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Economic analysis of a school-based obesity prevention program

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Record status	This record was compiled by CRD commissioned reviewers according to a set of guidelines developed in collaboration with a group of leading health economists.
Health technology	The use of a school-based obesity prevention programme, referred to as Planet Health. Planet Health was designed to reduce obesity in youth of middle-school age. The programme was an interdisciplinary curriculum, whereby intervention material was infused into four major subject areas (language arts, mathematics, 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.
Type of intervention	Primary prevention.
Hypothesis/study question	The objective of the study was to assess the cost-effectiveness and cost-benefit of Planet Health, a school-based intervention designed to reduce obesity in youth of middle-school age. The school-based intervention was compared with a no intervention alternative, whereby students received the usual curricula and physical education classes. A societal perspective was adopted in the economic analysis.
Economic study type	Cost-utility analysis.
Study population	The study population comprised female students of middle-school age.
Setting	The setting was the community. The economic study was conducted in the USA.
Dates to which data relate	The effectiveness data were derived from a study reporting efficacy data on the Planet Health intervention that was conducted in 1995 and published in 1999 (Gortmaker et al., see Other Publications of Related Interest), a study published in 1997 (Whitaker et al., see Other Publications of Related Interest), and from the National Health and Nutrition Examination Study Epidemiological Follow-up Study (NHANES I EFS) conducted from 1971 to 1992. The resource use data were derived from studies and sources published between 1997 and 1999. The price year was 1996.
Source of effectiveness data	The effectiveness data were derived from the study reporting efficacy data on the Planet Health intervention, a study predicting obesity in young adulthood from childhood and parental obesity (Whitaker et al.), and from the NHANES I EFS.
Modelling	A decision model was created to calculate the cost-effectiveness of the health intervention over 25 years. A two-stage overweight progression model was used to determine the expected number of adulthood overweight cases by age 40 years among the 310 female students in the intervention, compared with the same 310 students in a hypothetical no intervention condition. Overweight was defined as a body mass index (BMI) of at least 25 kg/m2.
Outcomes assessed in the review	The outcomes assessed were: the probability of a 14-year-old overweight female student becoming an overweight young woman by 21 to 29 years of age;

	the probability of a 14-year-old non-overweight female student becoming an overweight young woman by 21 to 29 years of age; the probability of an overweight young woman aged 21 to 29 becoming an overweight women by age 40 years; the probability of a non-overweight young woman aged 21 to 29 becoming an overweight woman by age 40 years; the years of healthy life scores by BMI for women aged 40 to 64 years; the probability of dying during the 25-year period by BMI; and the expected number of years of life after age 40 years by BMI for women who died during the 25-year period.
Study designs and other criteria for inclusion in the review	Not reported.
Sources searched to identify primary studies	Not reported.
Criteria used to ensure the validity of primary studies	Not reported.
Methods used to judge relevance and validity, and for extracting data	Not reported.
Number of primary studies included	The effectiveness data were derived from a study predicting obesity in young adulthood from childhood and parental obesity (Whitaker et al., see Other Publications of Related Interest) and from the NHANES I EFS. Three further published studies were used to derive utility values and life expectancy.
Study sample	Efficacy data on the Planet Health intervention was derived from the study by Gortmaker et al. (see Other Publications of Related Interest). The authors provided brief details of this study. In 1995, 10 middle schools in four communities in the Boston metropolitan area were randomly assigned to either the intervention (5 schools) or control condition (5 schools). A total of 1,203 students in the schools were randomised to receive the intervention.
Study design	The study was based on a randomised controlled trial that was undertaken in 10 different schools. Although 1,203 students in schools were randomised to receive the intervention, only 310 girls and 331 boys completed the follow-up for 2 school years.
Method of combination of primary studies	Not relevant.
Investigation of differences between studies	Not relevant.
Results of the Review	The proportion overweight at ages 21 to 29 years was 75.4% (95% CI: 64.4 - 86.2) among those who were overweight at age 14, and 9.8% (95% CI: 7.5 - 12.1) among those who were not overweight at age 14. The estimated proportion overweight at 40 years was 91.2% (95% CI: 85.0 - 97.5) among those who were overweight at age 21 to 29 years, and 39.3% (95% CI: 33.5 - 45.1) among those who were not overweight at age 21 to 29 years. The years of healthy life scores per woman age 40 to 65 years were 0.835 (95% CI: 0.827 - 0.842) for non-overweight females and 0.753 (95% CI: 0.743 - 0.764) for overweight females. The probability of dying during the 25-year period was 0.117 for non-overweight females and 0.152 for overweight females. The expected number of years of life after age 40 years among women who died during the 25-year period was 16.50 for overweight females and 16.05 for non-overweight females.

Analysis of effectiveness	The analysis of the clinical study was conducted on the basis of treatment completers only. The measure of outcomes used was the change in obesity from baseline (autumn 1995) to follow-up (spring 1997) among students in the intervention and control schools. Obesity was defined as a composite indicator based on having both BMI and a tricep-skinfold value greater than or equal to age- and gender-specific 85th percentiles.
Effectiveness results	The trial found that, during the 2-year intervention, the prevalence of obesity among girls declined from 23.6 to 20.4% in the intervention schools (n=310), but increased from 21.5 to 23.7% in the control schools. After controlling for baseline covariates, the prevalence of obesity among girls in the intervention schools was reduced significantly compared with girls in the control schools (odds ratio 0.47, 95% confidence interval, CI: 0.24 - 0.93; p=0.03). No significant differences were found among boys.
Clinical conclusions	The study concluded that the Planet Health intervention was efficacious in reducing the prevalence of obesity in female students of middle-school age.
Measure of benefits used in the economic analysis	The measure of benefits used was the quality-adjusted life-years (QALYs). In the present study, QALYs were calculated using the Healthy People 2000 years of healthy life measure, in conjunction with the 1990 National Health Interview Survey (NHIS) for women aged 40 to 64 years. These estimates of years of healthy life were then combined with the life expectancy estimates from a published study (Gorsky et al., see Other Publications of Related Interest), to calculate QALYs for overweight and non-overweight women. The benefits were discounted at an annual rate of 3%.
Direct costs	The resource use and quantities were reported separately for some resource categories only. The direct costs to the third-party payer were included in the analysis. These costs included the intervention costs of Planet Health, such as teacher training workshops, wellness sessions and fitness funds, and the medical costs of being overweight. The costs of teacher training included salaries for a trainer and assistant trainer for delivering the training, teachers' stipends for attending the training, and cost of food provided during the training. The medical costs due to being overweight included the direct health care and medication costs associated with women who were currently 40 years of age and who maintained an overweight status through age 65 years. The medical costs estimated were those associated with events of fatal and nonfatal coronary heart disease, hypertension, diabetes, symptomatic gallstones, and osteoarthritis. These costs were based on a published study (Gorsky et al., 1996). Since the costs were incurred until the female students were aged 65 years, discounting was relevant and was appropriately performed using a rate of 3% per annum. The study reported the incremental costs. The price year was 1996.
Indirect costs	The indirect costs due to lost productivity consisted of the costs associated with lost or impaired ability to work or to engage in leisure activities because of morbidity, and lost economic productivity because of death. In this study, the authors estimated the excess costs associated with excess work-days lost and excess life-years lost per overweight woman, compared with a non-overweight woman, for a period of 25 years from 40 to 65 years of age. The authors used the 1990 NHIS of the Health Promotion and Disease prevention sample person file to estimate the mean work-loss days among employed women aged 40 to 64 years by their BMI status. The median weekly earnings per age group were derived from the Bureau of Labour Statistics of the US Department of Labour. Since the costs were incurred until the female students were 65 years old, discounting was relevant and was appropriately performed at a rate of 3% per annum. The study reported the incremental costs. The price year was 1996. However, for the cost-effectiveness analysis, the authors did not include the costs of lost productivity averted, and only included the intervention costs and the medical care costs averted.
Currency	US dollars ($).
Statistical analysis of costs	The costs were treated as point estimates (i.e. the data were deterministic).
Sensitivity analysis	To test whether the results of the base-case analysis were dependent on the accuracy of the parameter estimates derived from either the efficacy study or published studies, the authors conducted sensitivity analyses by varying 10 parameters (e.g. the conditional probabilities of being overweight, the years of healthy life scores, the expected number of years of life, and the annual workdays lost). Both one- and multi-way sensitivity analyses were used. For medical cost per care prevented the authors used Gorsky(s estimates as a plausible range. For

	discount rate, the range was 0% to 5%. For other parameters, the authors used 95% CIs for each parameter and a Monte Carlo simulation (using 10,000 iterations) was performed. Further, to test whether the Planet Health programme would be cost-effective in other locations, the authors performed separate univariate analyses to examine the sensitivity of the results to the variation of intervention costs.
Estimated benefits used in the economic analysis	The number of QALYs saved due to the Planet Health Intervention was 4.13 QALYs.
Cost results	The intervention costs of Planet Health were $33,677. The medical care costs averted because of Planet Health were $15,887. The costs of lost productivity averted because of Planet Health were $25,104. Hence, the authors estimated that Planet Health was associated with savings of $7,313.
Synthesis of costs and benefits	The costs and benefits were combined using an incremental cost-utility ratio (i.e. the cost per extra QALY gained). The costs of lost productivity averted because of Planet Health were not included in this analysis. The authors found that the incremental cost per QALY gained was $4,305 when Planet Health was compared with no intervention. The univariate results showed that the cost-effectiveness of the programme remained relatively unaffected by changes in most of the parameter variations, but was relatively more sensitive to the annual discount rate. The authors also found that the results remained cost-saving to society under most scenarios. The results of the Monte Carlo simulation resulted in 95% CIs between $1,612 and $9,010 per QALY saved. The results of the univariate sensitivity analysis on intervention costs showed that, while teachers' stipends varied from $15 to $29, the cost-effectiveness of the intervention fell in a range of $2,666 to $4,964 per QALY saved, and the costs to society remained a net saving of $4,602 to $14,094.
Authors' conclusions	The Planet Health programme was cost-effective and cost-saving. The authors also concluded that school-based prevention programmes of this type were likely to be cost-effective uses of public funds.
CRD commentary	Selection of comparators: A justification was given for using a no intervention programme as the comparator. It represented current practice in the authors' settings. You should decide if this is a widely health technology in your own setting. Validity of estimate of measure of effectiveness: The analysis was based on a trial that investigated the efficacy of a school-based obesity prevention programme on the prevalence of obesity over 2 years. The authors then constructed a model to extrapolate these results up to the age of 65. Two-year efficacy data on Planet Health were derived from a randomised controlled trial (RCT). This was appropriate for the study question as well-conducted RCTs are the 'gold' standard study design when comparing different health interventions. Even though the authors provided only some details of this study, it would appear that the study was well conducted, with the study sample being representative of the study population and the analysis of efficacy being handled credibly. Other data to supplement the model was based on a synthesis of published studies. The authors did not report that a systematic review of the literature was conducted, nor the methodology of the review. However, the studies used would appear to be very relevant and credible, as they included results of US-wide surveys on nutrition. The methods of combining the efficacy data from Planet Health, the conditional probabilities of becoming overweight, life expectancy and quality of life were clearly described, and further details were reported in appendices. Validity of estimate of measure of benefit: The estimation of benefits was modelled using a decision tree analytic model, which was appropriate for the study question. As the benefits were incurred over a long time period, future QALYs were discounted at a rate of 3% per annum.

	Validity of estimate of costs: All the categories of cost relevant to the societal perspective adopted were included in the analysis. Further, all relevant costs for these categories appear to have been included in the analysis. Importantly, though, the authors did not take all the direct and indirect costs associated with obesity during adolescence and young adulthood into consideration. However, the authors reported that the inclusion of these costs would have made the cost-effectiveness and savings to society due to Planet Health even larger. The authors did not include the indirect costs in the incremental cost analysis, but clearly showed that when they were included the Planet Health intervention became cost-saving. The costs and the quantities were only reported separately for the intervention costs, which will enhance the generalisability of the authors' results. The intervention costs were derived from the actual costs of the Planet Health Intervention. For these costs, the authors performed separate univariate analyses to test whether the intervention programme would be cost-effective in other settings. Other costs were derived from the literature, with appropriate sensitivity analyses being undertaken using appropriate ranges. Discounting was necessary, as the costs were incurred during a long time period, and was appropriately undertaken. The price year was reported, which will aid any possible inflation exercises. Other issues: The authors did not compare the results of their study with those from other studies, as no cost-effectiveness study had been published in the field of obesity prevention. The issue of generalisability to other settings was addressed in the sensitivity analyses. The authors do not appear to have presented their results selectively. In their conclusions, the authors reported that Planet Health was cost-effective, implying it was cost-effective generally. However, the authors did not mention that the study investigating the efficacy of the Planet Health intervention only found it to be effective on girls, and the subsequent analyses in this study were based on females only. The authors reported a number of further limitations to their study. First, the study was retrospective, with intervention costs being modelled rather than measured. Second, only single data sources were available for most of the model parameters, therefore 95% CI estimates had to be used for sensitivity analyses. Third, the authors did not consider overweight relapse among students who lost weight during the 2-year study period. Fourth, although the definition of childhood obesity in the study of Planet Health was based on both BMI and body fat measures, the only progression probability estimates from the literature used only BMI measures. Fifth, intervention effectiveness was estimated from 310 female students, but the intervention costs were estimated to include all participants in the study. Six, the authors did not take all the direct and indirect costs associated with obesity during adolescence and young adulthood into consideration. However, the authors reported that the inclusion of these would have made the cost-effectiveness and savings to society due to Planet Health even larger.
Implications of the study	The authors reported that more research is needed on the relationship between overweight status in children and obesity in adults, and the QALYs and costs due to lost productivity of overweight and non-overweight adults. In addition, the authors recommended that future school-based obesity programmes should routinely collect programme cost information so that more cost-effectiveness calculations can be conducted. The authors also suggested that school-based obesity prevention programmes should be included in portfolios of obesity prevention programmes to efficiently reduce the burden of obesity to society.
Other publications of related interest	Whitaker RC, Wright JA, Pepe MS, et al. Predicting obesity in young adulthood from childhood and parental obesity. New England Journal of Medicine 1997;337:869-73. Gortmaker SL, Peterson K, Wiecha J, et al. Reducing obesity via a school-based interdisciplinary intervention among youth. Planet Health. Archives of Pediatrics and Adolescent Medicine 1999;153:409-18. Gorsky RD, Pamuk E, Williamson DF, et al. The 25-year health care costs of women who remain overweight after 40 years of age. American Journal of Preventive Medicine 1996;12:388-94. Comment: Obesity Research 2003;11:1275-7.

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