A tool for evaluating the cost-effectiveness and return on investment from public health interventions to reduce the prevalence of obesity

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Abstract

In the UK, around two thirds of the population is overweight or obese. Over the last 25 years the prevalence of obesity has quadrupled to in excess of 20% of the population. Whilst the annual direct cost the NHS of obesity itself is relative light (£45.8 – £49.0m in 2002 – Commons Health Select Committee, 2004), the costs of treating co-morbid conditions arising as a direct consequence are substantial (£945 - £1.075bn in 2002, ibid), and when indirect costs are included, the cost to society is between £3.34 – £3.72bn per annum (3.2% - 3.5% of GDP, 2002).

Tackling the growing problem of obesity is a very topical issue in the public health arena, but there is a dearth of evidence on what works, especially the longer term impact of such interventions, the relative cost effectiveness of different interventions and return on investment from anti-obesity measures.

We developed an interactive model to calculate the expected burden of disease and cost of treatment of obesity and its co-morbidities over the next 20 years based on current obesity trends. The impact of an intervention (even of limited duration of effectiveness) can then be modelled to compare the difference in burden of disease and cost over the same time period.

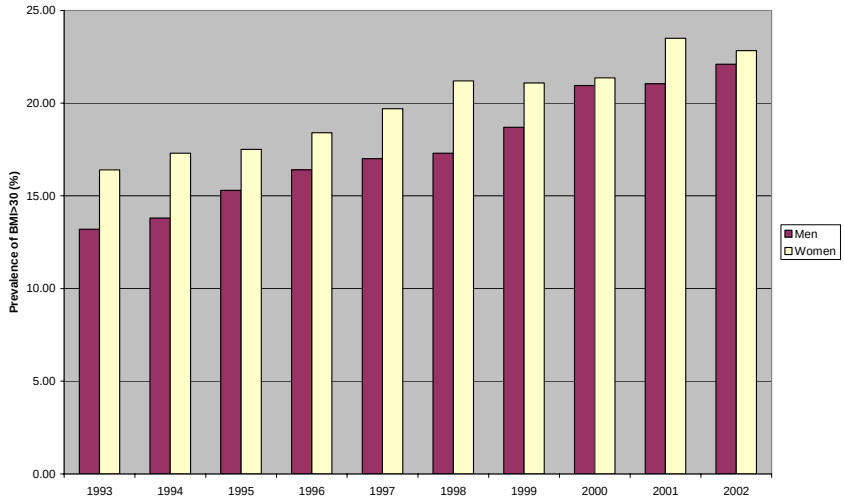
The model shows year by year, the expected difference in cases of CHD, T2DM etc, and the payback time for a given intervention. It can be used to perform an incremental analysis of a number of interventions to identify the most cost-effective strategy(ies) for tackling obesity and their net financial impact.

Introduction

Obesity is defined as possessing a body mass index (kg/m^2) of 30 or above. Older people, people in lower socio-economic groups and people from certain ethnic backgrounds are more likely to be obese[1]. Obesity increases the risk of developing cardio-vascular diseases, type 2 diabetes mellitus, certain cancers, osteoarthritis, respiratory diseases, reproductive disorders and mental health problems[1]. These conditions can lead to premature death and a reduction in quality of life.

Between 1993 and 2002, the prevalence of obesity in England increased from 13.2% in men and 16.4% in women to 22.1% in men and 22.8% in women[2] (Figure 1)

Figure 1: Prevalence of obesity by gender, 1993-2002, England.



Obesity itself incurs relatively minor costs on the NHS (in 2002, the English NHS spent between £45.8-£49.0m on GP consultations, hospital activity and anti-obesity prescriptions: approximately £160,000 per Primary Care Trust), but the cost of treating conditions arising as a direct consequence of obesity are substantial (£945 - £1,075m in 2002, or 2.5% of English NHS expenditure). When indirect costs attributable to morbidity and premature mortality are taken into account, the total societal cost of obesity in England rises to between £3.3 - £3.7bn[3].

Investing in measures to reduce the prevalence of obesity should lead to a reduction in the prevalence of complications from obesity, resulting in a health gain to the population, and a reduction in the cost of treatment of obesity and its associated complications.

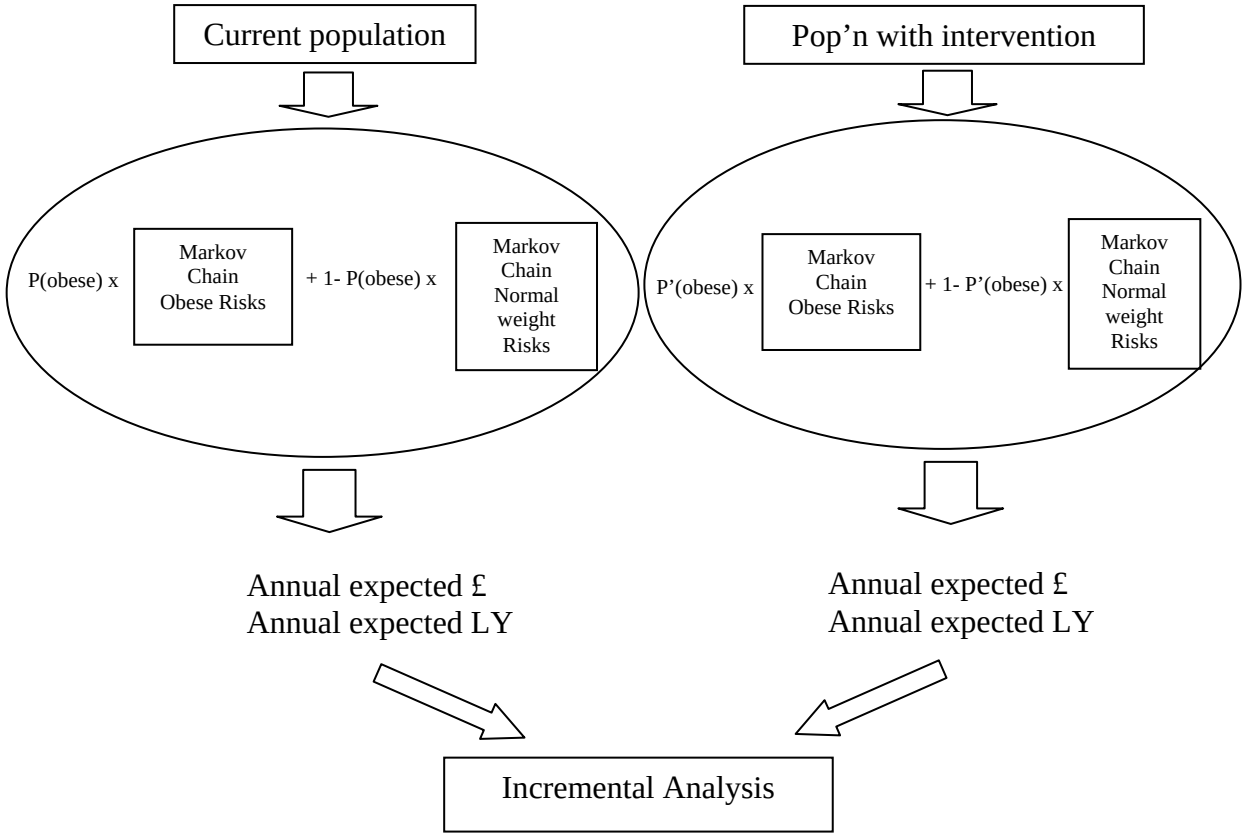
We report the development of a model to calculate the long term health and cost impact (and therefore cost-effectiveness) of public health interventions of known short term effectiveness aimed at reducing the prevalence of obesity.

Method

Model

A conceptual diagram of the model is shown in Figure 2.

Figure 2: Conceptual diagram of model



Two populations are modelled over a period of 20 years. The first is the 'current population' which has a certain prevalence of obesity. The obese members of the population, denoted P(obese), will be at risk of developing comorbidities. These are modelled in the 'Markov chain obese risks' box. The non-obese members will experience different risks for the same comorbidities, modelled in the 'Markov chain normal weight risks' box. The weighted average of outcomes from the two models (dependent on the prevalence of obesity) gives an annual expected cost and life years within the current population. Each age year and sex cohort is modelled separately and aggregated.

If there is a public health intervention that succeeds in reducing the prevalence of obesity, the prevalence will now be P'(obese). The same population is now modelled as a weighted average of outcomes for the obese and normal weight, where the weight is P'(obese). Thus an expected cost and life years sum is gained for the population with this lower prevalence of obesity. An incremental analysis of the intervention compared with base case can then be performed.

Markov Chains

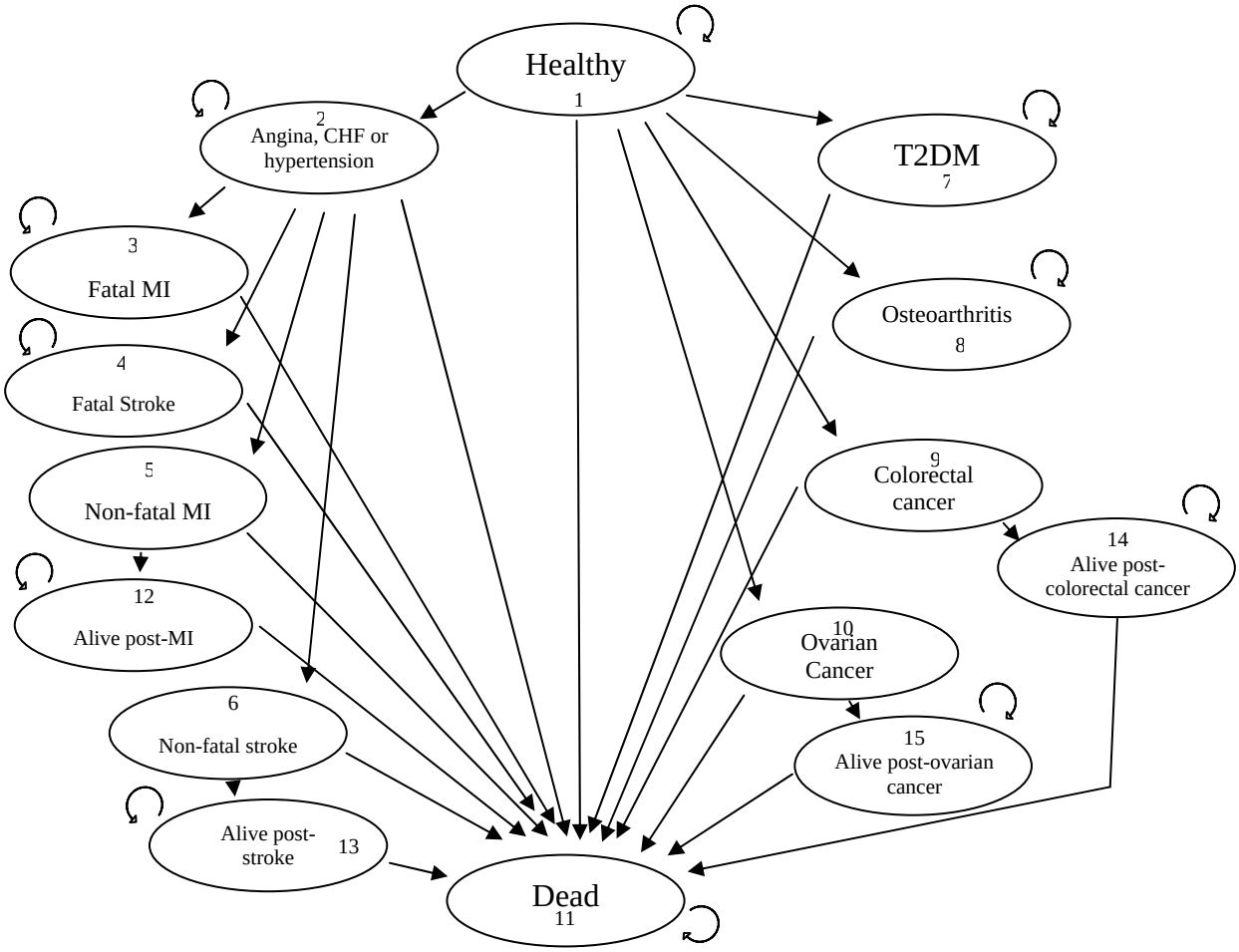
This section describes the structure of the Markov model used in the analysis.

There are many co-morbidities associated with obesity. For the purpose of this model, we limited the options to:

- Circulatory diseases (defined as angina, congestive heart failure and/or hypertension with resulting risks of myocardial infarction and stroke)
- type 2 diabetes
- osteoarthritis
- colorectal cancer
- ovarian cancer

The original list of co-morbidities was based upon those listed by the National Audit Office[1], but was subsequently modified to keep the model as simple as possible and to take account of data availability (e.g. gall bladder diseases were excluded). The structure of the model is shown in Figure 3.

Figure 3 Markov Model



This is a somewhat complex model, however it was important to include the major co-morbidities and their consequences (circulatory disease, type 2 diabetes and cancers) whilst avoiding unnecessary complication as far as possible.

A given group of the population begins in state 1 (healthy). Each year, a certain proportion will either remain healthy (remain in state 1), develop circulatory disease (defined as either hypertension, angina or congestive heart failure – state 2), type 2 diabetes (state 7), osteoarthritis (state 8), colorectal cancer (state 9) or ovarian cancer

(state 10). Patients in state 2 (circulatory disease) have a chance each year of either nothing happening (remain in state 2), experiencing a fatal myocardial infarction (MI - state 3), non-fatal MI (state 5), a fatal stroke (state 4), non-fatal stroke (state 6), or dying from some other cause (state 11). Patients experiencing non-fatal MI or stroke will then become 'alive post-MI' (state 12) or 'alive post-stroke' (state 13), or die (state 11). The other states follow similar paths.

A cost is assigned to each state according to health service activity and health outcome of 1 if the patient is alive and 0 if dead.

The transition probabilities are dependent on age, gender and obesity status (simplified to a binary obese / normal weight rather than a continuous BMI variable).

It is therefore possible to model a population with a given age and gender make-up all of normal weight, and repeat the analysis for a completely obese population. The actual outcome will then be a weighted average of the two extremes, according to the prevalence of obesity. Changes in the prevalence of obesity can then be modelled, and compared with the baseline scenario.

Each scenario will generate a total cost and total life years. The incremental cost and incremental life years gained can then be calculated for a range of interventions.

Results

Model Inputs

Transition Probabilities

A variety of sources were used to estimate the probability of a patient of given age and gender developing one of the possible comorbidities. These were adjusted for the relative risk of development in the obese to estimate the probability of development if a person of a given age and gender is obese, and normal weight.

Detailed method for the calculation of the transitions from states 1 to 7 (healthy -> type 2 diabetes) and states 1 to 2 (healthy -> circulatory disease) are shown by way of example. Full details of calculation of the other transitions are available upon request from the authors.

Probability of transition from healthy to type 2 diabetes mellitus (state 1 -> state 7)

Whilst there are plenty of studies on the prevalence of type 2 diabetes, there is very little on the incidence. We located a source based upon one study[4], but was subsequently modified by expert opinion for the purposes of a specific screening project[5]. The data showed the expected incidence of type 2 diabetes in 10 year age bands (Table 1).

Table 1: Incidence of type 2 diabetes per 1000 general population

Age	Male	Female
20-29	0.2	0.2
30-39	0.7	0.4
40-49	1.5	1.2

50-59	2.4	2.2
60-69	3.2	3.0
70-79	3.5	3.4
80-89	3.8	3.4
90-99	3.8	3.4

We required the risk by individual year of age rather than 10 year age band, so an OLS regression was performed to 'smooth the curve'. Where this generated incidence estimates below zero, the figures were set to equal zero.

The relative risk of developing type 2 diabetes in the obese compared with normal weight is 12.7 for women and 5.2 for men[1]. This information combined with the prevalence of obesity allows calculation of the incidence in the normal weight population as:

$$I_o = \frac{I_T}{RR.Pe + Po}$$

and the incidence in the obese population:

$$I_e = RR.I_o$$

Where I_T is the incidence in the total population, RR is the relative risk in the obese population, P_e is the prevalence of obesity and P_o is $1-P_e$, or the prevalence of normal weight.

The incidences were calculated separately for every age and gender cohort. Figures 4a and 4b show the calculated estimates.

Figure 4a men T2DM

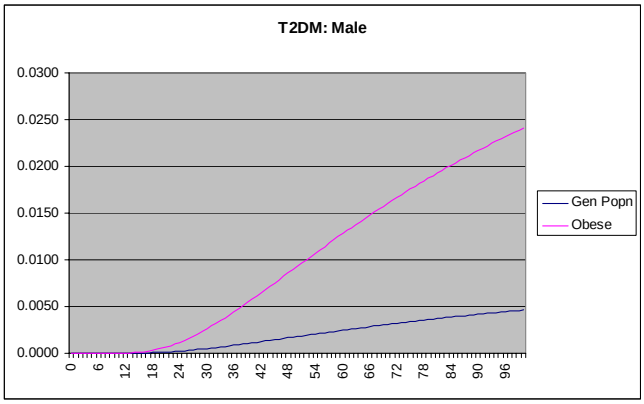
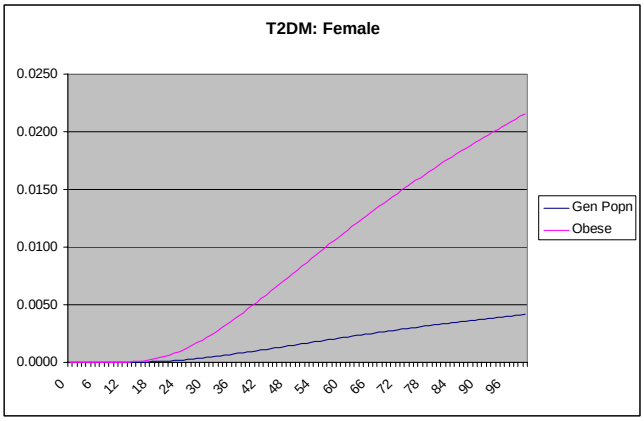


Figure 4b women T2DM



Probability of transition from healthy to circulatory disease (state 1 -> state 2)
Due to data availability, the estimates of risk of developing circulatory disease were less robust than those for diabetes. For the purpose of this model, the incidence of circulatory disease is defined as the sum of the incidences of hypertension, angina and congestive heart failure. These are each dealt with separately below.

Hypertension
Hypertension is defined as diastolic pressure of >=90mmHg or systolic >=140mmHg. We were unable to locate an estimate of the incidence of hypertension broken down by individual year of age and gender, but prevalence estimates by age group and gender were readily available[6] (Table 2).

Table 2 prevalence of high blood pressure

Age	Mid age point	Male	Female
16-24	20	20.3%	5.5%
25-34	30	17.6%	7.4%
35-44	40	23.0%	11.7%
45-54	50	41.3%	33.5%
55-64	60	58.1%	54.4%
65-74	70	68.3%	73.7%
75+	80	70.2%	78.7%

To estimate the prevalence at every year of age, we performed an Ordinary Least Squares regression of prevalence against age for males and females. The best-fit lines were defined as:

Male:
Prevalence = $92.3286 – 6.2828 \times age + 0.1548 * age^2 – 0.0010 * age^3$
Female:
Prevalence = $79.8786 – 6.4741 \times age + 0.1611 \times age^2 – 0.0010 * age^3$

For under 20 year olds and over 75s, this model did not provide realistic values, therefore we assumed a straight line increase to age 20, and the implied incidence from age 74 to 75 was used for over 75s.

The difference in the prevalence from one age year to the next is a crude measure of the incidence (although this ignores those who die or become normotensive). The

combination of the cubic form of the regression model and the imprecise measurement yielded a number of negative incidence figures here. For the purpose of the model these were set to zero.

The above is a somewhat convoluted and potentially unreliable means of estimating the incidence of hypertension, but in the absence of raw incidence data, is the best available.

The relative risk of hypertension in the obese versus non-obese is 2.6 in males and 4.2 in females[1]. Using the same formulae as for diabetes, the incidence in the obese and normal weight populations can be estimated. Figures 5a and 5b show the incidence of hypertension in males and females of normal weight or obese. The shape of these curves are rather odd, suggesting for males, a decline in the risk of developing hypertension from birth to age 25, with a zero risk to mid to late 30s, and a peak risk of developing hypertension in the sixth decade of life. Confirmation of this by expert opinion is required to justify this chart and it is likely than an alternative modelling technique may yield more consistent estimates.

Figure 5a. Incidence of hypertension in males

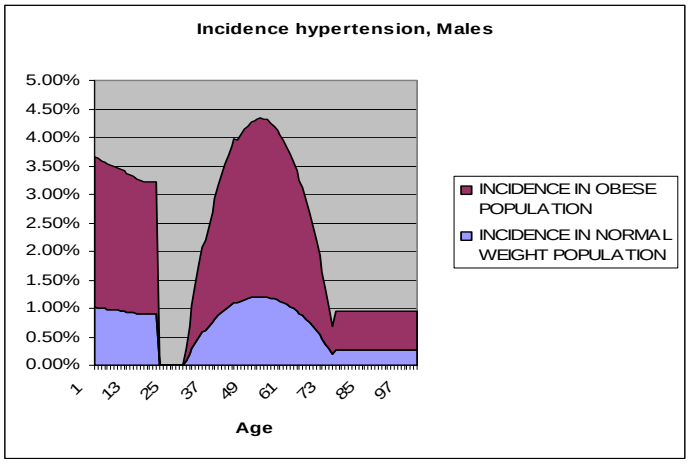
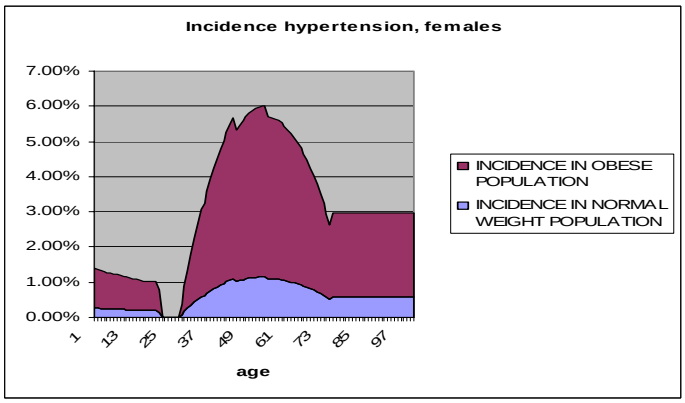


Figure 5b. Incidence if hypertension in females



Angina

We performed a meta-analysis of the results of three studies reporting the incidence of angina[7-9] to generate a weighted average of the results of each (based on sample size). An OLS regression was performed to estimate missing values and where this

generated negative values they were set to zero. The incidence in the obese and normal weight populations was calculated using relative risk data as per hypertension.

Congestive Heart Failure

Published data on the incidence of CHF[10] were extrapolated as per hypertension and angina estimates. We were unable to locate an estimate of the relative risk of CHF in obese patients, therefore we assumed the relative risk was the same as that for myocardial infarction (3.2 in females and 1.5 for males)[1].

Overall risk of circulatory disease

To estimate the overall risk of developing hypertension, angina or congestive heart failure, the three incidences were summed. The resulting overall incidence of circulatory disease by age and gender for obese and non-obese patients is shown in Figures 6a and 6b.

Figure 6a Risk of circulatory disease, Males

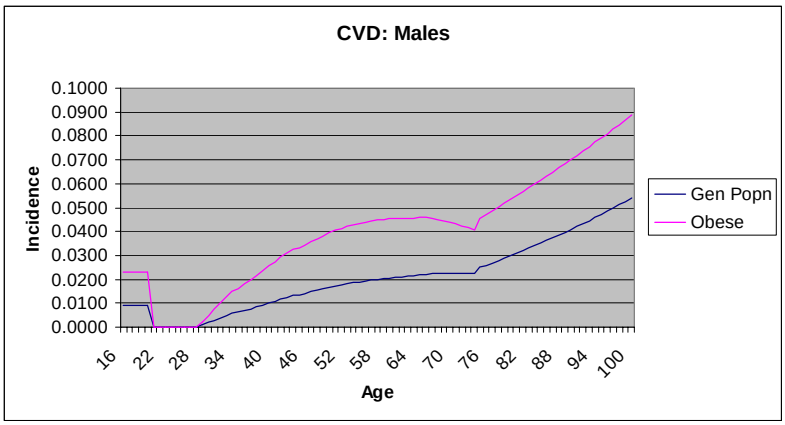
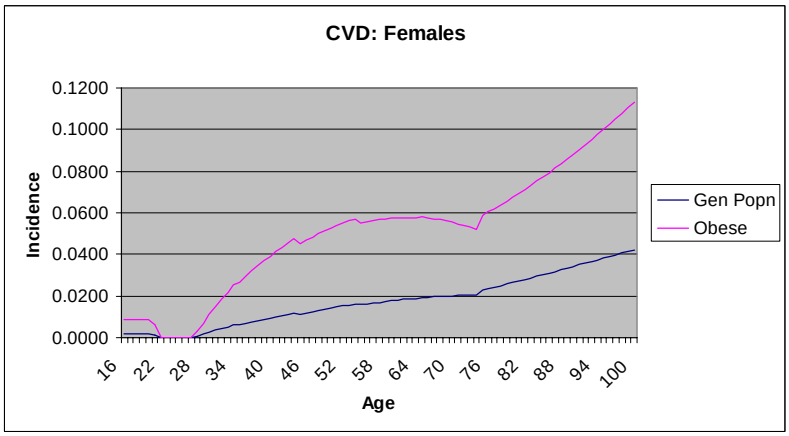


Figure 6b Risk of circulatory disease, Females



Summary of inputs to Markov model

A summary of transition probabilities used in 25 and 65 year old male and 25 and 65 year old females are illustrated in Appendix 1. Full tables are available from the authors.

Costs

Each of the 15 states was assigned a cost based on the best evidence available (Appendix 2). The data available from which to estimate the state costs varied in quality, and therefore the reliability of the estimates is also variable, ranging from directly relevant published cost of illness studies (for example, for heart failure[11] and angina[12]), to crude estimates based on broad assumptions of health service activity (for example treatment and longer term care of ovarian cancer patients).

The cost estimates for each state are assumed to be the same for both obese and normal weight patients, except that obese patients are assumed to incur an additional annual cost of £5.02. This represents NHS activity and prescriptions directly attributable to obesity itself.

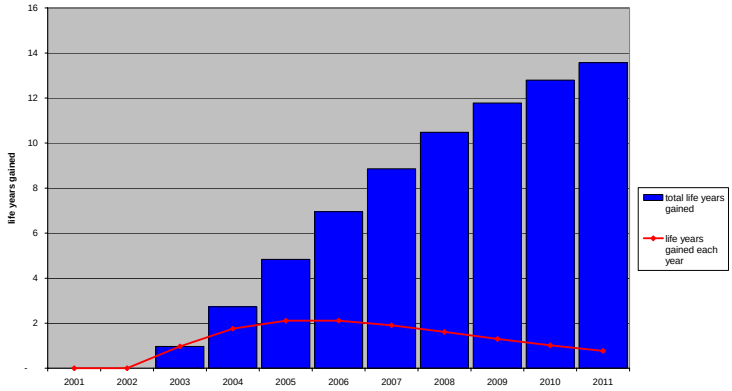
Model results

(Note, as the model is still under development, real results are not yet available, and the following is an example of the model outputs).

The model calculates an expected cost and life years for the population for each year for the next 20 years. The model is run again for the population assuming a different prevalence of obesity representing the effects of a public health intervention, generating a different cost and life year total.

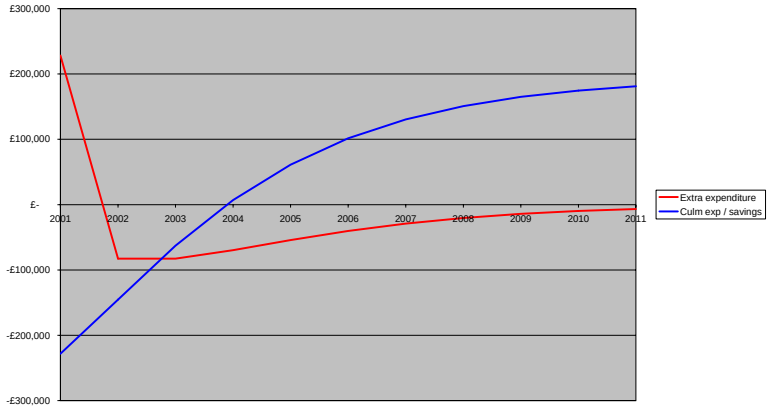
For example, suppose a population-wide intervention cost £250,000 to implement in the first year and succeeded in reducing the prevalence of obesity by 3% that year, with the effect reducing by 2/3rds each subsequent year. This gives a different cost and life years each year. These can be analysed in a number of ways, for example, the health gain, in terms of life years gained, can be shown for each year (Figure 7).

Figure 7 health gain from anti-obesity intervention



The time to payback for the intervention can also be calculated (Figure 8)

Figure 8 Time to payback



In this example, the initial outlay of £250,000 in the first year is repaid within 3, and after 10 years, the cumulative savings are approximately £180,000.

The final output from the model is an incremental analysis of the intervention using present values of costs and outcomes (Table 3).

Table 3 Incremental Analysis

	Baseline	Intervention	Difference
PV of Cost	£248,815,969	£248,708,643	-£107,326
PV of Life years	4,743,204	4,743,216	12
ICER			(dominant)

A number of alternative strategies for reducing obesity can be compared using this methodology to determine the preferred option(s).

Discussion

We have developed a tool to model the long term cost-effectiveness of interventions to tackle obesity where only short term evidence of effectiveness is known. The model allows comparison of a number of strategies which can then be compared in terms of their relative cost-effectiveness.

The tool is still under development, and therefore there are no full results at this stage, only indicative outputs.

Economic analyses of the impact of obesity have either concentrated on cost of illness studies[1;3;13-17], or cost-effectiveness analyses of specific treatments and interventions (e.g. surgery[18-22] and drugs[23-29]), whilst there are a number of analyses of preventative public health strategies [30-40]. It is notoriously difficult to show the value for money from public health interventions, as typically, their beneficial effects are not seen until many years after the funds have been spent. This model helps to address this problem by tracking the expected health gain from reductions in the prevalence of obesity for future years, and showing the time to payback from a given intervention.

The strengths of this model are that it estimates the impact of changes in the obesity prevalence on a number of common comorbidities, rather than concentrating on just diabetes or CHD for example. This allows a decision maker to get a better feel for the impact of anti-obesity measures, and the overall costs and benefits of different strategies.

The limitations of this model are that it is ambitious and complex in structure. In particular, the data requirements are substantial, and thus where data are lacking, the credibility of some incidence estimates may be somewhat stretched. The use of relative risk data on top of this may magnify any errors in incidence estimation.

A particular methodological issue is that the Markov chains allow for one co-morbidity per patient only. For example, it is not possible to trace the path of an individual patient who may develop both type 2 diabetes and circulatory disease. Therefore this model *cannot* be used to predict individual patient outcomes in this way. But the focus of this analysis is on the population level: the model must predict the total 'stock' of comorbidities within the population at a given time, rather than individual patient pathways. The structure of the model allows this. The only caveat is that if in any given transition period (year), the total proportion of patients moving from healthy to a diseased state is greater than 100%. For example, if 50% of patients developed circulatory disease, 30% developed type 2 diabetes and 30% developed osteoarthritis in a single year, then the model would be inappropriate. Fortunately, this situation did not arise in the model.

Conclusion

This is an attempt to develop a tool which can be used to model the long-term cost-effectiveness of strategies to reduce the prevalence of obesity. The model is still under development and therefore we currently present no firm results. We would appreciate comments and discussion on the validity of the approach, and whether any changes should be made to the model (for example restricting the scope).

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Appendix 1 Transition Probability Summary

The table below summarises transition probabilities for 8 cohorts: 25 and 65 year old males and females, and obese, non-obese.

Transition	P[normal weight, 25yo ♂]	P[normal weight, 65yo ♂]	P[normal weight, 25yo ♀]	P[normal weight, 65yo ♀]	P[obese, 25yo ♂]	P[obese, 65yo ♂]	P[obese, 25yo ♀]	P[obese, 65yo ♀]	Notes / Source
1 -> 1 (remain healthy)	0.9981	0.9179	0.9984	0.9119	0.9963	0.8435	0.9971	0.8384	Is 1 – sum of other transitions.
1 -> 2 (Healthy -> circulatory disease)	0.0000	0.0220	0.0000	0.0192	0.0000	0.0463	0.0000	0.0578	Risk is sum of incidence of CHF, angina and hypertension[2;6-10], and relative risk estimate from National Audit Office[1]
1 -> 7 (Healthy -> T2DM)	0.0003	0.0028	0.0002	0.0024	0.0014	0.0144	0.0011	0.0127	Based on statistics from Diabetic Retinopathy Screening Project website[5] and relative risk estimate from National Audit Office[1]
1 -> 8 (Healthy -> osteoarthritis)	0.0008	0.0385	0.0011	0.0547	0.0015	0.0731	0.0015	0.0766	Incidence estimate from Arthritis Research Campaign website[41] and relative risk estimate from National Audit Office[1]
1 -> 9 (Healthy -> colorectal cancer)	0.0000	0.0019	0.0000	0.0012	0.0000	0.0057	0.0000	0.0032	Incidence estimate from ONS[42] and relative risk estimate from National Audit Office[1]
1 -> 10 (Healthy -> Ovarian cancer)	0.0000	0.0000	0.0000	0.0004	0.0000	0.0000	0.0000	0.0011	Incidence estimate from ONS[42] and relative risk estimate from National Audit Office[1]
1 -> 11 (Healthy -> Dead)	0.0008	0.0170	0.0003	0.0101	0.0008	0.0170	0.0003	0.0101	Government Actuary Department Life Tables for 2000-2002, based on 2001 Census[43]
Sum	1	1	1	1	1	1	1	1	
2 -> 2 (circ. disease)	0.9988	0.9657	0.9996	0.9787	0.9987	0.9581	0.9994	0.9653	Is 1 – sum of other transitions.
2 -> 3 (circ. Disease -> fatal MI)	0.0001	0.0051	0.0000	0.0026	0.0002	0.0077	0.0001	0.0082	Incidence and fatality data from published studies[44-46]
2 -> 4 (circ. Disease -> fatal stroke)	0.0000	0.0012	0.0000	0.0012	0.0000	0.0015	0.0000	0.0015	Source study only included males[47]. No data available for females so assumed the same as males.
2 -> 5 (circ. Disease -> non-fatal MI)	0.0002	0.0064	0.0001	0.0028	0.0003	0.0097	0.0002	0.0089	Incidence and fatality data from published studies[44-46]
2 -> 6	0.0000	0.0046	0.0000	0.0046	0.0000	0.0060	0.0000	0.0060	Source study only included males[47]. No data available for

(circ. Disease -> non-fatal stroke)									females so assumed the same as males.
2 -> 11 (circ. Disease -> death)	0.0008	0.0170	0.0003	0.0101	0.0008	0.0170	0.0003	0.0101	This is death due to other than circulatory disease, so assumed same as for general population[43]
Sum	1	1	1	1	1	1	1	1	
5 -> 11 (die year after non-fatal MI)	0.0030	0.0628	0.0012	0.0375	0.0030	0.0628	0.0012	0.0375	Based on estimate of relative risk of death following MI versus no evidence of IHD of 3.7[46]
5 -> 12 (non-fatal MI -> post MI care)	0.9970	0.9372	0.9988	0.9625	0.9970	0.9372	0.9988	0.9625	Is 1 – sum of other transition.
Sum	1	1	1	1	1	1	1	1	
6 -> 11 (die year after non-fatal stroke)	0.0030	0.0628	0.0012	0.0375	0.0030	0.0628	0.0012	0.0375	No data available, so assume risk of death is same as for post MI (state 5 -> 11)
6 -> 13 (non-fatal stroke -> post stroke care)	0.9970	0.9372	0.9988	0.9625	0.9970	0.9372	0.9988	0.9625	Is 1 – sum of other transition.
Sum	1	1	1	1	1	1	1	1	
7 -> 7 (T2DM)	0.9991	0.9818	0.9997	0.9898	0.9991	0.9818	0.9997	0.9898	Is 1 – sum of other transition.
7 -> 11 (T2DM -> dead)	0.0009	0.0182	0.0003	0.0102	0.0009	0.0182	0.0003	0.0102	Dept of Health Compendium of clinical & Health Indicators 2002 relative risk of death (all cause) is 1.07 for men and 1.02 for women with diabetes.
Sum	1	1	1	1	1	1	1	1	
8 -> 8 (osteoarthritis)	0.9992	0.9830	0.9997	0.9899	0.9992	0.9830	0.9997	0.9899	Is 1 – sum of other transition.
8 -> 11 (osteoarthritis -> dead)	0.0008	0.0170	0.0003	0.0101	0.0008	0.0170	0.0003	0.0101	Assume is same as for general population.
Sum	1	1	1	1	1	1	1	1	
9 -> 11 (colorectal cancer -> dead)	0.1303	0.1464	0.1298	0.1396	0.1303	0.1464	0.1298	0.1396	Based on a 50% 5-year survival rate[48], which is added to the general population survival rate[43].
9 -> 14 (colorectal cancer -> post colorectal cancer care)	0.8697	0.8536	0.8702	0.8604	0.8697	0.8536	0.8702	0.8604	Is 1 – sum of other transition.
Sum	1	1	1	1	1	1	1	1	
10 -> 11 (ovarian cancer -> dead)	0.1856	0.2018	0.1851	0.1949	0.1856	0.2018	0.1851	0.1949	No data specific to ovarian cancer located, so used 5-year survival rate for all cancer as a proxy (36%)[49] and added general population survival rate[43]
10 -> 15	0.8144	0.7982	0.8149	0.8051	0.8144	0.7982	0.8149	0.8051	Is 1 – sum of other transition.

(ovarian cancer -> post-ovarian cancer care)									
Sum	1	1	1	1	1	1	1	1	
12 -> 12 (post MI care)	0.9970	0.9372	0.9988	0.9625	0.9970	0.9372	0.9988	0.9625	As per transitions 5->11
12 -> 11 (post MI care -> death)	0.0030	0.0628	0.0012	0.0375	0.0030	0.0628	0.0012	0.0375	
Sum	1	1	1	1	1	1	1	1	
13 -> 13 (post stroke care)	0.9970	0.9372	0.9988	0.9625	0.9970	0.9372	0.9988	0.9625	As per transitions 6->11
13 -> 11 (post stroke care -> death)	0.0030	0.0628	0.0012	0.0375	0.0030	0.0628	0.0012	0.0375	
Sum	1	1	1	1	1	1	1	1	
14 -> 14 (post colorectal cancer care)	0.8697	0.8536	0.8702	0.8604	0.8697	0.8536	0.8702	0.8604	As per transitions 9->11
14 -> 11 (post colorectal cancer care -> death)	0.1303	0.1464	0.1298	0.1396	0.1303	0.1464	0.1298	0.1396	
Sum	1	1	1	1	1	1	1	1	
15 -> 15 (post ovarian cancer care)	0.8144	0.7982	0.8149	0.8051	0.8144	0.7982	0.8149	0.8051	As per transitions 10->11
15 -> 11 (post ovarian cancer care -> death)	0.1856	0.2018	0.1851	0.1949	0.1856	0.2018	0.1851	0.1949	
Sum	1	1	1	1	1	1	1	1	

Appendix 2 Cost by state

State #	Description	Annual cost in obese	Annual cost in normal weight	Basis of cost assumption / source	Relative reliability
1	Healthy	£ 5.02	£ -	GP, IP, OP & DC contacts with NHS, plus drugs. [1;2;9;18;50-52]	M
2	Angina, CHF or hypertension	£246.36	£ 241.34	Weighted average of annual cost of angina, CHF & hypertension including NHS contacts, drugs and surgery[11;12;51-53]	H
3	Fatal MI	£977.96	£ 972.93	NHS reference costs 2001[52]	H
4	Fatal Stroke	£ 2,062.56	£ 2,057.54	NHS Reference costs 2001[52]	H
5	Non-fatal MI, acute costs	£977.96	£ 972.93	NHS reference costs 2001[52]	H
6	Non-fatal stroke, acute costs	£ 2,062.56	£ 2,057.54	NHS Reference costs 2001[52]	H
7	T2DM	£ 1,483.00	£ 1,477.97	1 Swiss study[54]	M
8	Osteoarthritis	£ 129.84	£ 124.81	GP consultations and hip & knee replacement surgery[41;51;52;55]	M
9	Colorectal Cancer	£ 3,209.54	£ 3,204.52	Diagnostic endoscopy, double contrast barium enema, surgery, pre-op radiotherapy[52;56]	M
10	Ovarian Cancer	£ 831.05	£ 826.02	Crude estimate based on oophrectomy[52]	L
11	Dead	£ -	£ -		H
12	Survive MI, chronic costs	£ 347.92	£ 342.90	Assumed GP visit frequency. Drugs based on BNF recommendations[57]	M
13	Survive Stroke, Chronic costs	£ 1,411.43	£ 1,406.40	Including at home or institutional care[58]	L
14	Post colorectal cancer chronic care	£ 208.84	£ 203.82	[51;52;56]	L
15	Post ovarian cancer chronic care	£ 83.02	£ 78.00	Assumes 3 GP visits per year	L