Overweight and obesity: the public health burden

A

This section of the toolkit focuses on the public health case for developing a local overweight and obesity strategy.

What are 'overweight' and 'obesity'?

Overweight and obesity are terms used to describe increasing degrees of excess body fatness which can lead to increasingly adverse effects on health and wellbeing. Potential problems include respiratory difficulties, chronic musculoskeletal problems, depression, relationship problems and infertility. The more life-threatening problems fall into four main areas: cardiovascular disease problems; conditions associated with insulin resistance such as type 2 diabetes; certain types of cancers, especially the hormonally related and large bowel cancers; and gallbladder disease.[1] (For more on the conditions associated with obesity, see page 21.)

The likelihood of developing life-threatening problems such as type 2 diabetes rises steeply with increasing body fatness. Hence, there is a need to identify the ranges of weight at which health risks to individuals increase, using simple assessment methods such as Body Mass Index (BMI).

Methods of assessing overweight and obesity in adults

Body Mass Index

Overweight and obesity ranges are commonly assessed by using Body Mass Index (BMI), which is defined as the person's weight in kilograms divided by the square of their height in metres (kg/m^2). BMI is used because, for most people, it correlates with their proportion of body fat. The National Institute for Health and Clinical Excellence (NICE) has classified overweight and obesity according to BMI as shown in Table 1 on the next page.[2] 'Overweight' is classified as a BMI of 25 to 29.9kg/m^2 and 'obesity' is classified as a BMI of 30kg/m^2 or more. This classification accords with that recommended by the World Health Organization (WHO).[3]

NICE recommends that the BMI measurement should be interpreted with caution because it is not a direct measure of adiposity (amount of body fat).

Table 1 NICE classification of overweight and obesity in adults

Classification	BMI (kg/m^2)
Healthy weight	18.5 - 24.9
Overweight	25 - 29.9
Obesity I	30 - 34.9
Obesity II	35 - 39.9
Obesity III (Severely or morbidly obese)	40 or more

Source: National Institute for Health and Clinical Excellence [2]

The concept of different cut-offs for different ethnic groups has been proposed by the WHO because some ethnic groups, notably Asians, have higher cardiovascular and metabolic risks at lower BMIs. This may be because of differences in body shape and fat distribution. However, in the absence of universal agreement on this, including the levels of the different cut-offs, NICE recommends that the same cut-off points as those shown in Table 1 (above) be used to classify overweight and obesity in all ethnic groups in the UK.[2] * This approach is supported by the Department of Health and the Food Standards Agency.

Note: Although BMI is used as a common method of assessing overweight and obesity, it does not distinguish between mass due to body fat and mass due to muscular physique, so other methods of measurement, particularly waist circumference and waist-hip ratio, can be used to find out more about the proportion and distribution of body fat.

Waist circumference

The waist circumference measurement is used to assess a patient's abdominal fat content or 'central' fat distribution. Central obesity is linked to a higher risk of type 2 diabetes and coronary heart disease. NICE recommends that waist circumference may be used, in addition to BMI, to assess risk in people with a BMI of less than 35kg/m^2.(2) The currently recognised waist circumference thresholds used to assess health risks in the general population are shown in Table 2.

Table 2 Waist circumference thresholds used to assess health risks in the general adult population

At increased risk	Male	Female
Increased risk	94cm (37 inches) or more	80cm (31 inches) or more
Greatly increased risk	102cm (40 inches) or more	88cm (35 inches) or more

Source: National Institute for Health and Clinical Excellence (2006),[2] International Diabetes Federation (2005),[5] WHO/IASO/IOTF (2000),[4] and World Health Organization (2000)[3]

Different waist circumference cut-offs for different ethnic groups have been proposed by the World Health Organization[4] and the International Diabetes Federation.[5] ** This is because ethnic populations differ in the level of risk associated with a particular waist circumference. For example, in South Asians (of Pakistani, Bangladeshi and Indian origin) living in England, a given waist circumference tends to be associated with more features of the metabolic syndrome (see page 23) than in Europeans.[2] However, because a globally applicable grading system of waist circumference for ethnic populations has not yet been developed, NICE does not recommend separate waist circumference cut-offs for different ethnic groups in the UK.[2]

* A proposed classification of overweight and obesity for Asian adult populations has been developed by the World Health Organization (WHO).[4] The proposed cut-offs are 18.5-22.9kg/m^2 (healthy weight), 23 kg/m^2 or more (overweight), 23-24.9kg/m^2 (at risk), 25-29.9kg/m^2 (obesity I), 30kg/m^2 or more (obesity II).

** The International Diabetes Federation (IDF) and the WHO have proposed waist circumference thresholds for Asian adult populations of 90cm (35 inches) or more for men, and 80cm (31 inches) or more for women.[3-5] Note that the IDF definition is for South Asians and Chinese populations only.

Waist-hip ratio

Waist-hip ratio is another measure of body fat distribution. The waist-hip measurement is defined as waist circumference divided by hip circumference, ie waist girth (in metres)/hip girth (in metres). Although there is no consensus about appropriate waist-hip ratio thresholds, a raised waist-hip ratio is commonly taken to be 1.0 or more in men, and 0.85 or more in women.[2, 4] However, neither NICE[2] nor the Department of Health[6] recommends the use of waist-hip ratio as a standard measure of overweight or obesity.

Methods of assessing overweight and obesity in children and young people

Body mass index

The National Institute for Health and Clinical Excellence (NICE) recommends that BMI (adjusted for age and gender) should be used as a practical estimate of overweight in children and young people despite there being no universally accepted BMI-based classification system for childhood obesity. The BMI measurement in children and young people should be related to the UK 1990 BMI growth reference charts to give age- and gender-specific information. Pragmatic indicators for action have been recommended as the 91st centile for overweight, and the 98th centile for obesity.[2]

Waist circumference

Waist circumference is not currently recommended as a means of diagnosing childhood obesity as there is no clear threshold for waist circumference associated with morbidity outcome in children and young people.[7] Thus, NICE recommends that waist circumference is not used as a routine measurement in children and young people, but may be used to give additional information on the risk of developing other long-term health problems.[2]

Tools 3-6 give more information about the various methods for the measurement and assessment of overweight and obesity in adults and children.

Prevalence and trends of overweight and obesity

Prevalence of overweight and obesity among adults

KEY FACTS

Prevalence

According to the latest figures (2005), 22.1% of men and 24.3% of women are obese and almost two-thirds of all adults – approximately 31 million adults – are either overweight or obese. The proportion who are severely (morbidly) obese (with a BMI over 40kg/m^2) is 0.9% in men and 2.7% in women.[8]

Age

- In both men and women, mean BMI (kg/m^2) generally increases with age, apart from in the oldest age group (those aged 75 plus).[8]
- Among those aged 25-74, almost three-quarters (71.6%) of men are overweight or obese, and more than half of women are overweight or obese (61.1%).[8]
- In men, the proportion who are severely obese (with a BMI over 40kg/m^2) is highest in those aged 55-64 (1.8%), and in women in those aged 45-54 (4.3%).[8]
- In both men and women aged 16-74 years, prevalence of raised waist circumference increases with age.[9]

Gender

- Mean BMI levels are the same for men and women (26.9kg/m^2).[8]
- A greater proportion of men (42.6%) are overweight than women (32.1%).[8]
- Approximately three times as high a proportion of women (2.7%) as men (0.9%) are severely obese.[8]
- Raised waist circumference is more prevalent in women (41%) than men (31%).[9]

Sociocultural patterns

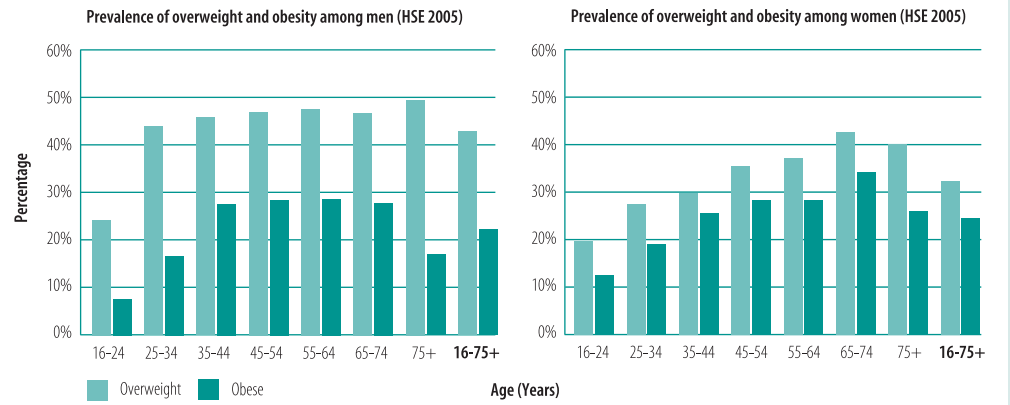
- Overweight and obesity are more common in lower socioeconomic and socially disadvantaged groups, particularly among women.[10]
- Women's obesity prevalence is far lower in managerial and professional households (18.7%) than in households with routine or semi-routine occupations (29.1%).[9]
- The prevalence of morbid obesity (BMI over 40kg/m^2) among women is also lower in managerial and professional households (1.6%) than in households with routine or semi-routine occupations (4.1%).[9]

Ethnic differences

- In women, the mean BMI is markedly higher in Black Caribbeans (28.0kg/m^2) and Black Africans (28.8kg/m^2) than in the general population (26.8kg/m^2), and markedly lower in Chinese (23.2kg/m^2).[11]
- In men, the mean BMI of Chinese (24.1kg/m^2) and Bangladeshis (24.7kg/m^2) is significantly lower than that of the general population (27.1kg/m^2).[11]
- The increase in waist circumference with age occurs in all ethnic groups for both men and women.[11]

Notes: The Health Survey for England (HSE) figures are weighted to compensate for non-response. (Before the HSE 2003, data were not weighted for non-response.)
A raised waist circumference is defined as 102cm or more for men, and 88cm or more for women.[9]

Figure 1 Prevalence of overweight and obesity among adults, by age and sex, England, 2005



Note: Figure 1 uses the Health Survey for England figures which are weighted to compensate for non-response.

Source: Health Survey for England 2005 [8]

Table 3 Prevalence of obesity and central obesity among adults aged 16 and over living in England, by ethnic group, 2003/2004

Figures are from the *Health Survey for England 2004: The health of ethnic minority groups*,[11] except for those marked 'HSE 2003', which are from the *Health Survey for England 2003*. [9]

GENDER	Black Caribbean	Black African	Indian	Pakistani	Bangladeshi	Chinese	General population
Men							
Overweight (including obese)	67.4%	61.8%	53.2%	55.5%	44.4%	36.8%	66.5%
Obese (including severely obese)	25.2%	17.1%	13.8%	15.1%	5.8%	6.0%	22.7%
Severely obese	0.2%	0.3%	0.4%	1.0%	0.3%	0.3%	0.9%
Raised waist-hip ratio (HSE 2003)	25.0%	16.0%	36.0%	37.0%	32.0%	17.0%	33.0%
Raised waist circumference (HSE 2003)	22.0%	19.0%	20.0%	30.0%	12.0%	8.0%	31.0%
Women							
Overweight (including obese)	64.5%	69.8%	55.2%	62.3%	50.8%	24.9%	57.1%
Obese (including severely obese)	32.1%	38.5%	20.2%	28.1%	17.2%	7.6%	23.2%
Severely obese	4.2%	5.0%	1.2%	2.1%	0.6%	0.3%	2.4%
Raised waist-hip ratio (HSE 2003)	37.0%	32.0%	30.0%	39.0%	50.0%	22.0%	30.0%
Raised waist circumference (HSE 2003)	47.0%	53.0%	38.0%	48.0%	43.0%	16.0%	41.0%

Note: The prevalence figures in this table are weighted to compensate for non-response in different groups.

Source: Health Survey for England 2004: The health of ethnic minority groups,[11] and Health Survey for England 2003 [9]

Trends in overweight and obesity among adults

KEY FACTS

- There has been a marked increase in the levels of obesity (BMI above 30kg/m^2) among adults in England. The proportion of men classified as obese increased from 13.2% in 1993 to 23.1% in 2005 – a relative increase of 75%; and from 16.4% of women in 1993 to 24.8% in 2005 – a relative increase of 51%.[8]
- The prevalence of severe (morbid) obesity (BMI above 40kg/m^2) in men rose from 0.2% in 1993 to 1% in 2005 – ie it more than quadrupled. For women it rose from 1.4% to 2.9% – ie it doubled.[8]
- Mean BMI increased by 1.2kg/m^2 in men and by 1.3kg/m^2 in women between 1993 and 2005.[8]

Note: For accuracy, unweighted figures have been used for time comparisons. (Before the Health Survey for England 2003, HSE data were not weighted for non-response.)

Prevalence of overweight and obesity among children

KEY FACTS

Prevalence

- The mean BMI in girls aged 0-15 is 18.7kg/m^2 compared to 18.4kg/m^2 in boys.[8]
- Among children aged 2-10 years, 16.8% are obese and 31% are overweight (including obese). Among children aged 11-15 years, 20.6% are obese and 35.1% are overweight (including obese). Almost one-third of children aged 2-15 are overweight (including obese) (32.6%) and almost one-fifth are obese (18.3%).[8]
- A greater percentage of boys (33%) than girls (29%) aged 2-10 years are overweight (including obese), but a similar percentage of boys (16.9%) and girls (16.8%) are obese. Among children aged 11-15 years, a similar percentage of boys and girls are overweight (including obese) (35.3% and 34.9% respectively) and obese (20.4% and 20.8% respectively).[8]
- Between the ages of 2 and 10, there is a steady increase in the proportion who are overweight (including obese) and obese only, in both sexes. Also, the percentage of children who are overweight (including obese) and obese increases between 2-10 and 11-15 years, for both sexes.[8]

Sociocultural patterns

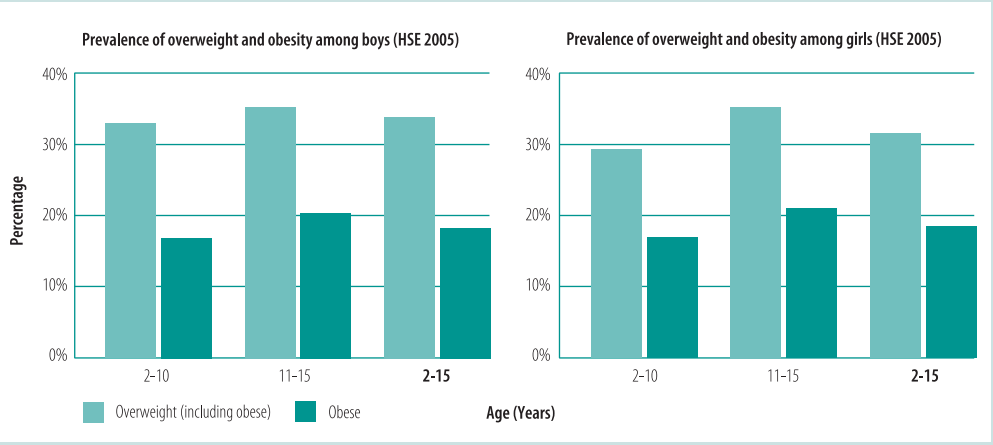
- Obesity prevalence is lowest among children in managerial and professional households (12.4%), and highest among children in routine and semi-routine households (17.1%).[12]

Ethnic differences

- Mean BMIs are significantly higher among Black Caribbean and Black African boys (19.3kg/m^2 and 19.0kg/m^2 respectively) and girls (20.0kg/m^2 and 19.6kg/m^2 respectively)[11] than in the general child population. (In 2001-2002 boys in England had a mean BMI of 18.3kg/m^2 and girls had a mean BMI of 18.7kg/m^2.)[13]
- Prevalence of overweight (including obese) among Black African (42%), Black Caribbean (39%) and Pakistani (39%) boys is significantly higher than that of the general population (30%). The same is true of Black Caribbean (42%) and Black African (40%) girls who have a markedly higher prevalence than that of the general population (31%).[11]
- Obesity is almost four times more common in Asian children than in white children.[14]

Note: The Health Survey for England (HSE) figures are weighted to compensate for non-response. (Before the HSE 2003, data were not weighted for non-response.)

Figure 2 **Prevalence of overweight and obesity among children, by age and sex, England, 2005**



Source: Health Survey for England 2005 [8]

Table 4 **Prevalence of obesity among children aged 2-15 living in England, by ethnic group, 2004**

GENDER	Black Caribbean	Black African	Indian	Pakistani	Bangladeshi	Chinese	General population (2001-02)
Boys							
Overweight	11%	11%	12%	14%	12%	8%	14%
Obese	28%	31%	14%	25%	22%	14%	16%
Overweight including obese	39%	42%	26%	39%	34%	22%	30%
Girls							
Overweight	15%	13%	11%	10%	14%	22%	15%
Obese	27%	27%	21%	15%	20%	12%	16%
Overweight including obese	42%	40%	31%	25%	33%	34%	31%

Source: Health Survey for England 2004: The health of ethnic minority groups [11]

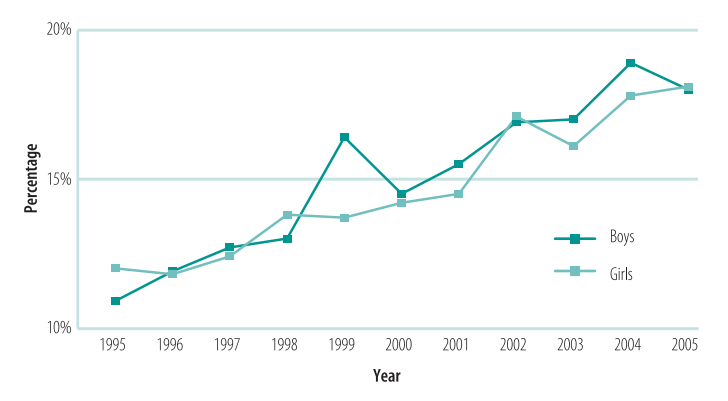
Trends in overweight and obesity among children

KEY FACTS

- Obesity among children aged 2-10 rose from 9.9% in 1995 to 16.7% in 2005 – an increase of 69%. Among 11-15 year olds, obesity rose from 14.4% in 1995 to 20.5% in 2005 – an increase of 42%.[8]
- The proportion of children aged 2-10 classified as overweight (including obese) increased from 22.7% in 1995 to 30.9% in 2005 – an increase of 36%. For 11-15 year olds, levels increased from 28.1% in 1995 to 35% in 2005 – an increase of 25% [8]
- There has been a marked gender difference for children aged 2-15 years. Among boys, the proportion of overweight (including obese) rose from 24% in 1995 to 33.9% in 2005 – an increase of 41%; and among girls, from 25% in 1995 to 31% in 2005 – an increase of 24%.[8]
- Between 1995 and 2001, mean BMI (kg/m^2) increased among boys (from 17.6kg/m^2 to 18.1kg/m^2). Among girls aged 0-15, mean BMI (kg/m^2) increased from 18.2kg/ BMI (kg/m^2) in 2001 to 18.6kg/m^2 in 2005, but there was no significant increase among boys aged 0-15 over that same period.[8]

Note: For accuracy, unweighted figures have been used for time comparisons. (Before the Health Survey for England 2003, HSE data were not weighted for non-response.)

Figure 3 **Obesity trends among children aged 2-15, England, by sex, 1995-2005**



Note: For accuracy, Figure 3 uses unweighted figures (Before the HSE 2003, data were not weighted for non-response.)

Source: Health Survey for England 2005 [8]

For more information

Forecasting obesity to 2010
P Zaninotto, H Wardle, E Stamatakis, J Mindell and J Head (2006).
London: Joint Health Surveys Unit.
Available from: www.dh.gov.uk/assetRoot/04/13/86/29/04138629.pdf

Health Survey for England 2005: Updating of trend tables to include 2005 data
The Information Centre for Health and Social Care (2006).
London: The Information Centre for Health and Social Care.
Available from: www.ic.nhs.uk/pubs/hseupdate05

Health Survey for England 2004: The health of minority ethnic groups – headline tables
The Information Centre for Health and Social Care (2006).
London: The Information Centre for Health and Social Care (2006).
Available from: www.ic.nhs.uk/pubs/hlthsvyeng2004ethnic

Health Survey for England 2003. Volume 2: Risk factors for cardiovascular disease
K Sproston and P Primatesta (eds.) (2004).
London: TSO.
Available from: www.dh.gov.uk/assetRoot/04/09/89/11/04098911.pdf

Health Survey for England 2002: The health of children and young people
K Sproston and P Primatesta (eds.) (2003).
London: TSO.
Available from: www.archive2.official-documents.co.uk/document/deps/doh/survey02/hse02.htm

Obesity among children under 11
D Jotangia, A Moody, E Stamatakis and H Wardle (2005).
London: National Centre for Social Research, Department of Epidemiology and Public Health at the Royal Free and University College Medical School.
Available from: www.dh.gov.uk/PublicationsAndStatistics/Publications/PublicationsStatistics/PublicationsStatisticsArticle/fs/en?CONTENT_ID=4109245&chk=WB/AR1

Management of obesity in children and young people. A National Clinical Guideline
Scottish Intercollegiate Guidelines Network (2003).
Edinburgh: SIGN.
Available from: www.sign.ac.uk/guidelines/fulltext/69/index.html

Storing up problems. The medical case for a slimmer nation
Working Party of the Royal College of Physicians of London, Royal College of Paediatrics and Child Health, and Faculty of Public Health (2004).
London: Royal College of Physicians of London.

The health burden of overweight and obesity

Premature mortality

It has long been known that obesity is associated with premature death. Obesity increases the risk of a number of diseases including the two major killers – cardiovascular disease and cancer. It is estimated that, on average, obesity reduces life expectancy by between 3 and 13 years – the excess mortality being greater the more severe the obesity and the earlier it develops.[15]

Obesity-related morbidity

In public health terms, the greatest burden of disease arises from obesity-related morbidity. Table 5 gives details of the health problems associated with obesity.

Table 5 Relative risks of health problems associated with obesity

Greatly increased risk *(Relative risk much greater than 3)*	Moderately increased risk *(Relative risk 2-3)*	Slightly increased risk *(Relative risk 1-2)*
• Type 2 diabetes • Insulin resistance • Gallbladder disease • Dyslipidaemia (imbalance of fatty substances in the blood, eg high cholesterol) • Breathlessness • Sleep apnoea (disturbance of breathing)	• Coronary heart disease • Hypertension (high blood pressure) • Stroke • Osteoarthritis (knees) • Hyperuricaemia (high levels of uric acid in the blood) and gout • Psychological factors	• Cancer (colon cancer, breast cancer in postmenopausal women, endometrial [womb] cancer) • Reproductive hormone abnormalities • Polycystic ovary syndrome • Impaired fertility • Low back pain • Anaesthetic risk • Foetal defects associated with maternal obesity

Note: All relative risk estimates are approximate. The relative risk indicates the risk measured against that of a non-obese person of the same age and sex. For example, an obese person is two to three times more likely to suffer from hypertension than a non-obese person.

Source: Adapted from World Health Organization, 2000 [3]

The associated health outcomes of childhood obesity are similar to those of adults and include: [7, 16]

- hypertension (high blood pressure)
- dyslipidaemia (imbalance of fatty substances in the blood)
- hyperinsulinaemia (abnormally high levels of insulin in the blood).

(The above three abnormal findings constitute the 'metabolic syndrome' – see page 23.)

Other possible consequences for children and young people include:

- mechanical problems such as back pain and foot strain
- exacerbation of asthma

- psychological problems such as poor self-esteem, being perceived as unattractive, depression, disordered eating and bulimia
- type 2 diabetes.

Some of these problems appear in childhood, while others appear in early adulthood as a consequence of childhood obesity. The most important long-term consequence of childhood obesity is its persistence into adulthood and the early appearance of obesity-related disorders and diseases normally associated with middle age, such as type 2 diabetes and hypertension. Studies have shown that the higher a child's BMI (kg/m^2) and the older the child, the more likely they will be an overweight or obese adult.[17] Furthermore, research has demonstrated that the offspring of obese parents have a greater risk of becoming overweight or obese adults,[18] increasing the likelihood of developing such health problems later in life.

Conditions associated with obesity

Type 2 diabetes

Perhaps the most common obesity-related co-morbidity, and that which is likely to cause the greatest health burden, is type 2 diabetes. Around 70% of type 2 diabetes appears to be related to having a BMI over 25kg/m^2. With increasing weight, the risk of developing type 2 diabetes increases exponentially.[19] At a BMI of 35kg/m^2 a woman is more than 80 times more likely and a man more than 40 times more likely to develop type 2 diabetes than at a BMI of 22kg/m^2. [(20)] For women, the Nurses' Health Study showed that the single most important risk factor for type 2 diabetes was overweight and obesity.[21] The risk is especially high for women with a central pattern of fat distribution, characterised by a large waist circumference (often described as 'apple-shaped') and often mediated through the metabolic syndrome (see page 23). The risk is less for women with a similar BMI who tend to deposit their excess fat on the hips and thighs ('pear-shaped').[15] For men, data from the Health Professionals Follow-up Study indicated that a western diet (high consumption of red meat, processed meat, high-fat dairy products, French fries, refined grains, and sweets and desserts), combined with lack of physical activity and excess weight (BMI in excess of 30kg/m^2), dramatically increases the risk of developing type 2 diabetes.[22]

Coronary heart disease

Coronary heart disease is often associated with weight gain and obesity. In general, the relationship between BMI and coronary heart disease is stronger for women than for men. At a BMI of 26kg/m^2, women are two times more likely and men are one and a half times more likely to develop coronary heart disease than at a BMI of 21kg/m^2. [(23)]

For women, the Nurses' Health Study showed a clear relationship between coronary heart disease and elevated BMI even after controlling for other factors such as age, smoking, menopausal status and family history. The risk of coronary heart disease increased two-fold with a BMI between 25 and 28.9kg/m^2, and three-fold (3.6) for a BMI above 29kg/m^2, compared with women with a BMI of less than 21kg/m^2. [(15, 24)]

For men younger than 65 years, a US study showed that there was an increased risk of coronary heart disease the higher the BMI. At a BMI of 25-28.9kg/m^2, men were one and a half times (1.72) at risk, at a BMI of 29.0-32.9kg/m^2 men were two and a half times (2.61) at risk, and at a BMI of more than 33.0kg/m^2 men were three and a half times at risk, compared with the risk at a BMI of less than 23kg/m^2. [(25)]

Hypertension (high blood pressure) and stroke

The Framingham Heart Study estimated that 75% of the cases of hypertension in men and 65% of the cases in women are directly attributable to overweight/obesity.[26] Long duration obesity does not appear necessary to elevate blood pressure as the relationship between obesity and hypertension is evident in children.[27]

Overweight/obesity is thought to be a major risk factor in stroke. Several studies have shown an increased risk for stroke with increasing BMI (kg/m^2) but others have found no association. In some studies there was an association with waist-to-hip ratio, but not BMI, suggesting that central obesity rather than general obesity is the key factor.[28] In a 28-year study of men in mid-life, it was found that obesity can have a significant impact on stroke risk, doubling its likelihood later in life. Men with a BMI of between 20kg/m^2 and 22.49kg/m^2 were significantly less likely to suffer a stroke than those with a BMI of more than 30kg/m^2.[(28)]

Metabolic syndrome

Metabolic syndrome refers to a cluster of risk factors related to a state of insulin resistance, in which the body gradually becomes less able to respond to the metabolic hormone insulin. People with the metabolic syndrome have an increased risk of developing coronary heart disease, stroke and type 2 diabetes.[29] The component risk factors related to insulin resistance are:

- increased waist circumference
- high blood pressure
- high blood glucose
- high serum triglyceride
- low blood HDL cholesterol (the 'good' cholesterol).

The development and severity of all the components are linked to the predominant risk factor of central obesity. Previously known as Syndrome X, metabolic syndrome is becoming increasingly common although the true prevalence of the disease is unknown. In the UK, it is estimated that as much as 25% of the adult population show clear signs of the metabolic syndrome,[30] a figure which is expected to increase in parallel with the rising epidemic of obesity.[31] Incidence has been found to be higher in certain ethnic sub-groups such as Asian and African-Caribbean groups.[32] In addition, it has been noted that in people with normal glucose tolerance, the prevalence of the metabolic syndrome increases with age and is higher in men than women, but these differences are not seen in diabetic patients.[33] Childhood obesity is a powerful predictor of the metabolic syndrome in early adulthood.[10]

Dyslipidaemia

Obesity is associated with dyslipidaemia. It is characterised by increased triglycerides, elevated LDL cholesterol (the 'bad' cholesterol) and decreased concentrations of HDL cholesterol (the 'good' cholesterol).[34] On average, the more fat, the more likely an individual will be dyslipidaemic and to express elements of the metabolic syndrome. However, location of fat, age and gender are important modifiers of the impact of obesity on blood lipids:

- *Location of fat* – Fat cells exert the most damaging impact when they are centrally located because compared to peripheral fat, central fat is insulin resistant and more rapidly recycles fatty acids.[35]
- *Age* – Among the obese, younger people have relatively larger changes in blood lipids at any given level of obesity.[34]
- *Gender* – Among overweight women, excess body weight seems to be associated with higher total, non-HDL and LDL cholesterol levels, higher triglyceride levels, and lower HDL cholesterol levels. Total cholesterol to HDL cholesterol ratios seem to be highest in obese postmenopausal women, due to the much lower HDL cholesterol concentrations.[34]

Cancer

Research suggests that, in women, obesity increases the risk of various types of cancer, including colon, breast (postmenopausal), endometrial (womb), cervical, ovarian and gallbladder cancers; and in men, obesity increases the risk of colorectal and prostate cancer. The clearest association is with cancer of the colon, for which obesity increases the risk by nearly three times in both men and women.[36] Obesity is estimated to account for 20% of cancer deaths in women.[37]

Gallbladder disease

Obesity is an established predictor of gallbladder disease. The risk of developing the disease increases with weight gain although it is unclear how being overweight or obese may cause gallbladder disease. However, the most common reason for gallbladder disease is gallstones, for which obesity is a known risk factor. Research suggests that 30% of overweight and obese people have gallstones compared to 10% of non-obese persons.[38]

Reproductive problems

Obesity, especially morbid or severe obesity (defined as a BMI of 40kg/m^2 or over), is linked to infertility and an increased risk of complications during pregnancy. These include hypertension, pre-eclampsia, gestational diabetes and an increased risk of foetal abnormalities including neural tube defects.[15]

Mechanical disorders such as osteoarthritis and low back pain

Osteoarthritis, or degenerative disease of the weight-bearing joints such as the knee, is a very common complication of obesity, and causes a great deal of disability. Pain in the lower back is also frequently suffered by obese people, and may be one of the major contributors to obesity-related absences from work. It is likely that the excess weight alone, rather than any metabolic effect, is the cause of these problems.[36]

Obstructive sleep apnoea

A number of respiratory disorders are exacerbated by obesity, the most serious of which is obstructive sleep apnoea (OSA), a condition characterised by short repetitive episodes of impaired breathing during sleep. It has been estimated that as many as 60-70% of people suffering from OSA are obese.[39] Obesity, especially in the upper body, increases the risk of OSA by narrowing the individual's upper airway. OSA can increase the risk of high blood pressure, angina, cardiac arrhythmia, heart attack and stroke.

Breathlessness

Breathlessness on exertion is a very common symptom in the obese.[40] For example, in a large epidemiological survey, 80% of obese middle-aged subjects reported shortness of breath after climbing two flights of stairs compared with only 16% of similarly aged non-obese controls, and this was despite smoking being significantly less frequent in the obese.[41] In another study of patients with type 2 diabetes, one-third reported troublesome shortness of breath and its severity increased with BMI.[42] Importantly, breathlessness in the obese may be due to any of several factors including co-existent (but often obesity-related) cardiac disease, unrelated respiratory disease or the effects of obesity itself on breathing, although it is not clear whether breathlessness at rest can be attributable to obesity.[40]

Psychological factors

Psychological damage caused by overweight and obesity is a huge health burden.[43]

In childhood, overweight and obesity are known to have a significant impact on psychological wellbeing, with many children developing a negative self-image, lowered self-esteem and a higher risk of depression. In addition, almost all obese children have experiences of teasing, social exclusion, discrimination and prejudice.[44-48] In one study, it was shown that children as young as six demonstrated negative perceptions of their obese peers.[49]

In adults, the consequences of overweight and obesity have led to clinical depression, with rates of anxiety and depression being three to four times higher among obese individuals.[50] Obese women are around 37% more likely to commit suicide than women of normal weight.[43] Stigma is a fundamental problem. Many studies (for example: Gortmaker *et al*, 1993;[51] Wadden and Stunkard, 1985[49]) have reported widespread negativity regarding obese people, particularly in terms of sexual relations. The psychological experiences of overweight and obesity are extremely complex and linked to culture and societal values and 'norms'.

The health benefits of losing excess weight

Weight loss in overweight and obese individuals can improve physical, psychological and social health. There is good evidence to suggest that a moderate weight loss of 5-10% of body weight in obese individuals is associated with important health benefits, particularly in a reduction in blood pressure and a reduced risk of developing type 2 diabetes and coronary heart disease.[52, 53] Table 6 shows the results of losing 10kg.[54]

Table 6 The benefits of a 10kg weight loss

	Benefit
Mortality	• More than 20% fall in total mortality • More than 30% fall in diabetes-related deaths • More than 40% fall in obesity-related cancer deaths
Blood pressure (in hypertensive people)	• Fall of 10mmHg systolic blood pressure • Fall of 20mmHg diastolic blood pressure
Diabetes (in newly diagnosed people)	• Fall of 50% in fasting glucose
Lipids	• Fall of 10% of total cholesterol • Fall of 15% of low density lipoprotein (LDL) cholesterol • Fall of 30% of triglycerides • Increase of 8% of high density lipoprotein (HDL) cholesterol
Other benefits	• Improved lung function, and reduced back and joint pain, breathlessness, and frequency of sleep apnoea • Improved insulin sensitivity and ovarian function

Source: Adapted from Jung, 1997; [54] Mulvihill and Quigley, 2003 [16]

In relation to reduction in co-morbidities, the Diabetes Prevention Program in the US has shown that, among individuals with impaired glucose tolerance, a 5-7% decrease in initial weight reduces the risk of developing type 2 diabetes by 58%.[55]

It is important to recognise that, for very obese people, such changes will not necessarily bring them out of the 'at-risk' category, but there are nevertheless worthwhile health gains. A continuous programme of weight reduction should be maintained to help continue to reduce the risks.

Weight reduction in overweight and obese people can improve self-esteem and can help tackle some of the associated psychosocial conditions. It should not be forgotten that small changes can have a positive impact on the overall health and wellbeing of individuals by increasing mobility, energy and confidence.

For more information

Obesity: the prevention, identification, assessment and management of overweight and obesity in adults and children
National Institute for Health and Clinical Excellence (NICE) (2006).
London: NICE.
Available from: www.nice.org.uk/guidance/CG43

Easing the pressure: tackling hypertension. A toolkit for developing a local strategy to tackle high blood pressure
Faulty of Public Heath and the National Heart Forum (2005).
London: Faculty of Public Health and National Heart Forum.
Available from: www.heartforum.org.uk/downloads/nhfhypefull.pdf

National Obesity Forum training resource for health professionals
National Obesity Forum.
London: National Obesity Forum.
Available from: nationalobesityforum.org.uk/content/blogcategory/62/133

Obesity in Scotland. Integrating prevention with weight management. A National Clinical Guideline recommended for use in Scotland (Under review)
Scottish Intercollegiate Guidelines Network (1996).
Edinburgh: SIGN.
Available from: www.sign.ac.uk/pdf/sign8.pdf

Obesity: Preventing and managing the global epidemic. Report of a WHO consultation
Technical Report Series 894(3).
World Health Organization (2000).
Geneva: WHO.

Obesity: Third report of session 2003-2004, volume 1
House of Commons Health Select Committee (2004).
London: TSO.
Available from: www.publications.parliament.uk/pa/cm200304/cmselect/cmhealth/23/23.pdf

Storing up problems: The medical case for a slimmer nation
Working Party of the Royal College of Physicians of London, Royal College of Paediatrics and Child Health, and Faculty of Public Health (2004).
London: Royal College of Physicians of London.

Tackling obesity in England
National Audit Office (2001).
London: TSO.
Available from: www.nao.org.uk/publications/nao_reports/00-01/0001220.pdf

The economic burden of overweight and obesity

KEY FACTS

The House of Commons Health Select Committee[43] estimated that, in England in 2002*:

- the economic costs of obesity were between £3.3 billion and £3.7 billion per year and the costs of overweight plus obesity between £6.6 billion and £7.4 billion per year
- the direct costs of treating obesity and its consequences were between £990 million and £1,135 million (2.0-2.3% of NHS expenditure), and
- the indirect costs amounted to between £2.3 billion and £2.6 billion.

* Based on data presented in the House of Commons Health Select Committee report (2004)[43]

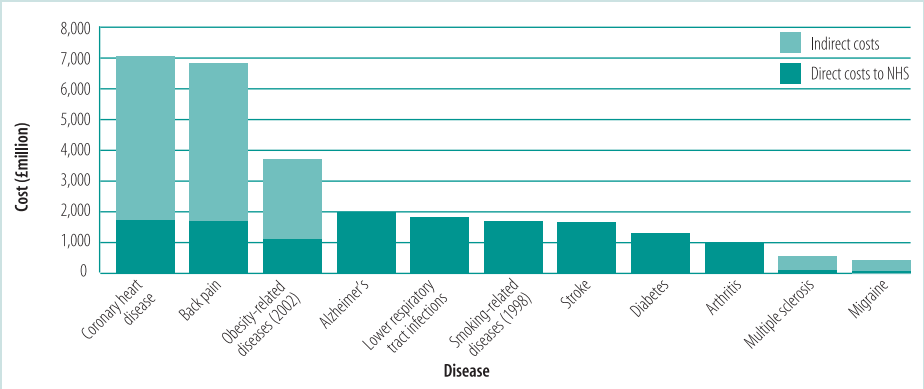
Direct costs

Illness associated with obesity gives rise to costs to the NHS. Direct costs of obesity arise from NHS consultations, diagnostic tests, drugs and other treatments of diseases attributable to obesity. The total cost for anti-obesity medication has increased rapidly since 1998 with the licensing of orlistat (a drug which reduces the absorption of fat from the diet). Following NICE guidance issued in mid-2001, the number of prescriptions for orlistat increased from 18,000 to over 540,000 in 2002.[43] Similar guidance for the other main anti-obesity drug, sibutramine (which reduces cravings to over-eat) also led to an increase in prescriptions. (Note that NICE guidance on orlistat and sibutramine has now been replaced by the NICE guideline on obesity[2]).

Indirect costs

The indirect costs of obesity are defined in terms of lost output in the economy due to sickness absence or death of workers. The House of Commons Health Select Committee report stated that in 2002 there were 15.5-16 million days of certified incapacity attributable to obesity and other co-morbidities.[43] Figure 4 shows the direct and indirect costs of selected diseases.

Figure 4 Cost of selected diseases in the UK, 1999



Note: Obesity figures are for England only.

Source: House of Commons Health Select Committee, 2004;[43] Department of Health, 1998;[56] Liu *et al*, 2002[57]

Implications of trends

It is important to consider the rapid increase in obesity over the past two decades and the possibility that this trend might continue. The current figures do not take into account that most obesity is undiagnosed and if all cases were identified and treatment sought, the NHS would not be able to cope with the demand and costs. At present, obesity is often not treated as a disease or illness but rather its medical complications are addressed.

For more information

Obesity: Costing template and **Obesity: Costing report**
National Institute for Health and Clinical Excellence (NICE) (2006).
London: NICE.
Available from: www.nice.org.uk/guidance/CG43

Obesity: Third report of session 2003-2004, volume 1
House of Commons Health Select Committee (2004).
London: TSO.
Available from: www.publications.parliament.uk/pa/cm200304/cmselect/cmhealth/23/23.pdf

Tackling obesity in England
National Audit Office (2001).
London: TSO.
Available from: www.nao.org.uk/publications/nao_reports/00-01/0001220.pdf

What causes overweight and obesity?

Many factors can play a part in causing overweight and obesity for the individual and society. Genes appear to influence the metabolism and distribution of body fat, and are thought to contribute 25-40% to the causes of overweight and obesity.[58] However, the rapid increase in levels of obesity throughout the developed world has occurred in too short a time for there to have been significant genetic changes within the population. It is therefore likely that this so-called 'epidemic' has been brought about mainly by environmental and behavioural changes which have led to a more energy-dense (high-calorie) diet and more sedentary way of life.[36]

Food intake

According to the National Food Survey, the average household energy intake (calories consumed in the home) increased from the late 1950s to a peak in 1970, and then declined by around 9% by 2004.[59] However, the National Food Survey does not take account of food and drink purchased and eaten outside the home, or alcoholic and soft drinks and confectionery brought home.[36] In 1998, these components, which have only been recorded since 1994, accounted for about an extra 20% of energy intake. Eating outside the home is becoming increasingly popular,[36] and surveys indicate that the food eaten out tends to be higher in fats and added sugars than food consumed in the home.[15, 36, 59]

Fat contains more than twice as many calories as protein or carbohydrate, so high-fat meals are particularly energy-dense and fattening. (Fat contains 9kcal per gram, compared with 4kcal per gram for protein or carbohydrate.)

Concerns about diet are compounded by the trend towards larger portions of many food items, notably soft drinks, savoury snacks and confectionery – so called 'supersize' packs. Food eaten outside the home is frequently offered in extra-large portions, often at minimal additional cost. Research shows that large portions increase calorie intake without necessarily making the individual feel full.[36]

Physical inactivity

Over the last 25 years it appears that in the UK there has been a significant decrease in physical activity as part of daily routines, particularly at work, but a small increase in the proportion of

people taking physical activity for leisure. Data from the National Travel Survey[60] show that in England between 1975/76 and 2003 the average number of miles per year travelled by foot fell by around a quarter and by cycle by around a third. (These data exclude walking and cycling for leisure.) Over the same period the average number of miles per year travelled by car increased by just under 70%.[61]

KEY FACTS

Adults

- In 2004, only 35% of men and 24% of women met the current recommended target of achieving at least 30 minutes of moderate intensity physical activity at least five times a week.[8]
- The proportion of the population reaching the recommended target fell steadily with age. For men, levels fell from 56% at ages 16-24, to 9% at ages 75 plus; and for women, levels fell from 31% at ages 16-24 to 4% at ages 75 plus.[8]

Children

- Almost one-third of boys and two-fifths of girls do not achieve the recommended weekly activity level of at least one hour of moderate intensity physical activity a day.[10]

Schools in England are at the bottom of the European league in terms of time allocated to physical education in primary and secondary schools. Only 5% of children use their bicycles as a form of transport in the UK compared with 60-70% in the Netherlands, and 30-40% of children are now taken to school by car, compared with 9% in 1971.[62]

Social and psychological factors

Our eating, drinking and exercise habits are greatly influenced by social and psychological factors.[63] High consumption of fatty foods and low consumption of fruit and vegetables are strongly linked to those in routine and manual occupations. Over-consumption of sweet foods and drinks can be a reaction to more negative feelings including low-self esteem or depression. So called 'comfort foods' (ie foods high in sugar, fat and calories) seem to calm the body's response to chronic stress. There may be a link between so-called modern life and increasing rates of over-eating, overweight, and obesity.[64] One study showed that men were more likely to eat when stressed if they were single, divorced or frequently unemployed. Among women, those who felt a lack of emotional support in their lives had a greater tendency to eat to cope with stress.[65] Understanding these behavioural determinants in greater depth is critical in engaging with individuals and helping to devise rational treatment strategies.[15]

Economic changes

As the average income in a country rises, its reliance on technology and labour-saving devices increases, leading to lower levels of physical activity and higher consumption of processed foods. In many developing countries these trends are leading to an increase in the prevalence of obesity and diabetes.

In fully developed nations, economic prosperity brings greater reliance on convenience foods and eating out, with higher calorie consumption. People increasingly depend on time-saving gadgets, which reduce effort, and children in particular spend hours in front of the TV or computer.[15]

Wider determinants of health

A wide range of factors contribute to the health of individuals including:

- their age, sex and constitutional factors
- individual lifestyle factors
- social and community networks
- living and working conditions, and
- general socioeconomic, cultural and environmental conditions.

These factors or determinants of health are shown in Figure 5 as a series of layers, starting from the individual and moving to the determinants of the wider society. Most of these 'wider determinants' lie outside the direct influence of the health services.

Figure 5 Wider determinants of health

Source: Dahlgren and Whitehead, 1991 [66]

Some of the wider determinants can impact on the prevalence of overweight and obesity. For example, the traditional habits and customs of a person's social network can determine the balance of their diet; a poorly built environment or a fear of crime can discourage physical activity; and the accessibility of fresh, affordable fruit and vegetables can influence intake. The *Nutrition and food poverty* toolkit, produced by the National Heart Forum and the Faculty of Public Health, provides further information about the built environment and food accessibility as important factors in food choice. For details of the toolkit, see page 31.

The key risk factors for overweight and obesity are developed over the life course, and many originate during childhood.[67] Children are particularly vulnerable to social and environmental conditions within the household and the wider community. Socioeconomic deprivation seems to

be an important determinant of obesity in childhood which compounds problems experienced in later life – studies have shown that obese children have poorer educational and social outcomes.[44, 51, 68] Healthy children are vital to the future health and productivity of society as a whole, so it is important to tackle wider determinants at the earliest possible stage if the prevalence of overweight and obesity is to be reduced and maximum health gain achieved. The National Heart Forum's *young@heart* project has highlighted the issues associated with children's health and well-being.[67, 69.]

The challenge is to find ways to reduce the burden of overweight and obesity. Section B explores this in more detail.

For more information

Family food in 2003-04. A National Statistics publication by Defra
Department for Environment, Food and Rural Affairs (2005).
London: TSO.
Available from: statistics.defra.gov.uk/esg/publications/efs/2004

Nutrition and food poverty: A toolkit for those involved in developing or implementing a local nutrition and food poverty strategy
V Press, on behalf of the National Heart Forum and Faculty of Public Health (2004).
London: National Heart Forum.
Available from: www.heartforum.org.uk/downloads/Nut_TkitAll.pdf

Policies and strategies to promote social equity in health
G Dahlgren and M Whitehead (1991).
Stockholm: Institute for Future Studies.

Preventing chronic disease: A vital investment. WHO global report
World Health Organization (2005).
Available from: www.who.int/chp/chronic_disease_report/full_report.pdf

Storing up problems: The medical case for a slimmer nation
Working Party of the Royal College of Physicians of London, Royal College of Paediatrics and Child Health, and Faculty of Public Health (2004).
London: Royal College of Physicians of London.

Towards a generation free from coronary heart disease: Policy action for children's and young people's health and well-being
National Heart Forum (2002).
London: National Heart Forum.

References

1 World Health Organization (2003) *Obesity and overweight.* Geneva: WHO. www.who.int/dietphysicalactivity/publications/facts/obesity/en

2 National Institute for Health and Clinical Excellence (NICE) (2006) *Obesity: the prevention, identification, assessment and management of overweight and obesity in adults and children.* London: NICE. www.nice.org.uk/guidance/CG43

3 World Health Organization (2000) *Obesity: Preventing and managing the global epidemic. Report of a WHO consultation.* WHO Technical Report Series 894(3), i-253. Geneva: WHO

4 World Health Organization, International Association for the Study of Obesity and International Obesity Task Force (2000) *The Asia-Pacific perspective: Redefining obesity and its treatment.* Melbourne, Australia: Health Communications Australia Pty Limited

5 International Diabetes Federation (2005) *The IDF consensus worldwide definition of the metabolic syndrome.* Brussels, Belgium: IDF

6 Department of Health (2006) *Care pathway for the management of overweight and obesity*. London: Department of Health

7 Scottish Intercollegiate Guidelines Network (2003) *Management of obesity in children and young people. A National Clinical Guideline.* Edinburgh: SIGN

8 The Information Centre for Health and Social Care (2006) *Health Survey for England 2005: Updating of trend tables to include 2005 data.* London: The Information Centre for Health and Social Care. www.ic.nhs.uk/pubs/hseupdate05

9 Sproston K, Primatesta P (eds.) (2004) *Health Survey for England 2003. Volume 2: Risk factors for cardiovascular disease.* London: TSO. www.dh.gov.uk/assetRoot/04/09/89/11/04098911.pdf

10 Working Party of the Royal College of Physicians of London, Royal College of Paediatrics and Child Health and Faculty of Public Health (2004) *Storing up problems: The medical case for a slimmer nation.* London: Royal College of Physicians of London

11 NHS Health and Social Care Information Centre (2005) *Health Survey for England 2004: The health of ethnic minority groups – headline tables.* London: NHS Health and Social Care Information Centre

12 Jotangia D, Moody A, Stamatakis E, Wardle H (2005) *Obesity among children under 11*. London: National Centre for Social Research, Department of Epidemiology and Public Health at the Royal Free and University College Medical School

13 Sproston K, Primatesta P (eds.) (2003) *Health Survey for England 2002: The health of children and young people.* London: TSO. www.archive2.official-documents.co.uk/document/deps/doh/survey02/hse02.htm

14 Department of Health (2003) *Annual report of the Chief Medical Officer 2002. Health check: On the state of the public health.* London: Department of Health

15 Jebb S (2004) Obesity: causes and consequences. www.medicinepublishing.co.uk/resources/sample_pages/wohm.1.1.38.pdf

16 Mulvihill C, Quigley R (2003) *The management of obesity and overweight. An analysis of reviews of diet, physical activity and behavioural approaches: Evidence briefing.* 1st edition. London: Health Development Agency

17 Guo SS, Wu W, Chumlea WC, Roche AF (2002) Predicting overweight and obesity in adulthood from body mass index values in childhood and adolescence. *The American Journal of Clinical Nutrition;* 76; 3: 653-658

18 Parsons TJ, Power C, Logan S, Summerbell CD (1999) Childhood predictors of adult obesity: A systematic review. *International Journal of Obesity;* 23; Suppl 8: S1-S107

19 Avenell A, Broom J, Brown TJ, Poobalan A, Aucott L, *et al* (2004) Systematic review of the long-term effects and economic consequences of treatments for obesity and implications for health improvement. *Health Technology Assessment;* 8 (21): 1-473

20 Medical Research Council Human Nutrition Research website. Type 2 diabetes. www.mrc-hnr.cam.ac.uk/research/obesity/diabetes.html

21 Hu FB, Manson JE, Stampfer MJ, Colditz G, *et al* (2001) Diet, lifestyle, and the risk of type 2 diabetes mellitus in women. *The New England Journal of Medicine;* 345: 790-797

22 van Dam RM, Rimm EB, Willett WC, Stampfer MJ, Hu FB (2002) Dietary patterns and risk for type 2 diabetes mellitus in US men. *Annals of Internal Medicine;* 136: 201-209

23 Hu FB (2003) Overweight and obesity in women: Health risks and consequences. *Journal of Women's Health;* 12; 2: 163-172

24 Manson JE, Willet WC, Stampfer MJ (1997) The Nurses' Health Study: Body weight and mortality among women. *The New England Journal of Medicine;* 333: 677-85

25 Rimm EB, Stampfer MJ, Giovannucci E, Ascherio A, *et al* (1995) Body size and fat distribution as predictors of coronary heart disease among middle-aged and older US men. *American Journal of Epidemiology;* 141; 12: 1117-27

26 Garrison RJ, Kannel WB, Stokes J 3rd, Castelli WP (1987) Incidence and precursors of hypertension in young adults: the Framingham Offspring Study. *Preventive Medicine;* 16: 235-251

27 Davy KP, Hall JE (2004) Obesity and hypertension: Two epidemics or one? *American Journal of Physiology – Regulatory, Integrative and Comparative Physiology;* 286: R803-R813

28 Jood K, Jern C, Wilhelmsen L, Rosengren A (2004) Body mass index in mid-life is associated with a first stroke in men: A prospective population study over 28 years. *Stroke;* 35: 2764

29 Department of Health (2004) *Choosing health: Summary of intelligence on obesity.* London: Department of Health. www.dh.gov.uk/assetRoot/04/09/49/76/04094976.pdf

30 Tonkin R (2003) *The X factor: Obesity and the metabolic syndrome.* London: The Science and Public Affairs Forum

31 British Nutrition Foundation website. Lipgene. www.nutrition.org.uk/upload/Lipgene%20Q%20and%20A%20pdf.pdf

32 Nugent AP (2004) Review: The metabolic syndrome. *Nutrition Bulletin;* 29: 36-43

33 Isomaa B, Almgren P, Tuomi T, Forsen B, *et al* (2001) Cardiovascular morbidity and mortality associated with the metabolic syndrome. *Diabetes Care;* 24: 683-689

34 Ruotolo G, Howard BV, Robbins DC. Chapter 10: Dyslipidemia of obesity. In: Caro JF (2003) *Obesity*. Endotext.com

35 Rexrode KM, Carey VJ, Hennekens CH, Walters EE, *et al* (1998) Abdominal adiposity and coronary heart disease in women. *The Journal of the American Medical Association;* 280: 1843-48

36 National Audit Office (2001) *Tackling obesity in England.* London: TSO

37 Calle EE, Rodriguez C, Walker-Thurmond K, Thun MJ (2003) Overweight, obesity and mortality from cancer in a prospectively studied cohort of US adults. *The New England Journal of Medicine:* 348: 1625-38

38 American Obesity Association (2005) *AOA Fact sheets: Health effects of obesity.* Washington DC: AOA. www.obesity.org/subs/fastfacts/Health_Effects.shtml

39 Loube DI, Loube AA, Erman MK (1997) Continuous positive airway pressure treatment results in weight loss in obese and overweight patients with obstructive sleep apnea. *Journal of the American Dietetic Association;* 97: 896-897

40 Gibson, GJ (2000) Obesity, respiratory function and breathlessness. *Thorax;* 55; Suppl 1: S41-S44

41 Sjostrom L, Larsson B, Backman L, Bengtsson C, *et al* (1992) Swedish obese subjects (SOS). Recruitment for an intervention study and a selected description of the obese state. *International Journal of Obesity and Related Metabolic Disorders: Journal of the International Association for the Study of Obesity;* 16: 465-79

42 Bulpitt CJ, Palmer AJ, Battersby C, Fletcher AE (1998) Association of symptoms of type 2 diabetic patients with severity of disease, obesity and blood pressure. *Diabetes Care;* 21: 111-15

43 House of Commons Health Select Committee (2004) *Obesity: Third report of session 2003-2004, volume 1.* London: TSO. www.publications.parliament.uk/pa/cm200304/cmselect/cmhealth/23/23.pdf

44 Wardle J (2005) Symposium on 'Treatment of obesity'. Understanding the aetiology of childhood obesity: implications for treatment. *Proceedings of the Nutrition Society;* 64: 73-79

45 Strauss RS, Pollack HA (2003) Social marginalization of overweight children. *Archives of Pediatrics and Adolescent Medicine;* 157: 746-752

46 NHS Centre for Reviews and Dissemination (2002) *Effective health care: The prevention and treatment of childhood obesity;* vol 7; number 6

47 Puhl R, Brownell KD (2001) Bias, discrimination, and obesity. *Obesity Research;* 9: 788-805

48 Strauss RS (2000) Childhood obesity and self-esteem. *Pediatrics;* 105; 1: e15

49 Wadden TA, Stunkard AJ (1985) Social and psychological consequences of obesity. *Annals of Internal Medicine;* 103: 1062-1067

50 International Obesity Task Force (IOTF) website. About obesity. www.iotf.org/aboutobesity.asp

51 Gortmaker SL, Must A, Perrin JM, Sobol AM, Dietz WH (1993) Social and economic consequences of overweight in adolescence and young adulthood. *The New England Journal of Medicine;* 329: 1008-12

52 Vidal J (2002) Updated review on the benefits of weight loss. *International Journal of Obesity and Related Metabolic Disorders: Journal of the International Association for the Study of Obesity;* 26, Suppl 4: S25-S28

53 Scottish Intercollegiate Guidelines Network (1996) *Obesity in Scotland. Integrating prevention with weight management. A National Clinical Guideline recommended for use in Scotland.* Edinburgh: SIGN. (Under review)

54 Jung R (1997) Obesity as a disease. *British Medical Bulletin;* 53: 2: 307-321

55 Diabetes Prevention Program Research Group (2002) Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *The New England Journal of Medicine;* 346; 6: 393-404

56 Department of Health (1998) *Smoking kills: A white paper on tobacco.* London: TSO

57 Liu JLY, Maniadakis GA, Rayner M (2002) The economic burden of coronary heart disease in the UK. *Heart;* 88: 597-603

58 Maffeis C (2000) Aetiology of overweight and obesity in children and adults. *European Journal of Paediatrics;* 159; Supp 1: S35-44

59 Department for Environment, Food and Rural Affairs (2005) *Family food in 2003-04. A National Statistics publication by Defra.* London: TSO. statistics.defra.gov.uk/esg/publications/efs/2004/default.asp

60 Department for Transport (2003) *National Travel Survey.* London: Department for Transport. www.dft.gov.uk

61 British Heart Foundation statistics website. Trends in physical activity. www.heartstats.org/datapage.asp?id=984

62 North West Public Health Observatory (2002) Obesity: The biggest unrecognised public health problem? *NW Health Bulletin;* vol 2; issue 4. www.nwph.net/Regional%20Documents/nwh_v2_4.pdf

63 Murcott A (ed) (1998) *The nation's diet: The social science of food choice.* London: Longman

64 Dallman MF, Pecoraro N, Akana SF, la Fleur SE, *et al* (2003) Chronic stress and obesity: A new view of 'comfort food'. *Proceedings of the National Academy of Sciences of the United States of America;* 100, 11696-701

65 Mercola J (2002) Stress often leads to overeating and extra weight. *Preventive Medicine;* 34: 29-39

66 Dahlgren G, Whitehead M (1991) *Policies and strategies to promote social equity in health.* Stockholm: Institute for Future Studies

67 National Heart Forum (2002) *Towards a generation free from coronary heart disease. Policy action for children's and young people's health and well-being.* London: National Heart Forum

68 Armstrong J, Dorosty AR, Reilly JJ, Child Health Information Team, Emmett PM (2003) Coexistence of social inequalities in undernutrition and obesity in preschool children: population based cross sectional study. *Archives of Disease in Childhood;* 88: 671-75

69 Giles A (ed) on behalf of the National Heart Forum (2003) *A lifecourse approach to coronary heart disease prevention. Scientific and policy review.* London: TSO