PART I

The problem of overweight and obesity

2. Defining the problem

2.1 Introduction

Obesity is often defined simply as a condition of abnormal or excessive fat accumulation in adipose tissue, to the extent that health may be impaired (*1*). The underlying disease is the undesirable positive energy balance and weight gain. However, obese individuals differ not only in the amount of excess fat that they store, but also in the regional distribution of that fat within the body. The distribution of fat induced by weight gain affects the risks associated with obesity, and the kinds of disease that result. Indeed, excess abdominal fat is as great a risk factor for disease as is excess body fat *per se*. It is useful, therefore, to be able to distinguish between those at increased risk as a result of "abdominal fat distribution", or "android obesity" as it is often known, from those with the less serious "gynoid" fat distribution, in which fat is more evenly and peripherally distributed around the body.

Classifying obesity during childhood or adolescence is further complicated by the fact that height is still increasing and body composition is continually changing. Furthermore, there are substantial international differences in the age of onset of puberty and in the differential interindividual rates of fat accumulation.

This section outlines the most appropriate methods for: (a) classifying overweight and obesity in adults; and (b) identifying abdominal fat distribution. It also briefly discusses the use of additional tools for use in the more detailed characterization of obese individuals. The final section outlines the current lack of consistency and agreement between studies in the classification of obesity in childhood and adolescence, and highlights the need for a globally standardized classification system.

The key issues covered include the following:

- Obesity can be defined simply as the disease in which excess body fat has accumulated to such an extent that health may be adversely affected. However, the amount of excess fat, its distribution within the body, and the associated health consequences vary considerably between obese individuals.
- The graded classification of overweight and obesity: (a) permits meaningful comparisons of weight status within and between populations; (b) makes it possible to identify individuals and groups at increased risk of morbidity and mortality; (c) enables priorities to be identified for intervention at individual and community levels; and (d) provides a firm basis for the evaluation of interventions.

- Body mass index (BMI) (see section 2.3) provides the most useful, albeit crude, population-level measure of obesity. It can be used to estimate the prevalence of obesity within a population and the risks associated with it. However, BMI does not account for the wide variation in body fat distribution, and may not correspond to the same degree of fatness or associated health risk in different individuals and populations.
- Obese individuals with excess fat in the intra-abdominal depots are at particular risk of the adverse health consequences of obesity. Therefore, measurement of waist circumference provides a simple and practical method of identifying overweight patients at increased risk of obesity-associated illness due to abdominal fat distribution.
- Ethnic populations differ in the level of risk associated with a particular waist circumference, and a globally applicable grading system of waist circumference has not yet been developed.
- Additional tools available for the more detailed characterization of the obese state include methods of measuring body composition (e.g. underwater weighing), determining the anatomical distribution of body fat (e.g. magnetic resonance imaging), and measuring energy intake (e.g. prospective dietary record) and energy expenditure (e.g. doubly labelled water). However, the cost of such techniques and the practical difficulties involved in applying them limit their usefulness to research.
- As previously mentioned, the classification of the weight status of children and adolescents is complicated by the fact that height and body composition are continually changing, and that such changes often occur at different rates and times in different populations, making simple universal indices of adiposity of little value. To date, there has not been the same level of agreement on the classification of obesity for children and adolescents as there is for adults.

2.2 Why classify overweight and obesity?

The graded classification of overweight and obesity is valuable for a number of reasons. In particular, it allows:

— meaningful comparisons of weight status within and between populations;
— the identification of individuals and groups at increased risk of morbidity and mortality;
— the identification of priorities for intervention at individual and community levels;
— a firm basis for evaluating interventions.

2.3 Body mass index

BMI is a simple index of weight-for-height that is commonly used to classify underweight, overweight and obesity in adults. It is defined as the weight in kilograms divided by the square of the height in metres (kg/m^2).

For example, an adult who weighs 70kg and whose height is 1.75m will have a BMI of 22.9:

$$BMI = 70(kg)/1.75^2(m^2) = 22.9$$

The classification of overweight and obesity, according to BMI, is shown in Table 2.1. Obesity is classified as a BMI ≥30.0. The classification shown in Table 2.1 is in agreement with that recommended by WHO (*2*), but includes an additional subdivision at BMI 35.0–39.9 in recognition of the fact that management options for dealing with obesity differ above a BMI of 35. The WHO classification is based primarily on the association between BMI and mortality (see section 4.6).

2.3.1 *Use of other cut-off points in the classification of obesity*

A BMI of 30 or more is now widely accepted as denoting obesity. In some studies, however, other BMI cut-off points both above and below 30 have been used (*3*). Differences in cut-off points have a major impact on estimates of the prevalence of obesity. For meaningful comparisons between or within populations it is therefore advisable to use the single BMI cut-off points proposed in Table 2.1.

2.3.2 *Variation in the relationship between BMI and body fatness*

Although it can generally be assumed that individuals with a BMI of 30 or above have an excess fat mass in their body, BMI does not distinguish between weight associated with muscle and weight associated with fat. As a result, the relationship between BMI and body fat content varies according to body build and proportion, and it has been shown repeatedly that a given BMI may not correspond to the same degree of fatness across populations. Polynesians, for example, tend to have a lower fat percentage than Caucasian Australians at an identical BMI (*4*). In addition, the percentage of body fat mass increases with age up to 60–65 years in both sexes (*5, 6*), and is higher in women than in men of equivalent BMI (*7*). In cross-sectional comparisons, therefore, BMI values should be interpreted with caution if estimates of body fat are required.

Differences in body proportions and in the relationship between BMI and body fat content can affect the BMI range considered to be healthy. Calculations based on the ratio of sitting height to standing

Table 2.1
Classification of adults according to BMI[a]

Classification	BMI	Risk of comorbidities
Underweight	<18.50	Low (but risk of other clinical problems increased)
Normal range	18.50–24.99	Average
Overweight:	≥25.00	
Preobese	25.00–29.99	Increased
Obese class I	30.00–34.99	Moderate
Obese class II	35.00–39.99	Severe
Obese class III	≥40.00	Very severe

[a] These BMI values are age-independent and the same for both sexes. However, BMI may not correspond to the same degree of fatness in different populations due, in part, to differences in body proportions (see section 2.3.2). The table shows a simplistic relationship between BMI and the risk of comorbidity, which can be affected by a range of factors, including the nature of the diet, ethnic group and activity level. The risks associated with increasing BMI are continuous and graded and begin at a BMI above 25. The interpretation of BMI gradings in relation to risk may differ for different populations. Both BMI and a measure of fat distribution (waist circumference or waist: hip ratio (WHR)) are important in calculating the risk of obesity comorbidities.

height that allow BMI to be corrected to take account of unusual leg lengths are now available. Thus, very tall and lean Australian Aboriginals tend to have a deceptively low BMI; a healthy BMI range for this population appears to be between 17 and 22, metabolic complications developing rapidly as BMI increases above 22. Recalculating Aboriginal data to allow for their unusual body proportions increases both the mean BMI and the BMI distribution, so that the percentage with a BMI >25 increases from 8% to 15% (*8*).

2.3.3 *Use of BMI to classify obesity*

BMI can be considered to provide the most useful, albeit crude, population-level measure of obesity. The robust nature of the measurements and the widespread routine inclusion of weights and heights in clinical and population health surveys mean that a more selective measure of adiposity, such as skinfold thickness measurements, provides additional rather than primary information. BMI can be used to estimate the prevalence of obesity within a population and the risks associated with it, but does not, however, account for the wide variation in the nature of obesity between different individuals and populations.

2.4 Waist circumference and waist:hip ratio

Abdominal fat mass can vary dramatically within a narrow range of total body fat or BMI. Indeed, for any accumulation of total body fat, men have on average twice the amount of abdominal fat than is generally found in premenopausal women (*9*). Other methods in addition to the measurement of BMI would therefore be valuable in identifying individuals at increased risk from obesity-related illness due to abdominal fat accumulation.

Over the past 10 years or so, it has become accepted that a high WHR (WHR >1.0 in men and >0.85 in women) indicates abdominal fat accumulation (*10*). However, recent evidence suggests that waist circumference alone — measured at the midpoint between the lower border of the rib cage and the iliac crest — may provide a more practical correlate of abdominal fat distribution and associated ill health (*11–13*).

Waist circumference is a convenient and simple measurement that is unrelated to height (*10*), correlates closely with BMI and WHR (*13*) and is an approximate index of intra-abdominal fat mass (*14–16*) and total body fat (*17*). Furthermore, changes in waist circumference reflect changes in risk factors for cardiovascular disease (CVD) (*18*) and other forms of chronic disease, even though the risks seem to vary in different populations.

Some experts consider that the hip measurement provides additional valuable information related to gluteofemoral muscle mass and bone structure (*19*). The WHR may therefore remain a useful research tool, but individuals can be identified as being at increased risk of obesity-related illness by using waist circumference alone as an initial screening tool.

Populations differ in the level of risk associated with a particular waist circumference, so that globally applicable cut-off points cannot be developed. For instance, abdominal fatness has been shown to be less strongly associated with risk factors for CVD and non-insulin-dependent diabetes mellitus (NIDDM) in black women than in white women (*20*). Also, people of South Asian (Bangladeshi, Indian and Pakistani) descent living in urban societies have a higher prevalence of many of the complications of obesity than other ethnic groups (*21*). These complications are associated with abdominal fat distribution that is markedly higher for a given level of BMI than in Europeans. Finally, although women have almost the same absolute risk of coronary heart disease (CHD) as men at the same WHR (*22*, *23*), they show increases in relative risk of CHD at lower waist circumferences than men. Thus, there is a need to develop sex-specific waist circumference cut-off points appropriate for different populations.

Table 2.2
Sex-specific waist circumference and risk of metabolic complications associated with obesity in Caucasians[a]

Risk of metabolic complications	Waist circumference (cm)	
	Men	Women
Increased	≥94	≥80
Substantially increased	≥102	≥88

[a] This table is an example only. The identification of risk using waist circumference is population-specific and will depend on levels of obesity and other risk factors for CVD and NIDDM. This issue is currently under investigation.

The sex-specific waist circumferences given in Table 2.2 denote enhanced relative risk for a random sample from the Netherlands of 2183 men and 2698 women aged 20–59 years (*23*).

2.5 Additional tools for the assessment of obesity

In addition to the anthropometric assessment methods previously outlined, there are various other tools that are useful for measuring body fat in certain clinical situations and in obesity research. These tools are particularly useful when trying to identify the genetic and environmental determinants of obesity and their interactions, as they enable the variable and complex nature of obesity to be split up into separate components. Thus, obese individuals can be characterized by measuring body composition, anatomical distribution of fat, energy intake, and insulin resistance, among others.

A list of those characteristics of obesity considered suitable for measuring in genetic studies has recently been agreed (*24*) and is summarized in Table 2.3. Measures in a given category are not necessarily of equal validity.

2.6 Classifying obesity in childhood

To date, there has not been the same level of agreement over the classification of overweight and obesity in children and adolescents as in adults. There has been confusion both in terms of a globally applicable reference population and of the selection of appropriate cut-off points for designating a child as obese.

2.6.1 *Use of growth charts*

Many countries have produced reference charts for growth based on weight-for-age and height-for-age. However, these measures are a reflection only of the child's size (height and girth) and provide no indication of relative fatness. The close correlation between height

Table 2.3
Currently recommended characteristics for measurement in genetic studies

Characteristic of obesity measured	Examples of measurement tools
Body composition	BMI; waist circumference; underwater weighing; dual-energy X-ray absorptiometry (DEXA); isotope dilution; bioelectrical impedance; skinfold thickness
Anatomical distribution of fat	Waist circumference; WHR; computer tomography; ultrasound; magnetic resonance imaging
Partitioning of nutrient storage	[^{13}C] palmitic acid; extended overfeeding challenge
Energy intake	"Total" by prospective dietary record or recall; "macronutrient composition" by prospective dietary record or recall or by dietary questionnaire
Energy expenditure	"Total" by double-labelled water; "resting" by indirect calorimetry; physical activity level (PAL) by questionnaire, motion detector, heart-rate monitor, etc.

and weight during childhood means that an index of weight adjusted for height can provide a simple measure of fatness.

2.6.2 *International childhood reference population*

The most widely used growth reference, which WHO has recommended for international use since the late 1970s (*25, 26*), was developed by the US National Center for Health Statistics (NCHS). However, a WHO Expert Committee (*2*) has drawn attention to a number of serious technical and biological problems with this growth reference. WHO is therefore currently undertaking the development of a new growth reference for infants and children from birth to 5 years. This will be based on a sample of infants and children from different parts of the world whose caregivers follow internationally recognized health recommendations. A similar reference will also be required for older children and adolescents.

2.6.3 *BMI-for-age reference curves*

Adult BMI increases very slowly with age, so age-independent cut-off points can be used to grade fatness. In children, however, BMI changes substantially with age, rising steeply in infancy, falling during the preschool years, and then rising again during adolescence and early adulthood. For this reason, child BMI needs to be assessed using age-related reference curves.

Such curves have been produced for a number of countries (*6, 27–29*). However, many are imperfect either because the data are old or because the age range is restricted. More recent BMI-for-age charts have been developed for British, Italian and Swedish children (*30–32*) using the least mean square (LMS) method of Cole (*33*), which adjusts BMI distribution for skewness and allows BMI in individual subjects to be expressed as an exact centile or standard deviation score. The use of BMI-for-age is currently being explored, in parallel with other potential techniques, by an expert working group in order to determine the best method of classifying overweight and obesity in childhood. A common standard should allow the comparative evaluation of childhood obesity internationally.

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3. Global prevalence and secular trends in obesity

3.1 Introduction

Evidence is now emerging to suggest that the prevalence of overweight and obesity is increasing worldwide at an alarming rate. Both developed and developing countries are affected. Moreover, as the problem appears to be increasing rapidly in children as well as in adults, the true health consequences may only become fully apparent in the future.

The value of estimating the prevalence of, and secular trends in, overweight and obesity cannot be overemphasized. Knowledge of the level and changing distribution of overweight and obesity can be used to:

— identify populations at particular risk of obesity and its associated health and economic consequences;
— help policy-makers and public health planners in the mobilization and reallocation of resources for the control of disease;
— provide baseline data for monitoring the effectiveness of national programmes for the control of obesity.

This section provides a global overview of secular trends in obesity among adults. It begins with a note of caution on comparisons between different studies, and then outlines the results of the comprehensive WHO MONICA (MONItoring of trends and determinants in CArdiovascular diseases) study. The bulk of the section, however, is a review of secular trends over the past 10–20 years and the most recent prevalence data available within each of the six WHO regions — Africa, the Americas, South-East Asia, Europe, the Eastern Mediterranean and the Western Pacific.

Despite the limited availability of nationally representative data (particularly secular trend data), the following conclusions can be drawn:

- Obesity prevalence is increasing worldwide at an alarming rate in both developed and developing countries.
- In many developing countries, obesity coexists with undernutrition (BMI <18.5). It is still relatively uncommon in African and Asian countries, but is more prevalent in urban than in rural populations. In economically advanced regions, prevalence rates may be as high as in industrialized countries.
- Women generally have higher rates of obesity than men, although men may have higher rates of overweight.
- The current lack of consistency and agreement between different studies in the classification of obesity in children and adolescents

makes it difficult to give an overview of the global prevalence of obesity in younger age groups. Nevertheless, irrespective of the classification system used, studies of obesity during childhood and adolescence have generally reported that its prevalence has increased.

3.2 A note of caution

Several factors can make comparisons of data between different cross-sectional studies problematic, namely:

- *Classification of obesity*: in a number of studies, the recommended WHO international classification of obesity, i.e. BMI ≥30, has not been used.
- *Age group*: the age group chosen affects the proportion of obese individuals identified.
- *Age standardization*: in many studies, the age structure of the population has not been standardized according to a reference such as the new standard world population data (*1*).
- *Time period/year of data collection*: there is a need for the continuous monitoring of programmes so that current data are always available.
- *Measured versus self-reported weight and height*: self-reported weight and height are notoriously unreliable, especially in the obese.

Many studies have been excluded from this review because of problems caused by the factors listed above, or because they were conducted several years ago without any follow-up and are therefore of limited value. The prevalence data cited in this section are those most recently available and illustrate the global nature of the prevalence of obesity; they have generally been derived from representative national surveys. However, due to the limited availability of longitudinal data, secular trends have often been illustrated with data from representative samples.

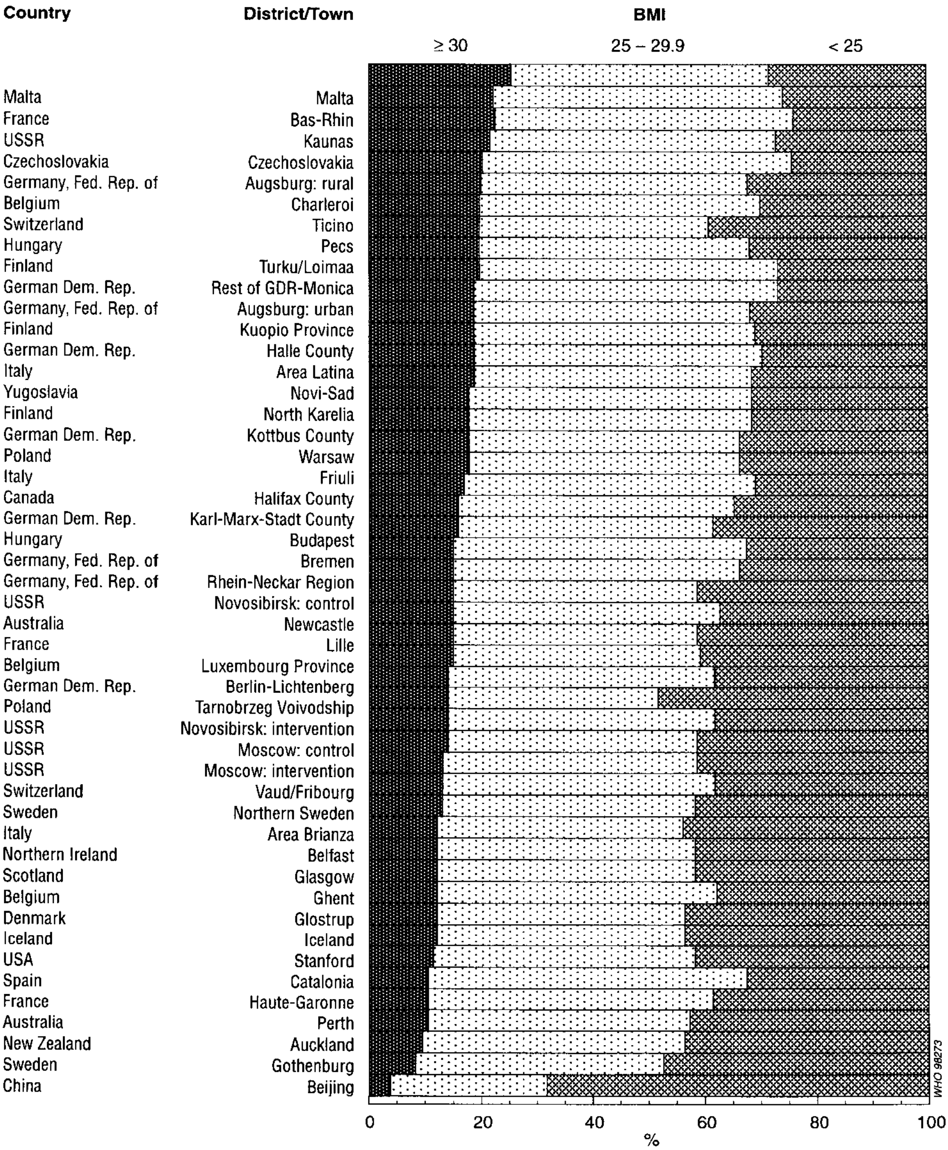
In all the tables in this section, obesity is classified as BMI ≥ 30 unless otherwise stated.

3.3 The WHO MONICA project

The most comprehensive data on the prevalence of obesity worldwide are those of the WHO MONICA project (*2*). Although the populations are not necessarily representative of the countries in which they are located, the 48 populations shown in Figs 3.1 and 3.2 can be

Figure 3.1

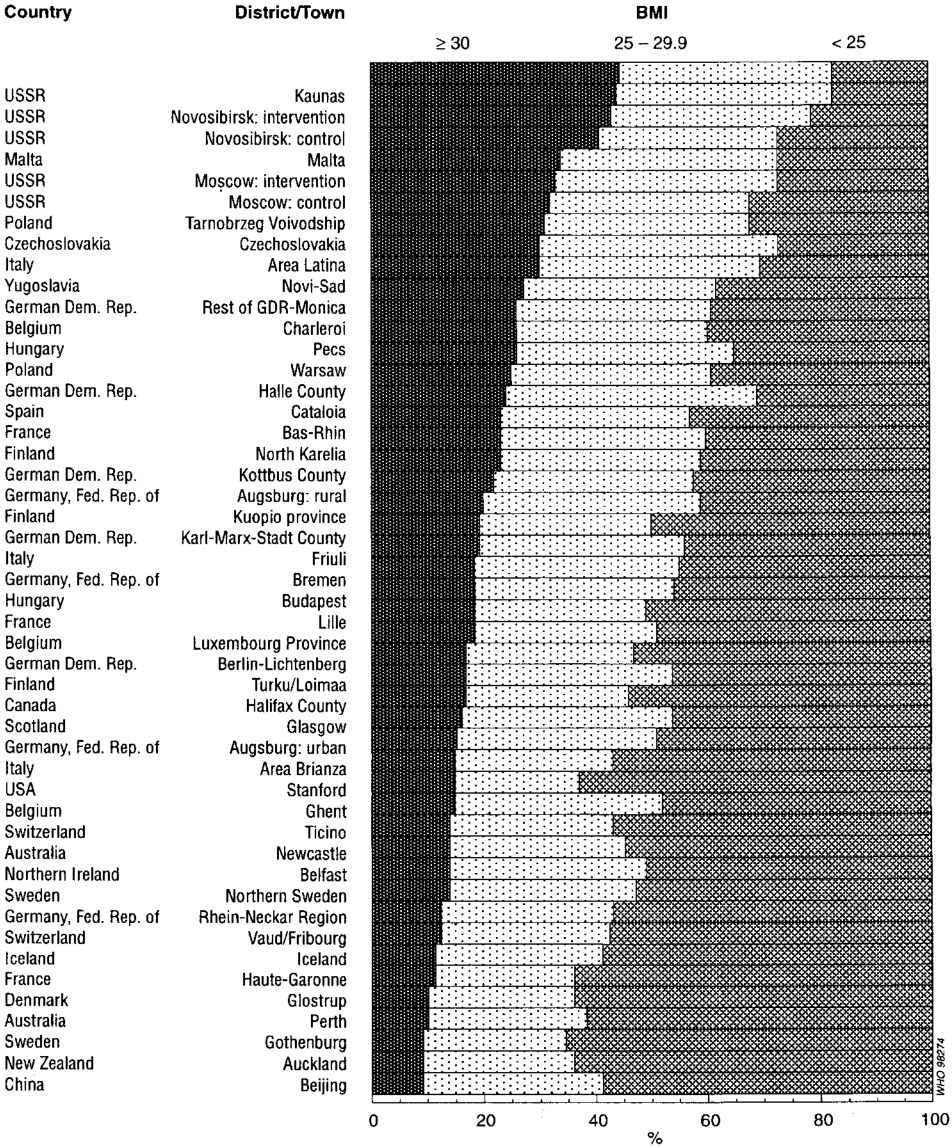
BMI distribution: age-standardized proportions of selected categories in MONICA populations, age group 35–64 years (men)



Note 1. The proportions of men classified as obese, overweight and normal weight in 48 populations (mainly European) taking part in the WHO MONICA study are shown. Although these populations are not necessarily representative of the countries in which they are located, they can be compared because the data were collected in the same time period, are age-standardized, and are based on heights and weights measured in accordance with identical protocols. The WHO MONICA study has generated one of the most comprehensive data sets on the prevalence of obesity worldwide. The data were collected over the period 1983–1986 (*3*).

Note 2. Names of countries are those that were valid at the time of data collection.

Figure 3.2
BMI distribution: age-standardized proportions of selected categories in MONICA populations, age group 35–64 years (women)



Note 1. The proportions of women classified as obese, overweight and normal weight in 48 populations (mainly European) taking part in the WHO MONICA study are shown. Although these populations are not necessarily representative of the countries in which they are located, they can be compared because the data were collected in the same time period, are age-standardized, and are based on heights and weights measured in accordance with identical protocols. The WHO MONICA study has generated one of the most comprehensive data sets on the prevalence of obesity worldwide. The data were collected over the period 1983–1986 (*3*).

Note 2. Names of countries are those that were valid at the time of data collection.

compared because the data were collected in the same time period, are age-standardized, and are based on weights and heights measured in accordance with identical protocols. The data presented were collected in the first round between 1983 and 1986, and more recent data have been published since the time of the WHO Consultation.[1] The majority of the data are for European populations.

Figs 3.1 and 3.2 show the BMI distributions in 48 MONICA populations for men and women, respectively (*3*). Although this report focuses on data relating to obesity, i.e. BMI ≥30, it is important to note that a BMI between 25 and 29.9 is responsible for the major part of the impact of overweight on certain obesity comorbidities; it has been estimated, for example, that about 64% of male and 77% of female cases of NIDDM would theoretically be prevented if no one had a BMI ≥25. These figures may be compared with those for a BMI cut-off point of less than 30, namely 44% and 33%, respectively (*4*, *5*).

Figs 3.1 and 3.2 show that, in all but one male population, and in the majority of female populations, between 50% and 75% of adults aged 35–64 years were either overweight or obese during the period 1983–1986. In a few populations, this figure was over 75%. Thus, between 1983 and 1986, the majority of adults in these populations were at increased risk of illness due to overweight or obesity. Based on the evidence that the prevalence of obesity is increasing worldwide, the situation is now likely to be even worse.

3.4 African Region

3.4.1 *Secular trends in obesity*

Many countries in the African Region have necessarily focused principally on undernutrition and food security. As a result, trends in obesity have been documented in only a few African countries or populations. However, one recent study in Mauritius has shown the same trend as that seen in the other five WHO regions — a dramatic increase in obesity prevalence over a five-year period in both men and women aged 25–74 years. The proportion of obese men increased from 3.4% in 1987 to 5.3% in 1992, while the proportion of obese women increased from 10.4% to 15.2% in the same period. This increase was seen in all age groups and ethnic groups (*6*, *7*). Although

[1] Tunstall-Pedoe H et al. Contribution of trends in survival and coronary-event rates to changes in coronary heart disease mortality: 10 year results from 37 WHO MONICA Project populations. *Lancet*, 1999, **353**:1547–1557.

Table 3.1
Obesity prevalence (BMI ≥ 30) in some African countries and populations

<table>
<tr><th rowspan="2">Country or population</th><th rowspan="2">Year</th><th rowspan="2">Age (years)</th><th colspan="2">Prevalence of obesity (%)</th><th rowspan="2">Reference</th></tr>
<tr><th>Men</th><th>Women</th></tr>
<tr><td>Ghana</td><td>1987–1988</td><td>20+</td><td colspan="2">0.9</td><td>8</td></tr>
<tr><td>Mali</td><td>1991</td><td>20+</td><td colspan="2">0.8</td><td>8</td></tr>
<tr><td>Mauritius</td><td>1992</td><td>25–74</td><td>5</td><td>15</td><td>7</td></tr>
<tr><td>Rodrigues (creoles)</td><td>1992</td><td>25–69</td><td>10</td><td>31</td><td>9</td></tr>
<tr><td>South Africa, Cape Peninsula (blacks)</td><td>1990</td><td>15–64</td><td>8</td><td>44</td><td>10</td></tr>
<tr><td>United Republic of Tanzania</td><td>1986–1989</td><td>35–64</td><td>0.6</td><td>3.6</td><td>11</td></tr>
</table>

it could be argued that Mauritius is not typical of other countries in the African Region, this study highlights both the adverse effects of lifestyle change in rapidly modernizing populations and how quickly obesity can become a public health problem.

3.4.2 *Current prevalence of obesity*

From the fragmentary and limited prevalence data available, it is evident that obesity does exist in the developing as well as in the more developed countries in the African Region, particularly among women. Table 3.1 shows data from a number of studies carried out in African countries.

In developing countries, rural adults still maintaining a traditional lifestyle gained little or no weight with age until relatively recently. This was formerly the case in Africa, and still is today in the few remaining hunter–gatherer populations, such as the San people, in northern Botswana (*12*). However, with the improvement in socio-economic status and increasing changes due to rapid urbanization, the prevalence of obesity among some groups of black women has risen markedly to levels exceeding those in populations in industrialized countries (*13*). In fact, approximately 44% of African women living in the Cape Peninsula were estimated to be obese in 1990 (*10*).

3.5 Region of the Americas

3.5.1 *Secular trends in obesity*

Secular trend data are available for Brazil, Canada and the USA, and are summarized in Table 3.2. These data indicate that obesity rates for both men and women are increasing not only in developed countries, but also in developing countries and in countries such as Brazil going through rapid socioeconomic transition.

Table 3.2
Trends in obesity (BMI ≥ 30) in selected countries in the Americas

Country	Year	Age (years)	Prevalence of obesity (%)		Reference
			Men	Women	
Brazil	1975	25–64	3.1	8.2	*15*
	1989	25–64	5.9	13.3	*15*
Canada	1978	20–70	6.8	9.6	*16*
	1981	20–70	8.5	9.3	*17*
	1988	20–70	9.0	9.2	*18*
	1986–1990	18–74	15.0	15.0	*19*
United States of America	1960–1962	20–74	10.4	15.1	*14*
	1971–1974	20–74	11.8	16.1	*14*
	1976–1980	20–74	12.3	16.5	*14*
	1988–1994	20–74	19.9	24.9	*14*

The most comprehensive data on national trends in the prevalence of obesity in a developed country in the Region are those for the USA. These are based on comparisons of data from NHES I (1960–1962), NHANES I (1971–1974), NHANES II (1976–1980), and NHANES III (1988–1994) (*14*). The figures for the USA presented in Table 3.2 are particularly valuable as they have been recalculated from those of the above-mentioned NHES and NHANES surveys for the WHO classification of obesity, i.e. BMI ≥ 30. These suggest that obesity is an escalating problem in the USA; there was a slight increase in the overall estimated prevalence of obesity during the period covered by the first three surveys, but a much larger increase between the third and the fourth surveys.

Data from Brazil provide the most valuable information on obesity prevalence and trends in a country in transition in the Region; two comparable, nationally representative, random nutrition surveys made 15 years apart make possible a detailed investigation of changing patterns of the nutritional status of children and adults, men and women, rich and poor. These surveys, which were undertaken by the Brazilian agency in charge of national statistics in 1974–1975 (the National Study of Family Expenditure (ENDEF) survey) and in 1989 (the National Survey on Health and Nutrition (PNSN)), show that adult obesity has increased in all groups of men and women. However, a greater increase has been observed among lower-income families. The problem of dietary deficit in Brazil is rapidly being replaced by one of dietary excess (*15*).

3.5.2 *Current prevalence of obesity*

The most recent data for the prevalence of obesity in the USA are those from NHANES III (1988–1994). A recent reanalysis of the data

Table 3.3
Obesity prevalence (BMI ≥ 30) in selected countries in the Americas

Country	Year	Age (years)	Prevalence of obesity (%)		Reference
			Men	Women	
Brazil	1989	25–64	6	13	*15*
Canada	1986–1990	18–74	15.0	15.0	*19*
USA	1988–1994	20–74	19.9	24.9	*14*

using BMI ≥30 to classify obesity is particularly valuable for use in global comparisons, and showed that around 20% of all men and 25% of all women in the USA are obese. Table 3.3 shows that, in the early 1990s, obesity was more widespread in the USA than in Canada. Detailed subgroup analysis of the data shows that black women and other minority populations in the USA tend to have particularly high rates of obesity.

The only Latin American country to have conducted a nationally representative survey in the last 10 years is Brazil. The PNSN survey indicated that obesity is prevalent in Brazil, affecting about 6% of men and 13% of women in 1989 (*15*).

Evidence from the Caribbean, specifically Barbados, Cuba, Jamaica and Saint Lucia, indicates that obesity is a significant problem in this region. It is more common in those countries with a higher per capita GNP, affects women more than men, and is associated with a parallel increase in the prevalence of hypertension and NIDDM (*20*). However, as an unusual classification system (obese males: BMI ≥31.1; obese females: BMI ≥32.3) is used, the study is not cited in Table 3.3.

3.6 South-East Asia Region

3.6.1 *Secular trends in obesity*

Good-quality, nationally representative, secular trend data for countries in the South-East Asia Region were unavailable. However, data from two studies conducted by the same research centre in Thailand do suggest that diet-related chronic diseases, including obesity, are increasing in affluent urban populations. The first study was conducted in 1985 among 35–54-year-old Thai officials; it was found that 2.2% of the 2703 men, and 3.0% of the 792 women, had a BMI ≥30 (*21*). The second study in 1991 was smaller (66 men and 453 women), and had a broader age range (19–61 years), but also assessed nutritional factors in affluent urban Thais. Results of this study showed that 3.0% of men and 3.8% of women had a BMI ≥30. Prevalence figures for BMI 25–29.9 were considerably higher (15.2% in men and 23.2% in women) (*22*).

3.6.2 *Current prevalence of obesity*

Only limited obesity prevalence data are available for countries in the Region. Various studies on nutritional status have been carried out, particularly in India, but these have generally been on undernutrition and on selected population groups and have not used the WHO classification of obesity. As many countries in south-east Asia are currently going through the so-called "nutrition transition",[1] there is a special need to collect good-quality, nationally representative obesity prevalence data. The nutrition transition is associated with a change in the structure of the diet, reduced physical activity and rapid increases in the prevalence of obesity (*23*).

3.7 European Region

3.7.1 *Secular trends in obesity*

Although the most comprehensive data on the prevalence of obesity in Europe are those of the WHO MONICA study (*2*), the 42 populations in 38 centres chosen across Europe are not necessarily representative of their host countries, and only data from the first cycle have so far been published.[2] The best picture of secular trends in obesity prevalence in European countries should therefore be provided by data from national surveys. Population-level trend data on obesity prevalence in Europe are available for several countries, including England, Finland, Germany, the Netherlands and Sweden. Some of these data are summarized in Table 3.4, from which it can be seen that the prevalence of obesity has increased by about 10–40% in the majority of European countries in the past 10 years. The most dramatic increase has been observed in England, where it has more than doubled during this period (*24*). There is some evidence, however, that there has been less of an increase among women in recent years, at least in some Scandinavian countries (*25*).

3.7.2 *Current prevalence of obesity*

Obesity is relatively common in Europe, especially among women and in southern and eastern European countries. The average preva-

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[1] The rapid transition, or shift, from the problem of dietary deficit (or undernutrition) to one of dietary excess (or overnutrition and/or unbalanced nutrition).

[2] Updated material has been published since the Consultation: Tunstall-Pedoe H et al. Contribution of trends in survival and coronary-event rates to changes in coronary heart disease mortality: 10-year results from 37 WHO MONICA project populations. *Lancet*, 1999, **353**:1547–1557.

Table 3.4
Trends in obesity (BMI ≥ 30) in selected European countries

Country	Year	Age (years)	Prevalence of obesity (%)		Reference
			Men	Women	
England	1980	16–64	6.0	8.0	*26*
	1986–1987		7	12	
	1991		12.7	15.0	
	1994		13.2	16.0	*27*
	1995		15.0	16.5	*24*
Finland	1978–1979	20–75	10	10	*28*
	1985–1987		12	10	
	1991–1993		14	11	
Former German Democratic Republic	1985	25–65	13.7	22.2	L. Heinman, personal communication, 1996
	1989		13.4	20.6	
	1992		20.5	26.8	
Netherlands	1987	20–29	6.0	8.5	*29*
	1988		6.3	7.6	
	1989		6.2	7.4	
	1990		7.4	9.0	
	1991		7.5	8.8	
	1992		7.5	9.3	
	1993		7.1	9.1	
	1994		8.8	9.4	
	1995		8.4	8.3	
Sweden	1980–1981	16–84	4.9	8.7[a]	*30*
	1988–1989		5.3	9.1[a]	

[a] Obesity is defined as BMI >28.6.

lence of obesity in European centres participating in the WHO MONICA study between 1983 and 1986 was about 15% in men and 22% in women, although there was great variability both within and between countries. The lowest prevalence was found in Gothenburg, Sweden (men 7%, women 9%) and the highest in Kaunas, USSR (now Lithuania) (men 22%, women 45%).

The most recent data from individual national studies suggest that the prevalence of obesity in European countries is currently in the range 10–20% in men and 10–25% in women (Table 3.5). In agreement with the MONICA data, the prevalence of obesity is generally higher in women than in men.

3.8 Eastern Mediterranean Region

3.8.1 *Secular trends in obesity*

Good-quality, nationally representative, secular trend data for countries in the Eastern Mediterranean Region are not available.

Table 3.5
Obesity prevalence (BMI ≥ 30) in selected European countries

Country	Year	Age (years)	Prevalence of obesity (%)		Reference
			Men	Women	
Former Czechoslovakia	1988	20–65	16	20	V. Hainer, personal communication, 1997; *31*
England	1995	16–64	15	16.5	*24*
Finland	1991–1993	20–75	14	11	*28*
Former Federal Republic of Germany	1990	25–69	17	19	*32*
Former German Democratic Republic	1992	25–69	21	27	L. Heinman, personal communication, 1996
Netherlands	1995	20–59	8	8	*29*

3.8.2 *Current prevalence of obesity*

Data on the prevalence of adult obesity in the Eastern Mediterranean Region have not been well documented at the national level except in Saudi Arabia. Various surveys have been conducted but these have tended to be only for specific population groups within a country, such as women attending an infertility clinic, and/or have not classified obesity as BMI ≥30. Nevertheless, the limited data available, some of which are shown in Table 3.6, indicate that the prevalence of adult obesity in countries in the Region is high, and that women in particular are affected. In general, the prevalence of obesity among women is higher than that reported for women in most industrialized countries.

A nationally representative, cross-sectional survey was conducted between 1990 and 1993 to study the effects of sex, age and regional distribution on the prevalence of overweight and obesity among 13177 randomly selected adult Saudi subjects. The prevalence of obesity among the female subjects was several-fold higher than the reported prevalence in more highly industrialized countries, and was higher than among male subjects for all regions of Saudi Arabia (*33*).

In the United Arab Emirates, obesity is recognized as a major public health problem that may play an important role in the increasing incidence of other chronic diseases. Data from the National Nutrition Survey showed that 38% of married women and 15.8% of married

Table 3.6
Obesity prevalence (BMI ≥ 30) in selected Eastern Mediterranean countries

Country	Year	Age (years)	Prevalence of obesity (%)		Reference
			Men	Women	
Bahrain:	1991–1992	20–65			*35*
Urban			9.5	30.3	
Rural			6.5	11.2	
Cyprus	1989–1990	35–64	19	24	*13*
Iran, Islamic Republic of (south)	1993–1994	20–74	2.5	7.7	*36*
Kuwait	1994	18+	32	41	*37*
Saudi Arabia:	1990–1993	15+			*33*
Total			16	24	
Urban			18	28	
Rural			12	18	
United Arab Emirates	1992	17+	16	38	*34*

men were obese (*34*). In Bahrain, obesity was more common in urban than in rural areas, especially in women (*35*).

Finally, a recent study in the south of the Islamic Republic of Iran revealed that obesity is prevalent in the adult population, and is more frequent among women than men (*36*).

3.9 Western Pacific Region

3.9.1 *Secular trends in obesity*

Trend data on the prevalence of overweight and obesity in countries in the Western Pacific Region are available for Australia, China, Japan and Samoa. These are summarized in Table 3.7 and show an increasing prevalence of obesity among Australians and Samoans. The Australian data are from three National Heart Foundation studies conducted in the six state capitals in 1980 and 1983, with two extra cities added in 1989 (*38*). Rural residents were not included.

Detailed analysis of data from the National Nutrition Survey in Japan conducted by the Japanese Ministry of Health and Welfare ($n = 5000$ per year) has shown that there has been a secular increase in obesity in both men and women during the period 1976–1993. Obesity among men increased by a factor of about 2.4; in women, in the 20–29-year age group, obesity increased by a factor of about 1.8 (S. Inoue, personal communication).

Table 3.7
Trends in obesity (BMI ≥ 30) in selected Western Pacific countries

Country	BMI cut-off	Year	Age (years)	Prevalence of obesity (%)		Reference
				Men	Women	
Australia		1980	25–64	9.3	8.0	*38*
		1983		9.1	10.5	
		1989		11.5	13.2	
China	27	1989	20–45	1.7	4.3	*39*
		1991		2.9	4.3	
	30	1989	20–45	0.29	0.89	C. Chunming, personal communication
		1991		0.36	0.86	
Japan	26.4	1976	20+	7.1	12.3	S. Inoue, personal communication
		1982		8.4	12.3	
		1987		10.3	12.6	
		1993		11.8	13.0	
	30	1976	20+	0.7	2.8	S. Inoue, personal communication
		1982		0.9	2.6	
		1987		1.3	2.8	
		1993		1.8	2.6	
Samoa: Urban	30	1978	25–69	38.8	59.1	*40*
		1991		58.4	76.8	
Rural	30	1978	25–69	17.7	37.0	*40*
		1991		41.5	59.2	

Data for 1989 and 1991 from the China Health and Nutrition Survey (CHNS) show an increase in the proportion of adult men, but not women, who are severely overweight (BMI ≥ 27) and obese (BMI ≥ 30) (*39*). This longitudinal survey, which is now under way, is considered to be representative of all provinces in China. As the plan is for surveys to be conducted every two years, the CHNS should prove a valuable source of data for documenting the secular trends in obesity in a country in economic transition. Data from the 1993 survey have been published since the time of the WHO Consultation.[1]

Secular trends have also been observed in Samoa, where there has been a marked increase in the prevalence of obesity between 1978

[1] Wang Y, Popkin B, Zhai F. The nutritional status and dietary pattern of Chinese adolescents, 1991 and 1993. *European Journal of Clinical Nutrition*, 1998, **52**(12):908–916.
Guo X et al. Food price policy can favorably alter macronutrient intake in China. *Journal of Nutrition*, 1999, **129**:994–1001.

and 1991, especially among men living in rural areas. Obesity is not new to Pacific populations and has long been regarded as attractive and a symbol of high social status and prosperity (*40*). However, there is evidence that these traditional notions are being replaced by an image of small body size (*41*).

3.9.2 *Current prevalence of obesity*

Table 3.8 shows the most recent estimates of obesity rates in a number of countries in the Western Pacific. The prevalence of obesity in the general population of both Australia and New Zealand appears to be in the range 10–15%. Studies of Aborigines living in different regions of Australia are not consistent with this finding; depending on the degree of "westernization" of Aboriginal communities, they have either a much higher or a substantially lower prevalence of obesity than the general Australian population (*42*).

Interim data from the Japanese National Nutrition Survey show that the prevalence of obesity in Japan is around 2% in males and 3% in females. When a BMI cut-off point of 26.4 is used (≥120% of standard body weight (SBW)), the figures are around 12% and 13%, respectively. Various studies have also been conducted on specific population groups and centres within Japan (S. Inoue, personal communication).

The current prevalence of obesity in China is probably best documented by the 1992 third Nationwide Nutritional Survey (NNS III). This survey was conducted throughout both urban and rural provinces, and data were collected from a larger representative sample of men (n = 14964) and women (n = 14590) aged 20–45 years than the CHNS cohort (n = 5000 approximately). Data from NNS III show that obesity does exist in China, albeit at a low prevalence, is more common in women than in men (Table 3.8), and is more prevalent in urban than in rural areas. These findings are supported by a study in 11478 randomly selected Chinese adults aged 40 years and older, although slightly higher rates were reported than in the younger age group studied in NNS III (C. Chunming, personal communication). A number of other data sets are available but the WHO classification of obesity is rarely used in them, they are not age-standardized and tend not to be nationally representative.

The most striking feature of Table 3.8 is the extremely high age-standardized prevalence of obesity observed in the Pacific island populations of Melanesia, Micronesia and Polynesia. In urban Samoa, for example, the prevalence of obesity has been estimated to be over 75% in adult women and almost 60% in adult men. However,

Table 3.8
Obesity prevalence (BMI ≥ 30) in selected Western Pacific countries

Country	Year	Age (years)	Prevalence of obesity (%)		Reference
			Men	Women	
Australia	1989	25–64	11.5	13.2	*38*
China	1992	20–45	1.20	1.64	C. Chunming, personal communication
Japan	1993	20+	1.7	2.7	S. Inoue, personal communication
Nauru (Micronesia)	1987	25–69	64.8	70.3	*40*
New Zealand	1989	18–64	10	13	*43*
Papua New Guinea (Melanesia):	1991	25–69			*40*
Coastal urban			36.3	54.3	
Coastal rural			23.9	18.6	
Highlands			4.7	5.3	
Samoa (Polynesia):	1991	25–69			*40*
Urban			58.4	76.8	
Rural			41.5	59.2	

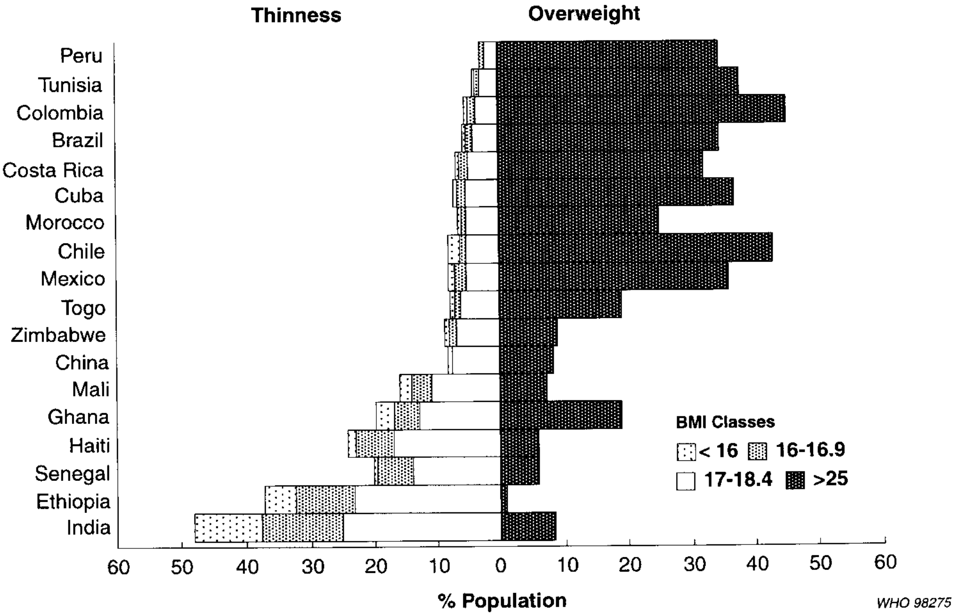
Swinburn et al. (*44*) recently concluded that Polynesians seem leaner than Caucasians at any given body size, so that the prevalence of obesity in Polynesian populations may not be quite as high as is currently estimated using Caucasian-derived classifications based on BMI. The prevalence in rural populations is also extremely high, but lower than in urban areas.

Among adults aged 18–60 years in Malaysia, 4.7% of men and 7.9% of women were found to have a BMI above 30. In the women, overweight and obesity problems were more serious in the Indian population; 17.1% of Indian women had a BMI over 30 compared to 8.8% of Malay and 4.3% of Chinese women. Among the Malay population, a considerably higher proportion of both men and women had a BMI over 30 (men: 5.6% urban, 1.8% rural; women: 8.8% urban, 2.6% rural), whereas the reverse was true for undernutrition; prevalence rates of undernutrition for men and women were 7% and 11% in urban areas and 11% and 14% in rural areas, respectively. Overall, overweight (BMI ≥25) was more prevalent than undernutrition in both urban and rural settings (*45*).

3.10 Body mass index distribution in adult populations

BMI distribution varies significantly according to the stage of development reached in a transitional society. As the proportion of the

Figure 3.3
BMI distribution of various adult populations worldwide (both sexes)[a]



There is a tendency for an almost symmetrical increase in the proportion of a population with high BMI as the proportion of the population with low BMI decreases.

[a] Source: reference *11*.

population with a low BMI decreases, there is an almost symmetrical increase in the proportion with a BMI above 25 (Fig. 3.3). This indicates a tendency for a population-wide shift to take place as socio-economic conditions improve, with overweight replacing thinness.

In the first stages of the transition, the wealthier sections of society show an increase in the proportion of people with a high BMI, whereas thinness remains the main concern among the less wealthy. Thus, in countries in the early stage of transition, overweight can coexist with underweight, so that the burden of disease may be doubled.

The distribution of BMI tends to change again in the later phases of the transition, with an increase in the prevalence of high BMI among the poor.

3.11 Obesity during childhood and adolescence

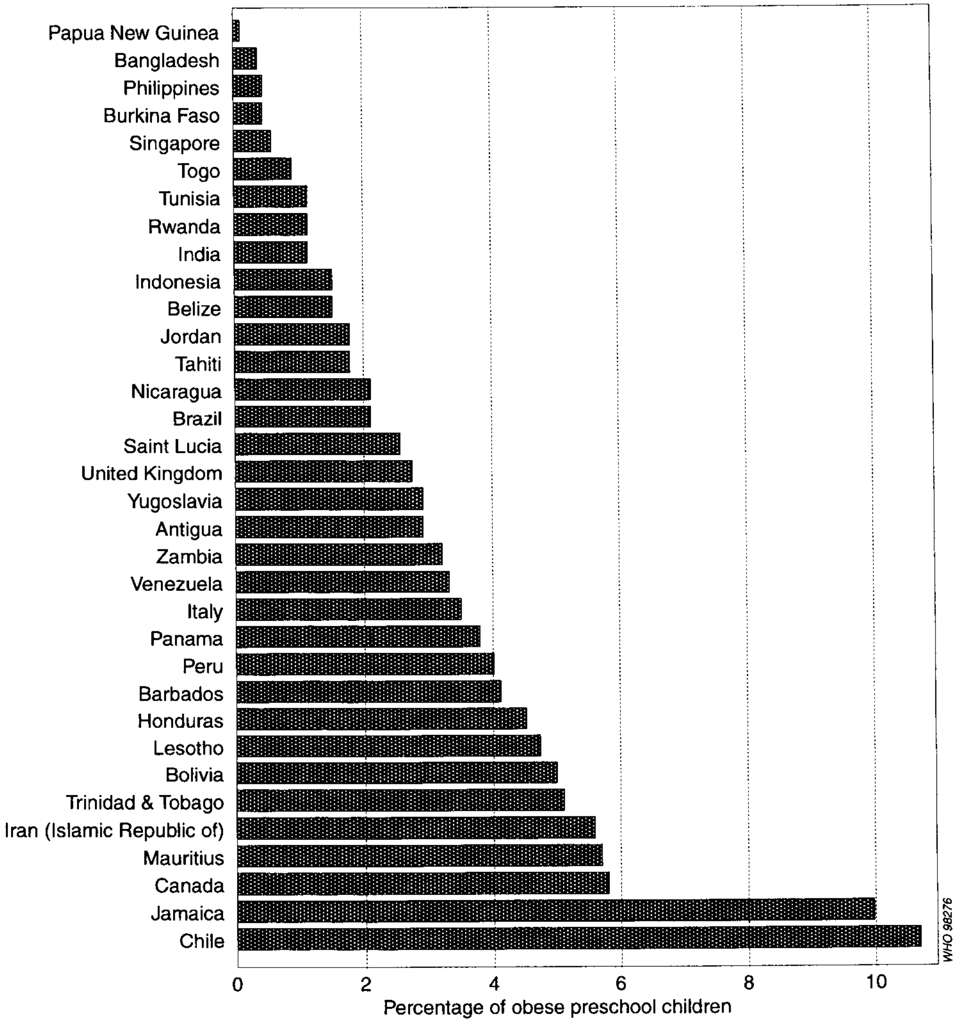
The lack of consistency and agreement between different studies in the classification of obesity in children and adolescents (see section 2) means that it is not yet possible to give an overview of the global prevalence of obesity in these younger age groups. Nevertheless, whatever method is used to classify obesity, studies of this disease during childhood and adolescence have generally reported both a high prevalence and rates that are increasing. In the USA, for example, the prevalence of overweight (defined by the 85th percentile of weight-for-height) among 5–24-year-olds from a biracial community of Louisiana (total $n = 11\,564$) increased approximately twofold between 1973 and 1994. Furthermore, the yearly increases in relative weight and obesity during the latter part of the study period (1983–1994) were approximately 50% greater than those between 1973 and 1982 (*46*). A similar trend has been observed in Japan; the frequency of obese schoolchildren (>120% SBW) aged 6–14 years increased from 5% to 10%, and that of extremely obese (>140% SBW) children from 1% to 2% during the 20 years between 1974 and 1993. The increase was most prominent in male students aged 9–11 years. Early obesity leads to an increased likelihood of obesity in later life, as well as to an increased prevalence of obesity-related disorders. In the Japanese study, approximately one-third of obese children grew into obese adults (*47*).

Childhood obesity is not confined to the industrialized countries, as high rates are already evident in some developing countries. The prevalence of obesity among schoolchildren aged 6–12 years in Thailand, as diagnosed by weight-for-height exceeding 120% of the Bangkok reference, rose from 12.2% in 1991 to 15.6% in 1993 (*48*), and in a recent study of 6–18-year-old male schoolchildren in Saudi Arabia, the prevalence of obesity was found to be 15.8% (*49*).

The only integrated data currently available that give an overview of the global prevalence of obesity during childhood are those compiled by the WHO Programme of Nutrition (*50, 51*). In the WHO analysis, children were classified as obese when they exceeded the NCHS median weight-for-height plus two standard deviations or Z-scores.[1] The reported prevalence of obese children for the age group 0–4.99 years is shown in Fig. 3.4. It should be noted, however, that some children classified as obese under this system may actually have a higher relative weight due to stunting rather than as a result of excess adiposity. This is of particular significance in developing countries

[1] The Z-score is the deviation of an individual's value from the median value of a reference population divided by the standard deviation of the reference population.

Figure 3.4
Prevalence of obese preschool children (0–59 months) in selected countries and territories[a]



Obesity is defined as more than two standard deviations above the reference median weight-for-height (NCHS reference population).

[a] Source: reference *52*.

undergoing the nutrition transition, where a higher risk of obesity in stunted children has been described (*53*).

There is an urgent need to evaluate existing and future data sources concerning children and adolescents from across the world based on a standardized obesity classification system.

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