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The necessity for a balanced diet in children: physical, mental and intellectual development

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PUK

INTRODUCTION

- A holistic approach is necessary to address the child's overall development,
- including physical, mental, emotional and behavioural development
- Many factors impact on growth and development,
- but malnutrition impair physical, mental and intellectual development

INTRODUCTION

Childhood nutrition

- Risk for immediate health problems e.g. iron deficiency associated with poor school performance, eating disorders, obesity, undernutrition and dental caries
- Long-term health implications: obesity, coronary heart disease and osteoporosis

Nutritional status of South African children

- A wide range of percentages of children under any given anthropometrical cut-point
- Pockets of malnutrition
- A low prevalence of wasting or acute malnutrition
- Stunting (low height-for-age) 20%
- Relative overweight ± 17%

Biochemical nutritional status: minerals and vitamins

- SAVACG results:
  - 33% marginal vitamin A status in 6-71 month old children
  - Iron-deficiency anemia (Hb < 11g/dl): 21%
- Other studies:
  - Low red blood cell folate concentration in some groups
  - Multiple micronutrient deficiencies in rural black children

Dietary intakes of SA children

- Mostly adequate energy and protein intakes
- Low calcium intakes
- Low iron intakes, especially in girls 11-15.9 years old
- Low zinc intakes
- A wide range of vitamin A and C and folate intakes

Critical periods of intense growth

- During infancy
- During adolescence
- High nutritional demands
- Make children particularly vulnerable to deficiency

Nutritional needs of children

- Energy and nutrients for growth
- Illness may increase nutritional requirements and decrease food intake
- Competitive sport
- Allergies: important food groups, e.g. milk may be excluded
- Peer pressure to eat snack foods
- Self-imposed dieting by adolescents

Key minerals for child development

- Iron: for optimal growth, skeletal development, cellular immunity, cognitive function
- Zinc: normal growth, skeletal development, neuropsychological function
- Calcium: High velocity of bone growth during infancy and adolescence
- Iodine: for normal growth and intellectual development

Iron

Iron deficiency associated with:

- Loss of appetite
- Higher morbidity and
- Growth retardation

Iron and child growth

- Iron-deficient children tend to be shorter and lighter
- Improved growth after iron supplementation
- Mechanism: improved appetite and food intake?
- Or: improved cellular immunity, decreased morbidity

Iron and cognitive function

Iron-deficient children:

- Poor cognitive function and educational achievement
- Less attentive and playful
- Mechanism: role of iron in nerve myelination or level of brain neurotransmitters

Zinc

- Zinc plays a role in growth, via protein synthesis processes
- Short stature is associated with zinc deficiency
- Increase in height and food intake after zinc supplementation
- Mechanism: increase in insulin-like growth factor-1 after zinc supplementation

Calcium

- High calcium requirements during growth spurt periods
- About 25% of peak bone mass depends on calcium intake and physical activity
- Decreased risk of osteoporosis later in life

Teenage dieters

- Lower calcium intakes due to exclusion of milk
- Fad diets contribute to low calcium intakes
- Teenage period is associated with growth spurt and high demand for calcium

Importance of milk in the diet

- Associated with higher calcium intakes
- Associated with higher levels of insulin-like growth factor (IGF-1)
- No detrimental effect on iron status associated with calcium intake of 1500mg/day
- Thus: recommend intake of low-fat milk products for dieting teenagers

Iodine

- Children from iodine sufficient regions have higher IQ scores than children from iodine-poor regions
- Children born >3.5 years after implementation of an iodine supplementation programme had significantly higher IQ scores (12-17 IQ points) than children born before the programme
- Iodine status plays a crucial role in the intellectual development of children

SA: iodine added to table salt since 1995

Mineral interactions

- High calcium intakes may interfere with iron absorption
- In a supplementation trial 1500mg Ca/day was still associated with favourable serum ferritin and hemoglobin levels

  Ilich-Ernst *et al*. Am J Clin Nutr 1998;68:880-877
- High zinc intakes may interfere with iron absorption
- Such interactions are only likely to be important at levels of intake achieved by the use of supplements; take supplements between meals

  Fairweather-Tait. Proc Nutr Soc 1995;54:465-473

Key vitamins for child development

- Vitamin A: normal growth, eyesight, immunity
- Folate: growth and development of new cells
- B-vitamins: involved in behavioural and cognitive outcomes

Vitamin A

- Essential for growth, eyesight, bone development, immunity, epithelial tissue
- Supports normal growth

  Mechanism:

- Regulates nocturnal growth hormone secretion? or:
- Reduces infection, allowing optimal growth

Folate

- Essential for cell division and development
- Increased demand during the growth spurt periods

Folate deficiency:

- associated with megaloblastic anaemia
- increased risk of cardiovascular disease
- increased risk of babies born with neural tube defects

Other B vitamins

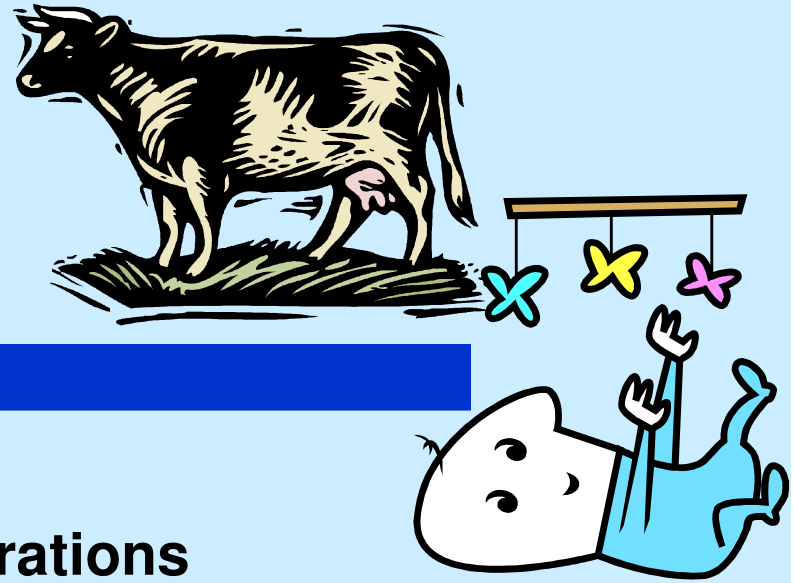
- Linked to a variety of behavioural and cognitive outcomes
- Vitamin B_6 plays a role in neurotransmitter systems of learning and memory
- Results from observational studies, no proof of cause and effect

  Wachs. J Nutr 1995;125:2245S-2254S

BREASTFEEDING

- Studies in low-birthweight infants show an advantage of breastfeeding in cognitive function measured by IQ points
- These studies are difficult, because socio-economic factors confound the association between breastfeeding and cognitive function

BREASTFEEDING



- **Breastmilk has higher concentrations**

of fat and specifically certain fatty acids than cow's milk (docosahexaenoic acid, DHA)

"Docosahexaenoic acid and brain function: breastmilk and fish are good for you"

Long-chain polyunsaturated fatty acids

Higher intakes or supplementation with LC-PUFAs at 6-12 months have shown favourable effects in visual acuity at short-term

BREASTFEEDING

- Results of studies indicate that overall nutritional status (measured as head circumference) and educational status of the mother have a stronger association with childhood intellectual development than breastfeeding only
- Maternal smoking was negatively associated with IQ

Neuringer *et al*. Pediatr 1994;125:S39-47
Santiago Burruchaga *et al*. An Esp Pediatr 2000;52:530-6
Auestad *et al*. Pediatrics 2003;112:e177-183
Corbett & Drewett. J Child Psychol Psychiatry 2004;45:641-654
Ivanovic. Nutrition 2004;20(10):878-889

Alcohol intake of pregnant women

- **Western Cape farm areas has the highest reported rate of fetal alcohol syndrome in the world (65-74 per 1000 children)**
- **Poor growth and development and lower intellectual functioning**
- **Negative behaviour outcomes**

Viljoen *et al*. J Stud Alcohol 2005;66:593-604

Undernutrition at an early age

Negative long-term effect on

- Growth: stunting
- Brain development: intellectual achievement and final IQ scores
- Motor development

Iron supplementation is only beneficial in infants who are iron-deficient

Iron supplementation may have adverse effects in iron-replete children and in children in malaria-endemic areas/ HIV positive children

Ivanovich *et al*. Nutrition 2000;16:1056-63; Lozoff *et al*. Nutr Rev 2006;64:S34-S43

Becquet *et al*. Pediatrics 2006;117:e701-710

EFFECTS OF GENERAL UNDERNUTRITION

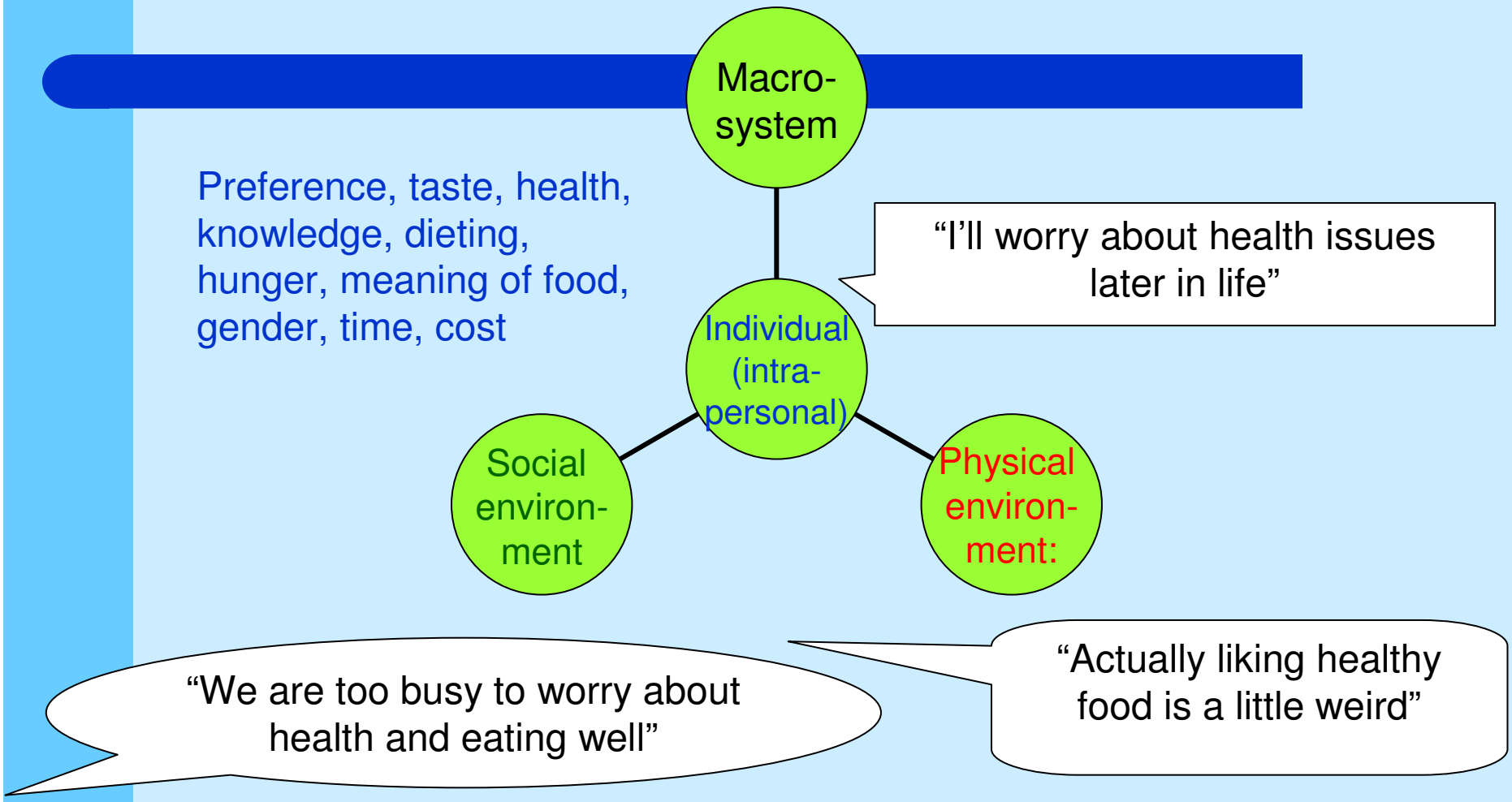
Stunted children had significantly lower intelligence and academic achievement scores than children of normal height

Wheeler *et al*. Arch Pediatr Adolesc Med 2004;158:236-43

Establishing eating and activity habits

- Childhood offers a unique opportunity to positively influence the adoption of healthful eating and physical activity patterns
- Adolescents as a group have poor eating habits that do not meet dietary recommendations
- Concerns: unhealthful dieting, skipping meals, high intakes of fast foods and cold drinks, low intake of milk, fruit and vegetables
- Due to social and environmental changes, including growing independence, eating away from home, peer pressure and concern with physical appearance

Conceptual framework for understanding children's eating behaviour



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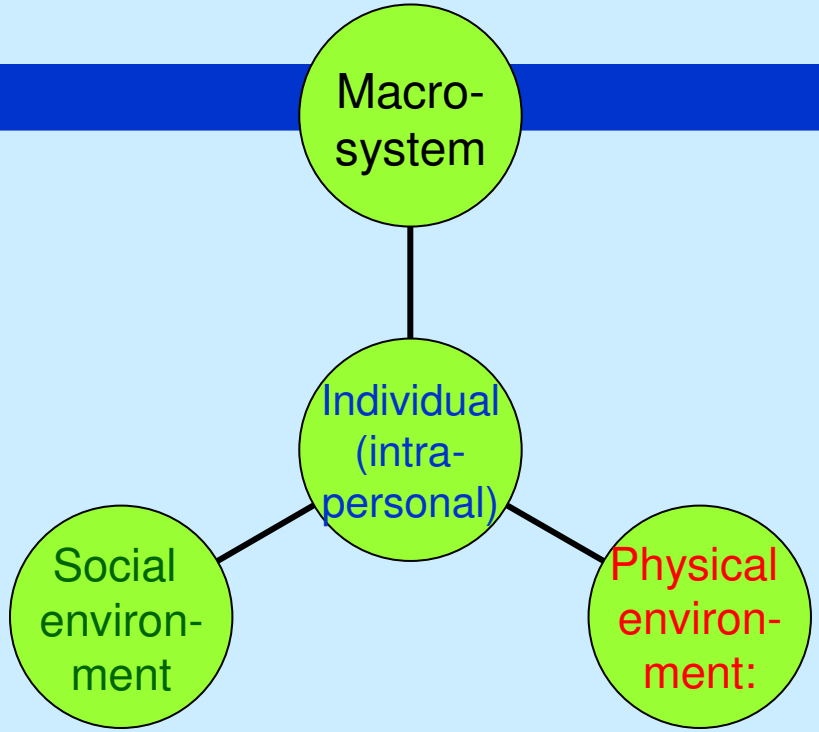
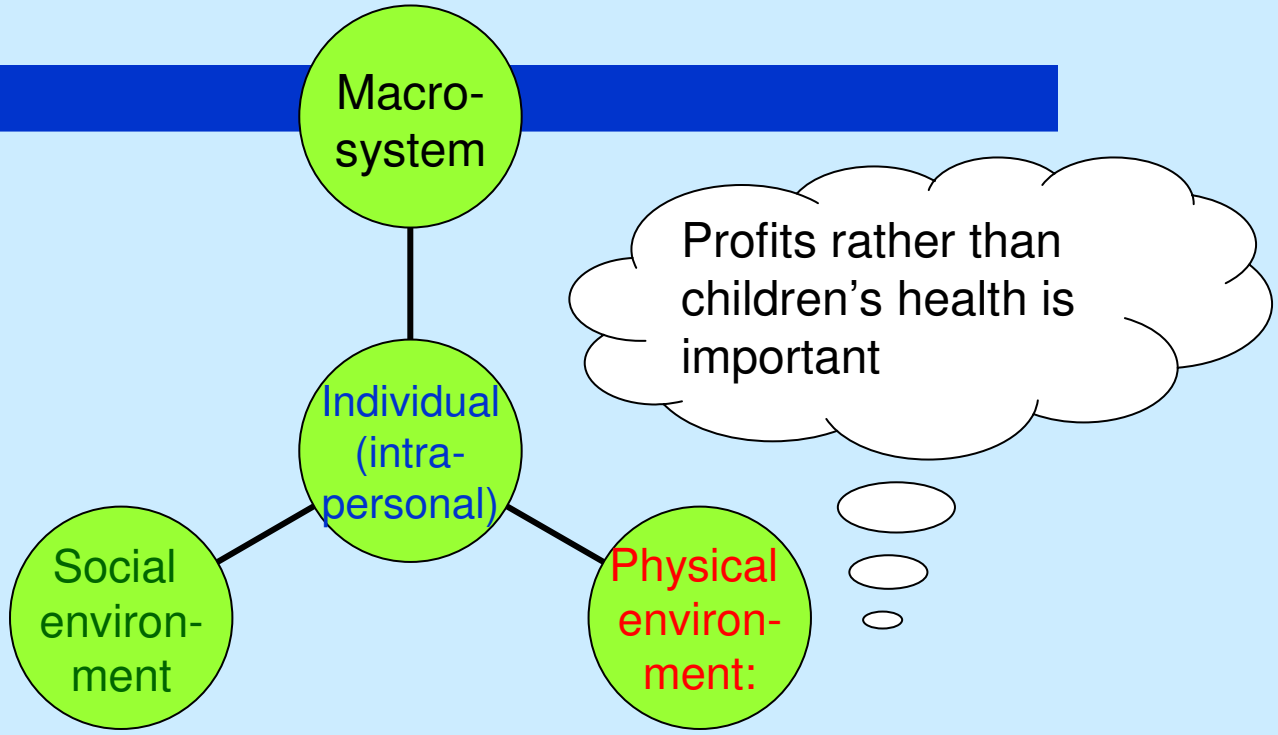


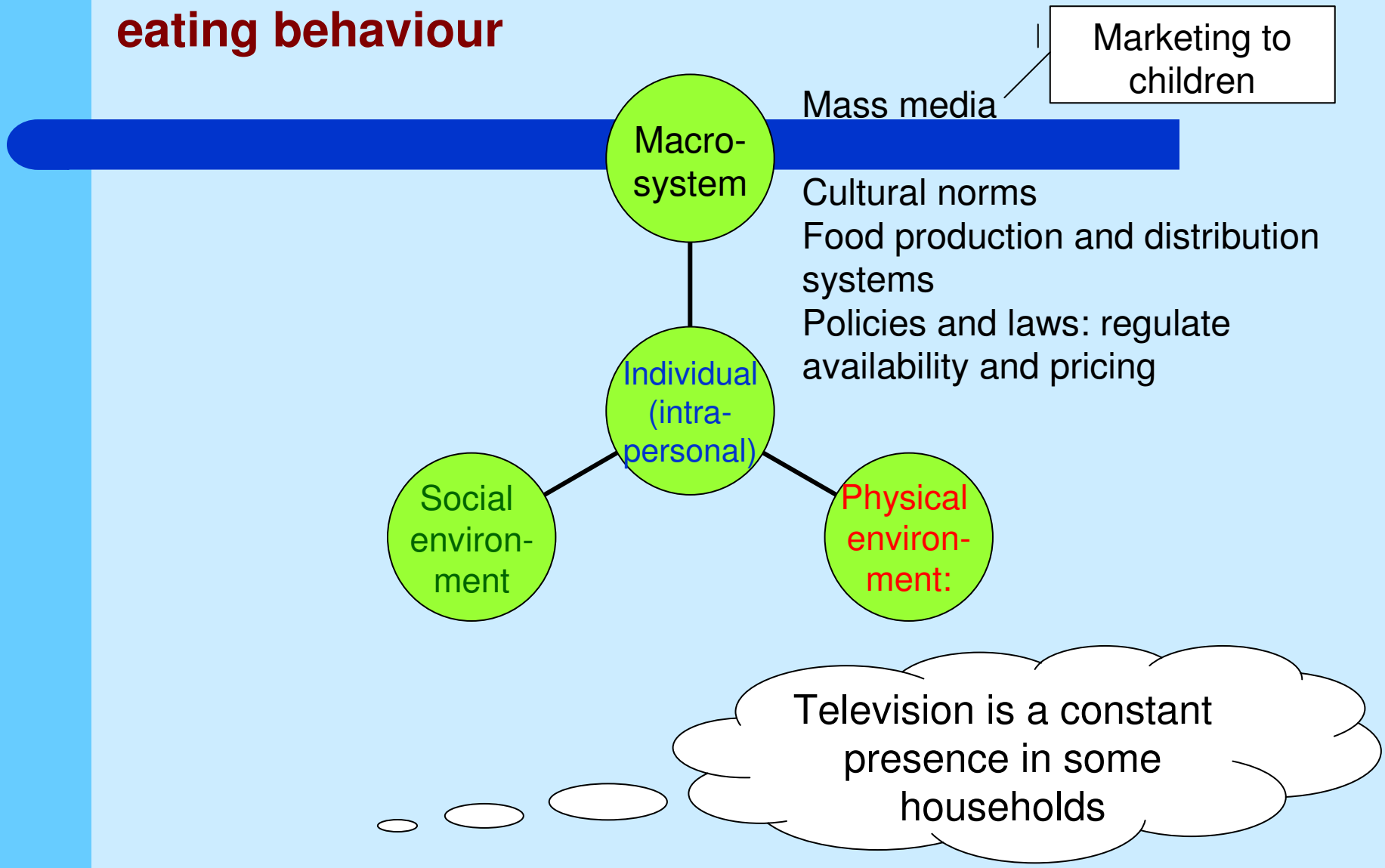
Family, friends, peers

The family is a major influence on children's eating behaviour
Changing demographics: single parent, gatekeepers

Conceptual framework for understanding children's eating behaviour



Conceptual framework for understanding children's eating behaviour



The school environment and eating habits

- Current school environment: need for snacks during break
- Tuck-shops, vendors, lunch-boxes
- A good opportunity to provide nutrient-dense snacks, such as fruit, brown bread sandwiches, fruit or cereal bars, yogurt, fresh and flavoured milk drinks

Habits adopted from early years with long-term effects

- Environment changed over the past decades: more tasty, energy-dense foods generally available,
  more sedentary lifestyles
- Children's eating habits changed:

  they eat more high fat foods and drink more cold drinks
- Additional kJ intake provided by cold drinks: about 600kJ extra /day, up to an additional 4000kJ/day
- Milk consumption among adolescents decreased dramatically

Explanations for a possible link between increased cold drink consumption and obesity

- Cold drinks are easily consumed at large quantities, with low satiety value
- The total energy intake is thus higher (600-4000kJ/d)
- Cold drinks replaced milk in the diet
- An increasing body of literature suggests that dairy calcium may play a role in maintaining stable body weight

South African studies: dietary intakes (Thusa Bana Study, 2000-2001)

Total group (n=1257)	Boys 10-15y (n=608)	Girls 10-15y (n=594)
Sugar: 23g	Sugar:25g	Sugar: 22g
Milk: 192ml	Milk: 201ml	Milk: 183ml
Maize meal: 180g	Maize meal: 202g	Maize meal: 159g
White bread: 153g	White bread: 162g	White bread: 144g
Brown bread: 144g	Brown bread: 144g	Brown bread: 144g
Tea: 297ml	Tea: 293ml	Tea: 300ml
Margarine: 15g	Margarine: 16g	Margarine: 15g
Rice: 157g	Rice: 160g	Rice: 154g
Coffee: 289ml	Coffee: 289ml	Coffee: 289ml
Chicken: 58g	Chicken: 56g	Chicken: 60g

South African studies: snack and cold drink intakes (Thusa Bana)

Total group (n=1257)	Boys (n=608)	Girls (n=594)
11. Cold drink, carbonated: 360ml	10. Cold drink, carbonated: 396ml	13. Cold drink, carbonated: 321ml
12. Chips/cheese curls: 41g	15. Chips/cheese curls: 45g	11. Chips/cheese curls: 38g
21. Cold drink, squash: 242ml	24. Cold drink, squash: 233ml	23. Cold drink, squash: 250ml
25. Apple: 170g	30. Apple: 173g	24. Apple: 167g
26. Candy, e.g.toffees: 23g	28. Candy, e.g.toffees: 26g	27. Candy, e.g.toffees: 21g
31. Banana: 115g	32. Banana: 122g	35. Banana: 108g

Long-term health implications of poor eating habits

- Children who are overweight have a 1.5 to 2-fold higher risk for becoming overweight as adults
- Children with type 2 diabetes are usually overweight
- Obese children have higher C-reactive protein concentrations, indicating low-grade inflammation and increased risk of cardiovascular disease later in life
- Overweight children had an increased prevalence of cardiovascular risk factors (increased blood pressure and total serum cholesterol)
- Long-term low intakes of milk was associated with shorter stature (more body fat) and poor bone health

Recommendations

- Interventions should occur early in childhood to prevent or reverse the possible adverse health effects of under- or overnutrition
- Interventions aimed at modification of children's eating habits and food intakes have met with mixed success
- Failure to improve children's eating habits may be due to inadequate understanding of factors associated with children's eating behaviour

Recommendations

Schools can be an environment where healthy lifestyle is reinforced

- Encourage policy to restrict the sale of soft drinks and foods high in fat and sugar in the school environment
- E.g. in California: at least 50% of food items sold should be selected from a “nutritious foods list”
- Nutrition information can be displayed in school tuck-shops
- Pricing in tuck-shops has a strong effect on food choices

Recommendations

- **Schools** should be an environment where a physically active lifestyle is modeled and reinforced

- Department of Education, teachers, school governing boards and children's representatives should work together to create a more healthy school environment that fosters good eating and physical activity habits

Recommendations

Community level strategies to reduce environmental barriers

More opportunities for healthful eating and activity habits

Healthful foods offered at food outlets close to places where children spend their leisure time, such as public parks and recreation facilities

More recreation facilities where children can safely participate in enjoyable sports and games

Recommendations: health professionals

Health professionals have developed comprehensive transdisciplinary health promotion programmes for children based at community centres or schools

Involve parents

Interventions for culturally diverse groups should be culturally appropriate and should be implemented at the level of the community

Recommendations for interventions

Interventions should address factors at different levels of influence, which build upon each other

Partnerships between health professionals, the media, government programmes, industry and youth groups are necessary to help children to establish good nutritional status

CONCLUSION

- Interventions to improve the mineral and vitamin nutritional status of undernourished children have a positive impact on:
- Growth and health of children
- Educational outcomes
- Productivity
- National economies

Thank you