School based group education to reduce population levels of obesity

Matrix Insight, in collaboration with Imperial College London, Kings College London and Bazian Ltd, were commissioned by Health England to undertake a research study to develop and apply a method for prioritising investments in preventative interventions for England. Seventeen preventative health interventions were included in the study. Each intervention was evaluated in terms of the following criteria: reach; inequality score; cost-effectiveness; and affordability. This report presents the results of the analysis for one of the interventions: school based group education to reduce population levels of obesity. The full report of the study is available from the ***H.E.L.P.*** website.

Summary

Description of the intervention
A school-based intervention designed to reduce obesity in youth of middle-school age. The program was an inter-disciplinary curriculum for both male and female students. Intervention material was incorporated into four major subject areas (language arts, math, science, and social studies) and into physical education. Sessions focused on decreasing television viewing, decreasing consumption of high-fat foods, increasing fruit and vegetable intake, and increasing moderate and vigorous physical activity. The intervention was effective only among female students (Wang et al, 2003).

Criteria	Measure	Value	Certainty
1. Reach			
Percentage of population affected by the condition and that could potentially benefit from the intervention.	Females 11 to 16 years old as a percentage of the population aged 11 and above in England (Office for National Statistics, 2009)	3.59%	★★★
2. Inequality score			
Ratio of the percentage of disadvantaged population to the percentage of the general population that could potentially benefit from the intervention.	Assumption	1	★
3. Cost-effectiveness			
Cost of the intervention per QALY gained (in £2007/08)	See cost-effectiveness	£1,813	★★
Net cost of the intervention per QALY gained (in £2007/08)	See cost-effectiveness	£599	★★
Timing of benefits	QALY gain and cost savings are estimated to occur in the long-run (5 years or more after the intervention).		
4. Affordability			
Total cost of implementing the intervention at the national level	Multiple of eligible individuals and unit cost of the intervention	Less than £100 million	★★

Key to certainty grading scales

★ Low quality evidence

★★ Medium quality evidence

★★★ High quality evidence

Box 1. Cost per QALY gained

A quality adjusted life year (QALY) is a simple way of combining quality of life with length of life.
One QALY is equivalent to one year in full health. The cost per QALY gained is therefore the cost of achieving one extra year of full health. Its calculation is based on the following formula:

$$cost\ per\ QALY\ gained = \frac{incremental\ cost\ of\ intervention}{QALYs\ gained}$$

The net cost per QALY gained is the cost per QALY considering the incremental cost of the intervention as well as the cost saved through health treatment avoided. Its calculation is based on the following formula:

$$net\ cost\ per\ QALY\ gained = \frac{incremental\ cost\ of\ intervention - cost\ savings}{QALYs\ gained}$$

Cost effectiveness

Cost. School based group education to reduce levels of obesity among middle-school age female students cost on average £24 per person more than usual curricula (£2007/08).

Effect. Compared to usual curricula, school based group education reduce the chances of middles-school age students of becoming overweight adult females by 1.87 per cent. This effect was obtained from a review undertaken to identify evidence on the effectiveness and cost-effectiveness of school based group education to reduce population levels of obesity.

Benefits. The benefits of the intervention derive from preventing overweight in adulthood. Two types of benefits are considered: QALYs and health care cost savings.[1] Based on the QALYs gained and the health care cost savings of prevented overweight in adulthood, a 1.87 per cent reduction in the rate of overweight adulthood is associated with the following benefits:

- An additional 0.013 QALYs per person
- Cost savings of £16.2 per person (£2007/08)

Please refer to the decision model for details on how the QALY gain and cost savings were calculated.

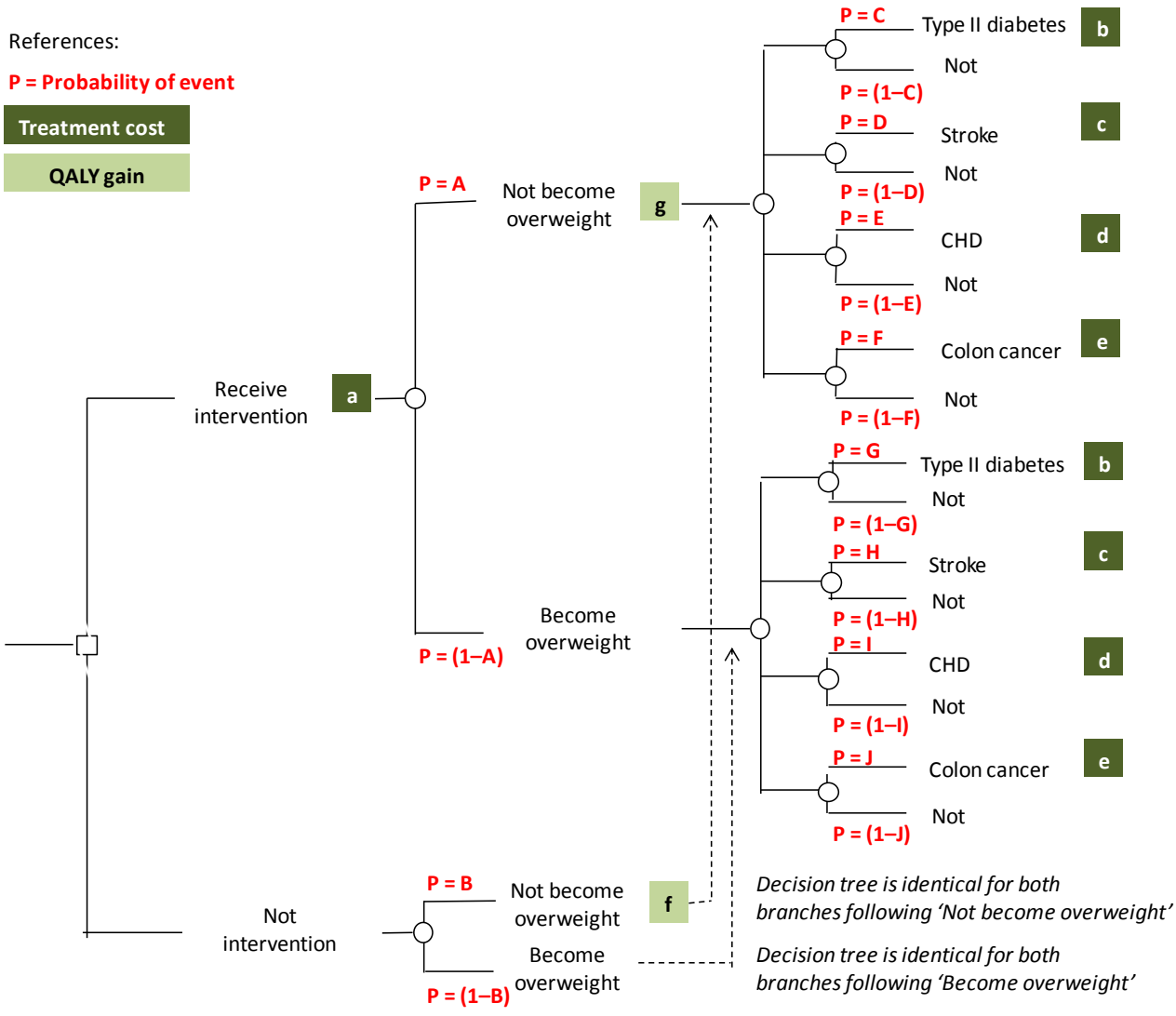
[1] Cost associated with increased life expectancy resulting from the intervention –such as pensions and health care costs– are not included in the analysis.

Decision model

An economic model was built to estimate the cost-effectiveness of the intervention. The model estimates the QALY gain and cost savings associated with the intervention. Figure 1 illustrates the structure of the model, which is based on the following assumptions:

- The effect of the intervention is given by a change in the chances of middle-school age female students becoming overweight in adulthood.
- Individuals receiving the intervention are assumed to be 14 years old on average.
- Overweight is assumed to be associated with four diseases: type II diabetes; stroke: coronary heart diseases (CHD); and colon cancer. These diseases have impacts in terms of quality of life and health care costs. The costs of colon cancer were not included in the estimates of health care cost savings given that no reliable annual cost for the treatment colon cancer could be identified.
- The probabilities of experiencing these diseases vary for overweight and non-overweight adults. Non-overweight adults have reduced probabilities of experiencing the diseases. Thus, preventing adulthood overweight reduces the probability of experiencing these diseases and produces corresponding improvements in quality of life and health care cost savings.

Figure 1. Adulthood overweight model



Unless stated otherwise, the analysis was undertaken in accordance with H.M. Treasury's Green Book (HM Treasury, 2003). Specifically:

- Any costs and effects incurred more than one year after the intervention were discounted at 3.5%.
- Where necessary monetary values were converted in 2007/8 prices using Gross Domestic Product (GDP) deflators (HM Treasury, 2008).
- Where necessary monetary values were converted into pounds sterling using: www.x-rates.com

The model draws the following estimates from the literature:

- The unit cost of the intervention (Table 1).
- The effect of the intervention on the probability of middle-school age female students becoming overweight in adulthood (Table 1).
- The probabilities that those who become overweight in adulthood experience diseases (Table 2).
- The probabilities that those who do not become overweight in adulthood experience diseases (Table 2).
- The impact of experiencing diseases on quality of life, measured in QALYs (Table 3).
- The impact of experiencing diseases on health care treatment costs (Table 3).

Table 1. Intervention costs and effects (monetary values in £2007/08)

Ref	Description	Value	Calculation and source
a	Cost of intervention	£24.2	Unit cost estimates are based on the resource units involved in the delivery of the intervention, as reported by Wang et al (2003), and UK prices (where the price was not available, an assumption was made). The resources involved in the delivery of the intervention include: training workshop delivered by a dietician and an assistant dietician; teachers' reimbursement; teachers' wellness activities; schools' fitness funds; and programme book.
A	P(if intervention, adulthood overweight)	0.0691	This is the probability of a female student receiving the intervention of becoming overweight at age 40. It is calculated as the probability of a female student receiving the intervention of being obese at age 14 times the difference between an overweight and a non overweight female at age 14 of becoming overweight by age 21 to 29 years times the difference between an overweight and a non overweight women at age 21-29 of becoming overweight by age 40 (Wang et al, 2003). See evidence review.

Ref	Description	Value	Calculation and source
B	P(if no intervention, adulthood overweight)	0.0878	This is the probability of a female student not receiving the intervention of becoming overweight at age 40. It is calculated as the probability of a female student not receiving the intervention of being obese at age 14 times the difference between an overweight and a non overweight female at age 14 of becoming overweight by age 21 to 29 years times the difference between an overweight and a non overweight women at age 21-29 of becoming overweight by age 40 (Wang et al, 2003). See evidence review.

Table 2. Transition probabilities

Ref	Description	Value	Calculation and source
Definitions for overweight and non-overweight based on Body Mass Index (BMI): • Non-overweight: BMI < 25 kg/m2 • Overweight: BMI ≥ 25 kg/m2			
C	P(if overweight, type II diabetes)	0.0600	The prevalence of type I diabetes is assumed to be equivalent to the prevalence of type I and II diabetes. It was calculated as the average doctor diagnosed prevalence of diabetes type I and II among overweight and obese women (The Health and Social Care Information Centre, 2008).
G	P(if non-overweight, type II diabetes)	0.0115	The prevalence of type I diabetes is assumed to be equivalent to the prevalence of type I and II diabetes. It was calculated as the average doctor diagnosed prevalence of diabetes type I and II among underweight and normal women. (The Health and Social Care Information Centre, 2008)
D	P(if overweight, stroke)	0.0247	The probability of stroke for (non) overweight females was assumed to be equivalent to the average prevalence among (non) overweight females. The following formula was used in the calculation: $D = \frac{x}{t} \cdot D_x \cdot RR_x + \frac{y}{t} \cdot D_y \cdot RR_y$ where: D = prevalence of disease; RR = relative risk of contracting the disease; x = non-overweigh; y = overweight; and t = total population. The following parameters were applied to the formula: • Prevalence of the disease in total female population aged 55 to 64 years old (D=0.002).
H	P(if non-overweight, stroke)	0.0208	

Ref	Description	Value	Calculation and source
			• Relative risk of stroke (RR overweight female=1.19; RR non-overweight female=1) (Hu et al, 2007). • Proportion of non-overweight females in the general population (x/t=0.44). • Proportion of overweight females in the general population (y/t=0.56). Source: except where indicated otherwise, The Health and Social Care Information Centre, 2008.
E	P(if overweight, CHD)	0.1370	The prevalence of CHD is assumed to be equivalent to the prevalence of CVD. It was calculated as the average prevalence of CVD among underweight and normal women (The Health and Social Care Information Centre, 2008).
I	P(if non-overweight, CHD)	0.0975	The prevalence of CHD is assumed to be equivalent to the prevalence of CVD. It was calculated as the average prevalence of CVD among overweight and obese women (The Health and Social Care Information Centre, 2008).
F	P(if overweight, colon cancer)	-	Not included in the model as no reliable annual cost for the treatment colon cancer could be identified.
J	P(if non-overweight, colon cancer)	-	

Table 3. Associated outcomes (monetary values in £2007/08)

Ref	Outcome	Value	Calculation and source
All lifetime treatment cost calculations were based on the present value of the annual treatment cost through the expected duration of the disease. The duration of the disease was assumed to be given by the difference between the average onset and mortality ages for the disease. The onset age was assumed to be 55 years old. Total treatment costs were discounted to the age of individuals receiving the intervention, which was assumed 14 years old, at a 3.5% annual rate.			
b	Type II diabetes treatment cost	£13,147	The annual treatment cost was estimated by Matrix (2006) at £3213 (in £2007/08) based on NHS annual costs and the incidence of the disease in the UK. According to Matrix (2006) it is assumed that the mortality age for women experiencing diabetes at age 55 is 80.5 years old.
c	Stroke treatment cost	£3,996	The annual treatment cost was estimated by Matrix (2006) at £2194 (in £2007/08) based on NHS annual costs and the incidence of the disease in the UK. According to Matrix (2006) it is assumed that the mortality age for women experiencing a stroke at age 55 is 63.8 years old.

Ref	Outcome	Value	Calculation and source
d	CHD treatment cost	£5,349	The annual treatment cost of CHD was estimated by Matrix (2006) at £1,511 (in £2007/08) based on data from the British Heart Foundation. According to Matrix (2006) it is assumed that the mortality age for women experiencing CHD is 75.6 years old.
e	Colon cancer treatment cost	-	Not included in the model as no reliable annual cost for the treatment colon cancer could be identified.
f	QALYs: 12 month quit	0.712	This is based on the QALY difference between overweight and non-overweight women estimated by Wang et al (2003). This difference accounts for: (a) mean years of healthy life scores (YHL) by BMI for women 40 to 64 years of age, controlling for age-race smoking status; and (b) life expectancy estimates for overweight and non-overweight women. Parameters involved: annual mean YHL score for a non/overweight woman; probability of dying during the 25-year period for a non/overweight woman; expected number of years of life after age 40 years among non/overweight women who die during the 25-year period; annual discount rate. The YHL score [0-1] is derived from answers to two questions: activity limitations with 6 response categories and self-rated health with five response categories. The responses to these two questions were used to assign each person to 1 of 30 health states ranging from 0.1 to 1.0. Mean YHL scores by BMI were estimated by linear regression controlling for age, race and smoking status.

Effectiveness evidence

A literature review was undertaken by Bazian to identify evidence on the effectiveness and cost-effectiveness of school based group education to reduce population levels of obesity. Further details are available on the evidence methods page of the ***H.E.L.P.*** website.

The review of the evidence on the effectiveness of brief interventions delivered in GP surgeries identified one randomised control study. Table 4 provides the following details of the studies identified:

- Population
- Intervention
- Results

The review of the evidence on the cost-effectiveness of brief interventions delivered in GP surgeries identified one economic study. Table 5 provides the following details of the studies identified:

- Population, intervention and model
- Perspective, discounting, inflation, cost year
- Utility/benefit
- Unit costs
- Efficiency

Table 6 and Table 7 provide a quality assessment of the studies. Further details are available on the quality appraisal methods page.

The following criteria were applied to select effectiveness evidence for undertaking the economic analysis:

- Location. Studies from the UK were preferred over studies from other locations.
- Population. Studies applied to the general population were preferred over studies applied to restricted population groups (e.g. pregnant women; individuals from specific communities/nationalities).
- Counterfactual. Studies for which the counterfactual intervention was ‘usual care’ or ‘do nothing’ in a UK setting were preferred over studies for which the counterfactual was different from ‘usual care’ or ‘do nothing’.
- Method. Studies using more rigorous design methods (e.g. randomised controlled trials or quasi experimental designs with regression models controlling for confounders) were preferred over studies using less rigorous design methods (e.g. before-after studies or simple correlation analysis).

Table 4. Effectiveness of school based group education to reduce population levels of obesity

Study reference	Population	Intervention	Results
Gortmaker et al, 1999; USA ▪ randomised controlled trial ▪ Wang et al retrospective cost study is based on this RCT – see below	School girls in Boston aged < 14 years. 1,203 girls participated in baseline (and are used for estimates of per participant costs by researchers). 310 school girls are discussed as being the participants in the interventions throughout the rest of the paper.	*Intervention* ▪ Cost-effectiveness analysis of Planet Health Scheme based on RCT of intervention which focused on decreasing television viewing, decreasing consumption of high fat foods, increasing fruit and vegetable intake and increasing moderate and vigorous physical activity *Control* ▪ Usual curricula and physical education classes.	Reduction in obesity prevalence with intervention: -3.2% Change in obesity prevalence with control: +2.2% Odds ratio (of obesity intervention v control): 0.47 (95% CI 0.24 to 0.93)

Table 5. Cost-effectiveness of school based group education to reduce population levels of obesity

Study reference	Population, intervention and model	Perspective, discounting, inflation, cost year	Utility/benefit	Unit costs	Efficiency
Wang, et al, 2003; USA	Cost-effectiveness analysis of Planet Health Scheme based on RCT of intervention which focused on decreasing television viewing, decreasing consumption of high fat foods, increasing fruit and vegetable intake and increasing moderate and vigorous physical activity vs. usual curricula and physical education classes. School girls in Boston aged < 14 years. 1,203 girls participated in baseline (and are used for estimates of per participant costs by researchers). 310 school girls are discussed as being the participants in the interventions throughout the rest of the paper.	▪ Social perspective ▪ 3% discounting ▪ Unclear whether adjustment for inflation ▪ Cost year: USD1996	4.1 QALYs saved by programme Society would save $15,887 in medical costs $25,104 in loss of productivity costs Number of cases of adulthood overweight prevented: 5.805 (i.e. 1.9%)	$14 per student per year Total cost breakdown: $33,677 for 2 years Training workshop: Trainer: 1,462 Assistant trainer: 1,115 Teacher reimbursement: Subject teachers: 15,150 PE teachers: 1,800 Food: 2,200 Teacher wellness activities: Trainer: 900 Fitness funds: 5,000 Planet health book: 6,050	Net saving $7313 to society Cost of lost productivity averted: $25,104 $4305 per QALY gained

Study reference	Population, intervention and model	Perspective, discounting, inflation, cost year	Utility/benefit	Unit costs	Efficiency
	Progression model to estimate adult overweight cases by 40 years of age. Costs incurred during the 2 year program were measured as intervention costs. All costs averted and QALYs saved were calculated over a period of 25 years, from 40 to 65 years of age. Model assumed that prevention resulted in weight maintenance for 1 year. Study estimates that as a result of the intervention, 1.9% of female students will be prevented from becoming overweight adults.				

Table 6. Quality assessment for effectiveness studies

Study reference	QA for trials/RCTs					Score	Grading (++ 4-5; + 3; -0-2)
	Follow-up	Intention to treat?	Attrition	Groups similar or controlled?	Randomised?		
Gortmaker et al, 1999; USA	Yes	Yes	Yes	Yes	Yes	5	++

Table 7. Quality assessment for Quality assessment for economic studies

Study reference	QA for economic studies						Score	Grading (++ 4-6; + 3; -0-2)
	All costs of intervention included?	Market values used for costs?	Perspective reported?	Sensitivity analysis?	Reports base year adopted?	Effectiveness data from RCT or MA?		
Wang et al, 2003; USA	Yes	Don't know	Yes	Yes	Yes	Yes	5	++

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