Obesity, insulin resistance and diabetes – a worldwide epidemic

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Obesity is now commonly defined in adults as a BMI $> 30\,kg/m^2$. The prevalence of obesity in established market economies (Europe, USA, Canada, Australia, etc.) varies greatly, but a weighed estimate suggests an average prevalence in the order of 15–20 %. The prevalence in these countries generally shows increasing trends over time. Obesity is also relatively common in Latin America, but much less so in sub-Saharan Africa and Asia where the majority of the world population lives. Nevertheless obesity rates are increasing there as well and, more importantly, rates of diabetes are increasing even more quickly, particularly in Asian countries. The risks of type 2 diabetes mellitus in these countries tend to increase sharply at levels of BMI generally classified as acceptable in European and North American white people. There have been suggestions to adopt specific classifications of obesity in Asians (e.g. BMI 23 for overweight and 25 or $27\,kg/m^2$ for obesity) and this will greatly affect the prevalence estimates of obesity worldwide (currently at about 250 million people). Particularly for health promotion purposes BMI may be replaced by a classification based on waist circumference, but also specific classifications for different ethnic groups may be necessary. The number of diabetics has been projected to increase from 135 million in 1995 to 300 million in 2025. Much of this increase will be seen in Asia. In summary, both obesity and type 2 diabetes are common consequences of changing lifestyles (increased sedentary lifestyles and increased energy density of diets). Both are potentially preventable through lifestyle modification on a population level, but this requires a coherent and multifaceted strategy. Such strategies are not developed or implemented. These developments point toward the great urgency to develop global and national plans for adequate prevention and management of obesity and type 2 diabetes mellitus.

Obesity: Insulin resistance: Diabetes: Diabetes mellitus

'In developing countries, as their economies grow, non-communicable diseases will become more prevalent largely because of the adoption of 'western' lifestyles and their accompanying risk factors – smoking, high-fat diets, lack of exercise'

The World Health Report 1998 (WHO, 1998*a*)

The worldwide epidemic of obesity

Obesity is increasingly common throughout the world. The prevalence in the USA overall is about 20 %, but in certain subgroups such as non-whites the prevalence is even higher (Flegal *et al.* 1998). In Europe the prevalence of obesity is also high, and in many countries there is evidence for an increase. For instance, Fig. 1 shows the time trends of the Health Survey of England where obesity is now almost as prevalent as in the USA. Prevalences and time trends can be quite different in countries with similar economic circumstances. In the Netherlands, for instance, obesity rates were similar to those in the UK in the early 1980s but are currently only at 50 % of those in the UK (Fig. 2). In general, in countries with established market economies the prevalence of obesity is often 10–15 % in men and 15–20 % in women at ages between 25 and 55 years. There is evidence that obesity is also increasing in countries where there was traditionally little obesity. The increase in obesity is most notable in countries undergoing rapid economic transition, as seen in many countries in Asia and Latin America (Seidell & Rissanen, 1998).

On an ecological level these time trends are not too difficult to explain, although exact quantification of different factors is almost impossible. On the one hand there is an increase in the average energy supply *per capita*. The World Health Report (WHO, 1998*a*) has estimated that the average energy supply *per capita* in the world was 2300 kcal in 1963, 2440 in 1971 and 2720 in 1992, and it is estimated that in 2010 this will be 2900 kcal. These increases are obviously not evenly distributed across the world's population and, sadly, many remain undernourished, although in Asia (particularly China and India) and most of Latin

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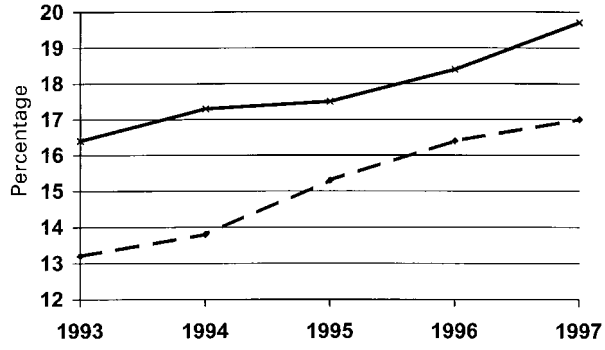

Fig. 1. Time trends in the prevalence of obesity (BMI > 30 kg/m^2) in the Health Survey for England (ages 16+), 1993–1997. Solid line, women; broken line, men.

America these numbers are declining. The number of people with access to at least 2700 kcal has increased from 0·145 billion in 1969–71 to 1·8 billion in 1990–92, and is estimated to grow to 2·7 billion in 2010. Even when corrected for the increase in the world's population this implies a more than 10-fold increase in the number of people with access to high-caloric diets. The globalization of agricultural production and food processing has affected not only the quantity of energy available *per capita*, but also the energy density (Seidell, 1999*a*).

At the same time there are continuing changes in the physical demands of work and leisure time. Increasingly we are at leisure during working hours and we work out during leisure time. Mechanization of many types of work and changes in transportation are causing ever-increasing numbers of people to be sedentary for most of the time.

Given these changes it is not surprising that on average people gain weight, although for many individuals this seems to remain a mystery. With small changes in average body weight the prevalence of obesity increases rapidly. For every unit increase in BMI there is an increase in the prevalence of obesity of 5 percentage points (WHO, 1998*b*). The WHO has estimated that in 2025 about 300 million will be obese (WHO, 1998*a*). This author has made a crude approximation of the current levels of obesity with numbers approaching 250 million, albeit with a large margin of uncertainty due to incomplete data (Seidell, 1999*b*).

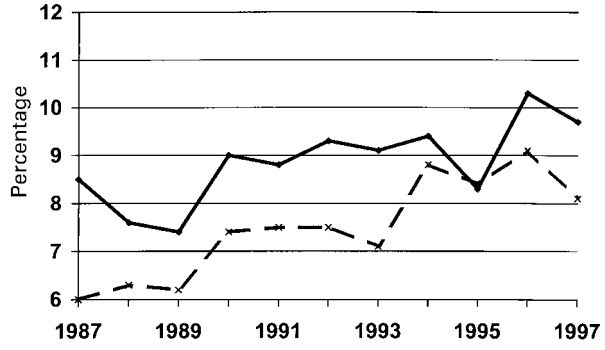

Fig. 2. Time trends in the prevalence of obesity (BMI > 30 kg/m^2) in the Monitoring of Risk Factors and Health Study in the Netherlands (MORGEN) project, ages 20–65, 1993–97. Solid line, women; broken line, men.

The socio-economic dimensions of obesity are very important, especially on a world scale. In most affluent countries obesity is typically seen in those with lowest socio-economic status. Molarius *et al.* (2000) assessed the recent time trends of the relation between educational level and the degree of obesity in mainly European centres participating in the MONICA Study. Their analysis suggests that these time trends are generally increasing. This is not seen everywhere. In the USA, similar time trends in obesity prevalence were seen across all ethnic and socio-economic groups. This suggests that in some countries the environmental changes in determinants of obesity are affecting everybody, whereas in other countries those with relatively high socio-economic status seem to be able to prevent obesity to some degree. In countries undergoing economic transition, such as China, obesity is more common in those with low socio-economic status in urban areas but less common in those with relatively high socio-economic status in rural areas (Popkin *et al.* 1993).

One very interesting illustration of the changing socio-economic dimensions can be found in a paper by Monteiro *et al.* (2000) who studied time trends in Brazil by income and degree of urbanization. Their results show rapid increases in obesity in Brazilian men in all groups (Fig. 3), although the levels of obesity in those with low income from rural areas are still only slightly higher than 1 %. This is low compared to the prevalence of about 10 % in urban men with high incomes. In women the situation is quite different. Obesity rates are generally higher compared to men in all groups. There were rapid continuing increases in obesity in women with low income, but in those with high income there seems to be a stabilization or even a decline (Fig. 4). Such data highlight the profound effect of socio-economic conditions on the prevalence of obesity.

Egger & Swinburn (1997), in a similar vein, have argued that obesity should be regarded as a normal response to an abnormal environment rather than *vice versa*. In many societies obesity is still regarded as a personal disorder that requires individual treatment. Although there is a great challenge to treat people who are currently obese, there seems to be an overemphasis on commercial activities focused on weight loss. However laudable such initiatives may be, this does very little to stem the growing epidemic.

In terms of prevention, most people in public health

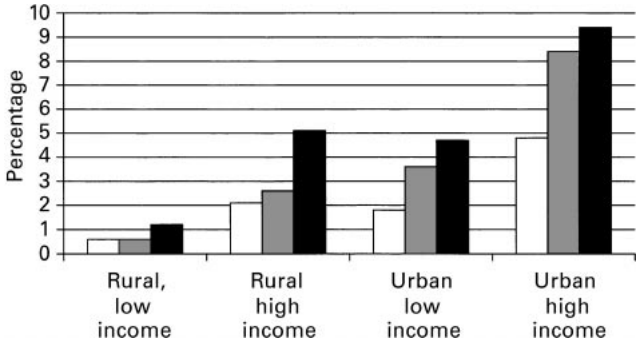

Fig. 3. Time trends in the prevalence of obesity (BMI > 30 kg/m^2) in Brazil by income (highest and lowest quartile of income) and degree of urbanization in men (adapted from Monteiro *et al.* 2000). White bars, 1975; grey, 1989; black, 1997.

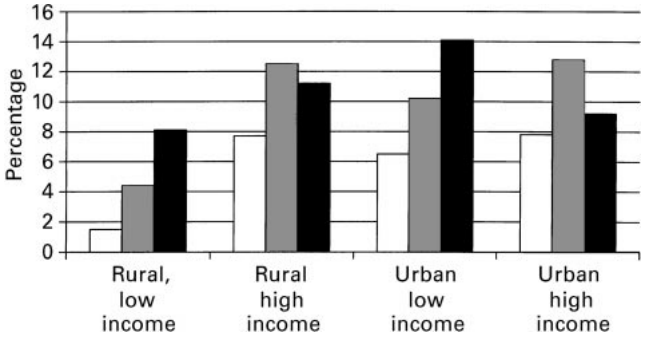

Fig. 4. Time trends in the prevalence of obesity (BMI > 30 kg/m^2) in Brazil by income (highest and lowest quartile of income) and degree of urbanization in women (adapted from Monteiro *et al.* 2000). White bars, 1975; grey, 1989; black, 1997.

consider that prevention of obesity is just part of health promotion in general. Educational efforts to promote physical activity and improvement of nutritional habits should do the trick and keep weights in the normal range or even promote weight loss in those already overweight or obese. As is evidenced by many examples of health promotion campaigns, such efforts may be quite successful (but not always) in reducing incidence of coronary heart disease through an influence on blood pressure levels, serum cholesterol and smoking cessation. There are many examples of opposite trends in cardiovascular disease and its main determinants and time trends in obesity. A good example is the situation in Finland where from 1972 to 1992 there was a 55 % reduction in mortality from ischaemic heart disease among men and 68 % in women, which could largely be explained by changes in serum cholesterol, blood pressure and smoking (Vartiainen *et al.* 1994). Similarly, two-thirds of the 66 % reduction in stroke mortality in men (60 % in women) could be explained by these risk factors (Vartiainen *et al.* 1995). Cholesterol fell by about 1 mmol/l and most of this could be accounted for by dietary change (Pietinen *et al.* 1996*a*). In the meantime, however the prevalence of obesity almost doubled in men from 11 % in 1972 to 21 % in 1992 in North Karelia and the Kuopio Province (where the greatest reduction in CHD was achieved) (Pietinen *et al.* 1996*b*). In women the prevalence of obesity decreased somewhat from 22 % in 1972 to 18 % in 1992 in North Karelia and remained at 22 % in Kuopio

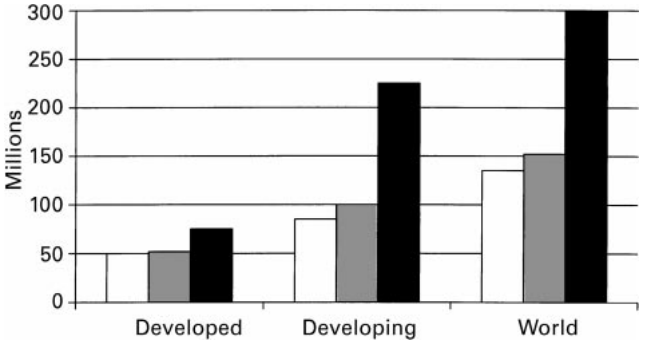

Fig. 5. Projected numbers of diabetics in the World by 2025 (adapted from King *et al.* 1998). White bars, 1995; grey, 2000; black, 2025.

(although briefly dipping to 16 % in 1982). Williamson summarized the effect of community-based health education trials on body weight (Williamson, 1996). Among the reasons cited for the lack of effectiveness were:

(1) opposing messages from other groups such as 'food marketers' (i.e. advertising and product promotion)
(2) most people are already highly interested in weight control with very little added effect of further education
(3) usually people are asked to change many types of behaviour simultaneously which may have reduced the specific effect on weight loss
(4) 'deeply ingrained behaviours with strong hedonic value may ultimately not be amenable to educational intervention and require stronger economic and regulatory interventions to permanently alter the environment rather than individuals' educational levels' (Williamson, 1996)
(5) smoking cessation is blunting or opposing effects of weight control
(6) the emphasis on a reduction in fat consumption may not lead to low energy intakes (see also Seidell, 1999*a*, *c*).

Robert W. Jeffery and Simone A. French are among those who have most seriously tried to prevent weight gain in populations at high risk of developing obesity. In their most recent study (the pound of prevention study), individuals in intervention groups reported favourable changes over time in frequency of weighing and healthy dieting practices. However, weight gain over 3 years was not significantly different between the intervention and control groups (Jeffery & French, 1999). In short, obesity rates in the population are quite resistant to efforts aimed at modification of individual lifestyle. Egger & Swinburn (1997) have further explored the possibility that these efforts are so unsuccessful because there are so many counteracting environmental influences acting at a macro level (the population level) or at a micro level (the level of the individual). Food intake and physical activity are influenced in many ways through aspects of the physical, economic and socio-cultural environments (Egger & Swinburn, 1997). Such 'obesogenic' environments may completely overwhelm educational efforts, and structural approaches may be necessary.

Again to quote the WHO World Health Report (1998*a*; 1, p. 87): 'Obesity is becoming one of the most important contributors to ill health'. Prevention of obesity and appropriate management of those already obese is therefore of great importance to public health. There will, however, be no easy or popular strategies to successfully prevent further increases in the global prevalence of obesity. The main reason is that obesity is a side-effect of our and our ancestors' continuous struggle to reach a state of complete food security with a continuous and abundant supply, as well as to reduce hard physical labour and exertion as much as possible in our daily lives. Effective strategies will have to trade off with the general population how much of this achievement they are willing to give up in return for improved health and quality of life.

The worldwide epidemic of type II diabetes mellitus

The World Health Organisation has predicted that the number of diabetics will double from 143 million in 1997

to about 300 million in 2025, largely because of dietary and other lifestyle factors. The incidence of type II diabetes is closely linked to obesity. It has been calculated that in white people around 65–75 % of incident cases of diabetes could be avoided if the whole population would not exceed a BMI of 25 kg/m^2 (Seidell, 1998). Adult weight gain, the degree of obesity and the duration of obesity are all independently and strongly predicting the risk of type II diabetes (Wannamethee & Shaper, 1999).

There are many indications, however, that in other ethnic groups (particularly of Asian origin) the risk of diabetes starts to increase rapidly at levels of BMI or waist circumference well in the acceptable range of BMI or waist for Europeans (Kosaka *et al.* 1996). This may imply that cut-off points, as recommended for white populations (BMI $>$ 30 kg/m^2, waist larger than 88 cm in women or 102 cm in men) have little value for identifying Asian individuals at high risk who constitute more than half of the world's population. Lowering the cut-off points, however, will further dramatically increase the number of overweight and obese individuals worldwide.

The sensitivity to develop diabetes, particularly in these populations, is probably one of the main reasons why King *et al.* (1998) have projected that most of the increase in the prevalence of type II diabetes is to be expected in developing countries. The countries with the largest numbers of diabetics in 2025 will be India, China and the USA (King *et al.* 1998). Diabetes is also by far the most important of the direct and indirect costs associated with obesity (Wolf & Colditz, 1998).

King *et al.* (1998) recommend worldwide surveillance of diabetes as a necessary first step towards its prevention and control, and this is now endorsed by WHO (1998*a*). The prevention of diabetes will have to follow the same paths as discussed under the prevention of obesity. To have separate initiatives and task forces for the prevention of obesity and diabetes, as is currently the case, is not tenable in the future and clearly these efforts should merge soon.

Conclusions

Both obesity and type 2 diabetes are common consequences of changing lifestyles (increasingly sedentary lifestyles and increased energy density of diets). Both are potentially preventable through lifestyle modification on a population level, but this requires a coherent and multifaceted strategy. Such strategies have not been developed or implemented. These developments indicate the great urgency for development of global and national plans for adequate prevention and management of obesity and type 2 diabetes mellitus.

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