

The burden of overweight and obesity-related ill health in the UK

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Summary

This paper reviews previous cost studies of overweight and obesity in the UK. It proposes a method for estimating the economic and health costs of overweight and obesity in the UK which could also be used in other countries. Costs of obesity studies were identified via a systematic search of electronic databases. Information from the WHO Burden of Disease Project was used to calculate the mortality and morbidity cost of overweight and obesity. Population attributable fractions for diseases attributable to overweight and obesity were applied to National Health Service (NHS) cost data to estimate direct financial costs. We estimate the direct cost of overweight and obesity to the NHS at £3.2 billion. Other estimates of the cost of obesity range between £480 million in 1998 and £1.1 billion in 2004 [Correction added after online publication 11 June 2007: 'of the cost of obesity' added after 'Other estimates']. There is wide variation in methods and estimates for the cost of overweight and obesity to the health systems of developed countries. The method presented here could be used to calculate the costs of overweight and obesity in other countries. Public health initiatives are required to address the increasing prevalence of overweight and obesity and reduce associated healthcare costs.

Keywords: Burden of disease, obesity, United Kingdom.

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Introduction

Each year, cardiovascular diseases (CVD) are responsible for more than 200 000 deaths in the UK (37% of total) and cancers a further 156 000 deaths (27% of total) (1). It is accepted that at least part of the cause of these diseases are due to overweight and obesity.

The World Health Report(2,3), found that overweight and obesity is responsible for between 8% and 15% of disability adjusted life years (DALYs) lost in Europe and North America. The World Health Organization (WHO) criteria for defining overweight and obesity is based on the body mass index (BMI) score; calculated as weight in kilograms divided by height in metres squared (2,3). Overweight is defined as a BMI of at least 25 kg m⁻² and obesity as a BMI of at least 30 kg m⁻². In England in 2004, 67% of men and 69% of women were overweight or obese.

The economic cost of current health-related behaviour and the potential savings of population shifts in behaviour can help policymakers justify health programme decisions. There have been various estimates published for the economic cost of overweight and obesity for the UK. Perhaps the most widely quoted is that of the National Audit Office (NAO) published in 2001 (4). This paper presents the results of a systematic review of good-quality studies of the economic costs of overweight and obesity carried out for the UK since 1998.

Recent work (5,6) has developed a method for estimating the financial and ill health burden to the UK of physical inactivity and unhealthy diets. A method is presented which uses data on the fraction of specific diseases which can be attributed to obesity from the World Health Report (2,3) to estimate the cost of diseases associated with overweight and obesity.

Method

Systematic review

A systematic search of the literature was conducted using the search terms 'cost' and 'obesity' in the following databases: Medline, CINAHL, EconLit, Science Citation Index, Social Science Citation Index, Index to Scientific and Technical Proceedings, EMBASE, Cochrane Library, York Database of Abstracts of Reviews of Effectiveness, National Health Service (NHS) Economic Evaluation Database, the Database of Consortium of University Research Libraries, the Health Management and Policy Database from The Healthcare Management Information Consortium, the Health Technology Assessment Database, the British Library database of report literature, the Cochrane database, and The Database of Social Science Literature.

An initial search strategy was developed by SA and tested on Medline and the search terms were then used for each database. Studies were included in the review if they were published between January 1998 and October 2006; if the paper was in English (for pragmatic reasons); and, if the results related to the cost of obesity to the NHS in the UK. The time limits were applied to ensure that only contemporaneous cost estimates were included in the review. The reference lists of all papers in the final stage of the review were reviewed to identify other potentially relevant studies.

Estimates of mortality, morbidity and direct costs because of overweight and obesity

The cost, or burden, of an illness can be measured by the loss of duration and quality of life and by the financial impact of related disease on the health system (direct costs) and on society (indirect costs). The burden of disease can be measured by its effect on the duration and quality of life using DALYs; an aggregate measure derived from years of life lost to premature death (YLL) and the years of life impeded by disability (YLD).

The method for calculating the direct cost of overweight and obesity to NHS involved four steps: 1 – diseases where overweight and obesity is a risk factor were identified from the World Health Report; 2 – the total numbers of deaths and the proportions of DALYs lost were calculated; 3 – the population attributable fractions (PAFs) for each disease were identified; 4 – these PAFs were applied to NHS cost data.

Data on mortality, YLL, YLD and DALYs were taken from the World Health Report (2,3) for European countries with very low child and very low adult mortality (WHO region EUR-A). The diseases defined by the WHO as having some relation to overweight and obesity were type 2 diabetes, coronary heart disease, ischaemic stroke, hyper-

tensive disease, breast cancer, colon/rectum cancer, corpus uteri cancer and osteoarthritis.

Estimates of the burden of disease in the population attributable to particular risk factors (PAFs) have been developed by the Global Burden of Disease Project (7). The risk factors included tobacco, alcohol, obesity, physical inactivity and unsafe sex. The World Health Report calculated the PAF because of overweight and obesity against a theoretical population in which all individuals had a BMI of 21 with a standard deviation of 1 (2,3). Although the WHO project provides a PAF for ischaemic stroke, data on DALYs, YLLs and YLDs are only available at the level of 'cerebrovascular diseases'; this category was used as a substitute for ischaemic stroke (2,3). The number of deaths in the UK because of overweight and obesity was calculated by applying PAFs to mortality data for the UK (1).

In 1996 the National Health Executive (8) published a study which ascribed 1992/1993 NHS costs to the International Classification of Disease (ICD) nine codes. This report represents the most recent detailed estimate of NHS costs by disease codes. NHS total cost was defined as the sum of NHS in-patient and out-patient costs, NHS primary care expenditure, NHS pharmaceutical expenditure and NHS net community care services expenditure for the year 1992/93. NHS expenditure by disease code in 1992/93 was applied to the total cost of the NHS in 2002 (i.e. £70.2 billion (8)) to provide an estimate of costs per disease for 2002. The cost of overweight and obesity was calculated by applying the PAFs for diseases related to overweight and obesity to 2002 disease-specific costs.

Results

Systematic review

Papers were included if they; were published between January 1998 and October 2006; were published in English; and presented results which related to the overall cost of obesity to the NHS in the UK. The initial keyword search generated a total of 951 papers. Of these, 921 were rejected on the basis of title or abstract and a further 22 were rejected after reviewing the full paper. Cost of obesity papers were dominated by studies from Northern America with a minority of studies from Europe and Australia. Papers were also excluded because, although they were concerned with costs of obesity to the NHS in the UK, they only reported the costs of a particular intervention such as gastric bypass, drug therapy or behavioural programmes. Three studies met the inclusion criteria and reported on the economic cost of obesity to the NHS (Table 1). Two other papers were identified from the references to these papers, which were published prior to the earliest inclusion date (1996) for this review: these papers are described briefly in the results.

Table 1 Summary of studies included in review (at 1999/2000 prices): economic evaluations

Author(s) (year of publication)	Year of estimate	Direct cost	Diseases included in estimate	Other detail
House of Commons Health Committee (2004) (9)	2002	£991million – £1.1 billion	As for NAO 2001	Re-calculation of costs using the NAO method and 2002 cost data
National Audit Office (2001) (4)	1998	£480 million	Hypertension Type 2 diabetes Angina pectoris Myocardial infarction Osteoarthritis Stroke Gallstones Colon Cancer Ovarian cancer Gout Prostate cancer Endometrial cancer Rectal cancer	Equivalent to 1.5% of NHS expenditure
Bagust <i>et al.</i> (1999) (10)	1996	£2.3 million*	Coronary heart disease Stroke Diabetes Hypertension Varicose veins Hemorrhoids	In-patient and out-patient costs combined were £3409 per 1000 people. There were 634 197 Finished Consultant Episodes reported for these diseases in 1998/99

*Estimate calculated by SA using Finished Consultant Episodes from Hospital Episode Statistics closest available to 1996 (1998/99). Finished Consultant Episode refers to a period of admitted patient care under a consultant or allied healthcare professional within an NHS trust. NAO, National Audit Office; NHS, National Health Service.

Bagust *et al.* (10) combined obesity prevalence data with resource usage information from Hospital Episode statistics for the North-west of England to estimate the proportion of excess patient costs attributable to obesity. Obesity prevalence data from the Health Survey for England was applied to cost data to estimate the proportion of in-patient resource usage which may be attributed to patients above a given BMI threshold. Out-patient attendances and costs were estimated pro-rata to in-patient admissions using historical usage statistics. Applying a BMI threshold of 25 kg m⁻², the authors estimated that the excess resource use attributable to overweight and obesity in the North-west of England was equivalent to 1% of total healthcare spending in 1996.

In 2001, the NAO (4) published an estimate for the economic cost of obesity which was updated for the House of Commons Health Select Committee's inquiry into obesity, the report of which was published in 2004 (9). These estimates are commonly cited in government and other publications. The 2001 NAO study considered 1998 costs for general practitioner consultations, hospital admissions and outpatient attendance, and the cost of drugs prescribed to help obese patients lose weight. Population attributable risks for obesity were identified via a literature search of studies undertaken in developed countries. The cost of treating the consequences of obesity was estimated by calculating the difference in cost of disease with the

current prevalence of obesity with the cost assuming there was no obesity. The NAO estimated that the direct cost of obesity was £480 million in 1998 or equivalent to 1.5% of NHS expenditure. The authors suggested that this was an underestimate and that there was potential bias because of attributable risk data being taken from international, and particularly US, studies.

In 2004, the House of Commons Health Select Committee published an update of the 2001 NAO study (9). Along with the limitations of the original study, the study reported in the Health Select Committee's report was further hampered by using the 1998 obesity prevalence figures of 20%, whereas the prevalence of obesity in 2002 was 22% among women and 23% among men. The 2004 study estimates the direct costs to be between £991 million and £1.1 billion; comprising £45.8–49.0 million for the costs of treating obesity directly and £469.9–1075 million for treating the consequences of obesity.

Two papers were identified in the references of reviewed papers which were published outside the time period for this review. West (11) calculated the attributable proportion of comorbid diseases because of obesity and applied this to cost data for each disease. Using this method, West estimated the annual direct costs of obesity to the UK in the late 1980s and early 1990s to be around £195 million. Hughes *et al.* (12,13) used a similar method to estimate the total 1995 cost of treating obesity and its related diseases at

Table 2 Proportion of deaths (mortality), years of life lost in early deaths (YLLs), years of life lost in disability (YLDs) and disability adjusted life years (DALYs) in WHO EUR-A region, 2002

For overweight and obesity	% of Mortality (n = 3 920 000)	% of YLLs (n = 23 792 000)	% of YLDs (n = 27 762 000)	% of DALYs (n = 51 734 000)
Communicable diseases, maternal and perinatal conditions and conditions and nutritional deficiencies	6.2	6.0	4.0	4.9
Cancer (malignant and other neoplasms)	27.2	32.8	3.1	16.9
Cardiovascular diseases	41.1	29.5	6.4	17.1
<i>Related to overweight and obesity</i>				
Type 2 diabetes	2.4	1.9	2.4	2.1
Coronary heart disease	17.1	13.7	1.1	6.9
Ischaemic stroke (cerebrovascular disease)	10.6	6.9	3.6	5.1
Hypertensive disease*	1.7	1.1	0.	0.6
Breast cancer	2.3	3.2	0.1	1.8
Colon/rectum cancer	3.5	3.6	0.0	2.0
Corpus uteri cancer	0.4	0.4	0.4	0.4
Osteoarthritis	0.0	0.0	4.3	2.3
Total related to overweight and obesity	37.9	30.8	11.8	21.3
Respiratory diseases	5.6	4.2	8.7	6.6
Musculoskeletal diseases	0.5	0.4	7.6	4.2
Injuries	0.1	11.5	4.7	7.9
Other	19.3	15.5	65.6	42.4
Total	100.0	100.0	100.0	100.0

*Data not provided for YLDs for hypertensive heart disease – need to check why.

Note: diseases related to overweight and obesity are a subset of other categories.

Source: World Health Organization. *World Health Report 2002*. Geneva: WHO, 2003.

£355 million: £3.8 million for treating obesity itself and £351 million for treating associated diseases.

New estimate of burden of overweight and obesity-related ill health in the UK in terms of mortality and morbidity

In 2002 CVD were responsible for 41% of all mortality and 17% of all DALYs lost; cancer caused 27% of mortality and 17% of DALYs lost (Table 2) in countries such as the UK. Those diseases with some relationship with overweight and obesity (type 2 diabetes, coronary heart disease, ischaemic stroke, hypertensive disease, breast cancer, colon/rectum cancer, corpus uteri cancer and osteoarthritis) were responsible for 38% of all mortality, 31% of YLLs, 12% of YLDs and 21% of DALYs. Among these diseases, 17% of all mortality was from coronary heart disease and 11% from ischaemic stroke. Of the 21% of all DALYs lost, 7% was due to coronary heart disease and 5% because of ischaemic stroke.

Table 3 shows that 7.3% of all DALYs lost were directly attributable to overweight and obesity. Coronary heart disease was the largest contributor to the burden of disease attributable to overweight and obesity accounting for 2.3% of all DALYs lost followed by ischaemic stroke (1.8%). The burden of DALYs lost because of overweight was higher

within women (7.8%) than men (6.9%). A large proportion of this difference is explained by the contribution of breast cancer (0.5%) and corpus uteri cancer (0.4%) to the burden among women. Among comparable diseases, the burden of disease measured as proportion of DALYs lost was higher among women than men for type 2 diabetes (women 1.9%; men 1.5%), stroke (women 1.9%; men 1.7%), hypertensive disease (women 0.4%; men 0.3%) and osteoarthritis (women 0.7%; men 0.3%). The burden of coronary heart disease was higher among men (2.9%) than women (1.7%).

When rates for the burden of disease attributable to overweight were applied to 2003/04 mortality figures more than 203 000 deaths within the UK occurred because of diseases which were linked to overweight and obesity. It was further estimated that 66 737 deaths were directly attributable to overweight and obesity, with more than half (54%) of these deaths because of coronary heart disease and 31% from stroke.

New estimate of direct costs of overweight and obesity in the UK

In 1992/93, 12% of total NHS costs, or £8.6 billion, were coded to diseases with some component of overweight or obesity (Table 4). Stroke (4.1%) and coronary heart disease

Table 3 Total DALYs lost and population attributable fractions for overweight and obesity (n and %), by sex, in WHO EUR-A region, 2002

	Male			Female			Total					
	DALYs lost (n)	PAF DALYs lost (%)	DALYs lost to overweight	% of all male DALYs	DALYs lost (n)	PAF DALYs lost (%)	DALYs lost to overweight	% of all female DALYs	DALYs lost (n)	PAF DALYs lost (%)	DALYs lost to overweight	% of all DALYs
Diabetes Mellitus	546 699	75	410 024	1.500	558 701	83	463 722	1.901	1 105 400	79	873 746	1.689
Ischaemic heart disease	2 304 061	34	783 381	2.866	1 265 131	33	417 493	1.711	3 569 191	34	1 200 874	2.322
Cerebrovascular disease	1 327 596	34	451 383	1.652	1 326 300	35	464 205	1.903	2 653 896	34	915 588	1.770
Hypertensive disease	1 347 701	57	76 780	0.281	1 71 862	59	101 399	0.416	306 564	58	178 178	0.344
Breast cancer	6 411	0	0	0.000	932 255	12	111 871	0.459	938 666	12	111 871	0.216
Colon/rectum cancer	561 854	15	84 278	0.308	465 609	17	79 153	0.324	1 027 463	16	163 432	0.316
Corpus uteri cancer	0	0	0	0.000	206 167	49	101 022	0.414	206 167	49	101 022	0.195
Osteoarthritis	477 145	19	90 658	0.332	709 864	23	163 269	0.669	1 187 009	21	253 926	0.491
Total	5 358 467	35	1 896 503	6.940	5 635 888	34	1 902 133	7.797	10 994 355	35	3 798 636	7.344

Source: World Health Organization. *World Health Report 2002*. Geneva: WHO, 2003. DALYs, disability adjusted life years; PAF, population attributable fractions.

(3.3%) were the two major contributors to the economic burden. Extrapolated to 2002 terms, the cost of disease which is directly attributable to overweight and obesity was £3.23 billion. Of the £3.23 billion directly attributable to overweight and obesity, the largest proportion was due to stroke (£983 million), followed by coronary heart disease (£773 million), hypertensive disease (£576 million) and diabetes mellitus (£533 million).

Discussion

This analysis suggests that over 66 000 deaths in 2003/04 could have been avoided if the population could achieve a theoretical healthy minimum BMI of 21 kg m⁻². Overweight and obesity was responsible for 7.3% of morbidity and mortality in the UK, contributing over £3 billion to the direct health cost burden to the NHS. This equates to 4.6% of total NHS expenditure in 2002.

In interpreting the estimate of direct costs, it is important to bear in mind that it does not include indirect costs such as production losses because of mortality, morbidity or informal care. If indirect costs such as days lost to sickness absence, premature mortality, private healthcare costs and home care had been included, the figure would have been far higher. Leal *et al.* (14) demonstrate this with their finding that the indirect healthcare costs of CVD in the UK in 2003 (£11 billion) were around 43% of the total cost (£26 billion).

Our estimate of £3.23 billion for the direct costs of overweight and obesity equates to around 5% of total NHS costs, comparable with Seidell's estimate of 4% for the costs associated with a BMI greater than 25 to the Dutch healthcare system (15). Other studies have estimated the cost of obesity to developed world health systems between 2% (in France) and 8% (in the United States) (16).

The NAO estimate of £480 million for healthcare costs related to obesity was low in comparison with our estimate of £3.23 billion. The NAO acknowledged that excluding overweight from their calculation had led to a large underestimate. In 2004, the NAO estimate was updated to include overweight as well as obesity (BMI ≥ 25). The result was that the NAO increased their estimate of the direct costs to around £1.1 billion per year (9).

One reason for our estimate being higher than other estimates of the cost of overweight and obesity – and in particular the latest NAO estimate – was that the PAF calculated in the World Health Report and used in this study was based on a BMI above 21. This estimate would include people with a BMI of between 22 and less than 25: a group that would not be included in NAO's 2004 estimate (9). Cost estimates such as these are very sensitive to the BMI cut point used: Levy *et al.* reported that a three-point increase in the BMI threshold led to a doubling in the estimated cost of obesity in France (17). The comparison of

Table 4 Percentage of total NHS costs attributable to different diseases in 1992/1993 and 2001/02

Cause	1992/93% of NHS total costs (£millions)*	Costs 2002 (£millions)	PAF for DALYs lost within specific disease to overweight and obesity†	Cost because of overweight and obesity (£millions)
Infectious diseases	1.0	102		
Cancer (malignant and other neoplasms)	4.1	2 878		
Cardiovascular diseases	12.1	8 494		
<i>Diseases related to overweight and obesity</i>				
Ischaemic heart disease	3.3	2 287	34	778
Stroke	4.1	2 892	34	983
Breast cancer	0.3	240	12	29
Colon/rectum cancer	0.5	383	16	61
Hypertensive diseases	1.4	994	58	576
Corpus uteri cancer	0.1	85	49	41
Osteoarthritis	1.6	1 090	21	229
Diabetes Mellitus	1.0	675	79	533
Total	12.3	8 645		3231
Musculoskeletal diseases	7.8	5 476		
Mental and nervous system disorders	25.0	17 550		
Respiratory diseases	6.2	4 352		
Injuries	3.8	2 668		
Other	40	28 080		
Total	100.0	70 200		

Note: diseases related to overweight are a subset of other groups.

*NHS Executive. Burdens of disease. A discussion document. Wetherby: Department of Health, 1996.

†Attributable DALYs lost within disease because of overweight as a percentage of total DALYs lost to disease.

NHS, National Health Service; DALYs, disability adjusted life years; PAF, population attributable fraction.

studies to determine the overall burden of disease attributable to particular behaviours is also hampered by the fact that different diseases were considered in each study.

A potential source of error is the differential mortality experienced by obese people in comparison with the general population. The higher mortality rate among obese people means that this group has a shorter period of time to incur healthcare costs. One estimate from Allison *et al.* (18) suggests that increased mortality among obese people may result in a 25% overestimate of direct healthcare costs when using population PAFs in cost estimates.

Limitations of study

The methods to calculate the burden of overweight and obesity used here are very simple but rely heavily on the PAFs calculated by the WHO Burden of Disease Project. This project calculates a PAF based on ischaemic stroke but provides data only to the level of cerebrovascular disease for mortality, DALYs, YLLs and YLDs. The application of PAFs for ischaemic stroke because of overweight and obesity as a surrogate for cerebrovascular disease will result in an overestimate of the burden of ill health. This overestimate will not be severe, however, as ischaemic stroke accounts for 80–85% of all cerebrovascular diseases (19).

The extrapolated costs for ICD disease codes were another source of potential error. In 2002 Wanless pub-

lished an assessment of NHS resource requirements. Wanless set the 2002 cost to the NHS of cancer at £2.5 billion and coronary heart disease at £2.4 billion, which compare favourably to our estimates of £2.9 and £2.3 billion respectively (20).

Directions for future research

A limitation to studies of this type is the absence of current NHS cost by disease category, which in this paper has been extrapolated from 1992 data. We would encourage future research to gain accurate contemporary cost by disease data, which when used in conjunction with more recent work on attributable risk, could provide more robust estimates on the direct costs of unhealthy behaviours.

Because of its retrospective nature, this method only provides a picture of the past costs of overweight and obesity and does not reflect the success or otherwise of recent and future interventions. The next steps in this type of work are to develop of models to estimate potential cost and health savings from population shifts in risk factor prevalence.

Murray and Lopez distinguish between the attributable burden – ‘the difference between burden currently observed and burden that would have been observed under an alternative population distribution of exposure’ – and the avoidable burden – ‘the reduction in the future burden . . . if the

current levels of exposure to a risk factor were reduced to those specified by the counterfactual distribution of exposure'. This distinction between attributable and avoidable burdens applies when examining burdens of ill health by disease as well as by cause (21. 9–21). The implications of the distinction have, as yet, been barely explored in relation to policy. An understanding of the avoidable burden of disease or cause can only come from combining the results of studies of the effectiveness of interventions with information about the extent of the attributable burden.

Implications for policy

Information about the costs of overweight and obesity are important in establishing a case for preventive action. This method can provide an estimate of the direct costs of different risk profiles and give some basis for comparing potential health service savings of different public health interventions.

The WHO PAFs are calculated for countries with different levels of development and adult and infant mortality. Thus, the method presented here is readily applicable to any country where health service cost data are available coded by disease. By providing a quick and relatively easy method to estimate direct costs, this method could also be used to track costs over time and potentially to model future costs.

Conclusion

There is a considerable public health burden because of overweight and obesity in the UK. Overweight and obesity was directly responsible for 7% of morbidity and mortality in the UK. The estimated direct cost to the NHS is £3.23 billion. Accurately establishing the financial cost of overweight and obesity is an important step in developing national public health strategy.

Conflict of Interest Statement

No conflict of interest was declared.

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