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Why another book on obesity? Recently we have
seen several similar books of which some are very
comprehensive. The finalizing of this book has been
delayed. It was originally meant to be presented at
the Paris Congress as another armament in the
current worldwide fight against obesity. This first
planned book was rather limited in contents, but it
was eventually decided to cover additional fields,
and here is the result.

The field of modern obesity research is fairly
young and has expanded considerably with time.
The 'pioneers' who began this research are still to a
large extent active, and several have contributed to
this book with reviews in their respective sub-
speciality of obesity research. One ambition with
the present book was to invite several younger re-
searchers to write chapters. In this way new angles
of the problem have been presented. Rethinking
and research should go hand in hand.

Although things appear to improve, I have the
impression that at least in certain countries obesity
is still not considered with sufficient seriousness.
The economic arguments seem to have made some
politicians and decision makers raise their eye-
brows. The involvement of central, international
organizations in making recommendations should
have an effect. National problems of obesity are
now also the subject of surveys in several countries
and counteractions are planned.

A major problem is, however, that we still have
difficulties impressing ourselves on adjacent areas
of research. To take one example, during a recent
major congress on diabetes mellitus I asked a hand-
ful of leading diabetes researchers the following
questions: Which is the major problem in diabetes
research? Unanimous answer: diabetes mellitus
type 2. Which is the most frequent risk factor or
precursor state to this type of diabetes? Unanimous
answer: obesity. I then suggested that we should
join forces and see what can be done to prevent and
treat obesity more successfully than is possible to-
day. This was met with considerable enthusiasm.

The obesity and diabetes fields are largely over-
lapping. As a matter of fact obesity might be con-
sidered as the first step towards diabetes, where
beta-cell insufficiency is eventually added. I think it
would be extremely useful for both fields to collab-
orate more than is now the case. In a way the
current situation is reminiscent of the clinical sub-
specialization where various organs are treated by
different specialists, who have difficulties in seeing
the world outside the fence, and thereby miss im-
portant information that might benefit the patient.

What we could do, as an initial step, is to reserve
large parts of obesity meetings for diabetes and vice
versa. Several presidents for upcoming congresses
in both obesity and diabetes have, as a response to a
direct question, agreed that this is a good idea, and
we will see if this is only lip-service or if the idea has
been taken seriously.

The concept of the metabolic syndrome, a syn-
drome strongly associated with abdominal obesity,
has been very helpful in facilitating the realization
that we are to a large extent dealing with a common
background to prevalent diseases. The awareness
of this syndrome has had the consequence that the
complex obesity–insulin resistance–dyslipidaemia–
hypertension is often discussed as a cluster in con-
gresses of diabetes, cardiology and hypertension.
The realization of this clustering of symptoms has
also had an impact on clinical activities, and has led
to work-up outside one particular specialty. It is
now more frequent that hypertensologists deter-
mine circulating lipids and that cardiologists exam-
ine insulin resistance, and, most importantly,
register height, weight and body circumferences.
This is clearly a large step forward.

Writing chapters for a book like this is a major task, interfering with the activities of an already busy day. I would like to thank the contributors who have taken on the task of writing chapters for this book, and also Wiley who asked me to organize it. The collaboration with Michael Osuch and Hannah Bradley has been very pleasant.

Per Björntorp

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Part I

Epidemiology
Obesity as a Global Problem

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INTRODUCTION

Obesity is a major public health and economic problem of global significance. Prevalence rates are increasing in all parts of the world, both in affluent Western countries and in poorer nations. Men, women and children are affected. Indeed, overweight, obesity and health problems associated with them are now so common that they are replacing the more traditional public health concerns such as undernutrition and infectious disease as the most significant contributors to global ill health (1). In 1995, the excess adult mortality attributable to overnutrition was estimated to be about 1 million deaths, double the 0.5 million attributable to undernutrition (2).

This chapter looks at obesity as a global problem. It begins with a brief overview of methods of classification, a critical issue for estimating the extent of obesity in populations. The serious impact of excess body weight on individuals and societies throughout the world in terms of associated health, social and economic costs is considered next. The body of the chapter concentrates on current prevalence and trends of adult obesity rates around the world, including projections for the year 2025. Comment is made on key features and patterns of the global epidemic followed by discussion of the major factors that are driving it. An overview of the emerging childhood obesity problem is given next. The chapter concludes with a call for global action to tackle the epidemic.

WHAT IS OBESITY AND HOW IS IT MEASURED?

At the physiological level, obesity can be defined as a condition of abnormal or excessive fat accumulation in adipose tissue to the extent that health may be impaired. However, it is difficult to measure body fat directly and so surrogate measures such as the body mass index (BMI) are commonly used to indicate overweight and obesity in adults. Additional tools are available for identification of individuals with increased health risks due to ‘central’ fat distribution, and for the more detailed characterization of excess fat in special clinical situations and research.

Measuring General Obesity

The BMI provides the most useful and practical population-level indicator of overweight and obesity in adults. It is calculated by dividing body weight in kilograms by height in metres squared (BMI = kg/m²). Both height and weight are routinely collected in clinical and population health surveys.

In the new graded classification system developed by the World Health Organization (WHO), a BMI of 30 kg/m² or above denotes obesity (Table 1.1). There is a high likelihood that individuals with a BMI at or above this level will have excessive body fat. However, the health risks associated with overweight and obesity appear to rise progressively
Table 1.1  Classification of overweight and obesity in adults according to BMI

<table>
<thead>
<tr>
<th>Classification</th>
<th>BMI (kg/m^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>&lt;18.5</td>
</tr>
<tr>
<td>Normal range</td>
<td>18.5–24.9</td>
</tr>
<tr>
<td>Overweight</td>
<td>≥25</td>
</tr>
<tr>
<td>Pre-obese</td>
<td>25.0–29.9</td>
</tr>
<tr>
<td>Obese class I</td>
<td>30.0–34.9</td>
</tr>
<tr>
<td>Obese class II</td>
<td>35–39.9</td>
</tr>
<tr>
<td>Obese class III</td>
<td>≥40</td>
</tr>
</tbody>
</table>

Source: WHO (1).

Table 1.2  Sex-specific waist circumference measurements for identification of individuals at increased health risk due to intra-abdominal fat accumulation

<table>
<thead>
<tr>
<th>Waist circumference (cm)</th>
<th>Risk of metabolic complications</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alerting zone</td>
<td>Increased</td>
<td>94</td>
<td>80</td>
</tr>
<tr>
<td>Action zone</td>
<td>Substantially increased</td>
<td>102</td>
<td>88</td>
</tr>
</tbody>
</table>

Adapted from WHO (1).

with increasing BMI from a value below 25 kg/m^2, and it has been demonstrated that there are benefits to having a measurement nearer 20–22 kg/m^2, at least within industrialized countries. To highlight the health risks that can exist at BMI values below the level of obesity, and to raise awareness of the need to prevent further weight gain beyond this level, the first category of overweight included in the new WHO classification system is termed ‘pre-obese’ (BMI 25–29.9 kg/m^2).

Caution is required when interpreting BMI measurements in certain individuals and ethnic groups. The relationship between BMI and body fat content varies according to body build and body proportion, and a given BMI may not correspond to the same degree of fatness across all populations. Recently, a meta-analysis among different ethnic groups showed that for the same level of body fat, age and gender, American blacks have a 1.3 kg/m^2 higher BMI and Polynesians have a 4.5 kg/m^2 higher BMI compared to Caucasians. By contrast, BMIs in Chinese, Ethiopians, Indonesians and Thais were shown to be 1.9, 4.6, 3.2 and 2.9 kg/m^2 lower than in Caucasians (3). This suggests that population-specific BMI cut-off points for obesity need to be developed.

Measuring Central Obesity

For a comprehensive estimate of weight-related health risk it is also desirable to assess the extent of intra-abdominal or 'central' fat accumulation. This can be done by simple and convenient measures such as the waist circumference or waist-to-hip ratio. Changes in these measures tend to reflect changes in risk factors for cardiovascular disease and other forms of chronic illness. Some experts believe that a health risk classification based on waist circumference alone is more suitable as a health promotion tool than either BMI or waist-to-hip ratio, alone or in combination (4). Recent work from the Netherlands has indicated that a waist circumference greater than 102 cm in men, and greater than 88 cm in women, is associated with a substantially increased risk of obesity-related metabolic complications (Table 1.2). The level of health risk associated with a particular waist circumference or waist-to-hip ratio may vary across populations.

THE HEALTH, SOCIAL AND ECONOMIC COSTS ASSOCIATED WITH OVERWEIGHT AND OBESITY

There is reason to be concerned about overweight and obesity as overwhelming evidence links both to substantial health, social and economic costs.

Overview of the Health Costs

US figures suggest that about 61% of non-insulin-dependent diabetes mellitus (NIDDM) and 17% of both coronary heart disease (CHD) and hypertension can be attributed to obesity. Indeed, as a person’s BMI creeps up through overweight into the obese category and beyond, the risk of developing a number of chronic non-communicable diseases such as NIDDM, CHD, gallbladder disease, and certain types of cancer increases rapidly. There is also a graded increase in relative risk of premature death (Figure 1.1).

Before life-threatening chronic disease develops, however, many overweight and obese patients de-
**Overview of the Economic Costs**

Conservative estimates clearly indicate that obesity represents one of the largest costs in national health care budgets, accounting for up to 6% of total expenditure in several developed countries (Table 1.4). In the USA in 1995, for example, the overall direct costs attributed to obesity (through hospitalizations, outpatients, medications and allied health professionals’ costs) were approximately the same as those of diabetes, 1.25 times greater than those of coronary heart disease, and 2.7 times greater than those of hypertension (5). The costs associated with pre-obesity (BMI 25–30 kg/m²) are also substantial because of the large proportion of individuals involved.

The economic impact of overweight and obesity does not only relate to the direct cost of treatment in the formal health care system. It is also important to consider the cost to the individual in terms of ill health and reduced quality of life (intangible costs), and the cost to the rest of society in terms of lost productivity due to sick leave and premature disability pensions (indirect costs). Overweight and obesity are responsible for a considerable proportion of both. Thus, the cost of lost productivity attributed to obesity in the USA in 1994 was $3.9 billion and reflected 39.2 million days of lost work. In addition, there were 239 million restricted-activity days, 89.5 million bed-days, and 62.6 million physician visits.

Estimates of the economic impact of overweight and obesity in less developed countries are not available. However, the relative costs of treatment if available are likely to exceed those in more affluent countries for a number of reasons. These include the accompanying rise in coronary heart disease and other non-communicable diseases, the need to import expensive technology with scarce foreign exchange, and the need to provide specialist training.

---

**Table 1.3 Relative risk of health problems associated with obesity**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Relative Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIDDM</td>
<td>Highly increased (relative risk much greater than 3)</td>
</tr>
<tr>
<td>Gallbladder disease</td>
<td>Moderately increased (relative risk 2-3)</td>
</tr>
<tr>
<td>Dyslipidaemia</td>
<td>Slightly increased (relative risk 1-2)</td>
</tr>
<tr>
<td>Insulin resistance</td>
<td>Certain cancers</td>
</tr>
<tr>
<td>Breathlessness</td>
<td>Reproductive hormone abnormalities</td>
</tr>
<tr>
<td>Sleep apnoea</td>
<td>Polycystic ovary syndrome</td>
</tr>
<tr>
<td></td>
<td>Impaired fertility</td>
</tr>
<tr>
<td></td>
<td>Low back pain due to obesity</td>
</tr>
<tr>
<td></td>
<td>Increased anaesthetic risk</td>
</tr>
<tr>
<td></td>
<td>Fetal defects arising from maternal obesity</td>
</tr>
</tbody>
</table>

Source: WHO (1).

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Develop at least one of a range of debilitating conditions which can drastically reduce quality of life. These include musculoskeletal disorders, respiratory difficulties, skin problems and infertility, which are often costly in terms of absence from work and use of health resources. Table 1.3 lists the health problems that are most commonly associated with overweight and obesity. In developed countries, excessive body weight is also frequently associated with psychosocial problems.

The risk of developing metabolic complications is exaggerated in people who have central obesity. This is related to a number of structural differences between intra-abdominal and subcutaneous adipose tissues which makes the former more susceptible to both hormonal stimulation and changes in lipid metabolism. People of Asian descent who live in urban societies are particularly susceptible to central obesity and tend to develop NIDDM and CHD at lower levels of overweight than other populations.
for health professionals. As many countries are still struggling with undernutrition and infectious disease, the escalation of obesity and related health problems creates a double economic burden.

### THE GLOBAL OBESITY PROBLEM

The number of people worldwide with a BMI of 30 or above is currently thought to exceed 250 million, i.e. 7% of the world’s adult population (Table 1.5) (4). When individual countries are considered, the range of obesity prevalence covers almost the full spectrum, from below 5% in China, Japan and certain African nations to more than 75% in urban Samoa. It is difficult to calculate an exact global figure because good quality and comparable data are not widely available. The assessment in Table 1.5 is a conservative estimate.

#### Important Issues Associated with Data Collation

Discussion and comparison of overweight and obesity rates throughout the world are complicated by a number of important issues associated with data collation. The first of these relates to the limited availability of suitable data for an accurate assessment of obesity prevalence and trends in different countries. Although it is half a century since obesity was introduced into the International Classification of Diseases (ICD), overweight and obesity are rarely recognized by health professionals as a distinct disease or cause of death, and so are infrequently recorded on morbidity or mortality statistics. This means that we have to rely on BMI data collected as part of specific health screening surveys or scientific studies. Unfortunately, very few countries conduct national surveys on a regular basis, and even fewer report obesity prevalence. This reflects the fact that most national nutrition surveys, at least in developing countries, are still used to provide information about undernutrition in women and young children. The costs and resources required to conduct regular comprehensive national surveys are a major barrier to implementation.

The second issue relates to the need for caution when making comparisons of obesity rates between studies and countries. Comparison is complicated by a number of factors including differences in obesity classification systems, mismatched age groups, inconsistent age-standardization of study populations, discordant time periods and dates of data collection, and use of unreliable self-reported weight and height measurements for calculation of

### Table 1.4  Conservative estimates of the direct economic costs of obesity

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Obesity definition</th>
<th>Estimated direct costs</th>
<th>% National health care costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>1995</td>
<td>BMI ≥ 30</td>
<td>US$52 billion</td>
<td>5.7</td>
</tr>
<tr>
<td>Australia</td>
<td>1989/90</td>
<td>BMI &gt; 30</td>
<td>AUD$464 million</td>
<td>&gt; 2</td>
</tr>
<tr>
<td>Netherlands</td>
<td>1981–89</td>
<td>BMI &gt; 25</td>
<td>Guilders 1 billion</td>
<td>4</td>
</tr>
<tr>
<td>France</td>
<td>1992</td>
<td>BMI ≥ 27</td>
<td>FF 12 billion</td>
<td>2</td>
</tr>
</tbody>
</table>

### Table 1.5  Estimated world prevalence of obesity

<table>
<thead>
<tr>
<th>Population aged ≥ 15 years (millions)</th>
<th>Prevalence of obesity (%)</th>
<th>Approximate estimate (mid-point) of number of obese individuals (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Established market economies</td>
<td>640</td>
<td>15–20</td>
</tr>
<tr>
<td>Former socialist economies</td>
<td>330</td>
<td>20–25</td>
</tr>
<tr>
<td>India</td>
<td>535</td>
<td>0.5–1.0</td>
</tr>
<tr>
<td>China</td>
<td>825</td>
<td>0.5–1.0</td>
</tr>
<tr>
<td>Other Asian countries and Islands</td>
<td>430</td>
<td>1–3</td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>276</td>
<td>0.5–1.0</td>
</tr>
<tr>
<td>Latin America and Caribbean</td>
<td>280</td>
<td>5–10</td>
</tr>
<tr>
<td>Middle East</td>
<td>300</td>
<td>5–10</td>
</tr>
<tr>
<td>World</td>
<td>3616</td>
<td></td>
</tr>
</tbody>
</table>

Source: Seidell (4).
BMI. In particular, the use of BMI cut-off points either above or below 30 kg/m² to denote obesity has a great impact on estimates of obesity prevalence in a given population. In the US, obesity has until very recently been routinely classified as a BMI of 27.8 kg/m² in men and 27.3 kg/m² in women. With these cut-off points, 31.7% of men and 34.9% of women were deemed obese in the period 1988–1994. These estimates fall to 19.9% of men and 24.9% of women when a BMI of 30 kg/m² is applied. Projects such as the WHO MONICA (MONItoring of trends and determinants in CArdiovascular diseases) study (see below), where data are collected from a large number of populations in the same time periods according to identical protocols, are particularly valuable for comparison purposes.

A third issue is the need to be aware that many countries such as Brazil and Mexico show great variation in wealth by region. Combining data from all areas into a single country figure, or from a number of countries into a regional figure, is likely to mask patterns of relationships between social variables and obesity.

Current Prevalence of Obesity

Despite the limited availability and fragmentary nature of suitable country-level data, it is clear that obesity rates are already high and increasing rapidly in all regions of the world. Table 1.6 shows the most current estimates of obesity prevalence, according to a BMI of 30 or greater, in a selection of countries from around the globe. Nationally representative data sets based on measured weight and height are presented where possible.

Examination of Table 1.6 reveals large variations in obesity prevalence between countries, both within and between regions. In Africa, for example, obesity rates are extremely high among women of the Cape Peninsula but very low among women in Tanzania.

Much of the developed world already has exceptionally high levels of overweight and obesity. In Europe, obesity prevalence now ranges from about 6 to 20% in men and from 6 to 30% in women. Rates are highest in the East (e.g. Russia, former East Germany and Czech Republic) and lowest in some of the Central European and Mediterranean countries. Recent data from the Russian Longitudinal Monitoring Survey indicate that Russia has a particularly serious obesity problem, especially among women where 28% of the population was obese in 1996. Results from the Italian National Health Survey indicate that Italy has one of the lowest levels of obesity in Europe. However, the Italian data may be underestimated due to self-reporting of weight and height measurements.

National figures for North America are similar to those of Europe, with approximately 20% of males and 25% of females currently obese in the USA, and 15% of all adults obese in Canada. Rates in the general populations of Australia and New Zealand are also in the range of 15–18%. Japan, at less than 3%, still has a very low level of obesity for an industrialized country.

In the oil-exporting countries of the Middle East, the adult populations appear to have a major obesity problem. Women in particular are affected, with prevalence several fold higher than that reported for many industrialized countries. Bahrain (urban), Kuwait, Jordan, Saudi Arabia (urban), and the United Arab Emirates all document female obesity rates well above 25%.

The highest obesity rates in the world are found in the Pacific Island populations of Melanesia, Polynesia and Micronesia. In urban Samoa, for example, approximately 75% of women and 60% of men were classified as obese in 1991. These figures correspond with some of the highest rates in the world of diabetes and other related chronic diseases. With regard to obesity, it should be noted that the prevalence figures may be slightly exaggerated because Polynesians are generally leaner than Caucasians at any given BMI.

From a nutrition perspective, research and policy in many Asian and lower-income countries have focused on undernutrition. However, there are clear indications that a number of these countries are now beginning, or are already experiencing, high levels of overweight and obesity. Urban China, urban Thailand, Malaysia and the Central Asian countries that were members of the Soviet Union before 1992 (such as Kyrgyzstan) are all examples. Overweight is also becoming a serious problem in urban India, most notable in the upper-middle class. The situation in China and India is further complicated by the fact that chronic energy deficiency is still a major problem for large parts of the population.
A similar picture is emerging in Central and South America. Mexico and Brazil are already experiencing high levels of obesity, especially among low income and urban populations. Within the African region too, there are clear pockets where obesity is already a major problem. These include the coloured population of Cape Peninsula and the multiethnic island nation of Mauritius. Only the very underdeveloped countries of Africa appear to be avoiding the worldwide epidemic of obesity, although the lack of good quality data makes it difficult to judge their true weight status.

### Table 1.6 Prevalence of obesity (BMI $\geq 30$ kg/m$^2$) in a selection of countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Age</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finland</td>
<td>1991/93</td>
<td>20–75</td>
<td>14</td>
<td>11</td>
</tr>
<tr>
<td>Netherlands</td>
<td>1995</td>
<td>20–59</td>
<td>8.4</td>
<td>8.3</td>
</tr>
<tr>
<td>UK, England</td>
<td>1997</td>
<td>16–64</td>
<td>17</td>
<td>20</td>
</tr>
<tr>
<td>Scotland</td>
<td>1995</td>
<td>16–64</td>
<td>16</td>
<td>17</td>
</tr>
<tr>
<td><em>Italy</em></td>
<td>1994</td>
<td>15+</td>
<td>6.5</td>
<td>6.3</td>
</tr>
<tr>
<td>France</td>
<td>1997?</td>
<td>15+</td>
<td>8.6</td>
<td>8.4</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>1995</td>
<td>20–65</td>
<td>22.6</td>
<td>25.6</td>
</tr>
<tr>
<td>former East Germany</td>
<td>1992</td>
<td>25–69</td>
<td>21</td>
<td>27</td>
</tr>
<tr>
<td>former West Germany</td>
<td>1990</td>
<td>25–69</td>
<td>17</td>
<td>19</td>
</tr>
<tr>
<td>Russia</td>
<td>1996</td>
<td>Adults</td>
<td>10.8</td>
<td>27.9</td>
</tr>
<tr>
<td>North America</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>1991</td>
<td>18–74</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>USA</td>
<td>1988–94</td>
<td>20–74</td>
<td>19.9</td>
<td>24.9</td>
</tr>
<tr>
<td>Central and South America</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mexico (urban)</td>
<td>1995</td>
<td>Adults</td>
<td>11</td>
<td>23</td>
</tr>
<tr>
<td>Brazil</td>
<td>1989</td>
<td>25–64</td>
<td>5.9</td>
<td>13.3</td>
</tr>
<tr>
<td>Curacao</td>
<td>1993/94</td>
<td>18+</td>
<td>19</td>
<td>36</td>
</tr>
<tr>
<td>Middle East</td>
<td>1993/94</td>
<td>20–74</td>
<td>2.5</td>
<td>7.7</td>
</tr>
<tr>
<td>Iran, Islamic Republic of (south)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyprus</td>
<td>1989/90</td>
<td>35–64</td>
<td>19</td>
<td>24</td>
</tr>
<tr>
<td>Kuwait</td>
<td>1994</td>
<td>18+</td>
<td>32</td>
<td>44</td>
</tr>
<tr>
<td>Jordan (urban)</td>
<td>1994–96</td>
<td>25+</td>
<td>32.7</td>
<td>59.8</td>
</tr>
<tr>
<td>Bahrain (urban)</td>
<td>1991/92</td>
<td>20–65</td>
<td>9.5</td>
<td>30.3</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>1990/93</td>
<td>15+</td>
<td>16</td>
<td>24</td>
</tr>
<tr>
<td>Australasia and Oceania</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia (urban)</td>
<td>1995</td>
<td>25–64</td>
<td>18.0</td>
<td>18.0</td>
</tr>
<tr>
<td>New Zealand</td>
<td>1989</td>
<td>18–64</td>
<td>10</td>
<td>13</td>
</tr>
<tr>
<td>Samoa (urban)</td>
<td>1991</td>
<td>25–69</td>
<td>58.4</td>
<td>76.8</td>
</tr>
<tr>
<td>Papua New Guinea (urban)</td>
<td>1991</td>
<td>25–69</td>
<td>36.6</td>
<td>54.3</td>
</tr>
<tr>
<td>South and East Asia</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Japan</td>
<td>1993</td>
<td>20+</td>
<td>1.7</td>
<td>2.7</td>
</tr>
<tr>
<td>India (urban Delhi middle class)</td>
<td>1997</td>
<td>40–60</td>
<td>3.19</td>
<td>14.28</td>
</tr>
<tr>
<td>China</td>
<td>1992</td>
<td>20–45</td>
<td>1.2</td>
<td>1.64</td>
</tr>
<tr>
<td>Malaysia</td>
<td>1980-90</td>
<td>18–60</td>
<td>4.7</td>
<td>7.9</td>
</tr>
<tr>
<td><em>Singapore</em></td>
<td>1992</td>
<td>Adults</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Kyrgyzstan</td>
<td>1993</td>
<td>18–59</td>
<td>4.2</td>
<td>10.7</td>
</tr>
<tr>
<td>Africa</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mauritius</td>
<td>1992</td>
<td>25–74</td>
<td>5.3</td>
<td>15.2</td>
</tr>
<tr>
<td>Tanzania</td>
<td>1986/89</td>
<td>35–64</td>
<td>0.6</td>
<td>3.6</td>
</tr>
<tr>
<td>Rodrigues (Creoles)</td>
<td>1992</td>
<td>25–69</td>
<td>10</td>
<td>31</td>
</tr>
<tr>
<td>Cape Peninsula (Coloured)</td>
<td>1990</td>
<td>15–64</td>
<td>7.9</td>
<td>44.4</td>
</tr>
</tbody>
</table>

*Data are from the Italian National Health Survey and are self-reported.

*Obesity criterion: BMI $\geq 31$ kg/m$^2$. 

Obesity criterion: BMI $\geq 31$ kg/m$^2$. 

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Recent Trends

Good quality data on trends in body composition are even harder to find than cross-sectional data on prevalence at one point in time, especially for countries outside Europe and the US. Fortunately, nationally representative or large nationwide data sets are now available for a small number of lower and middle income countries including Brazil, China, Mauritius, Western Samoa and Russia.

The countries of North America and Europe have seen startling increases in obesity rates over the last 10–20 years. In Europe, the most dramatic rise has been observed in England, where obesity prevalence more than doubled from 6% to 17% in men and from 8% to 20% in women after 1980. Prevalence has increased by about 10–40% over the last 10 years in the majority of other European countries.

Obesity rates in the USA have increased from 10.4% to 19.9% and from 15.1% to 24.9% in men and women, respectively, over the period 1960–1962 until 1988–1994. The largest increases, however, occurred from the period 1976–1980 onwards. In Japan, although overall rates of obesity remain below 3%, prevalence increased by a factor of 2.4 in the adult male population and by a factor of 1.8 in women aged 20–29 years.

Russia has seen a consistent increase in adult obesity from 8.4% to 10.8% in men and from 23.2% to 27.9% in women in only 4 years. This is despite marked shifts toward a lower fat diet in the post-reform period, during which price subsidies of meat and dairy products were removed. However, year-to-year fluctuations underscore the fact that the economy is in flux and that these changes cannot be used to predict trends. It is also worth noting that the prevalence of pre-obesity declined slightly between 1992 and 1994 in females but not in males.

Trend data from the western Pacific Islands indicate that obesity levels are not only high in these populations, but that the prevalence of obesity continues to increase considerably in each island (6).

Data from two comparable national surveys in Brazil conducted 15 years apart show that adult obesity has increased among all groups of men and women, especially families of lower income. National figures increased from 3 to 6% in men and from 8 to 13% in women. It is also of interest that the ratio between underweight and overweight—a measure of the relative importance of each problem in the population—changed dramatically between 1974 and 1989. This reversed from a ratio of 1.5:1 (underweight to overweight) in 1974 to a ratio of less than 0.5:1 in 1989 (7).

The level of obesity among Chinese adults remains low, but the marked shifts in diet, activity and overweight suggest that major increases in overweight and obesity will occur. During the most recent period of the national China Health and Nutrition Survey (CHNS), an ongoing longitudinal survey of eight provinces in China, data show a consistent increase in adult obesity in both urban and rural areas. Changes in diet and activity patterns are rapid in urban residents of all incomes but are even more rapid in middle and higher income rural residents.

Few countries seem to have escaped the rapid escalation in obesity rates in the last two decades. The Netherlands, Italy and Finland are rare exceptions where population height and weight data collected over this period indicate only small increases or even stabilization of the rates of obesity.

The MONICA Study

The WHO MONICA project provides a comprehensive set of obesity prevalence data from cities and regions. Information was collected in two risk surveys, conducted approximately 5 years apart from 38 populations. Most surveys were conducted in European cities but there were a few centres in North America, Asia and Australasia. Although they are not national data, they were collected from over 100000 randomly selected participants aged 35 to 64 years, are age-standardized and are based on weights and heights measured with identical protocols. This provides a high level of confidence in the detailed analysis of the data, including comparisons between centres and observations over time. Such analysis is rarely possible with less rigorously collected data sets.

Analysis of the results from the first round of data collection between 1983 and 1986 showed that the average prevalence of obesity among European centres participating in the study was 15% in men and 22% in women, with the lowest in Sweden (Göteborg: 7% in men, 9% in women) and the highest in Lithuania (Kaunas: 22% in men, 45% in women).
The average age-standardized absolute changes in the prevalence of obesity over 5 years showed that rates increased in three-quarters of the populations for men and in half of the populations for women (8). The largest increases were observed in Catalonia, where there was a 9.4% rise in absolute prevalence in men and a 6.5% rise in women. A small number of populations actually saw a statistically significant decrease in obesity prevalence over the 5-year period. The most notable of these was in Ticino (Switzerland), where absolute rates fell by 11.7% in men and 9.6% in women. Charleroi in Belgium saw a 14.9% decrease in obesity prevalence in women but not in men.

**Future Projections**

Worldwide growth in the number of severely overweight adults is expected to be double that of underweight adults between 1995 and 2025. Figure 1.2 presents some crude projections of the expected rise in obesity rates over the next 25 years for five of the countries included in Table 1.6. These estimates are based on a simple linear extrapolation of increases observed over the period 1975–1995 and indicate that by the year 2025, obesity rates could be as high as 40–45% in the USA, 30–40% in Australia, England and Mauritius, and over 20% in Brazil. It has even been suggested that, if current trends persist, the entire US population could be overweight within a few generations (9).

**KEY FEATURES AND PATTERNS OF THE GLOBAL OBESITY EPIDEMIC**

Closer analysis of obesity prevalence and trend data from around the world reveals a number of interesting patterns and features. These include an increase in population mean BMI with socioeconomic transition, a tendency for urban populations to have higher rates of obesity than rural populations, a tendency for peak rates of obesity to be reached at an earlier age in the less developed and newly industrialized countries, and a tendency for women to have higher rates of obesity than men. These and others are considered in some detail below.

**Socioeconomic Status**

Socioeconomic status (SES) is a complex variable that is commonly described by one or more simple indicators such as income, occupation, education and place of residence. Substantial evidence suggests that high SES is negatively correlated with obesity in developed countries, particularly among women, but positively correlated with obesity in populations of developing countries. As developing countries undergo economic growth, the positive relationship between SES and obesity is slowly replaced by the negative correlation seen in modern societies (see below, ‘What is Driving the Global Obesity Epidemic?’)

**Modern Societies**

In developed countries there is usually an inverse association between level of education and rates of obesity that is more pronounced among women. In the MONICA survey, a lower educational level was associated with higher BMI in almost all female populations (both surveys) and in about half of male populations. Between the two surveys, there was a strengthening of this inverse association and the differences in relative body weight by education increased. This suggests that socioeconomic inequality in health consequences associated with obesity may actually be widening in many countries (10). One analysis has shown that reproductive history, unhealthy dietary habits, and psychosocial stress may account for a large part of the association between low SES and obesity among middle-aged women (11).

There is some evidence to suggest that there are racial differences between BMI and SES in developed countries. Although women in the USA with low incomes or low education are more likely to be obese than those of higher SES overall, this association was not found in a large survey of Mexican American, Cuban American, and Puerto Rican adults (12). Similar findings have been reported for young girls where a lower prevalence of obesity was seen at higher levels of SES in white girls, but no clear relationship was detected in black girls (13), who tend to have much higher overall rates of obesity.
Developing and Transition Societies

New evidence from India illustrates the positive association between SES and obesity in developing countries. Nearly a third of males, and more than half of females, belonging to the ‘upper middle class’ in urban areas are currently overweight (BMI > 25). This is in stark contrast to the prevalence of overweight among slum dwellers (see Table 1.7) (14).

In Latin American and a number of Caribbean countries, a recent assessment of maternal and child obesity from national surveys since 1982 also found a tendency for higher obesity rates in poorly educated women throughout the region, except in Haiti and Guatemala where the reverse was true.

Urban Residence

Urban populations tend to have higher rates of obesity than rural populations, especially in less developed nations. Urbanization causes people to move away from their traditional way of living and is associated with a wide range of factors which adversely affect diet and physical activity levels. These include a shift to sedentary occupations, dependency on automated transport, reliance on processed convenience foods, and exposure to aggressive food marketing and advertising. Detrimental changes to family structures and value systems may also be an important contributor to reduced physical activity and poor diet associated with this shift.

In most countries, urbanization has led to populations consuming smaller proportions of complex carbohydrates, greater proportions of fats and animal products, more sugar, more processed foods, and more foods consumed away from home. Urbanization also has effects on physical activity levels. In Asian cities, bicycles are rapidly being displaced by motorbikes and cars with nearly