CHAPTER 3

Assessment of child and adult undernutrition in developing countries

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Methodology for assessing undernutrition by anthropometry

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Anthropometric assessment of nutritional status

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Summary and conclusions

The assessment of nutritional inadequacy in the preceding chapter was concerned with the entire population of a country or a region. While such a global assessment has its uses, it is also sometimes necessary to consider specific groups within a population, especially those regarded as target groups for intervention purposes, for example children, women, old people or others who may warrant particular attention. However, when applied to such specific groups, the methodology adopted in the preceding chapter is limited by the fact that separate data on the dietary energy intakes of these population subgroups are seldom available on a sufficiently large scale. As a result, any exercise in group-specific assessment must rely on different data and a methodology that is more capable of assessing the status of individuals within a defined group. One such methodology is nutritional anthropometry.

This chapter uses the anthropometric assessment method to measure the nutritional inadequacy of children and adults in the developing countries. As explained in the Introduction, this method and the food adequacy approach differ conceptually and methodologically and therefore cannot be expected to provide the same estimates of the number of undernourished people. When applied to a country, the results generated by each approach would not add up to the same estimates for the entire population.[7] Strictly speaking, therefore, the assessment presented in this chapter cannot show for separate subgroups what the assessment in the preceding chapter showed for populations as a whole. Nonetheless, the anthropometric assessment is complementary to the results presented in the preceding chapter inasmuch as it focuses on the status of people in subgroups within a population.

To assist in the interpretation of these results, a detailed discussion on the advantages and limitations of anthropometry in the nutritional status assessment of both children and adults presented in Appendix 4, which also covers issues related to reference values and cutoff points for the classification of individuals. The cutoff points are based on established relationships between anthropometric indices, on the one hand, and functional impairments, augmented risks of morbidity and mortality and other evidence of the consequences of food and non-food risk factors, on the other. In other words, they are based on the fact that values of anthropometric indicators below the lower cutoff point are usually associated with a high incidence of the ill-effects of nutritional

[7] A further complication is that there are several alternative anthropometric indicators for children, each related to a different aspect of child undernutrition.

inadequacy, such as physical dysfunctions, morbidity and mortality. It is in this sense that people whose anthropometric indicators fall below the cutoff points are said to be at risk of being undernourished. A similar interpretation applies to the upper cutoff points used for identifying those at risk of being overnourished.

It should be stressed that, as in the case of the estimates of food inadequacy discussed in Chapter 2, the anthropometric approach generates probability estimates. Since the majority of individuals in the reference population are found to have anthropometric values that fall within the upper and lower cutoff points, it follows that the majority of those with anthropometric values outside the normal range are likely to be suffering from malnutrition. At the same time, a small proportion will be misclassified, i.e. classified as being malnourished when in fact they are not, and vice versa, even in the absence of measurement errors. The nutritional assessment is thus probabilistic.

METHODOLOGY FOR ASSESSING UNDERNUTRITION BY ANTHROPOMETRY

The nutritional status of an individual or group of individuals can be assessed through the use of one or more anthropometric measurements to determine whether a person is likely to be well nourished or undernourished. This method generates objective measurements of body dimensions and composition as a proxy indicator of nutritional status. The most commonly used measurements of nutritional status assessment are based on growth and development in children and on body composition in adults.

Nutritional anthropometric indices have a number of advantages (see Box 2). However, they also have several limitations: i) day-to-day intra-individual variations in body weight may make it difficult to detect small weight losses owing to deficient energy intakes and/or increased health risks over short periods; ii) they are unable to distinguish the effects of specific nutrient deficiencies (such as zinc) that affect growth in children and induce changes in body composition from the effects of food and non-food risk factors; and iii) they are unable to detect the presence of undernutrition when it is manifested solely through a person's inability to undertake a desirable level of physical activity. As with most measurement techniques, there is also room for measurement errors, particularly if the survey personnel are not properly trained, although limitations on accurate age determination and sampling biases are perhaps potentially more serious sources of error.

The assessment of child and adult nutritional status is presented here in terms of two anthropometric measurements, weight and height, since these are the most widely applied indicators which allow highly specific and broadly accepted interpretations. Consequently, for a global assessment involving cross-region and cross-country comparisons, these two measurements are the most appropriate. A useful description of other anthropometric indicators (including their construction, application and interpretation) for children and adults may be found in WHO (1995) and Gibson (1990).

Infants and children

The three most frequently used indicators to assess child nutritional status are based on height and weight: they are height for age, weight for height and weight for age. The *height for age* of a child reflects linear growth and measures long-term growth faltering or stunting, while *weight for height* adequately reflects body proportion. Weight for height is particularly sensitive to acute growth disturbances and indicates the presence of wasting. *Weight for age* represents a convenient synthesis of both linear growth and body proportion (WHO, 1986 and 1995).

The presence of undernutrition in children is diagnosed using these three anthropometric indicators and by comparing the measured values with the [United States] National Center for Health Statistics/WHO reference values (WHO, 1983). A normal or low-risk range is identified on the distribution curve of reference values. The two ends of the range are taken as cutoff points for identifying children with inadequate or excess nutrition. It is now generally agreed that the most appropriate cutoff points on the normalized distribution curve are: -2 SD or -2 Z-scores, to signal that the child is at risk of being *underweight* (weight for age), *stunted* (height for age) or *wasted* (weight for height). On a population basis, the prevalence of undernutrition for children under the

BOX 2

ANTHROPOMETRY AS AN INDICATOR OF NUTRITIONAL STATUS

Anthropometric indices provide an approximate reflection of the nutritional status of a community. They are useful indicators because they constitute:

- **a simple and practical way of describing the problem;**
- **the best general proxy for constraints to human welfare, such as dietary inadequacies, infections and other environmental health risks;**
- **strong and feasible predictors, at individual and population levels, of the risks of subsequent morbidity, functional impairments and mortality;**
- **an appropriate indicator for measuring the success or failure of interventions.**

Source: ACC/SCN (1990).

age of five is estimated by the proportion of children whose measurements fall below the cutoff points on the respective indices. In the same way, the prevalence of overweight children as a result of overnutrition is estimated by the proportion of children with a weight adjusted for height above +2 SD (or +2 Z-scores) on the normalized distribution curve.

Older children and adolescents

The nutritional status in schoolchildren and adolescents is assessed by the same anthropometric indicators that are used for children under the age of five, i.e. weight for age, height for age and weight for height, and the same cutoff points (<-2 SD and >+2 SD of the NCHS/WHO reference values) are applied to classify schoolchildren and adolescents according to their risk of being malnourished. However, the same anthropometric indicators provide different information for children of different ages. For instance, a high prevalence of stunting among one-year-old children indicates the existence of current nutrition and health problems whereas, in children of five years or older, stunting reflects both past and current risks to growth and development. While the height indicator provides information about the past and present, indicators based on weight provide information about current processes. A proper interpretation of the actual nutrition situation of older children requires corroborating data related to food and diet, socio-economic status and the incidence of infectious diseases and parasitic infestation.

Adolescent nutritional status can also be assessed by a weight for height index, i.e. the BMI (weight [kg]/height^2 [m]). Adolescents with a BMI (adjusted for age) below the value corresponding to the 5th centile of the NCHS/WHO reference population are considered to be at risk of being undernourished (WHO, 1995). A BMI for age equal to or greater than that corresponding to the 85th centile indicates that an adolescent is at risk of being overweight. The estimated proportion of malnourished adolescents can be expected to be higher using the BMI and the indicated cutoff points than when using the -/+2 SD cutoff points, since the latter correspond to the 2.5th and 97.5th centiles of the respective distribution curves.

Adults

Until recently, anthropometric assessments of nutritional status were carried out almost exclusively for children and adolescents because there was no satisfactory indicator of adult nutritional status available. However, much progress has been made over these last years in identifying such an indicator, and the BMI (weight/height^2) is considered at present to be the most suitable anthropometric indicator of adult nutritional status (Shetty and James in FAO, 1994b; Ferro-Luzzi *et al.*, 1992; James, Ferro-Luzzi and Waterlow, 1988). The advantage of this indicator is that, while being consistently and highly correlated with body weight (or body energy stores), it is also relatively independent of adult stature so it permits a comparison of body proportion across population groups of varying statures (see Appendix 4).

A low BMI value reflects both low body fat and muscle mass for a given height. It has been argued that age, gender, body shape and ethnicity should be taken into account when interpreting BMI values in terms of body composition (Norgan, 1994), although in healthy populations the variations in BMI owing to such factors are likely to be small (Shetty and James in FAO, 1994b). Thus, if the observed BMI of an individual is found to lie below the lower end of a normal range of variation, there is a high risk that the person is suffering from the ill-effects of chronic nutritional deficiency (principally, chronic energy deficiency [CED]). Accordingly, the lower end of the range of normal variation is used as the cutoff point for the diagnosis of chronic undernutrition in adults. On the basis of current knowledge, the best estimate of this critical point is 18.5 (WHO, 1995) (see Appendix 4 for a more detailed explanation).

The lower limit of normality (the BMI value of 18.5) was established from the observation of BMI values of a large sample of male soldiers and healthy women in the United Kingdom (Shetty and James in FAO, 1994b). The universal application of the reference population and of the cutoff point of BMI 18.5 to other populations has been questioned (Garcia and Kennedy, 1994; Norgan, 1990 and 1994; Immink, Flores and Diaz, 1992). However, in the absence of more consistent data from different countries and population groups, this cutoff point has been accepted for the time being, among other reasons to facilitate cross-country comparisons. Concerns that lean but healthy and very active adults may be wrongly classified as undernourished initially resulted in the inclusion of energy turnover based on the BMR as an additional criterion but the BMI alone is now accepted as an anthropometric indicator of chronic adult undernutrition, since the numbers likely to be misclassified in a representative population sample are considered to be insignificant (James and François, 1994).

The BMI can also be used to assess overnutrition in adults, and specific cutoff points are applied for classifying people as overweight (25.0-29.9: obesity grade 1) or frankly obese (30.0-39.9: obesity grade 2; ≥40.0: obesity grade 3). The universal application of BMI 25.0 as the cutoff point to define obesity has also been questioned and it has been suggested that population-specific cutoff points and country-specific reference populations be established.

Using the BMI as an anthropometric indicator of adult nutrition has similar advantages to weight adjusted for height in children: it reflects the degree of severity of under- and overnutrition while height and weight data – the basic data from which the BMI is constructed – can readily be incorporated into ongoing national surveys. Finally, since the BMI is relatively independent of stature, its use permits comparative analyses of various kinds, for example between functional classifications (such as age-group, rural-urban location, occupation) as well as inter-regional and intercountry comparisons.

ANTHROPOMETRIC ASSESSMENT OF NUTRITIONAL STATUS

This section presents available estimates of the nutritional status of children, adolescents and adults, using the anthropometric indicators described above. The estimates are given in terms of the prevalence of undernutrition in different countries and regions and have been derived using the appropriate cutoff points and reference values.[a] Country data with the most recent prevalence of underweight, stunted and wasted children under five are found in Appendix 2, Table 8. For a limited number of countries, the prevalence of obesity (>2 SD) in the under-five group is also listed. The data available only permit global estimates for children under five while, for schoolchildren, adolescents and adults, data are given only for a limited number of countries.

Undernutrition in children under five: the current situation

The basic data on the anthropometry of children under the age of five are obtained from WHO's Global Database on Child Growth, which was initiated in 1986 for the purpose of compiling, systematizing and disseminating the results of representative anthropometric surveys in different parts of the world (de Onis *et al.*, 1993). Estimated *proportions* of underweight, stunted and wasted children under five are derived from this database and then applied to population estimates for 1990 in order to obtain the absolute *numbers*.

The results of this analysis are presented in Table 21 for broad regions of the developing world.[b] According to these estimates, two out of five children in the developing world are stunted (low height for age), one out

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[a] Like the food inadequacy approach discussed in the Introduction, anthropometry will also tend to underestimate the true prevalence of undernutrition, although for different reasons.

[b] The data for individual countries are presented in Appendix 2, Table 8.

TABLE 21

ESTIMATES OF PREVALENCE AND NUMBERS OF WASTED, STUNTED AND UNDERWEIGHT CHILDREN IN DEVELOPING COUNTRIES, 1990

Region/economic group	Wasted		Stunted		Underweight		Total number of children under five
	Percentage	Number (Millions)	Percentage	Number (Millions)	Percentage	Number (Millions)	(Millions)
REGION							
Sub-Saharan Africa	7	6	38	34	30	26	88
Near East and North Africa	9	4	32	16	25	12	49
South Asia	17	27	60	93	58	91	156
East and Southeast Asia	5	9	33	60	24	42	180
Latin America and the Caribbean	3	1	23	12	12	6	55
ECONOMIC GROUP							
Low-income	10	40	45	175	38	148	388
Middle- to high-income	6	8	29	40	22	31	140
Total	9	48	41	215	34	179	528

Source: WHO Global Database on Child Growth, available as of December 1995.

of three is underweight (low weight for age) and one out of ten is wasted (low weight for height). In absolute numbers, there were 215 million stunted children, 179 million underweight and nearly 50 million wasted children in 1990.

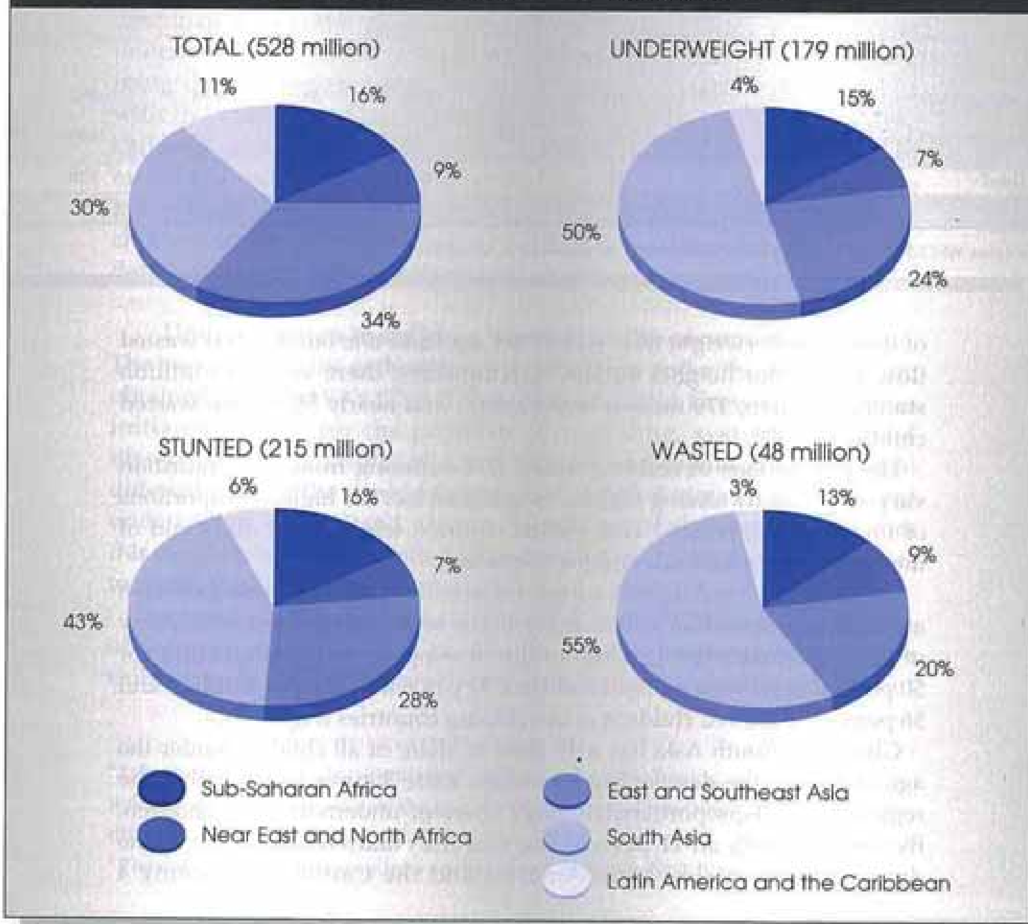
The proportions of children under five suffering from undernutrition vary significantly among regions: South Asia has the highest proportions of underweight, stunted and wasted children while at the other end of the scale is Latin America and the Caribbean.

South Asia's combination of the highest incidence of undernutrition and a large population makes it the home of an overwhelming majority of the undernourished children in the developing world: it accounts for 50 percent of all underweight children, 43 percent of stunted children and 56 percent of wasted children in developing countries (Figure 7).

Given that South Asia has a 30 percent share of all children under the age of five in the developing countries, these figures indicate that the region has a disproportionately large share of undernourished children. By contrast, with an 11 percent share of the children under five in the developing countries, Latin America and the Caribbean has only 4 percent of the underweight, 6 percent of the stunted and 3 percent of the wasted children. Similarly, with 22 percent of the children under five, China has only 11 percent of the underweight, 17 percent of the stunted and 8 percent of the wasted children. In East and Southeast Asia, the proportions of undernourished children (12 percent underweight, 11 percent stunted and 11 percent wasted) are quite similar to this region's share of the developing countries' population under the age of five (12 percent), and the same is true for sub-Saharan Africa and the countries of the Near East and North Africa.

FIGURE 7

REGIONAL DISTRIBUTION OF TOTAL NUMBER OF UNDERWEIGHT, STUNTED AND WASTED CHILDREN IN DEVELOPING COUNTRIES, 1990-92



An analysis based on the two-way classification of the developing countries into low-income and middle- to high-income groups revealed the following picture (see also Table 21). The average prevalence of underweight, stunted and wasted children was substantially higher in the low-income countries, at 38, 45 and 10 percent, respectively, compared with 22, 29 and 6 percent in the middle- to high-income group. The vast majority of undernourished children also live in the low-income countries, as do 73 percent of the total population of children under five in the developing world and more than 80 percent of the undernourished children (83 percent of the underweight, 81 percent of the stunted and 83 percent of the wasted children). Thus, the low-income countries have disproportionately high shares of underweight, stunted and wasted children.

In each of the regions, low-income countries as a group have a generally higher prevalence of undernutrition than middle- to high-income countries. The glaring exception in Southeast Asia is China. Also, only small differences in the prevalence of wasting is found between low-income and middle- to high-income countries in Latin America and the Caribbean (where the prevalence of child undernutrition is relatively low overall) and in the Near East and North Africa.

Among the low-income countries, the sharpest regional variation is found in the prevalence of underweight children as compared with the prevalence of stunting and wasting. For example, the proportion of underweight children varies from 58 percent in South Asia to 17 percent in China, whereas the proportion of wasting ranges from 17 percent in South Asia to 3 percent in Latin America and the Caribbean. Among the middle- to high-income countries, the interregional variation is much less pronounced for all three indicators.

In a small number of countries for which the information is available, the prevalence of obesity in children under five exceeds the prevalence expected in a healthy population, i.e. 2.5 percent (Appendix 2, Table 8). This is true for 11 out of the total of 22 countries with data available. In these 11 countries, the prevalence of underweight children is relatively low, although there are some notable exceptions such as China, Egypt and Mauritius. This points to a certain degree of coexistence of under- and overnutrition in some countries, as is also the case among adults.

Undernutrition in children under five: changes over time

Unlike in the case of food inadequacy, it is difficult to determine long-term trends in the prevalence of undernutrition based on anthropometric measures. At best, changes that have occurred over time in a number of developing countries can be analysed. This is because repeated and comparable surveys for different points in time are not available for most countries. Nevertheless, WHO has made a systematic attempt to compile and collate the findings of as many surveys as possible even though they are not always comparable within the same country and often differ in terms of methodology, sample frame, sample size, etc. Particularly limiting is the fact that repeated surveys do not always cover the same age group. For purposes of intercountry comparisons, an additional problem is that the time span covered by the repeated surveys is not identical for each country – in some cases the period extends from the mid-1970s to the early or mid-1990s whereas, in others, it covers only a part of the 1980s. Bearing these caveats in mind, some indication about the nature of change over time can be obtained from the data assembled in Table 22, which shows the direction in which the proportion of underweight children has changed according to repeated surveys in individual countries.

TABLE 22

CHANGE OVER TIME IN THE PREVALENCE OF UNDERWEIGHT CHILDREN (UNDER 5 YEARS) IN SELECTED DEVELOPING COUNTRIES

Region/country	Survey year	Underweight children under 5 years	
		Prevalence (Percentage)	Change over time
Sub-Saharan Africa			
Ethiopia, PDR	1982, 1992[2,3]	38.1, 47.7	↗
Ghana	1988, 1994[2]	27.1, 27.4	—
Kenya	1982,[1] 1987,[1] 1993	22.0, 18.0, 22.3	↘↗
Lesotho	1976, 1981, 1992	17.3, 13.3, 15.8	↘↗
Madagascar	1984, 1992	32.8, 39.1	↗
Malawi	1981, 1992	23.9, 27.2	↗
Mauritania	1981, 1991	31.0, 47.6	↗
Rwanda	1976, 1985, 1992	27.8, 27.5, 29.2	—↗
Senegal	1986,[4] 1993	17.5, 20.1	↗
Sierra Leone	1975, 1978, 1990	31.0, 23.2, 28.7	↘↗
Togo	1977,[3] 1988[3]	20.5, 24.4	↗
Zambia	1985, 1988, 1992	20.5, 25.8, 25.1	↗—
Zimbabwe	1984, 1988,[3] 1994	20.7, 10.0, 15.5	↘↗
Near East and North Africa			
Algeria	1987, 1990, 1992	8.6, 9.2, 9.2	—
Egypt	1978, 1990, 1992, 1995[2]	16.6, 10.4, 9.4, 16.8	↘↗
Jordan	1975, 1990	17.4, 6.4	↘
Morocco	1987,[4] 1992	11.8, 9.0	↘
Tunisia	1975, 1988[4]	20.2, 10.4	↘

(continued)

(continued)

TABLE 22

CHANGE OVER TIME IN THE PREVALENCE OF UNDERWEIGHT CHILDREN (UNDER 5 YEARS) IN SELECTED DEVELOPING COUNTRIES

Region/country	Survey year	Underweight children under 5 years	
		Prevalence *(Percentage)*	Change over time
Latin America and the Caribbean			
Bolivia	1981, 1989,[3] 1994[4]	14.5, 11.4, 15.7	↘↗
Brazil	1975, 1989	18.4, 7.0	↘
Chile	1978, 1982, 1986, 1994	2.1, 1.1, 2.5, 0.9	—
Colombia	1980, 1986,[1] 1989	16.7, 10.2, 10.1	↘—
Costa Rica	1978, 1982, 1992[7]	16.0, 6.0, 2.3	↘
Dominican Rep.	1986, 1991	12.5, 10.4	↘
El Salvador	1975, 1988, 1993[4]	21.6, 15.5, 11.2	↘
Guatemala	1980, 1987[8]	43.6, 33.5	↘
Haiti	1978, 1990[4]	37.4, 33.9	↘
Honduras	1987, 1992	20.6, 19.3	↘
Jamaica	1978, 1985, 1989	15.0, 14.9, 7.2	↘
Mexico	1988, 1989[10]	13.9, 19.0	↗
Nicaragua	1981, 1993	10.5, 11.9	↗
Panama	1980, 1992	15.7, 6.1	↘
Peru	1975, 1984, 1992	16.1, 13.4, 10.8	↘
Trinidad and Tobago	1976, 1987[8]	16.3, 6.9	↘
South Asia			
Bangladesh	1975, 1981, 1985, 1990[4]	84.4, 70.1, 71.5, 65.8	↘
India	1977,[8] 1989,[6] 1992	78.0, 69.0, 61.0	↘
Pakistan	1977, 1986 1991	54.7, 48.8, 40.4	↘
Sri Lanka	1976, 1980, 1987[8]	58.3, 47.5, 38.1	↘
Southeast Asia			
China	1987,[2] 1992	21.3, 17.4	↘
Laos	1984, 1994	36.5, 40.0	↗
Malaysia	1983, 1986, 1993	25.6, 17.1, 23.3	↘↗
Myanmar	1982, 1987, 1990, 1991[9]	42.0, 42.0, 32.4, 36.7	↘↗
Philippines	1982, 1987, 1992, 1993	33.2, 32.9, 33.4, 29.6	—↘
Thailand	1982, 1987,[6] 1990	36.0, 25.8, 13.0	↘
Viet Nam	1986, 1989, 1994	51.5, 41.9, 44.9	↘↗

[1] Rural areas only.
[2] Excludes some districts, provinces or zones.
[3] 0-35 months.
[4] 6-59 months.
[5] 6-36 months, adjusted 0-59 m.
[6] Adjusted for misreporting of age.
[7] 6-71 months.
[8] 3-36 months.
[9] 12-72 months.
[10] 12-59 months, rural areas.

Sources: ACC/SCN (1987; 1989; 1992; 1994) and WHO Global Database on Child Growth.

The overall picture is one of a varied pattern of change in the proportion of underweight children. Even within a number of countries, the pattern of change is not consistent. Among the 45 developing countries included, 20 show a somewhat consistent pattern of decline in the prevalence of child undernutrition while about half of these again (11) are located in Latin America and the Caribbean. All the four countries in South Asia, three of the seven Southeast Asian countries and three of the five countries in the Near East and North Africa also show a declining prevalence over time. However, in sub-Saharan Africa, almost all the countries show an increasing prevalence.

Undernutrition in schoolchildren

Because of the paucity of data, only general statements can be made about the prevalence of undernutrition in schoolchildren in specific developing countries. This is especially true of some Latin American countries, where the heights of all first grade students between the ages of six and nine were measured on a national basis. The periodic implementation of these national surveys, as has been done in Costa Rica and Panama for example, provides a picture of change over time (Table 23). In Costa Rica, the prevalence of stunting declined over time while, in Panama, after declining in the first half of the 1980s, stunting among schoolchildren tended to increase during the second half of the decade.

Undernutrition in adolescents and adults

Globally, representative data on adolescent nutritional status are generally lacking. Table 24 summarizes data compiled by Kurz and Johnson-Welch (1994) on stunting and thinness in both male and female adolescents of selected countries.[10] These data indicate significant intercountry differences in the proportion of stunted and thin adolescents, both among males and females. The comparability of these data sets is too limited to permit more precise statements on intercountry patterns but observations can be made regarding the pattern of gender differentials. First, while female adolescents suffer from more than twice as much stunting as males in India, the opposite is true in the two African countries, Benin and Cameroon. Second, the gender differential in thinness (low BMI for age) appears to have a uniform pattern everywhere – male adolescents have a consistently

[10] It should be noted that the cutoff points used in this study to define stunting (low height for age) and thinness (low BMI for age) differ slightly from those currently recommended by WHO (1995).

TABLE 23

PREVALENCE OF STUNTING INDICATED BY NATIONAL HEIGHT SURVEYS AMONG SCHOOLCHILDREN IN LATIN AMERICA AND THE CARIBBEAN

Country	Survey year	Prevalence of stunting among children of 6-9 years (Percentage)
Argentina	1985	10.0
Bolivia	1988-90	35.0
Chile	1990	27.5-28.6[1]
Costa Rica	1979	20.4
	1981	15.5
	1983	12.6
	1985	11.3
	1989	9.2
Dominican Rep.	1993	19.0
El Salvador	1988	30.0
Guatemala	1986	37.4
Honduras	1986	40.0
Nicaragua	1986	23.9
	1989	18.7
Panama	1982	23.1
	1985	18.8
	1988	24.4
Paraguay[2]	1988	9.3
Uruguay	1987	4.0
	1990	4.1

[1] Below the 10th centile of the NCHS/WHO reference values.
[2] Seven to 14 years of age.

Source: International Conference on Nutrition background country papers.

higher prevalence of thinness than female adolescents. Third, the high prevalence of thinness in both female and male adolescents in India and Nepal stands out in comparison with the other countries.

As mentioned before, the anthropometric assessment of adult nutritional status is a relatively new phenomenon. As a result, there are very few data sets, although BMI data for adults are now becoming increasingly available. Table 25 summarizes some of the available data based on representative surveys from different countries and geographical regions of the developing world, revealing the coexistence of adult under- and overnutrition (see also Box 3, p. 78). In Latin

TABLE 24

PREVALENCE OF STUNTING AND THINNESS AMONG ADOLESCENT MALES AND FEMALES IN SELECTED COUNTRIES

Country	Stunted[1]			Thin[2]		
	All	Males	Females	All	Males	Females
	(Percentage)					
Benin	41	55	27	23	32	14
Cameroon	12	19	8	4	7	2
Ecuador	50	...	...	9	13	6
Guatemala	57	...	...	4	...	...
India	32	20	45	55	69	37
Jamaica	2	...	...	3	...	...
Mexico	62	...	...	3	...	...
Nepal	47	...	...	36	49	25
Philippines (Cebu)	43	...	...	13	19	7
Philippines (Mindanao)	65	...	...	6	9	1

[1] Low height for age, defined as below the 5th percentile of the NCHS/WHO reference values. The recent WHO report (WHO, 1995) recommends below the 3rd percentile or -2 Z-scores as appropriate.
[2] Low BMI for age, defined as below the 5th percentile of the BMI for age.

Source: Kurz and Johnson-Welch (1994).

American countries the proportion of underweight adults is small; in fact, there is a strong tendency for adults to be overweight, tending particularly towards obesity grade 1. Among African adults, the proportion of those underweight is greater in the Sahelian countries than in tropical or subtropical areas, while the proportion of overweight adults on the continent as a whole tends to be significantly lower than in Latin America.

A relatively large proportion of adults in Asia have a BMI under the minimum acceptable level of 18.5, for example 12.5 percent in China, 16.9 percent in Laos and a staggering 48.6 percent in India. The proportion of adults found to be in the normal range of variation of BMI (18.5 to 25.0) in China and Laos approximates that in many African countries, but not so in India where the proportion is significantly lower. The prevalence of adult obesity in Asia is in general the lowest among the developing regions.

TABLE 25

PERCENTAGE OF ADULTS IN DIFFERENT BMI CLASSES BASED ON AVAILABLE COUNTRY SURVEYS

Country	BMI categories						Mean	No. of adults	Survey year
	<16.00	16.00-16.99	17.00-18.49	18.50-24.99	25.00-29.99	≥30.00			
Africa[1]									
Congo[2]	0.6	1.8	8.7	73.7	11.8	3.4	23.10	2 295	1986-87
Ghana	2.8	3.9	13.3	62.0	17.1	0.9	...	6 323	1987-88
Ghana[2]	0.8	1.7	8.7	75.9	9.7	3.2	21.79	1 833	1993
Kenya[2]	0.5	1.3	7.4	76.8	11.5	2.4	22.04	3 547	1993
Mali	1.9	3.2	11.2	76.5	6.4	0.8	21.10	4 868	1991
Morocco	0.5	1.1	5.4	69.1	18.7	5.2	22.97	41 921	1984-85
Morocco[2]	0.3	0.5	2.8	62.0	23.3	11.1	24.27	3 234	1992
Senegal	1.4	2.0	10.2	70.4	12.2	3.7	21.94	3 241	1992-93
Tunisia	0.3	0.6	3.0	58.9	28.6	8.6	24.25	10 023	1990
Zambia[2]	0.0	1.1	6.0	70.3	16.9	5.7	22.91	350[3]	1992
Latin America and the Caribbean									
Brazil	0.5	0.9	4.2	61.7	25.1	8.6	(22.8, 23.2)	32 381	1989
Cuba	0.6	1.3	5.4	56.3	26.9	9.5	...	30 363	1982
Peru	0.2	0.2	2.6	63.2	24.8	9.0	...	3 145	1975-76
Asia									
China	1.0	3.9	7.4	79.5	7.2	1.0	20.98	13 387	1982
India	10.2	12.7	25.7	47.9	3.0	0.5	...	21 361	1988-90
Laos	1.6	2.9	11.4	76.9	6.5	0.7	20.94	7 138	1994

[1] This classification refers to continental Africa, hence the inclusion of Morocco and Tunisia.
[2] Women only.
[3] Part of data set only.

Sources: IRD/Macro International Inc., Demographic and Health Surveys 1992 and 1993; Shetty and James in FAO (1994b).

SUMMARY AND CONCLUSIONS

The most frequently employed indicators of undernutrition in children (0 to ten years) are weight for age, height for age and weight for height. Children are classified according to their nutritional status by comparing their measurements with reference values for a normal healthy population and with specific cutoff values of the normalized distribution for that population.

BOX 3

NUTRITION PARADOX: COEXISTENCE OF LOW BODY WEIGHT AND OBESITY IN DEVELOPING COUNTRIES

The apparent paradox of the coexistence of undernutrition and overnutrition (as manifested in obesity) is being increasingly recognized because of its implications for nutrition policy. In a number of developing countries with relatively low per caput incomes, the prevalence of obesity among adults, particularly in urban areas, is often found to be surprisingly high. Prevalence figures for obesity grade 1 (25 ≤BMI <30.0) in some Latin American countries are often similar to those for some European countries and the United States, although figures for obesity grade 2 (BMI ≥30.0) are still somewhat lower. Furthermore, the prevalence of obesity among adults is often a multiple of the prevalence of weight deficiency.

The prevalence of obesity (weight for height >120 percent) reported for individuals over 15 years of age in a number of Caribbean countries in the 1970s and 1980s ranged from 6 to 21 percent among men and from 22 to 48 percent among women. In African countries[1] such as the Congo, Ghana, Mali, Morocco and Tunisia, during the 1980s the prevalence of obesity grade 1 was found to range from 6.4 percent (Mali) to 28.6 percent (Tunisia), and the prevalence of obesity grade 2 from 0.8 percent to 8.6 percent. Only in Asia is the problem still insignificant from a public health point of view.

Recent evidence from China and the urban Congo shows that the prevalence of obesity among adult men and women increases with income while the proportions of underweight as well as normal-weight adults decline. However, manifestations of under- and overnutrition coexist to some extent at all income levels.

Anthropometric data from Senegal and the Congo on children under five and their mothers are particularly revealing in demonstrating the nutrition paradox. In a rural population in Senegal, 3.6 percent and 18.9 percent of children under five were, respectively, wasted and stunted. Among their mothers, 6 percent were underweight (BMI <18.5) and 8.6 percent were overweight (BMI >25.0). Similarly, in the Congo, while 5.6 percent and 27.5 percent of rural children under five were respectively wasted and stunted, among their mothers 13 percent were underweight and 8.6 percent were overweight. A similar phenomenon of the coexistence of weight deficiency and obesity among mothers of undernourished children was also observed in the urban populations of both countries.

[1] Continental Africa, hence the reference to Morocco and Tunisia.

Source: Delpeuch (1995).

The cutoff points are based on an augmented risk of morbidity and mortality and, for all three indicators, are: <-2 SD = undernourished and >+2 SD = overweight (weight indicators only). In adults, the currently favoured indicator is the BMI (weight [kg]/height^2 [m]) which is used for assessing both undernutrition (<18.5) and obesity (≥25.0). The interpretation of the weight and height indices for children is relatively simple but the interpretation of the BMI for adults is more complex. It is estimated that, in 1990, there were 179 million children under five who were weight-deficient, 215 million who were stunted and 48 million who were wasted in the developing countries. Of the total population under five years of age, 41 percent were stunted, 34 percent were underweight and 9 percent were wasted. The highest proportions were found in South Asia, followed by sub-Saharan Africa. This ranking is the reverse of the one based on the prevalence of food inadequacy discussed in Chapter 2. A plausible explanation for this reversal is based on the differences in disease environments: a high population density combined with a monsoon climate makes the spread of diseases – especially the water-borne kinds – much easier and much more lethal in South Asia than in sub-Saharan Africa. As a result, the children of South Asia are much more susceptible to nutritional stress in spite of a lower overall prevalence of food inadequacy in this region. The combination of a high rate of undernutrition and a large population size makes South Asia the home of by far the largest number of undernourished children in the developing regions. Overall, in 1990, 80 percent of the world's undernourished children lived in Asia (mostly in South Asia), 15 percent in Africa and 5 percent in Latin America.

Globally, there is an indication that the prevalence of weight deficiency among children under five is declining over time in a number of countries. The pattern is strongest in South Asia and Latin America, while the prevalence of weight deficiency is actually increasing in sub-Saharan Africa and the situation in the remaining regions is mixed. Global assessments of the nutritional status of schoolchildren and adolescents are impossible since little empirical evidence can be drawn from national surveys.

Data on the BMI for adults are not widely available for developing countries. Evidence from selected countries reveals that adult undernutrition, as indicated by a BMI value of less than 18.5, is often less prevalent than manifestations of overnutrition (except in South Asia), as indicated by a BMI value greater than 25.0. The prevalence of adult obesity is generally highest in Latin America and lowest in Asia. Women tend to be more affected by obesity than men and obesity is more prevalent in urban than rural areas. More and more, one can observe the coexistence of under- and overnutrition among children and adults in the developing countries, which points to a process of "nutritional transition". Increased urbanization, changing food intake patterns and lifestyles as well as general economic growth all contribute to a gradual shift towards overnutrition, while undernutrition remains highly prevalent. It should be noted, however, that this shift is still barely evident in countries with very low levels of per caput income.