Review Article

The global epidemic of obesity

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Obesity is at last being recognized as a major public health problem of global significance. More quality national obesity prevalence data are urgently needed but it is clear that rates are already high and increasing in most parts of the world. Current estimates of the global prevalence exceed 250 million. The first formal World Health Organization Consultation on obesity concluded that the global epidemic is an unintended consequence of modernization, economic development, urbanization and other societal changes. These have led to widespread reductions in spontaneous and work-related physical activity and to excessive consumption of energy dense foods. Links between reduced growth *in utero* and increased risk of ill health in later life may partly explain why populations in many developing countries are especially susceptible to obesity, diabetes and heart disease when exposed to modern sedentary living. The International Obesity TaskForce has launched a global initiative for coherent action to tackle the epidemic.

Key words: obesity, diabetes, epidemic, global, WHO, non-communicable diseases (NCD), cardiovascular diseases (CVD), International Obesity TaskForce (IOTF).

Introduction

Historically, infectious disease and undernutrition have been the focus of global healthcare initiatives by international organizations such as the World Health Organization (WHO). However, there has been a move in recent years towards the prevention and management of chronic non-communicable diseases (NCD) such as cardiovascular disease (CVD) and cancer. Such conditions have spread rapidly and are no longer restricted to highly industrialised countries. Indeed, analyses show that for the first time in history, NCD now constitute a more significant contribution to ill health throughout the world than do infectious diseases.[1] According to WHO estimates, major NCD today are responsible for at least 40% of all deaths in developing countries and for 75% in industrialised countries, where CVD are the first cause of mortality and cancer is the third. By the year 2020, NCD will account for approximately three-quarters of all deaths in the developing world.

In 1993 WHO published global estimates for the prevalence of diabetes and impaired glucose tolerance in adults.[2] This report was instrumental in highlighting the fact that diabetes now occurs most frequently in developing countries and in the minority populations of the industrialised countries. A similar pattern is now emerging for obesity but, in contrast to diabetes, cancer and CVD, obesity has been largely ignored in health strategies developed at national and international levels. This is partly due to the fact that few people recognise or classify this medical condition as a disease.

Signs that the extent and implications of the global obesity problem are finally being recognised have appeared only in the past two years. The Division of Noncommunicable Diseases (NCD) at WHO released a statement in March 1996 warning that overweight and obesity present a major public health issue which demands urgent attention. In May 1996, the International Obesity TaskForce (IOTF) was officially launched to help improve awareness of the need for coherent action on tackling the global epidemic of obesity. The IOTF is a formal subgroup of the International Association for the Study of Obesity (IASO), the umbrella organisation which represents national obesity associations from over 30 countries. A formal Consultation on Obesity was then convened during June 1997 by WHO in Geneva, with the support and assistance of the IOTF. The aim of this consultation was to review global prevalence and trends of obesity among children and adults, and to draw up recommendations for developing public health policies and programmes for improving the prevention and management of obesity world-wide. The Consultation on Obesity, consisting of healthcare and obesity experts from 25 countries, emphasised that overweight and obesity represent a rapidly growing threat to the health of populations and an increasing number of countries across the globe. Obesity was recognised as a disease in its own right, and it was agreed that "obesity's impact is so diverse and extreme that it should now be regarded as one of the greatest neglected public health problems of our time with an impact on health which may well prove to be as great as that of smoking". The newly published report of the Consultation on

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Table 1. Classification of overweight in adults according to Body Mass Index (BMI)[3]

Classification	BMI (kg/m^2)
Underweight	< 18.5
Normal range	18.5–24.9
Overweight	≥ 25
Pre-obese	25–29.9
Obese class I	30.0–34.9
Obese class II	35–39.9
Obese class III	≥ 40

Obesity, *Obesity: Preventing and Managing the Global Epidemic*[3] provides a comprehensive overview of the global prevalence and trends of obesity; the health and economic costs of obesity; our understanding of how obesity develops; and a discussion of the prevention and management of obesity.

Documenting the patterns and trends of overweight and obesity

Documenting the patterns and trends of overweight and obesity in different populations is important for a number of reasons. These include the identification of populations at high risk of obesity; the facilitation of international comparisons of obesity rates; the prediction of the future obesity problem; the provision of baseline data for monitoring and evaluating the effectiveness of intervention strategies; and to enable health planners and policy makers to mobilize and reallocate resources in order to control the disease.

The collation of prevalence data, however, is hindered by a number of factors. First, overweight and obesity are not recognized as a distinct disease or a cause of death and so are generally not recorded on morbidity or mortality statistics. Most weight-related data is collected as part of specific health screening surveys or scientific studies. Second, comparisons between data sets are complicated by differing classifications of overweight and obesity, mismatched age-groups, failure to standardize the age structure of the study population, discordant time-periods and dates of data collection, and use of unreliable self-reported weight and height measurements for calculation of Body Mass Index (BMI).

It is therefore particularly valuable that WHO, in conjunction with the IOTF, are now in the process of developing a reliable and comprehensive database of adult obesity prevalence data from countries throughout the world. Estimates of obesity prevalence within a population will be based on the new BMI classification system presented in the report of the Consultation on Obesity (Table 1) in which a value of 30 kg/m^2 or above denotes obesity. The BMI is simply calculated by dividing body-weight in kilograms by height in metres squared (kg/m^2).

It can generally be assumed that individuals with a BMI of 30 kg/m^2 or above have excessive body fat. However, the health risks associated with overweight and obesity rise progressively with increasing BMI from a value below 25 kg/m^2, and it has been demonstrated that there are benefits to having a BMI in the lower end of the normal range, at least within industrialised countries.[4,5]

It is also important to recognise that BMI does not distinguish between weight associated with fat and weight associated with muscle. The relationship between BMI and body fat content therefore varies according to body build and body proportion, and a given BMI may not correspond to the same degree of fatness across populations. For example, Polynesians tend to have a lower percentage of fat compared with Caucasian Australians at an identical BMI.[6] Also, the percentage of body fat is higher in women than in men of equivalent BMI.[7]

The health burden of obesity can be more easily predicted if the hazards of accumulating intra-abdominal fat are also documented by simple and convenient measures such as waist circumference or waist–hip ratio. Changes in these measures tend to reflect changes in risk factors for cardiovascular disease and other forms of chronic illness. New evidence from India shows that abdominal obesity can be a major problem even at low relative weight; nearly 19% of urban middle-class male subjects with BMI < 25 kg/m^2, and 22% of non-overweight female subjects showed abdominal obesity. In overweight subjects with a BMI > 25 kg/m^2, abdominal obesity was found in a striking 68% of males and 58% of females (Table 2).[8] To indicate the real health risks that can exist within populations and different ethnic groups at BMIs below the level of obesity, the first category of overweight included in the new WHO classification system is now termed ‘pre-obese’.

The global problem of obesity

The most comprehensive obesity prevalence data set currently available for comparison between populations comes from the WHO MONICA (MONItoring of trends and determinants in CArdiovascular diseases) study. These data were collected in the same time-period, are age-standardised, and are based on weights and heights measured with identical protocols.[9] However, the published data are now old (they were collected between 1983 and 1986), are for cities rather than countries, and are mostly from European populations.

More recently, the IOTF has attempted to collect nationally representative data sets from as many countries around the world as possible. Suitable data have been limited and fragmentary. Nevertheless, this exercise has provided some indication of the scale of the obesity problem in a selection of countries from different WHO regions (Table 3).

Closer analysis of the obesity prevalence data reveals a number of important features. First, improvement in the economic conditions of a country tends to lead to a population-wide shift in BMI so that overweight problems replace those of underweight.[10] In the first stages of transition, the wealthier sectors of society tend to show an increase in the proportion of people with a high BMI but thinness remains the main concern for the less wealthy. As a result, overweight can coexist with underweight in countries in the early stage of

Table 2. Subjects with high waist to hip ratios (WHR, abdominal obesity) by grades of Body Mass Index (BMI) in urban Indians[8]

Classificaction	Grade of BMI	Percentage with a high WHR	
		Males (> 1.0)	Females (> 0.85)
Underweight	< 18.5	1.8	1.75
Normal	18.5–25	17.8	20.0
Overweight/obese	> 25	68.1	58.0

transition, presenting a double burden of disease. In the later stages, the population distribution of BMI tends to change again with an increase in the prevalence of high BMI among the poor. This is more clearly indicated in Fig. 1.

A second feature of interest is that women generally have higher rates of obesity than men, whereas the reverse is true for overall level of overweight. The higher rates of obesity in women can be seen in Table 3. Third, there is an urban–rural divide with urban populations showing significantly higher rates of obesity than rural populations. This is not surprising given that urban living is associated with more sedentary lifestyles and energy-dense high fat diets.[11] Finally, level of

Table 3. Prevalence of obesity (Body Mass Index (BMI) ≥ 30 kg/m^2) in a selection of countries by WHO region[3]

WHO region	Country	Year	Age	Prevalence of obesity (%)* Men	Women
AFRO	Mauritius	1987	25–74	3.4	10.4
		1992		5.3	15.2
	South Africa (Coloured, Cape Peninsula)	1990	15–64	8	44
EMRO	Saudi Arabia	1990/93	15+	16	24
	Cyprus	1989/90	35–64	19	24
EURO	England	1980	16–64	6	8
		1986/87		7	12
		1991/92		13	15
		1995		15	16.5
	Former E. Germany	1985	25–65	13.7	22.2
		1992		20.5	26.8
	The Netherlands	1987	20–59	6.0	8.5
		1991		7.5	8.8
		1995		8.4	8.3
PAHO	USA	1960	20–74	10.0	15.0
		1973		11.6	16.1
		1978		12.0	14.8
		1991		19.7	24.7
	Brazil	1975	25–64	3.1	8.2
		1989		5.9	13.3
SEARO	Good quality nationally representative data were not identified				
WPRO	Australia (urban)	1980	25–64	9.3	8.0
		1983		9.1	10.5
		1989		11.5	13.2
	China	1992	20–45	1.2	1.6
	Japan	1976	20+	0.7	2.8
		1987		1.3	2.8
	Malaysia	1995	18–60	4.7	7.9
	Western Samoa (urban)	1978	25–69	39	59
		1991		58	77

* Obesity is classified as BMI ≥ 30 kg/m^2. Data have generally been derived from representative national surveys. Adapted from WHO, 1998.[3]

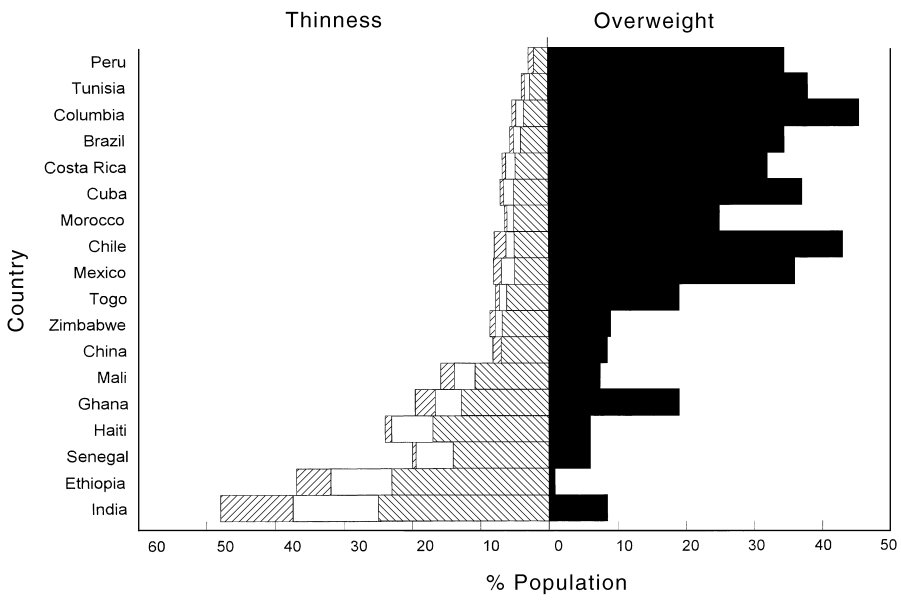

Figure 1. Body mass index (BMI) in adult populations. BMI classes: ▨, < 16; □, 16–16.9; ▧, 17–18.4; ■, > 25. Source: WHO Technical Report Series No. 854.[10]

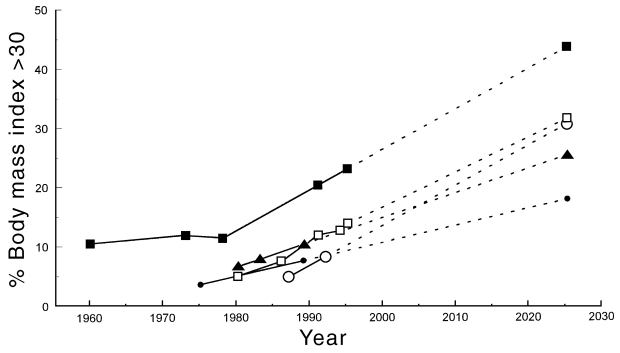

Figure 2. Obesity trends. (■), USA; (□), England; (▲), Australia; (○), Mauritius; (●), Brazil.

education appears to be inversely associated with body weight in industrialised countries,[12,13] possibly because individuals with higher education levels are more likely to follow dietary recommendations and avoid other risk avoidance behaviours.[14] Little is known about the relationship between education level and obesity in developing countries except that increased weight and girth are still viewed by many as a sign of health and prosperity.[15]

Trends and future projections

Obesity rates are reaching epidemic proportions in all regions of the world, both in industrialised countries and in poorer nations. Brazil, for example (Fig. 2), has seen increases in obesity from 3.1 to 5.9% among women and from 8.2 to 13.3% among men in the 14 years between 1975 and 1989.[16] In Europe, the most dramatic increase in obesity prevalence was observed in England, where the rates have more than doubled from 6 to 15% in men and from 8 to 16.5% in women since 1980.[17] In the majority of other European countries, prevalence has increased by approximately 10–40% over the last 10 years and now ranges from 10 to 20% in men and from 10 to 25% in women. Rates are highest in southern and eastern European countries. Figures for the USA are similar, with approximately 20% of males and 25% of females currently obese.[18] Within certain subpopulations of the USA, rates are even more alarming.

Current estimates of the global prevalence of obesity exceed 250 million, or 7% of the world's adult population. Figure 2 presents some crude projections of the expected rise in obesity rates over the next 25 years utilising currently published data prepared in 1997 by the IOTF. These estimates indicate that if obesity prevalence continues to increase at the rates observed over the period 1975–95, the proportion of the adult population that is obese will more than double by the year 2025 to over 45% in the USA, 33% in England, 32% in Mauritius, 27% in Australia and 20% in Brazil. The release of the latest obesity figures from Australia for the year 1995 show that obesity has already risen to 18% in both men and women [Service, 1998 No. 741], indicating how conservative the Figure 2 estimates are likely to be.

Overweight and obesity are also affecting children and adolescents. This is especially significant because weight problems and the associated health risks tend to extend into adulthood, and because ill health resulting from weight problems is related to the duration of time an individual has been overweight for.[19]

To date, the lack of a common standard for defining obesity in children and adolescents has made it difficult to provide reliable estimates of the extent of childhood overweight, or to provide an overview of the global obesity prevalence for these age groups. This issue has been the focus of much academic research and discussion over the years but attempts to reach any consensus on an acceptable international classification system have consistently failed. However, a recent IOTF forum was able to agree on an acceptable interim approach which aims to develop a global reference population and then develop a new classification system based on BMI-for-age from this more representative population.[20]

The only integrated data currently available which allow a global overview is a comparison of preschool aged children compiled by the WHO Nutrition Unit (Fig. 3). However, determination of the overweight level in such young children is complicated by rapid growth at this time of life. Some children classified as obese in this analysis may, therefore, have actually had a higher relative weight due to stunting and not as a result of excess fatness.

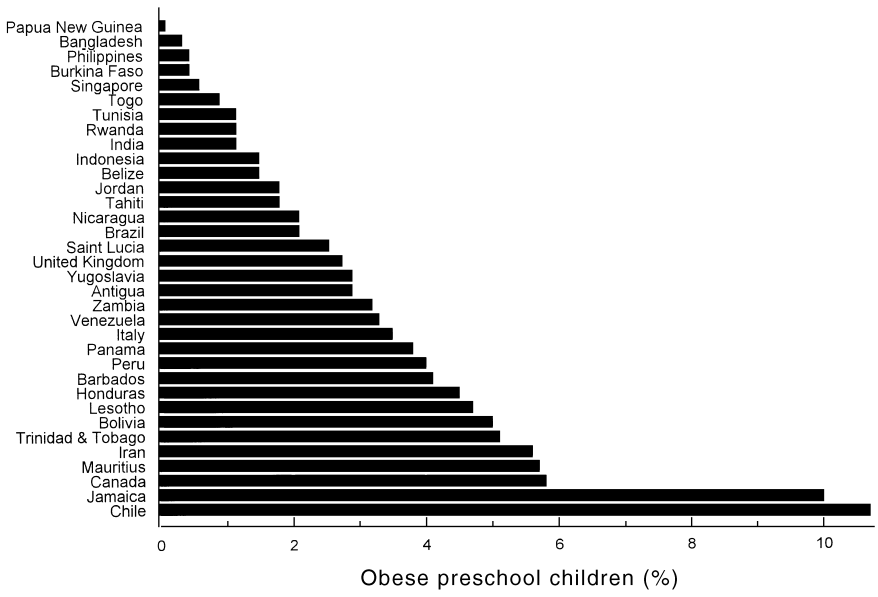

Figure 3. Prevalence of obese preschool children (0–59 months). Source: WHO Health Statistics Quarterly 41: 1988. NCHS reference population.

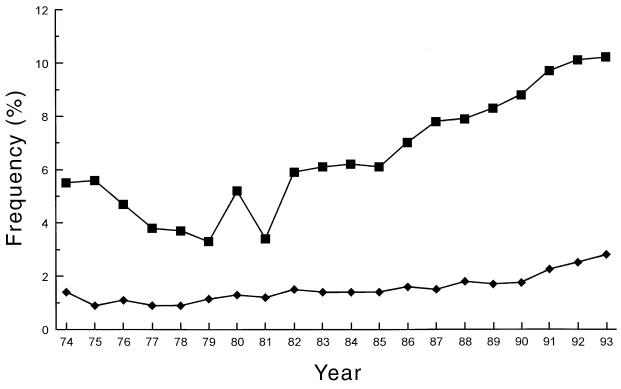

Figure 4. Prevalence of (■) obese and (◆) extremely obese children (6–14 years) in Izumiohtsu City, Japan, 1974–93.

Studies in older children have invariably reported a substantial rise in prevalence irrespective of the classification system used. For example, the frequency of obese schoolchildren (> 120% standard body weight, SBW) aged 6–14 years in a Japanese city increased from 5 to 10%, and that of extremely obese children (> 140% SBW) from 1 to 2% during the 20 years from 1974 to 1993 (Fig. 4). In this study, approximately one-third of obese children grew into obese adults.[21] It is also important to recognize that childhood obesity is not only confined to the industrialised countries as high rates are already evident in some developing countries. The prevalence of obesity among school children aged 6–12 years in Thailand, for example, rose from 12.2% in 1991 to 15.6% in 1993.[22]

Recently, considerable evidence has been mounting to suggest that reduced growth *in utero* leads to long-term detrimental changes in the body's structure, physiology and metabolism.[23] These changes have been associated with increased risk of CVD, non-insulin dependent diabetes mellitus (NIDDM) and impaired glucose tolerance in adult life, and appear to be especially important in people who become obese. Ravelli *et al.*, for example, have shown that deteriorations in glucose tolerance were greatest in obese adults subjected to famine in late- to mid-gestation (Table 4).[24] This has serious implications for those people born as thin babies to mothers of low body weight in times of famine and who later become obese when exposed to a more Western lifestyle. Indeed, this may help explain why obesity is now becoming so prevalent in many developing countries, and why the associated health risks develop so rapidly and result in a higher degree of premature mortality in some populations or subgroups.

Overweight and obesity in developing nations

The natural course of obesity and its health effects differ greatly between developed countries and the more newly industrialised societies. Figure 5 shows the general pattern in European countries where there is an increase in prevalence of obesity with age, reaching a maximum in the sixth decade, and then declining steadily thereafter.

In contrast to the situation in industrialised countries, Fig. 6 shows that in developing economies such as Western Samoa, obesity begins much earlier in life and reaches a peak by the early forties. It then tends to decline in association with the high mortality that accompanies the rapidly developing diabetes and CVD. In these societies, the rapid progress of modernisation is associated with a cluster of NCD including obesity, NIDDM, hypertension, dislipidaemia and CVD, as well as alcohol abuse and cigarette smoking. This has been described as the 'new world syndrome' and is responsible for the very high rates of mortality in developing nations and among the disadvantaged ethnic minority groups in developed countries. It is likely to create an enormous socio-economic and pubic health burden for poorer nations in the near future.

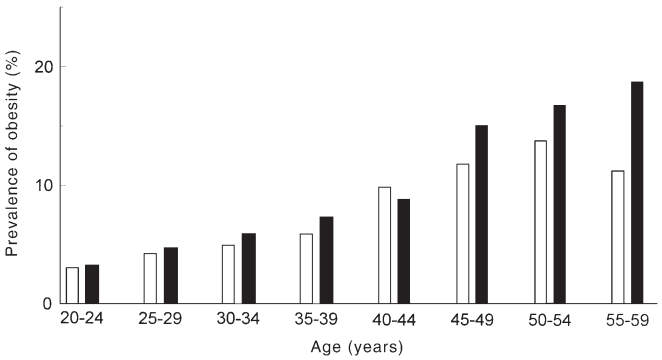

Figure 5. Prevalence of obesity (Body Mass Index > 30) in (□) men and (■) women in the Monitoring Project on Cardiovascular Disease Risk Factors in The Netherlands 1987–91. Source: Obesity Research 1995; 3 (Suppl. 2).

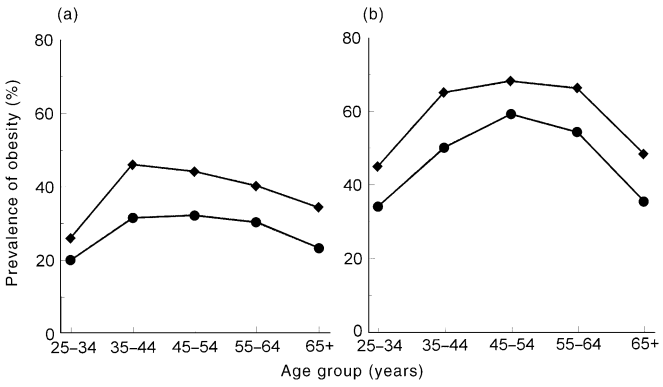

Figure 6. Prevalence of obesity by age group in Western Samoan (a) men and (b) women in (●) 1978 and (◆) 1991. Source: Obesity Research 1995; 3 (Suppl. 2).

Table 4. Mean 120 minute plasma glucose concentration by Body Mass Index (BMI) and exposure to famine[24]

Adult BMI	Born before famine	Late gestation	Mid gestation	Early gestation	Conceived after famine
≤ 24.0	5.0	5.3	5.5	5.6	5.2
26.5	5.5	5.8	5.7	6.1	5.7
30.0	5.6	6.7	6.2	5.4	6.0
> 30.0	7.1	8.2	7.9	7.4	6.7

What has caused the global obesity epidemic?

At the individual level, it is now evident that obesity should not be considered a self-inflicted condition resulting simply from an overindulgence of highly palatable foods and a lack of physical activity due to laziness; numerous diverse factors give rise to such weight gain promoting behaviours and it is the interaction between a number of these that underlies the development of obesity. Most significant are the powerful societal forces which influence daily energy intake and expenditure, and which can overwhelm the subconscious biological regulation of body weight. The susceptibility of individuals to these forces is affected by genetic and other biological factors, such as gender, age and hormonal activities, over which they have little or no control. Dietary factors and physical activity patterns are the major modifiable factors explaining excessive weight gain which, if corrected, can serve to prevent obesity (Fig. 7).

The WHO Consultation on Obesity concluded that at the population level, the obesity epidemic reflects profound changes in society which have resulted in a fall in spontaneous and work-related physical activity and a readiness for overconsumption of high fat foods. The rapid increases in obesity rates over recent years have occurred in too short a time for there to have been any significant genetic changes within populations.[3]

Key changes to societal structures implicated in the rapid global rise of obesity include modernisation, economic restructuring and transition to market economies, increasing urbanisation, changing occupational structures, and globalisation of food markets. Modernisation underlies many of these and, although standards of living have generally improved, urban crowding, increasing unemployment, family and community breakdown, and displacement of traditional foodstuffs by Westernised high-fat products have been a product of this process. These and other factors have negative consequences in terms of diet and physical activity patterns.

What can be done?

It is important to recognise that obesity cannot be prevented or managed solely at the individual level. National commitment to obesity control should be a shared responsibility. Indeed, governments, international agencies, consumers, industry/trade and the media, among others, all have important roles to play in promoting healthy population weights through supporting effective changes in diet and everyday levels of physical activity.

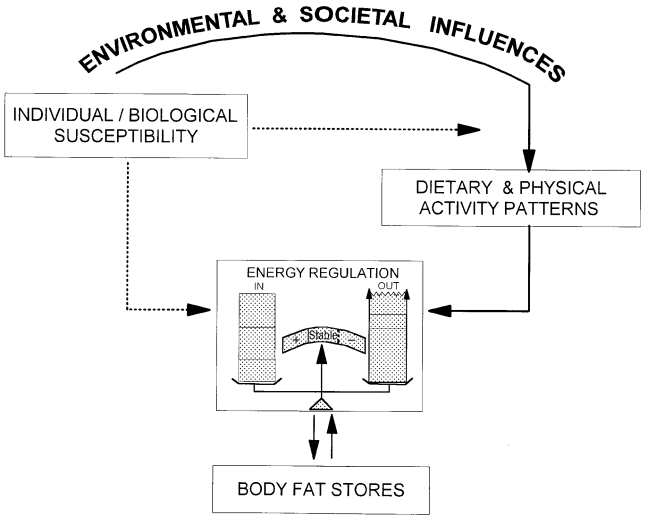

Figure 7. Influences on energy balance and weight gain[3]

Strategies aimed at preventing weight gain and obesity are likely to be more cost effective and to have a greater positive impact on long-term control of body weight than strategies for treating obesity once it has fully developed. The majority of therapies fail to keep weight off in the long term and health care resources are no longer sufficient to offer treatment to all. Prevention of overweight and obesity must begin early in life and should be based on life-long healthy eating and physical activity patterns. Action to prevent obesity should include public health strategies that aim to reduce the obesity promoting aspects of the environment for the entire population, thereby supporting positive behaviour changes and making the healthy choice the easy choice.

For those individuals and subgroups of the population who have already developed, or are at increased risk of developing, obesity and the associated health complications, obesity management programs within health care and community services are critical. The effectiveness of such programs is likely to be enhanced if improved and extended training of all relevant healthcare workers is provided. Obesity needs to be viewed as a disease in its own right and one which warrants intervention even when co-morbidities are not present. Negative attitudes of healthcare professionals towards the condition must also be improved.

Finally, in all interventions aimed at preventing and managing overweight and obesity, systematic assessment and evaluation should be a routine element.[25] Together with research into the development, consequences and scale of the global obesity epidemic, systematic assessment and evaluation has a key role in developing, improving and refining strategies to deal with the problem.

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