on different consumer proportions). Besides episodically consumed foods commonly eaten in the different countries, differentially eaten foods contributing to distinguish/maximize differences in eating habits should also be considered. A core food list with flexible population-specific components may be composed. In addition, inclusion of foods commonly consumed in specific groups should be made (e.g. in men and women or different age-groups). Sensitivity analyses to evaluate the completeness of the food list are crucial before designing its integration with the 24-HDR-method. Conclusion: A standardized European FPQ contributes to the enhancement of the accuracy of EPIC-Soft®-based 24-HDR-measurements, but was not available. As a complement of a well established reference method, the FPQ may also offer important covariate information to advanced statistical modelling of usual dietary intakes in international study contexts.

PP 402

SELECTION OF FOODS FOR A FOOD PROPENSITY QUESTIONNAIRE TO BE USED IN THE FRENCH DIETARY SURVEY

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INTRODUCTION: In 2009, the European Food Safety Agency (EFSA) published a guideline aiming at harmonizing the dietary collection methods used in individual dietary surveys in Europe. The French Agency for Food, Environmental and Occupational Health and Safety (ANSES) changes accordingly the method applied in its national dietary surveys, the Individual and National Food Consumption (INCA) surveys. In the INCA3 survey, the 7-day record will be replaced by repeated 24h-recalls, supplemented by a food propensity questionnaire (FPQ) in order to allow usual intake estimation.

OBJECTIVES: Our objective was to select food-groups for inclusion in the FPQ.

METHODS: Data from the INCA2 survey, performed in 2006-07, were used. Dietary intakes were recorded by a 7-day food record and portion sizes were estimated using a photographic booklet or expressed by weight or household measures. Average daily nutritional intakes for 37 nutrients were evaluated using the French food composition database. Average daily dietary exposure to 9 major chemical substances was evaluated using results from the French second total diet study. Analyses were performed separately on adults (n=1915) and children (n=1444).

Food-groups were selected if they met at least one of the three following criteria:

1. a substantial increase ($\geq 10\%$ in absolute and $\geq 20\%$ in relative) of the consumer rate observed between 3 non-consecutive days of the food record compared to the 7 days of the food record;
2. a contribution to the nutrient or chemical substance intake $\geq 5\%$;
3. a contribution to the inter-individual variability of the nutrient or chemical substance intake estimated using the reduced rank regression (RRR) method based on intake residuals after adjustment on age, gender, weight, height and season. Food-groups with a factor loading ≥ 0.20 on the first axis of the RRR were retained.

RESULTS: This method allowed us to select 50 food-groups for inclusion in the FPQ. Among the food-groups meeting the consumer rate criteria, 21 were selected for both nutritional and food safety issues, 14 for nutritional issues only and 4 for food safety issues only. The remaining food-groups were selected because of their major contribution to nutrient and chemical substance intakes even if they did not meet the consumer rate criteria.

CONCLUSIONS: The present method allowed the selection of food-groups taking into account both nutritional intakes and exposure to chemical substances. They correspond to two thirds of the final list retained in the FPQ to be used in the INCA3 survey.

PP 403

INFLUENCE OF DURATION OF RECORDING PERIOD ON FOOD AND ENERGY INTAKE IN THE FRENCH ADULT POPULATION

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Introduction : The two main options to assess dietary intakes are the food record over several consecutive days and repeated 24-hour recalls. At the European level, the European Food Safety Authority (EFSA) recommends to use the 24h recall method combined with a food propensity questionnaire for the future pan-European food consumption survey (EU MENU). In France, the next INCA3 survey planned in 2013 will accordingly use the 24h recall method whereas the two latest individual and national food consumption surveys (INCA1 1998-99 and INCA2 2006-07) were based on a 7 days-food record. Before changing the method, some analyses of the influence of the survey duration on the food and nutrient intakes reported were conducted on the INCA2 survey.

Objectives: To assess the influence of the duration of the survey record on food and energy intakes.

Methods: Data from the second French national food consumption study (INCA2) conducted in 2006-07 on a representative sample of adults and children were used. Diet was assessed using a food record on 7 consecutive days. Starting days of the food record were well distributed over the week. Nutrient intakes were assessed using the French nutritional composition database (CIQUAL 2008). 101 adults who didn't fill in the 7 days of the food record were excluded. Finally, analysis were performed on 2523 adults aged 18-79 y-old.

Results: The daily average food intake (in g) of the 7th day was about 10% lower than the intake of the first day, corresponding to a decrease in the total energy intake from 2037 kcal for day 1 (D1) to 1870 kcal for day 7 (D7). Average total food intake decreased gradually from D1 to D7 (about 1.3- to 1.8% reduction per day) for both men and women and in all age groups. However, this reduction was not uniform in all food groups. For some food groups such as bread, pasta, potatoes, hot drinks, non alcoholic beverages, fats the decrease between D1 and D7 was more important. Correlation coefficient on average daily intake was the same from one day to the next one (0.75) but decreased when the duration between days increases (0.67 for D1-D4 and 0.65 for D1-D7). performed on 2523 adults aged 18-79 y-old.

Conclusion: A tiredness effect is observed throughout the 7 days of registration of food consumption. It results in lower food and nutrient intake over the days from one day to the next one.

PP 404

REGISTERS OF CALIBRATED/VALIDATED DIETARY ASSESSMENT INSTRUMENTS PUBLICATIONS

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The U.S. National Cancer Institute has developed and is maintaining two registries of publications validating or calibrating various dietary assessment instruments. These registers aim to increase awareness in the international nutrition and health community of calibration/validation studies on dietary assessment methods being conducted worldwide. The Dietary Assessment Calibration/ Validation Register (<http://appliedresearch.cancer.gov/cgi-bin/dacv/index.pl>) was begun in 1993 as an outcome of the Second International Conference on Dietary Assessment. The Register contains publications and studies which compare dietary intake estimates from two or more dietary assessment methods. These methods include: food records or diaries, dietary recalls, food frequency questionnaires, dietary histories, observed intake, biological assessments, and other types of assessment methods. The register does not include food composition studies, studies which assess only household and not individual food consumption, or studies which assess only reliability. The study instruments are described but not included. Currently, the register includes 1226 publications. Publications may be searched by author, title, year, or journal, or instruments used. Many of the publications are linked to further data describing the studies in which the validation/calibration occurred. The register includes information about 264 studies. Studies may be searched by investigator or study name, instruments used, or various study sample characteristics (i.e. sex, race/ethnicity, age, SES, location, sample size, and start date. Studies from 32 different countries have been registered. In contrast, the Register of Validated Short Dietary Assessment Instruments (<http://riskfactor.cancer.gov/diet/shortreg/>), developed in 2011, contains descriptive information only about short instruments and their validation/calibration study publications. Information from the publication about the study instrument and the validation study sample is extracted and is searchable. Links to the validation study and the instrument, when available, are included. Currently, the register includes 103 instruments. The instruments may be searched by dietary factors, questionnaire format, and number of questions. Descriptive information about the validation study includes the reference tool, the study population (age, sex, race/ethnicity), and the geographical location. Instruments from 29 different countries have been registered. Both registries are continuously updated and maintained by staff at the National Cancer Institute.

PP 405**AGREEMENT BETWEEN EATING HABITS MARKED QUESTIONS AND USUAL FOOD CONSUMPTION OF ADULTS IN THE METROPOLITAN AREA OF RIO DE JANEIRO, BRAZIL.**E. Yokoo¹, R. Pereira², A. Gomes³¹Epidemiology and Biostatistics Department, Federal Fluminense University. , ²Institute of Nutrition. Federal University of Rio de Janeiro. , ³Program of Pos-Graduation in Collective Health of Federal Fluminense University.

Introduction: The investigation of dietary intake is considered a method with predictive capability in assessing the health of the population, especially in controlling the morbidity and mortality from chronic diseases. However, the assessment of food intake requires standardized methodology, using a valid instruments, reproducible and reliable. Thus, studies of methods to estimate food intake accurately and easily in the application are needed. **Objective:** To evaluate the agreement between a simplified questionnaire with marked questions of healthy eating habits with the usual intake of food. **Methodology:** The information was collected by trained interviewers on food intake by three methods: three non-consecutive days of 24-hour recall (24HR), two non-consecutive days of food record (FR) and a questionnaire of eating habits (EHQ), composed by twelve closed questions to check the consumption of some specific foods, by the adult population of the metropolitan region of Rio de Janeiro, Brazil. Respondents were drawn from a probability sample of 1275 individuals participating in the project VALID-RIO. The agreement analysis was based on a comparison of categorical data obtained by EHQ usual consumption and consumption data obtained by the usual three 24-hour recall and the two FR. Open questions obtained using the 24HR and FR were categorized. The agreements were estimated by the Kappa simple test and Kappa adjusted for prevalence, with a significance level of 5%. **Results:** The sample of this study was 288 adults, of which 54.5% were female, aged between 20 and 60. The variable consumption of semi-skimmed milk showed almost perfect agreement with Kappa of 0.96 set in comparison with the EAQ, 24HR or the RA. While the variable natural fruit juice showed weak agreement, with kappa equal to 0.12 in the analysis of the consistency with the 24HR and EHQ, and 0.17 in the analysis of the agreement between EHQ and FR. **Conclusion:** The EHQ was able to characterize the consumption of most foods tested because it showed good agreement between marked questions in dietary habits obtained from this instrument with the usual intake data obtained by two other instruments.

PP 406**PREVALENCE OF INADEQUATE INTAKE OF FRUITS AND VEGETABLES IN ADOLESCENTS ESTIMATED FROM 24-HOUR RECALL AND A FOOD FREQUENCY QUESTIONNAIRE**R. A. Gomes de Souza¹, P. R. Melo Rodrigues¹, R. Alves Pereira¹¹Federal University of Rio de Janeiro

Introduction: The consumption of fruits and vegetables (FV) is important for the human health as it appears to exert a protective effect on the risk of various diseases, including overweight, diabetes, cardiovascular disease, and some cancers. However, the evaluation and monitoring of FV consumption depends on valid estimates of food consumption. **Objective:** To compare the adequacy of FV consumption among adolescents according to estimates from one 24-hour recall (24HR) and from a food frequency questionnaire (FFQ).

Methods: The food intake of 11 to 19 years-old adolescents (n=104; 58% girls) from one public school in Niterói (Rio de Janeiro/Brazil) was evaluated during the school years of 2008 and 2009 by a FFQ and a 24HR. The 24HR was applied using the multiple-pass method with the support of photos of dinnerware and silverware. To estimate the FV consumption was considered all kinds of fresh fruits and vegetables, raw or cooked, including those used as ingredients in preparations. Following the recommendations of the Brazilian Dietary Guidelines, the FV consumption was considered adequate when it was equal or greater than 400 g/day. **Results:** The prevalence of FV inadequacy according to the 24HR was 96%, while the one estimated with FFQ was 86%. The average energy consumption estimated by the FFQ was higher than that estimated by the 24HR (3.903 vs. 2.447 kcal; p<0.01), as well as the FV intake (254 vs. 59 g, p<0.01) and the percentage of caloric intake from FV (3 vs. 1.5 %, p<0.01). **Conclusion:** The prevalence of FV intake inadequacy among the adolescents was excessive and differed according to the dietary assessment method by 10%. However, more significant differences were observed for the estimation of the amount consumed and for the contribution of FV to energy intake. These differences were possibly related to the limitations and characteristics of each dietary assessment method. The FFQ refers to the usual intake and is commonly related to the over report of food intake. On the other hand, the 24HR estimates the current consumption and is subjected to underreport, being necessary to be repeated at least twice in order to estimate usual intake after corrections for the intrapersonal variability. Nevertheless, the prevalence of FV inadequacy was similar using the two methods.

PP 407**WEB-BASED PICTURE BOOK GENERATOR DEVELOPED FOR HARMONIZED PORTION SIZE ESTIMATIONS IN EUROPEAN AND NATIONAL FOOD CONSUMPTION SURVEYS AMONG CHILDREN.**T. Christensen¹, M. Ege¹, E. Trolle¹¹Nutrition division, National Food Institute, Technical University of Denmark

Background/Aim: Within the PANCAKE project tools for conducting Pan-European food consumption surveys among children 0-10 years of age were developed and tested in three European countries. As part of this project a PANCAKE picture book was developed for quantification of portion sizes. In order to achieve a harmonized way of handling and sharing the pictures the aim was to develop a web-based tool including a picture repository to produce ready-to-print picture books. Methods: A need analysis was performed via brainstorm and discussion among involved personnel at the Technical University of Denmark (DTU Food?). A solution stack based on a LAMP-environment at a commercial available web-host (UnoEuro.com), standard open source web picture library (Coppermine) and custom scripts in PHP was chosen. The development phases included rapid prototyping for proof of concept followed by agile development (in PHP with PEAR) based on experiences from the initial prototype and user feedback on iterated versions of the system. Furthermore, functional testing were done for assuring that the system was capable of handling diacritical characters from several European languages. Results: A generator consisting of a picture library and a picture book editor with PDF-outputting capabilities has been developed and used for generating pilot picture books for generic use (in English) and for portion size estimation in Belgium (Flemish/French), Czech Republic (Czech) and Denmark (Danish). From this generator a country or study specific picture book can be composed, edited, downloaded and printed by other interested parties. Access to the library is administered by a login-system. New country specific pictures may be added to the library on the condition that protocols and guidelines for development and validation of the pictures are followed. A steering committee for evaluating pictures before uploading them to the library has been established. For a period of 3 years after the end of the PANCAKE project the web-site is hosted by DTU Food. The steering committee will decide if and how the Web Library for PANCAKE Pictures (WLPP) will continue after this period. Conclusion: The Web Library for PANCAKE Pictures is a unique tool that makes it possible to harmonize picture books and sharing picture series for dietary surveys among countries.

PP 408**HARMONIZED FOOD CONSUMPTION DATA INTERCHANGE WITH XML DATA TRANSPORT PACKAGE**H. Pakkala¹, K. Presser², I. Martínez de Victoria Carazo³, T. Christensen⁴¹Division of Welfare and Health Promotion, Department of Lifestyle and Participation, National Institute for Health and Welfare Q1 (THL), ²Department of Computer Science, ETH Zurich, ³University of Granada, ⁴Nutrition division, National Food Agency, Technical University of Denmark

Food consumption data are collected for a variety of purposes. They are used for example for clinical studies for analysing the diet of patients, epidemiological research, public health studies and in the food oriented risk assessment. The collected data are usually stored in an electronic format for further analysis. These datasets are often used with datasets of other kinds like for example food composition data, medical records or other information from the study person. It is common that food consumption data are linked or combined with data from other information systems. To summarize: there is a constant need for food consumption data interchange. However, there is no harmonized interchange format publicly available and supported. The data interchange is often carried out by temporary procedures using spreadsheets leading to manual work which is tedious, cumbersome, error prone – and expensive. Since 2005, harmonisation efforts in the field of food composition have been intensified through the EuroFIR Network of Excellence (2005-10). As the food composition data are commonly used with the food consumption data, perhaps similar harmonization scheme could be adopted – especially in the data interchange. Our aim was to present a general structure for a transfer package which could be used in the data interchange for food consumption data. The aim was to be very general: the transfer format should be versatile and it should fit into many different tasks and the format should not limit the purpose of use. However, the format should be suitable for the data collected with the most common collection methods (dietary records, 24h-records, Food frequency/propensity questionnaire). In addition, the package should facilitate including information from the study person and food composition. However, the transfer package should not be limited by any specific classification system. Moreover, our aim was to harmonize only the structure and format – not the content itself or the rules needed to create the content or interpret it. In general, the transport package should be based on widely used existing standards and concepts. We used Extensible Markup Language (XML) which is commonly used in sharing structured data. We defined first the main concepts, generated a very generic data model and finally implemented an XML schema to describe the elements and the attributes used in the data interchange. This data interchange was piloted using data from previous food consumption studies from Denmark, Finland and Spain. Our results show, that it was possible to use a very generic food consumption data transport package for data interchange. The first version, however, was tested with quite limited data and further work is needed for more

comprehensive harmonization together with different stakeholders producing and using the food consumption information. We hope that our trial leads to successful cooperation in future.

PP 409

VALIDATION OF SENSEWEAR ARMBAND AND ACTIHEART FOR ASSESSMENT OF TOTAL DAILY ENERGY EXPENDITURE AGAINST DOUBLY LABELED WATER IN WOMEN WITH COPD

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Background: Given the growing need to give individually adapted nutritional support to chronic obstructive pulmonary disease (COPD) patients, it is essential to use objective methods for assessment of energy requirement which are reliable, inexpensive, and simple to administer. Aim: The aim of this study was to validate the SenseWear Armband, software version 5.0 and 6.1 and ActiHeart for assessment of total energy expenditure in free-living women with COPD, compared with doubly labeled water (DLW).

Methods: Total daily energy expenditure (TEE) was measured in 19 women with COPD stage 2-3 for a period of 14 days with SenseWear Armband, software version 5.0 (TEESWA5) and version 6.1 (TEESWA6), and ActiHeart (TEEAH). Doubly labeled water method (TEEDLW) was used as the criterion method. Paired t-test was used to calculate the difference between the means of monitors and DLW. Bland-Altman analysis was carried out to examine the agreement between the monitors and the criterion method, DLW. **Results:** The mean (SD) age of patients was 69.2 (6.0) years; BMI 24.5 (3.5) kg/m², and FEV1 % predicted value was 56.5 (14.6) %. The mean difference (SD) between TEEDLW and TEESWA5 and between TEEDLW and TEESWA6, was respectively, -21 kJd⁻¹ (726, P = .9) and 709 kJd⁻¹ (667, P < .001), and between TEEDLW and TEEAH it was 709 kJd⁻¹ (786, P < .0001). Bland-Altman plots (Figure, a-c) showed a strong agreement between the TEESWA5 and TEEDLW. Although TEESWA6 and TEEAH had a reasonably fair agreement with the TEEDLW, these seemed to underestimate TEE by approximately 8%.

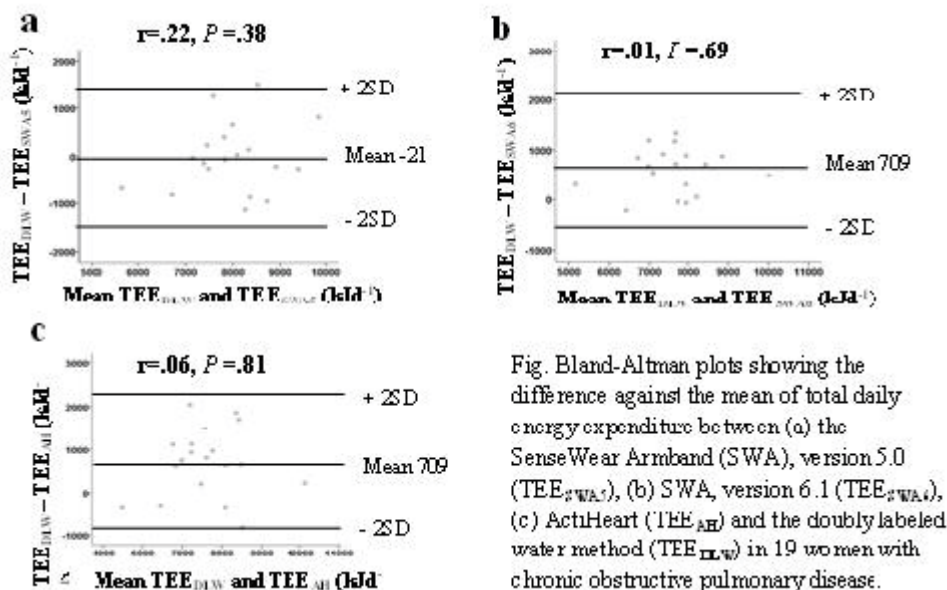


Fig. Bland-Altman plots showing the difference against the mean of total daily energy expenditure between (a) the SenseWear Armband (SWA), version 5.0 (TEESWA5), (b) SWA, version 6.1 (TEESWA6), (c) ActiHeart (TEEAH) and the doubly labeled water method (TEEDLW) in 19 women with chronic obstructive pulmonary disease.

Conclusion: Total daily energy expenditure can reliably be assessed by SenseWear Armband, software version 5.0 in women with COPD. Although SenseWear Armband, software version 6.1 and ActiHeart showed a reasonably fair agreement, these should be used with some caution, as they tend to underestimate the TEE.

PP 410

HARMONIZATION OF PHYSICAL ACTIVITY IN MULTI-CENTRE EPIDEMIOLOGICAL STUDIES. THE EXPERIENCE OF THE CHANCES PROJECT*

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Harmonization of data on exposure and outcome variables is a necessary procedure in epidemiological studies which are of multi-centre nature. The main problem in these studies is that different measurement approaches have been usually appointed, which do not allow for classification of participants in common levels of exposure/outcome variables. This problem is more evident for variables that are difficult to measure, such as physical activity (PA). PA is

important to measure in epidemiological studies since the lack of PA has been associated with increased mortality and increased incidence of cardiovascular diseases and of certain types of cancer. The main instrument used is the questionnaire which usually assesses the type, frequency and/or duration of activities at different domains. When different questionnaires for PA have been appointed within a multi-centre setting, harmonization procedures aim to create one or more variables based on the minimum information that is available in all (or in most of) the participating centres. It is also common practice to create additional harmonized variables that are common in a subsample of the participating centres and use these by means of sensitivity analyses when assessing the role of PA on health outcomes. We have undertaken a harmonization procedure for PA within the context of the CHANCES project. This project aims at combining and integrating on-going cohort studies in order to produce evidence on ageing-related health characteristics and determinants. Fourteen cohorts participate, covering populations from 18 EU Member States, as well as, from the USA. PA was measured by using questionnaires assessing PA in the past. Questionnaires differed with respect to the time period they referred to (e.g. last week, last year etc), the number of activities covered and the categories used to classify subjects within a specific activity. The harmonization procedure indicated that information on activities at the following domains: work, sleeping, resting, transportation and other specific type (such as walking, gardening, cycling etc) could be combined at a minimum level only among certain subsamples of cohorts. There was no level of common information regarding data about PA at home domain, thus the respective activities could not be used in a harmonized manner within this project. Finally, it was evident that a harmonized variable indicating the time engaged to sports combined most of the information collected across all cohorts for this activity. The validation of this variable within the CHANCES project may be considered in the future research. * This study was conducted in the context of the CHANCES project funded in the FP7 framework programme of DG-RESEARCH in the European Commission. The project is coordinated by the Hellenic Health Foundation, Greece. List of full CHANCES Consortium is available at www.chancesfp7.eu

PP 411

HARMONISING DIETARY DATA FOR RISK ASSESSMENT AND DIETARY MONITORING – “WHAT’S ON THE MENU IN EUROPE” (EFSA/EU MENU)

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Introduction: Harmonised, thus comparable food consumption data in the European Union (EU) is the basis for improving accuracy of EU wide exposure assessments. Improved risk assessments could further assure more targeted risk management and permit more accurate risk communication resulting in increased consumer confidence. Harmonised and detailed food consumption data serves also the needs of dietary monitoring in European countries. Since 2005, the European Food Safety Authority (EFSA) has worked towards a harmonised food consumption database in the EU.

Objectives: The collection of accurate and harmonised food consumption data is a top priority for EFSA for collaboration with the EU Member States. With the full support from Member States, all needed preparatory actions will be continued by EFSA to assure the full scale start of harmonised data collection in 2013.

Method/design: In 2007, EFSA created the “Expert group on food consumption data” (EGFCD), an EFSA network with representatives from each EU Member State. The Expert Group coordinates the efforts to harmonise the collection and collation of food consumption data. In 2009, the EFSA Guidance document on dietary surveys in EU was published in the EFSA Journal (<http://www.efsa.europa.eu/en/efsajournal/doc/1435.pdf>) after endorsement by the EGFCD. By early 2010 a pan-European food consumption survey project proposal was presented to the Advisory Forum (AF), the Scientific Committee of EFSA and to the European Commission (DG SANCO). Pilot projects covering age groups from infants to elderly were initiated in 2009 and 2010 (PANCAKE and PILOT-PANEU). A 2-year project (EMP-PANEU) on Food consumption data collection methodology for the EU Menu Survey started between EFSA and the International Agency on Cancer Research (IARC) in 2010. EFSA’s first support to Member States to comply national data collection to the EU Menu Survey requirements were granted in 2011 to France and Estonia. The EU Menu Survey coordinated by EFSA is proposed to be performed in the EU as a rolling program, i.e., in several countries per year within a 5-6 years period.

Results: The EU Menu protocols and pilot field surveys will be finalised by the end of the year 2012. Based on the pilot results, the methodology will be adjusted as needed.

Conclusions: The EFSA initiatives, actions and collaboration with the EU Member States since 2005 are an important part of the harmonization process for European dietary data collection.

PP 412

HARMONISING TOTAL DIET STUDIES FOR EXPOSURE ASSESSMENT

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Introduction: Reliable and detailed data on the occurrence of chemical substances (e.g. nutrients, residues, contaminants) in food in combination with food consumption data are essential for exposure assessments to support scientific advice on potential risks in the food chain. The chemical occurrence data used are often derived from official food controls, whereas the overall assessments of population dietary exposure to chemicals require representative and harmonised data collection.

Objectives: To review the state of art of Total Diet Studies (TDSs) and to compile guidance for internationally harmonized TDS methodology.

Method/design: A working group of experts involving members from EFSA, FAO, WHO and EU Member States reviewed the state of the art of TDSs and prepared a joint guidance on the TDS approach, aiming at harmonised exposure assessments at international level. The guidance provides principles for carrying out a study, including the planning phase, implementation, collection of results, exposure assessment calculation and communication of the results.

Results: A TDS consists of selecting and collecting foods representing the overall diet of a population, which are prepared as they are consumed and pooled into representative food groups before the levels of chemical substances (including nutrients) in the foods are analysed. The results are then combined with existing food consumption data representing the overall diet of the population. This allows scientists to calculate the amount of each chemical substance that is being consumed by a specific population as part of their typical diet. The approach is particularly suitable for estimating chronic dietary exposure. It is most efficient for estimating broadly occurring chemical substances and less appropriate for detecting chemicals that occur only regionally, seasonally or in specific foods. While existing official food monitoring and surveillance activities capture the presence of chemicals in individual food items, TDS provides a basis for calculating overall levels of chemical substances in the foods consumed with a typical diet of a population and estimating the overall impact and risk on public health.

Conclusions: A TDS is considered to be a good complement to existing food monitoring or surveillance programs to estimate population dietary exposure to chemical substances across the entire diet. Harmonising the TDS methodology will enhance the value of these programs by improving the accuracy and comparability at the international level.

PP 413

RED MEAT INTAKE, NUTRITION AND RISK EXPOSURE OF VULNERABLE GROUPS WITHIN A DEVELOPING COUNTRY

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Red meat can play a critical role in reducing the incidence of undernutrition and related disease in developing countries and reducing the global incidence of non-communicable disease and promoting global health requires a better understanding of the dietary patterns which influence animal product intake. Epidemiological studies designed to extrapolate the relationship between red meat and health outcomes would benefit from more rigor and consistent definitions for red meat, separation of data of processed versus fresh meat, more accurate information regarding cooking method and portion sizes, and the availability of up to date nutrient content data of local and traditional foods. International consensus could play a significant role towards standardising these, yet nutrient and risk exposure from animal product consumption by vulnerable groups in developing countries have various additional limitations which need to be bridged.

Within developing countries a diversity of economic status exists, from wealthy established urban consumers to marginalized rural consumers. The uneven distribution of consumer wealth is translated into noteworthy variations in food consumption patterns, affecting nutritional status. Since nearly half of the 10 to 11 million households in South Africa can be classified as low-, or very low, income households (< \$100 per month to spend), and very little information is available on their consumption patterns, a national study to determine the red meat intake of these South Africans commenced during 2011. The following will be discussed:

1) The *dietary assessment method and collection surveys tools* as these groups are often illiterate, and cultural and language barriers exist. During the current study visual aids (photo-book and picture board) were developed and piloted in rural communities to present an opportunity for the often illiterate female head-of-household to identify the type and composition of the meat dish, and portion size consumed by her family.

2) Accurate and understandable *description of food*, as there is no universal definition for red meat, and meat intake in these groups in SA often includes 5th quarter products, e.g. traditionally prepared intestines, and processed products, e.g.

polony, containing variable quantities of animal protein as part of traditional recipes. Red meat as part of a traditionally prepared recipe is not well defined, and therefore not soundly identified.

3) Accurate *nutrient composition data of indigenous foods and recipes* to translate food intake to nutrient and anti-nutrient intake.

PP 414

THE INTERNATIONAL FITNESS SCALE (IFIS): VALIDITY, RELIABILITY AND RELATIONSHIP WITH CARDIOVASCULAR RISK IN YOUTH

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The writing group takes sole responsibility for the content of this article.

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Background: Physical activity and physical fitness are tightly related. There is evidence that physical fitness is a marker of health in youth and that levels of physical fitness at these ages are associated with health in adulthood. Therefore, the assessment of physical fitness in youth throughout the world is of public health interest. Research on different methods for physical fitness assessment is needed and timely.

Objectives: We examined: 1) the usefulness of the International Fitness Scale (IFIS) to correctly rank adolescents into physical fitness levels; 2) the capacity of IFIS for predicting cardiovascular disease (CVD) risk; and 3) the reliability of IFIS in adolescents.

Methods: The study comprised 3059 adolescents (12.5-17.5y) from nine European countries (HELENA study). Blood samples were collected in one third of the participants (randomly selected, N=981). Test-retest reliability of IFIS was studied in a separate sample of 277 adolescents. Physical fitness (cardiorespiratory fitness, muscular fitness, speed-agility, flexibility and overall fitness) was self-reported using 5-point Likert-scale questions (1=very poor, 5=very good) and measured using standard field-based tests. The CVD risk factors measured included total/central adiposity indices and mean arterial pressure, total and HDL cholesterol, triglycerides, insulin resistance (HOMA) and C-reactive protein.

Results: ANCOVA showed that adolescents reporting better fitness had higher measured fitness levels for all the variables studied (all $P < 0.001$), regardless of gender, age and weight status. Adolescents reporting very good overall fitness, cardiorespiratory fitness and speed-agility had a healthier cardiovascular profile in 8 out of 9 CVD risk factors studied. Perfect agreement (same test-retest answer) was observed in 65% of the adolescents and perfect-acceptable agreement (same answer or ± 1) in 97% of the adolescents.

Conclusions: 1) IFIS is able to correctly rank adolescents according to their actual physical fitness levels; 2) Adolescents reporting a good/very good overall fitness, cardiorespiratory fitness or speed/agility had a more favorable cardiovascular profile; 3) IFIS is reliable in adolescents.

PP 415

VALIDITY OF RESTING ENERGY EXPENDITURE PREDICTIVE EQUATIONS BEFORE AND AFTER AN ENERGY-RESTRICTED DIET INTERVENTION IN OBESE WOMEN

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Background: We investigated the validity of REE predictive equations before and after 12-week energy-restricted diet intervention in Spanish obese ($30 \text{ kg/m}^2 > \text{BMI} < 40 \text{ kg/m}^2$) women.

Methods: We measured REE (indirect calorimetry), body weight, height, and fat mass (FM) and fat free mass (FFM, dual X-ray absorptiometry) in 86 obese Caucasian premenopausal women aged 36.7 ± 7.2 y, before and after (n=78 women) the intervention. We investigated the accuracy of ten REE predictive equations using weight, height, age, FFM and FM.

Results: At baseline, the most accurate equation was the Mifflin *et al.* (Am J Clin Nutr 1990; 51: 241-247) when using weight (bias:-0.2%, $P=0.982$), 74% of accurate predictions. This level of accuracy was not reached after the diet intervention (24% accurate prediction). After the intervention, the lowest bias was found with the Owen *et al.* (Am J Clin Nutr 1986; 44: 1-19) equation when using weight (bias:-1.7%, $P=0.044$), 81% accurate prediction, yet it provided 53% accurate predictions at baseline.

Conclusions: There is a wide variation in the accuracy of REE predictive equations before and after weight loss in non-morbid obese women. The results acquire especial relevance in the context of the challenging weight regain phenomenon for the overweight/obese population.

PP 416

DETERMINATION OF FOOD DENSITY USING X-RAY IMAGING

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Background: Knowledge of the density of foods is required for determining food energy from volumetric data. The upcoming novel dietary assessment technologies using mobile telephones require a density value to successfully convert digital volume estimates to gram weights. Food materials are naturally irregular in shape, so accurate determination of density is challenging with the existing tools and techniques. A possible solution is using the property of X-ray attenuation through a material depends on the density of the material. This exclusive characteristic is being further evaluated to determine the density of the food materials.

Objective: An objective of this work is to derive x-ray mass attenuation coefficients for fundamental food components and to determine density of foods based on the x-ray food density model at different x-ray energy levels.

Methods: Density model was developed based on the Beer-Lambert law relating absorption of light to properties of material. X-ray digital radiograph, RapidStudy EDR6 (Sound-Eklin, CA) was used to scan the pure food components and the food materials at 60kVp and 2.5mAs. Samples of pure food components representative of fundamental food components including carbohydrates (10, 30, 60%), proteins (10, 20, 30%), fats and salts (10, 20, 30%) at different concentrations quantities were prepared and scanned on the x-ray radiograph. Subsequently, commercially available baked foods were scanned on x-ray radiograph and the apparent densities were determined. For the second study, a different approach based on quantification of x-ray intensities at different energy levels was devised. The pure food components of varying concentrations and quantities were scanned at 40 kVp and 60 kVp and their x-ray attenuations were determined.

Results: The x-ray mass attenuation coefficients of the food components were found to lie in the range of 0.16-0.26 cm^2/g with the exception of salts. However salts are present in food materials in minute quantity, hence the effect of the x-ray attenuation of salts can be assumed to be negligible. The calculated x-ray mass attenuation coefficients of pure food components substantiated the x-ray food density model. This model was used to successfully determine the apparent density using the known composition of the commercial food materials. The second approach determined the apparent density directly from the x-ray intensities using at least two energy levels.

Significance: This study will establish that since density is an inherent property of foods, the use of x-rays can be an excellent method to determine the density of foods materials. Using this powerful methodology, a new technique to determine density of porous and food mixtures can be developed leading to a better computation of energy intake via image-based dietary assessment. Eventually, once a food item is scanned on x-ray, the complete information of the physical parameters of height; mass; volume; and apparent, bulk and true density can be obtained.

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