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Health Economics
C O N S O R T I U M

NATIONAL INSTITUTE FOR HEALTH AND CLINICAL EXCELLENCE

Workplace Health Promotion: How to Encourage Employees to be Physically Active

A Rapid Review of Economic Literature

PHIAC Report

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C O N S O R T I U M

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Executive Summary

Introduction

The National Institute for Health and Clinical Excellence (NICE) has been asked by the Department of Health (DH) to develop guidance on a public health interventions aimed at promoting physical activity in the workplace. Reviews of effectiveness literature have been carried out by a team from Salford University. This report presents findings from a review of the economic evidence relating to work place based initiatives which aim to increase employees' physical activity levels.

Methods

Literature searches were carried out by a team from Cardiff University and included searches of economic databases and grey literature. The University of York team also had access to the search results for the parallel effectiveness review being undertaken by the team from Salford University.

The economic search identified a total of 434 titles. The effectiveness search results were filtered using cost and economic terms and the resultant database contained 512 titles. Studies were excluded from the review if they were not the primary source of data and/or contained no cost information.

The titles, and where appropriate/available abstracts, were scanned for relevance and full copies of 26 studies were assessed for inclusion, with seven identified as being relevant for this review. Data were extracted from the studies and tabulated into evidence tables.

Results

Overall there was limited recent evidence on the economic benefits of workplace interventions that promote physical activity. A total of seven studies were included in the review and only one of these was published within the last nine years. A summary of the characteristics of the reviewed studies is presented in Table 1.

Table 1: Summary of reviewed studies

Study	Year	Type of Analysis*	Quality	Country
Physical Activity Counselling and Education				
Erfurt et al	1992	CEA	+	USA
Oldenburg et al	1995	CEA	+	Australia
Proper et al	2004	CEA	+	Netherlands
Physical Activity Facility				
Shephard et al	1992	CEA	-	Canada
Physical Fitness Programme				
Bell et al	1992	CEA	+	USA
Brown et al	1992	CEA	-	USA
Goetzel et al	1998	CEA	+	USA

* CEA = cost-effectiveness analysis

Conclusion

There is no strong economic evidence to support the implementation of workplace interventions that promote physical activity. Further, the applicability of the results may be limited as all studies were conducted outside of the UK.

Evidence Statements

Overall there is limited economic evidence with respect to workplace interventions that promote physical activity.

Workplace Physical Activity Counselling and Education

There is limited evidence of the cost-effectiveness of workplace physical activity interventions involving education and counselling over a 3 year study period from three (+) cost-effectiveness studies.

Workplace Physical Activity Facilities

There is evidence of the cost-effectiveness of workplace physical activity interventions involving the introduction of a physical activity facility over a 12 year study period from one (–) cost-effectiveness study.

Workplace Fitness Programmes

There is limited evidence of the cost-effectiveness of workplace physical activity interventions involving workplace fitness programmes over a 2.5 year study period from two (+) cost-effectiveness studies and one (–) cost-effectiveness study.

Section 1: Introduction

The National Institute for Health and Clinical Excellence ('NICE or 'the Institute') has been asked by the Department of Health (DH) to develop guidance on public health interventions aimed at promoting physical activity in the workplace. The guidance will provide recommendations for good practice based on the best available evidence of effectiveness, including cost effectiveness. It is aimed at employers both in the public and private sector. It is also aimed at professionals with occupational, public health or transport planning as part of their remit working within the National Health Service (NHS), local authorities and the wider public, private, voluntary and community sectors

1.1 THE NEED FOR GUIDANCE

1.1.1 Physical Activity and Ill Health

Increasing activity levels will contribute to the prevention and management of over 20 conditions and diseases including coronary heart disease, diabetes, cancer, and obesity. It can also help to improve mental health[1].

In 2004 the Department of Health estimated the financial cost of inactivity in England to be £8.2 billion annually – including the rising costs of treating chronic diseases such as coronary heart disease and diabetes. This does not include the contribution of inactivity to obesity – an estimated further £2.5 billion cost to the economy each year[2].

Around 35% of men and 24% of women[3] are physically active enough to meet the current national recommendations (achieving at least 30 minutes of at least moderate activity on 5 or more days a week). Seventy per cent of boys aged 2-15 years, compared with 61% of girls of the same age achieve the recommended physical activity levels (at least 60 minutes of at least moderate intensity physical activity each day). Physical activity varies between different ages, genders, classes and ethnicity.

1.1.2 Trends in Physical Activity

Trends between health surveys for England in 1997, 1998, 2003 and 2004 found small increases in physical activity levels between 1997 and 2004[3]. Data from the national travel surveys show that the distance people walk and cycle has declined significantly in the last three decades[4]. The average distance walked has fallen from 255 miles in 1975/6 to 192

1 Department of Health (2005) *Choosing activity: a physical activity action plan*. London: Department of Health.
2 Department of Health (2004) *At least five a week: Evidence on the impact of physical activity and its relationship to health*. London: Department of Health.
3 Joint Health Surveys Unit (2004) *Health survey for England 2004 – updating of trend tables to include 2004 data*. London: The Stationery Office.
4 National Statistics (2004) *National travel survey 2004*. London: Department for Transport.

miles in 2003. Bicycle mileage for the same years fell from 51 to 34 miles per person per year. However, note the absence of published confidence intervals, the use of different physical activity questionnaires[5] in the Health Surveys for England, and the failure of many transport surveys to capture off-road travel.

More and more people in the UK are employed in sedentary jobs. One of the easiest ways to increase physical activity is to include walking and cycling in the daily routine. For a number of employees minimum recommended daily physical activity levels could be achieved through active travel to and from work.

1.1.3 Physical Activity in the Workplace

Physical activity promotes mental wellbeing as well as helping to prevent chronic diseases[6]. Physically active employees are less likely to suffer from major health problems such as coronary heart disease, less likely to take sickness leave and less likely to have an accident at work[7].

Employees are a large, discrete population who are relatively easy to target. Adults who work full-time spend more time at work than in any other setting and therefore worksites can be important places to institute changes in behaviour. Further, large employers often have an existing infrastructure which they can use to enable them to offer relatively low-cost interventions.

1.2 THE SCOPE OF THE REVIEWS

1.2.1 Areas that will be Covered

NICE guidance will consider workplace based policies and initiatives which aim to increase employees' physical activity levels and are applicable in England. It will also consider initiatives outside the workplace that are initiated or endorsed by employers. These include:

- Health promotion activities and campaigns that encourage physical activity. For example, employee assistance programmes, organised lunchtime walks, onsite aerobics classes or running sessions;
- Subsidised membership of sports or leisure centres and other incentive schemes. For example, time off for exercise sessions during the working day;
- Schemes that encourage active travel. For example, schemes that encourage employees to walk or cycle part or all of the way to work, expenses policies that encourage active travel on company business and bicycle subsidies.

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5 Cavill N, Foster C, Oja P, Martin BW (2006) *An evidence-based approach to physical activity promotion and policy development in Europe: contrasting case studies*. Promotion and Education. In press.

6 Department of Health (2004). At least five a week: evidence on the impact of physical activity and its relationship to health. London. Department of Health

7 Dishman R K, Oldenburg B, O'Neal H et al (1998). Workplace physical activity interventions. American Journal of Preventive Medicine 15(4): 344-361

1.2.2 Population Groups that will be Covered

The groups that will be covered are adults who are working for someone else. Adults who are self-employed, unemployed or who do not work will not be covered.

1.2.3 Areas that will not be Covered

Modifications to the environment (build or natural) that encourage and support physical activity, since this is covered by NICE guidance in development.

1.2.4 Outcomes

This review focuses on cost-effectiveness evidence relating to the areas covered by the proposed guidance.

Section 2: Methodology

2.1 LITERATURE SEARCH

2.1.1 Search Strategy

The guidance will consider workplace based or endorsed policies and initiatives which aim to increase employees' physical activity levels and are applicable in England. As this could encompass a wide range of activities the search strategy was designed to be broad to ensure that all relevant activity was considered. Furthermore, as randomised controlled trials are not always appropriate for measuring public health interventions, all research designs were considered. Literature was considered from 1990 onwards and in English language only. No geographical restrictions were placed on the search strategy.

The following databases were searched:

- NHS EED;
- HEED;
- EconLit.

A search of grey literature was also undertaken. The IDEAS resource was searched specifically for cost-effectiveness information and the team from Salford University carrying out the review of effectiveness literature agreed to highlight any of their grey literature search results that were cost-effectiveness studies.

The literature searches were carried out by a team from Cardiff University. A copy of each of the search strategies can be found in Appendix A.

Further, the YHEC team were given access to all the results generated through the searches for effectiveness literature. To ensure that any potentially relevant studies were not missed these results were filtered using cost and economic terms and the resultant subset of effectiveness results (512 hits) were then searched by hand as described below.

2.1.2 Selection of Studies for Inclusion

Studies were reviewed if they provided economic evidence that was directly linked to workplace based policies and initiatives which aim to increase employees' physical activity levels and are applicable in England or to initiatives outside the workplace that are initiated or endorsed by employers (see Section 1.2.1).

Studies were excluded from the review if they were not the primary source of data and/or if they contained no cost information. Three studies proved to be unobtainable.

Selection procedure

Before acquiring studies for assessment, preliminary screening of retrieved items was carried out to discard irrelevant material. In the first instance, the titles were scanned and those outside the topic area were eliminated. A quick check of the remaining abstracts identified others that were clearly not relevant to the research question.

The remaining abstracts were then scrutinised against the in-out criteria. Abstracts that did not meet the inclusion criteria were eliminated. Once the sifting was complete, study copies of the selected studies were acquired for assessment. Those that failed to meet the inclusion criteria were excluded; the others were assessed.

To minimise the risk of overlooking any relevant studies, the selection process was carried out independently by two researchers. Further, during the process of identifying studies for inclusion into the effectiveness review, any studies that appeared to meet the criteria for inclusion into the economic literature review were passed on to the economics review team by the University of Salford.

Search Results

The search of the economic databases resulted in a total of 442 hits. The total number of hits for each database is as follows:

- HEED – 61
- NHS EED – 211
- Econlit – 170

Table 2.2 details the number of hits by search.

Table 2.2: Search results by literature search

	Search			Total
	Effectiveness Literature†	**Economic literature**	**Grey Literature**	
Number of hits	512	434	13*	**959**
Full studies retrieved for more detailed evaluation of evidence	21	5	0	**26**
Data extraction and quality appraisal	7	3	0	**10**

*These hits were found within the IDEAS database

Table 2.3 provides details of the original literature source for each of the reviewed studies.

Table 2.3: Reviewed study by literature search

Study	Effectiveness Literature	Economic literature
Bell et al, 1992	✓	
Brown et al, 1992	✓	
Erfurt et al, 1992	✓	✓
Goetzel et al, 1998	✓	✓
Oldenburg et al, 1995	✓	✓
Proper et al, 2004	✓	
Shephard, 1992	✓	

2.2 STUDY TYPE AND QUALITY APPRAISAL

Published studies that met the inclusion criteria were rated by two independent reviewers to determine the strength of the evidence. Each was assessed for methodological rigour and quality against the Drummond checklist[8], each study being graded using a code '++', '+' or '-', based on the extent to which the potential sources of bias had been minimised (see Table 2.4 overleaf).

To minimise any potential bias and subjectivity in the assessment, each study was assessed by two reviewers and any differences resolved by discussion or recourse to a third reviewer. Health economic appraisal forms for the included studies can be found in Appendix B.

Table 2.4: Quality grading of evidence

Grade	Criteria
++	All or most of the quality criteria have been fulfilled. Where they have been fulfilled the conclusions of the study or the review are thought to be very unlikely to alter.
+	Some of the criteria have been fulfilled. Where they have been fulfilled the conclusions of the study or the review are thought unlikely to alter.
-	Few or no criteria fulfilled. The conclusions of the study are thought to be likely or very likely to alter.

Study quality

A summary of study quality is presented in Table 2.5 below.

Table 2.5: Study type and quality

Study type	Study quality	Number of studies	Study
Cost–effectiveness	+	5	Bell et al, 1992; Erfurt et al, 1992; Goetzel et al, 1998; Oldenburg et al, 1995; Proper et al, 2004
Cost–effectiveness	-	2	Brown et al, 1992; Shephard, 1992

2.3 STUDY CATEGORISATION

2.3.1 Description of Studies

The seven reviewed studies are described in Section 3 and presented in the evidence table in Section 5. Three studies report on physical activity counselling and education, one on a physical activity facility and three on a fitness programme. All of studies were cost-effectiveness analyses.

2.3.2 Country of Studies

Four of the seven studies report on studies conducted in the USA. One of the remaining studies was carried out in Australia, another in Canada and the other in the Netherlands. Table 2.6 summarises the country of origin of the reviewed studies.

Table 2.6: Country of origin of economic studies

Country of origin	Study
Australia	Oldenburg et al, 1995
Canada	Shephard, 1992
Netherlands	Proper et al, 2004
USA	Bell et al, 1992; Brown et al, 1992; Erfurt et al, 1992; Goetzel et al, 1998

2.4 ASSESSING APPLICABILITY

Each study was assessed on its external validity: that is, whether or not it was directly applicable to the target population(s) and setting(s) in the scope. This assessment took into account whether the study was conducted in the UK, and any barriers identified by studies or the review team (with references as appropriate), to implementing each intervention in the UK.

Results from Goetzel et al, 1998 may not be applicable to the UK as the way in which health care is funded in the USA differs from the way in which it is funded in the UK. Results from all other reviewed studies may be applicable to the UK.

2.5 SYNTHESIS

It was not appropriate to use meta-analysis to synthesise the outcome data as interventions, methods and outcomes were heterogeneous. This review is restricted to a narrative overview of all studies that met the inclusion criteria and contained sufficient data for data extraction and quality assessment.

2.6 CURRENCY CONVERSION

In order to allow direct comparison of studies, component valuations of the costs and benefits have been adjusted and converted from local currencies to UK £2007 prices. This was performed by a two step process:

- Firstly costs and benefits were converted to pounds sterling (GBP) using a historical conversion rate[8];
- The costs and benefits were then inflated[9] to January 2007 pounds (GBP).

All costs and benefits in Section 3 are reported as they appear in the original study with the conversion in pounds in brackets next to them.

[8] Exchange conversion: http://www.oanda.com/convert/fxhistory
[9] Inflation Indices: http://www.statistics.gov.uk/statbase/tsdataset.asp?vlnk=229&More

Section 3: Summary of Findings

The interventions included in the reviewed studies can be categorised into three groups:

- Physical activity counselling and education;
- Physical fitness facility;
- Physical fitness programme.

3.1 PHYSICAL ACTIVITY COUNSELLING AND EDUCATION

There were three cost-effectiveness studies that considered workplace counselling and education programmes with the aim of increasing employees' participation in physical activity.

A US study, Erfurt et al, 1992 (CEA +) considered the cost-effectiveness of worksite wellness programmes at three manufacturing plants over a three year period. The worksite wellness programmes provide services designed to help employees reduce specific risks such as high blood pressure and cholesterol, cigarette smoking, obesity, and physical inactivity.

Four sites introduced wellness programmes aimed at increasing physical activity, namely:

- A health education programme took place at site A and this was performed by a health educator. This intervention tested whether employee's awareness of health issues stimulates their use of risk-reduction services. This intervention was a form of health promotion;
- A fitness facility was introduced at site B. The facility contained extensive aerobic and muscle-building exercise equipment and the facility was open to all employees. The site tested the effects of a fitness facility on employees' health risk factors;
- A health education and follow-up programme took place at site C. This intervention involved not only an awareness of the risk factors but support, assistance and encouragement concerning behaviour that would reduce these risk factors;
- A health education, follow-up and plant organisation programme was conducted at site D. This programme contained all of the strategies delivered at sites A to C and used plant-wide organisational strategies to encourage and support employees in making health improvements. This included marking out a mile long walking course within the plant and the use of lunch time walking contests to get employees' using the facility.

The study used health education at the sites to promote physical activity but did not comment on the specific contents of the education programme. The study was designed to

test and compare four worksite wellness programmes and the authors made two main hypotheses:

- That wellness programmes that include regular, persistent outreach and follow-up counselling with employees (Sites C and D) would produce greater risk reduction than those programmes without this outreach and counselling (Sites A and B);
- That programmes which develop social support systems at the worksite for healthy activities would be more effective at reducing relapse than programmes without these supports.

The study included six different types of costs, namely:

- The effort of the health educator (hired at an estimated cost of $20 (£23.92 UK2007) per hour);
- The effort of the wellness counsellor;
- Gym equipment attendants;
- Company incurred costs through the programme;
- Initial screening costs;
- Equipment costs.

The effectiveness was measured through the reduction in targeted risks and the prevention of relapse. The study did not apportion programme costs to specific risks, but instead summed the risks together giving the same weight to each risk. The risks assessed over the three years of the study were:

- High blood pressure;
- Diagnosed hypertensive with blood pressure under control;
- Overweight by 20% or more;
- Smoked cigarettes;
- Reported being an ex-smoker;
- Needing regular exercise.

The risk reduction in those employees that needed to reduce their risk through uptake of physical activity was measured through reporting regular exercise post-intervention (i.e., exercising three or more times a week for at least 20 minutes with enough intensity to work-up a sweat).

Table 3.1 details the average annual cost, percent risk reduction and incremental cost per risk reduced. The results show that risk reductions ranged from 32% at site B to 45% at site D for the high level[10] of reduction or relapse prevention group and from 36% to 51% respectively for the moderate risk reduction group[11]. The resulting incremental costs showed a $1.48 (£1.77 UK2007) and $2.09 (£2.50 UK2007) spend per employee per year to

[10] High level risk prevention are for those employees with a BP now below 140/90, lost 10lbs or ore, smokers quit and ex-smokers did not relapse, exercise 3+ times/week.

[11] Moderate level risk prevention are now below 160/95, lost 3lbs or more, smokers quit and ex-smokers did not relapse, exercise 3+ times/week.

reduce an additional percent of risk and prevent relapse in the high level risk reduction group for sites C and D. Site B has a lower effectiveness and costs more in comparison to site A and is therefore said to be dominated by site A. These cost-effectiveness results show support for follow-up counselling, health improvement programmes and education but do not justify the addition of fitness facilities alone in the workplace environment.

Table 3.1: Cost-effectiveness of Worksite Interventions (1988 USD (UK2007))

	Site A	Site B	Site C	Site D
Average annual cost per employee	$17.68 (£21.14)	$39.28 (£46.97)	$30.96 (£37.02)	$38.57 (£46.13)
Incremental cost per employee	-	$21.60 (£25.83)	$13.28 (£15.88)	$20.89 (£24.98)
Percent of four CVD risks reduced: High level of CVD risk prevention	35%	32%	44%	45%
Percent of four CVD risks reduced: Low level of CVD risk prevention	39%	36%	48%	51%
Cost per employee for each additional percent of risk reduced: High level of CVD risk prevention	-	-$7.20 (£8.61)	$1.48 (£1.77)	$2.09 (£2.50)
Cost per employee for each additional percent of risk reduced: Low level of CVD risk prevention	-	-$7.20 (£8.61)	$1.48 (£1.77)	$1.74 (£2.08)

Source: Erfurt et al, 1992

Oldenburg et al, 1995 (CEA +) considered the outcome data from a randomised trial of four work site interventions and used this to examine the cost-effectiveness of programmes aimed at reducing the risk of cardiovascular disease (CVD). The interventions involved employees undergoing counselling and education and were as follows:

- A Health Risk Assessment (HRA) which provided an assessment of the major risk factors for CVD and involved giving feedback to each employee given their risk profile during a 30 minute feedback session;
- A Risk Factor Education (RFE) session where employees received the same health risk assessment with standardised general advice on lifestyle changes required to reduce heart disease risk factors;
- A Behavioural Counselling (BC) session involving the same components as the risk factor education programme. However, under this programme, if risk factors were identified, participants were offered up to six lifestyle counselling sessions over a 10 week period following an initial assessment. The employee was provided with a lifestyle change manual based on a four stage model which consisted of; preparation for change, action to change, maintenance of change and relapse prevention;
- The Behavioural Counselling plus Incentives (BCI) involved the employee receiving the same components as the risk factor education condition. In addition they were provided with a lifestyle change manual and were offered a goal-setting and follow-up counselling session as well as a range of incentives. The incentives involved monetary rewards for the completion of the goals. Employees received on average two hours of counselling in addition to the 30 minute health risk assessment.

The outcomes included in this study were body mass index (BMI), percentage body fat, systolic and diastolic blood pressure, serum cholesterol, smoking status, number of cigarettes smoked daily and aerobic capacity. The effect of the programmes on physical activity was linked by changes in their aerobic capacity, which was measured using a standardised 7 minute test on a bicycle ergometer. These were assessed at baseline and at 3, 6, and 12 months following the baseline assessment. They were used to produce a composite risk score for each of the employees which could then be used to monitor the effect of the different interventions. This provided a value for the change in health risk units. The study found that three of the four interventions, RFE, BC and BCI significantly reduced the composite CVD risk score of participants by the conclusion of the programme which was six months after baseline.

The subset of costs included were those that were most sensitive to differences in the interventions that were used in the study. The costs included personnel costs for providing the behavioural counselling at a rate of $18.65 (£16.59 UK2007) per hour, travel costs for the health assessors, testing equipment costs and employers costs. The employer's costs resulted through conducting the intervention within the employer's time to maximise participation and to minimise the employee's costs.

Table 3.2: Cost-effectiveness of four levels of worksite CVD risk (AUD 1990 (UK2007))

	HRA	RFE	BC	BCI
Costs:				
Total cost	$81.00 (£69.23)	$106.00 (£90.59)	$199.00 (£170.08)	$207.00 (£176.91)
Incremental cost		$25.00 (£21.37)	$118.00 (£100.85)	$126.00 (£107.69)
Composite score:				
Incremental change in health risk unit reduced	No change	-2.96	-7.09	-4.01
Incremental cost per health risk unit	-	$8.45 (£7.22)	$16.63 (£14.21)	$31.39 (£26.83)
Sensitivity analysis: Number of visits, best case	-	-	$13.03 (£11.14)	$28.12 (£24.03)
Sensitivity analysis: Number of visits, worst case	-	-	$17.58 (£15.02)	$33.90 (£28.97)

Source: Adapted from Oldenburg et al, 1995

Table 3.2 shows the cost-effectiveness of the four worksite programmes. The incremental costs for RFE, BC and BCI were calculated by subtracting the costs associated with the assessment procedure. The least expensive programme, HRA, was not effective in initiating any change at all and the most expensive programme, BCI, was the least cost-effective option out of all three alternatives. The behavioural counselling (BC) programme was found to be a cost-effective strategy in the initiation and maintenance of the CVD risk factor reductions. The authors performed sensitivity analysis using the best and worst number of

sessions attended for the programmes and the results showed that the values were insensitive to the change in number of sessions attended.

Proper et al, 2004 (CEA +) evaluated the impact of worksite physical activity counselling using cost-benefit and cost-effectiveness analyses. The intervention was conducted over a 9 month period in which participants were offered seven consultations, all of which took place during work time and lasted for approximately 20 minutes. The counselling involved promoting physical activity and a healthy diet. The control and the intervention group were given general information about lifestyle factors but only the intervention group underwent counselling.

The outcome measures that were included in the study were physical activity, fitness, musculoskeletal symptoms and sick leave. The cost of sick leave was estimated using the mean salary cost of the employee, which included gross salary, the employer's social benefits and the vacation allowance. The mean employee salary was EUR 41,105 (£30,935 UK2007) per year and from this it was calculated that the mean salary cost per calendar day was EUR 112 (£84 UK2007).

The physical activity measures took place 2 weeks before the 9 month intervention and directly after it. The study assessed those that were active (30 minutes of physical activity per day for five or more days a week), the total energy expenditure of employees, physical fitness and musculoskeletal symptoms. The total energy expenditure was assessed using a structured interview which included recalling the physical activity undertaken during the previous 7 days. The employees' physical fitness was measured using a sub-maximal bicycle ergometer test and upper-extremity musculoskeletal symptoms were assessed using a questionnaire.

The employer perspective was used for the estimation of the costs and consequences. The costs considered were the intervention costs which were directly related to the implementation of the individual counselling programme, namely:

- Development and management of the programme;
- The information session;
- A consultation with a sports physician;
- The cost of a counselling session;
- The cost of fitness and health tests;
- Costs due to productivity loss on the part of the employee.

The study performed a partial cost-benefit analysis which compared the interventions costs with the monetary benefit due to sick leave reduction. Due to measurement difficulties this study did not include all of the potential benefits, i.e. employee turnover improvements, productivity benefits and improved corporate image. The results showed that there was no evidence of significant cost savings between the two groups. It was found that 12 months after the intervention the reduction in sick leave cost in the intervention group had increased further to (-) EUR 635 (£478 UK2007) in favour of the intervention. However, this was not found to be statistically significant. The authors suggested that if the study had used a

longer follow-up period the increasing trend in reductions in sick leave may have resulted in a significant net benefit for the counselled group. However, there does not appear to be any evidence to support such a trend after a 12 month follow-up period.

The study also reported cost-effectiveness ratios but the value of these estimates is limited as the authors use indices (per extra kilocalorie per day per employee and per beat per minute decrease in sub-maximal heart rate.) that are not easily interpretable. The cost-effectiveness ratios for energy expenditure and heart rate are EUR 5.2 (£3.91 UK2007) per extra kilocalorie per day per employee and EUR 234 (£176.11 UK2007) per beat per minute decrease in sub-maximal heart rate, respectively (see Table 3.3).

Table 3.3: Cost-effectiveness of energy expenditure and sub-maximal heart rate (EURO 2001 (UK2007))

	Costs		Effects		Ratio
	Mean	S.D.	Mean	S.D.	
Energy expenditure (kcal/day)					
Intervention group	EUR2,583 (£1,943)	545	64.2	491	-
Control group	EUR1,578 (£1,188)	4,442	-129	630	EUR5.2 (£3.91)
Sub-maximal heart rate (beats/min)					
Intervention group	EUR2,223 (£1,673)	4786	-2.2	8.9	-
Control group	EUR1,118 (£841)	3352	2.5	8.5	EUR235 (£176.86)

3.2 PHYSICAL ACTIVITY FACILITY

Shephard, 1992 (CEA -), a Canadian study, conducted a cost-benefit and cost-effectiveness analysis of the introduction of a gym facility in the offices of Canada Life Assurance with the aim of promoting physical activity. The company renovated a basement area to provide a low-cost 250 metre square gymnasium facility. The membership was limited to 400 out of the 1,200 employees and the programme took place over a 12 year period. The average utilisation of the gym at 12 years was 82%. The control group was obtained from a comparable life assurance company on an adjacent street which also had the same follow-up period.

The methods for evaluating the effectiveness of the physical activity intervention were not sufficiently reported in this study. The authors report the estimation of these effects but it is difficult to ascertain the methods used to calculate these effects from the information provided. The study briefly discusses changes after six months, seven years and ten years of implementing the scheme and suggests that the scheme has a positive effect on the risk of future cardiovascular disease. The reported outcomes are summarised in Table 3.4.

Table 3.4: Benefits of the physical activity facility (6 months)

Measure	Benefit
Recruitment and employee turnover	The authors found a decrease in employee turnover from 18% per year to only 1.8% per year in those employees that were frequent participants.
Absenteeism	A six month analysis suggested that absenteeism was reduced in frequent participants by 1.3 days per year.
Productivity	The productivity was more difficult to measure since many departments of the company do not have clearly defined end-products. The authors reported that they found a 7% gain in the volume of work performed, although it should be noted that those that did not participate (control office) also demonstrated a 4.3% gain.
Health benefits	They found that medical claims remained unchanged where the facility was introduced and found increasing medical claims at the control office.

The authors produced an early partial cost-benefit analysis and found that the immediate programme benefits were approximately CAD 679 (£522.01 UK2007) per worker per year. This produced an estimated cost-benefit ratio of 1:6.85. The authors did not discuss in detail the methods for calculating this estimate.

3.3 PHYSICAL FITNESS PROGRAMME

Bell et al, 1998 (CEA +) considered the differences in healthcare utilisation between participants and non-participants in an employee fitness programme. This study involved 206 employees at a large transportation company in the US, of which 98 were participants and 108 non-participants. The participants and non-participants were matched by age, gender, job position and years of service. All employees involved in the study were union members as this facilitated access to healthcare information.

Three outcome measures were of interest as a result of the physical activity workplace intervention, namely mean hospital stay, mean medical costs and mean number of medical claims made by the employees. These outcomes were measured over a 16 month period. The participants completed a series of fitness assessments that measured height, body weight, blood pressure (systolic/diastolic), timed push-ups and sit-ups, flexibility and body composition. The fitness programme included:

- 8,000 square-foot fitness facility which included various types of exercise equipment such as treadmills, stationary bikes, rowing machines and weight training equipment;
- Participants were offered cholesterol screening, sub-maximal stress tests and exercise prescriptions;
- Nutrition education, organised exercise classes and lecture based health and lifestyle programmes.

The results in this study represent a short-term analysis of healthcare utilisation among participants and non-participants of an employee fitness programme. The results suggest that significant reductions in hospital stay, medical costs and medical claims among members of a worksite fitness programme may not occur during the first six months of the programme. Surprisingly, the results showed that female non-participants had fewer medical claims and the authors commented that the reasons for this are not clearly understood. One possible explanation could be the small study sample size. Small samples may be influenced by a single random event such as an incidence of severe illness in the participant group. Such an event would increase the average utilisation of healthcare services for this group. The results of this study indicate the need for long-term worksite physical activity programmes that consider sufficiently large population samples.

A US study, Brown et al, 1992 (CEA -) conducted a cost-effectiveness analysis of a back school intervention for employees with previous musculoskeletal problems. Seventy four municipal employees with a history of on-the-job back injury participated in seven back schools which were held from September 1987 to March 1990. A control group was randomly selected from a list of employees that had experienced lost work time and compensated medical benefits from work-related back injury. The study did not measure changes in employees' overall physical activity levels but instead assessed the cost of lost work time, lost time cost of the employee and medical costs.

The back schools consisted of 6 weeks of exercises and education comprising:

- Strength and flexibility exercises which were performed for 20 minutes, 5 days per week under the supervision of an exercise physiologist;
- Thirty minute classes, held 4 days per week, on topics of back care which included information on structure and function of the spine, lifting, ergonomics, pain control, relaxation and weight control.

Table 3.5: Summary of lost work time, costs and injuries 6-month post-intervention for participant and control groups (USD 1992 (UK2007))

	Back school group (n=70)	**Control group (n=70)**
Lost work time	276 days	242 days
Lost time cost	$23,182.78 (£21,550.67)	$19,532.48 (£18,157.36)
Medical cost	$24,086.93 (£22,391.17)	$33,829.96 (£31,448.27)
Total cost	$47,269.71 (£43,941.83)	$53,362.44 (£49,605.62)
No. of reinjuries	16	33

Table 3.5 summarise the lost work time, dollar costs, and number of injuries for the back school and comparison groups 6-months post-intervention. The study found no statistically significant difference between groups in lost time cost and medical costs. The total cost was $6,092 (£5,663 UK2007) lower in the back school intervention group, and the number of injuries was statistically significant and nearly half that of the control group.

Although this study offers support for the intervention, there are a number of methodological limitations. Due to worksite constraints the authors did not randomly assign subjects to the intervention and control groups. This means that important differences may exist between worker's demographic characteristics and this may have influenced the results. Further, the authors did not include the cost of the instruction provided by a nursing school as this was provided free to the employer but, in general, this cost would be incurred in other worksites. This means that the estimated instructional costs were likely to be an underestimate of the true cost.

Goetzel et al, 1998 (CEA +) investigated alternative methods for evaluating the impact of a US based company's fitness centre programme over a 2.5 year period. The fitness programme took place at four worksite locations in the San Francisco Bay area and offered fitness facilities, health risk assessments, back care, weight control, nutrition information and stress management. The programme enrolled approximately 2,000 employees and early retirees.

Those employees recruited into the study were classified into four different groups by their level of participation in physical activity, namely:

- Non-participants - those that had never visited the fitness centre programme sites;
- Level 1 participants - those with fewer than an average of two visits per month but more than zero visits;
- Level 2 participants - those with fewer than an average of two visits per week but at least two per month;
- Level 3 participants - those who used the fitness centre at least twice per week during the 2.5 year study period.

The aim of this study was to establish whether the company's medical cost experience of participants and non-participants differed over time and whether such differences were associated with participation in the programme. This was achieved by using two separate models of participation, a descriptive model and a multivariate model. The multivariate methodology is useful for controlling for the observable confounders when random assignment to participant and non-participant groups is not feasible.

The descriptive model showed that participants were generally younger and less likely to be male. The results showed that, in general, the participant expenditure patterns on inpatient and drug use tended to be more favourable than that of non-participants.

The multivariate analysis used a two part model which included a logistic regression for those who participated and an ordinary least squares (OLS) regression for those that had positive spending on inpatients and drug expenditure. This two-part model controlled for the confounding factors that may differ with level of participation. The confounding variables controlled for were age, gender, exempt/non-exempt status and type of insurance coverage. The inclusion of these variables simultaneously ensured the effect of the fitness programme on participation level was independent of the demographic and other potential confounders.

This analysis showed a more accurate view of the impact of the programme on participation and medical expenditures than was generated by the descriptive model. Table 3.6 shows the impacts of programme participation on inpatient and drug expenditures.

Table 3.6: Adjusted multivariate model estimate of medical expenditure (USD 1998 (UK2007))

Group	Medical Expenditure
Non-participants	$1,041 (£820)
Level 1 participants	$1,195 (£941)
Level 2 participants	$990 (£780)
Level 3 participants	$685 (£540)

This study illustrates how participants and non-participants have different characteristics and how these characteristics account for the large differences in medical cost expenditures observed between these groups. It was found that those who participated at medium levels of activity had higher levels of medical expenditure than those who did not participate. This result may be explained by non-participant's fear of injury from participation or may be non-participants are health care avoiders. The study found that when employees undertook more than two visits per week, the fitness programme medical expenditures were lower than those recorded for non-participants. It should be noted that these are not causal estimates of the effects of participation on medical expenditure.

Section 4: Discussion

There appears to be very limited recent research reporting the economic benefits of workplace interventions that encourage employees to be physically active. This study reviewed only seven studies and only one of these studies was published within the last nine years.

There does not currently appear to be any standard methodology for measuring the economic benefits of workplace interventions that promote physical activity. The outcome and economic measured reported in the studies are summarised in Table 4.1.

The majority of studies reported outcomes related to physical activity such as blood pressure, aerobic capacity and musculoskeletal symptoms. These measures are correlated with changes in physical activity but cannot be a precise measure of the causal effect of the intervention on physical activity and its subsequent impact upon health.

It is difficult to compare study results as each study uses different outcome measures. This means that the reported interventions cannot be ranked by their cost-effectiveness. Furthermore, the methodologies used to determine the costs and consequences were varied between studies.

There are a number of issues around the applicability of study results to the UK. Firstly, the reviewed studies took place in Australia, Canada, the Netherlands and the USA. These countries all have health care systems that differ from the UK system. Secondly, the work culture in these countries may differ from that in this country. In particular, it is likely that factors such as absenteeism, patterns of access to health care and burden of payment for medical care differ between countries.

Most of the interventions were conducted in large commercial companies and thus there may be generalisability issues. Employee attitude towards healthy life-styles and companies that have a health promoting culture will influence participation. Further, large companies employing a large number of people will experience lower costs per employee and this will make an intervention more cost-effective.

It should be noted that the difference in cost-effectiveness between sub-groups was not addressed in any of the reviewed studies.

A summary of outcomes and economic measures is presented in Table 4.1.

Table 4.1: Outcome and economic measures

Study	Intervention	Outcome Measure	Economic Measure
Physical Activity Counselling and Education			
Erfurt et al.	4 worksite alternatives	Percentage of four CVD risk factors (blood pressure, overweight, smoking and lack of exercise) that were reduced or relapse prevented	Cost-effectiveness
Oldenburg et al.	4 alternative CVD risk factor interventions	BMI, percentage body fat, systolic and diastolic blood pressure, serum cholesterol, smoking status, number of cigarettes smoked daily and aerobic capacity were used to produce a composite risk score for each employee.	Cost-effectiveness
Proper et al.	A counselling program aimed at promoting physical activity and healthy dietary habits.	Physical activity, fitness, musculoskeletal symptoms and sick leave	Cost-effectiveness and partial cost-benefit
Physical Activity Facility			
Shephard et al.	The intervention involved the introduction of a gym.	The study did not report a physical activity outcome but assessed the effect upon recruitment and employee turnover, absenteeism, productivity and health benefit	Cost-effectiveness and partial cost-benefit
Physical Fitness Programme			
Bell et al.	The effects of a fitness program on a large company.	The study did not report a physical activity outcome but assessed the effect upon medical costs	Cost-analysis
Brown et al.	A Back School Intervention program for employees with musculoskeletal problems.	The study did not report a physical activity outcome but assessed the effect upon, lost working time, lost time cost and medical costs	Cost-effectiveness
Goetzel et al.	Health and fitness program at four worksite locations	The study did not report a physical activity outcome but assessed the effect upon medical expenditure	Cost-analysis

Section 5: Evidence Table

Table 5.1: Evidence table

Author, Year, Country	Study design, research type & quality	Research question	Study population and setting	Description of intervention	Main result	Confounders and bias	Applicability to the UK
Bell BC and Blanke DJ (1992) US	Cost-analysis CEA +	The study evaluated the effects of an employee fitness program on healthcare costs and utilisation.	Two hundred and six employees were selected from a total of 1,108 union clerks employed by a transportation company. Ninety eight were selected as participants and 108 were non-participants. Union clerks were chosen as the research subjects as opposed to other employees due to the accessibility of their health care information. The study took place over a 16 month period.	The fitness programme included: ▪ An 8,000 square-foot fitness facility which included various types of exercise equipment such as treadmills, stationary bikes, rowing machines and weight training equipment; ▪ Participants were offered cholesterol screening, sub-maximal stress tests and exercise prescriptions; ▪ Nutrition education, organised exercise classes and lecture based health and lifestyle programs.	The results represent a short-term analysis of health care utilisation among participants and non-participants of an employee fitness programme. The results suggest significant reductions in hospital stay, medical costs, and medical claims among members of a worksite fitness programme may not occur during the first six months of the programme.	This study did not perform sensitivity analysis. The study was conducted over a short period of time with a relatively small sample size.	This was a US study which may be applicable to the UK.

Author, Year, Country	Study design, research type & quality	Research question	Study population and setting	Description of intervention	Main result	Confounders and bias	Applicability to the UK
Brown KC, Hilyer, JC Thomas MJ (1992) US	Cost-consequence/ Cost-effectiveness CEA -	The purpose of the study was to report the cost-effectiveness findings of ongoing research in those individuals with excessive occupational back injury.	Seventy four municipal employees with a history of on-the-job back injury participated in seven back schools which were held from September 1987 to March 1990.	The back school intervention consisted of the following: ▪ Strength and flexibility exercises which were performed for 20 minutes, 5 days per week under the supervision of an exercise physiologist; ▪ Thirty minute classes, held 4 days per week, on topics of back care which included information on structure and function of the spine, lifting, ergonomics, pain control, relaxation and weight control. The back schools took place over six weeks.	The authors reported lost work time, dollar costs, number of injuries for back school and comparison groups at 6-months post intervention. The results for the back school group (n=70) were: ▪ Lost work time = 276 days; ▪ Lost time cost = $23,182.78; ▪ Medical cost = $24,086.93; ▪ Total cost = $47,269.71; ▪ No of re-injuries =16; The results for the control group (n=70) were: ▪ Lost work time = 242 days; ▪ Lost time cost = $19,532.48; ▪ Medical cost = $33,829.96; ▪ Total cost = $53,362.44; ▪ No of re-injuries =33; The study found no statistically significant difference between the two groups in terms of lost time cost and medical costs. The total cost was $6,092 lower in the back school intervention group and the number of injuries was statistically significant - nearly half that of the control group.	The study did not randomly assign subjects to the intervention and control groups. This means that important differences which may have existed between worker's demographics could have influenced the results. The authors did not include the cost of the instruction provided by the nursing school as this was provided free to the employer but, in general, this cost would be incurred for other worksites.	This was a US study which may be applicable to the UK.

Author, Year, Country	Study design, research type & quality	Research question	Study population and setting	Description of intervention	Main result	Confounders and bias	Applicability to the UK
Erfurt JC, Foote A, Heirich MA (1992) US	Cost-effectiveness CEA +	The study's purpose was to assess the cost-effectiveness of four worksite programmes with respect to risk of cardiovascular disease (CVD).	Four manufacturing sites which were similar in terms of size and employee demographics were randomly allocated to one of four experimental wellness programme models. At initial screening the following number of employees were screened at each site: ▪ Site A: 1,374; ▪ Site B: 2,448; ▪ Site C: 2,089; ▪ Site D: 1,893.	The following activities took place at each site: ▪ Site A: A Health education programme was performed by a health educator. This intervention tested whether employee's awareness of health issue stimulates their use of risk-reduction services. This intervention was a form of health promotion; ▪ Site B: At this site a fitness facility was introduced. This facility contained extensive aerobic and muscle-building equipment. The site tested the effects of a fitness facility on employees' health risk factors; ▪ Site C: This site had a health education and follow-up programme. ▪ Site D: A health education, follow-up and plant organisation program was conducted at this site	The results showed that risk reductions ranged from 32% at site B to 45% at site D for those in the high level of reduction or relapse prevention group and from 36% to 51% respectively for the moderate risk reduction group. The incremental costs showed a $1.48 and $2.09 spend per employee per year to reduce an additional percent of risk and prevent relapse in the high-level risk reduction group for sites C and D. The cost-effectiveness results show support for follow-up counselling, health improvement programmes and education but do not justify the addition of fitness facilities alone in the workplace environment.	The authors did not perform any sensitivity analysis to assess how sensitive the results were to changes in the effectiveness.	This was a US study which may be applicable to the UK.

Author, Year, Country	Study design, research type & quality	Research question	Study population and setting	Description of intervention	Main result	Confounders and bias	Applicability to the UK
Goetzel RZ, Dunn RL, Ozminkowski RJ, Satin K, Whitehead DA, Cahill K. (1998) US	Cost-analysis CEA +	The aim of this study was to consider alternative methods for evaluating the impact of Chevrons Corporation Health Quest fitness centre programme on medical expenditures, comparing descriptive and multivariate research designs.	The fitness programme took place at four worksite locations in the San Francisco Bay area and offered fitness facilities, health risk assessments, back care, weight control, nutrition information and stress management. The programme enrolled approximately 2,000 employees and early retirees.	The employees recruited into the programme were classified into four different groups, namely: ▪ Non-participants: those that had never visited the fitness centre programme sites; ▪ Level 1 participants – those that had fewer than two visits per month but more than zero visits to the fitness centre; ▪ Level 2 participants – those with fewer than an average of two visits per week but at least two per months to the fitness centre; ▪ Level 3 participants – those that used the fitness centre at least twice per week during the 2.5 year study period. The study was conducted over a 2.5 year period.	There were two models: ▪ A descriptive model; ▪ Multivariate two-part model. The descriptive model showed that participants were generally younger and less likely to be male. The results showed that, in general, the participant expenditure patterns on inpatient and drug use tended to be more favourable than that of non-participants. The adjusted multivariate model showed the following expenditures for each of the levels of participation: ▪ Non-participants: $1,041; ▪ Level 1 participants: $1,195; ▪ Level 2 participants: $990; ▪ Level 3 participants: $685. The study found that those who participated at medium levels of activity had higher levels of medical expenditure than those who did not participate.	The reported expenditures are not causal estimates of the effect of participation upon medical expenditure.	This was a US study. The results may not be generalisable to the UK because of the effects of the different systems on medical expenditure.

Author, Year, Country	Study design, research type & quality	Research question	Study population and setting	Description of intervention	Main result	Confounders and bias	Applicability to the UK
Oldenburg B, Owen N, Parle M, Gomel M (1995) Australia	Cost-effectiveness CEA +	The aim of the study was to produce an economic evaluation of the intervention programme, focusing on the costs of producing initial composite risk factor changes in a 12 month period.	The study was conducted in the Sydney Metropolitan division of the New South Wales Ambulance Service. Twenty eight stations with 12 or more employees were randomly selected for the study. The authors approached 488 staff members to participate in the study and they obtained consent from 431 of these employees.	Outcome data from a randomised trial of four work site interventions was used to asses the reduction in risk of cardiovascular disease (CVD). The interventions were as follows: ▪ A Health Risk Assessment (HRA) provided an assessment of the major risk factors for CHD and involved giving feedback to each employee given their risk profile during a 30 minute feedback session; ▪ A Risk Factor Education (RFE) session where employees received the same health risk assessment with standardised general advice on lifestyle changes required to reduce heart disease risk factors; ▪ A Behavioural Counselling (BC) session involved the same components as the risk factor education program. However, under this programme, if risk factors were identified, participants were offered up to six lifestyle counselling sessions over a 10 week period following an initial assessment. The employee was provided with a lifestyle change manual based on a four stage model which consisted of preparation for change, action to change, maintenance of change and relapse prevention; ▪ The Behavioural Counselling plus Incentives (BCI) involved the employee receiving the same components as the risk factor education condition. In addition, employees were provided with a lifestyle change manual and were offered a goal-setting and follow-up counselling session as well as a range of incentives. The incentives involved monetary rewards for the completion of the goals. Employees received on average two hours of counselling in addition to the 30 minute health risk assessment.	The results showed that at 6-months follow-up, the RFE, BC, and BCI interventions produced a significant reduction in cardiovascular risk. The incremental analysis showed: ▪ RFE to be more cost-effective, but not as clinically effective; ▪ BC was more cost-effective than RFE when assessment costs were included; ▪ BCI was judged to be the least cost-effective. At 12 months it was found that BC was the only programme to produce a significant reduction in the CVD risk. The study concluded that individual-specific behavioural counselling was found to be a cost-effective strategy for the initiation and maintenance of CVD risk reduction.	The cost assumptions and composite CVD risk measure may have biased the results obtained.	This was an Australian study which may be applicable to the UK.

Author, Year, Country	Study design, research type & quality	Research question	Study population and setting	Description of intervention	Main result	Confounders and bias	Applicability to the UK
Proper KI, de Bruyne MC, Hildebrandt VH, Van der Beek AJ, Meerding WJ, van Mechelen W (2004) Netherlands	Partial cost-benefit and cost-effectiveness analysis. CEA +	The objective of this study was to evaluate the impact of worksite physical activity counselling using cost-benefit and cost-effectiveness analysis.	The authors invited 600 employees to attend an information session. Subsequently, 299 volunteers were measured at baseline and randomised into the intervention group (n=131) or the control group (n=168). The intervention took place over a 9 month period.	Participants were offered seven consultations all of which took place during work time and lasted for approximately 20 minutes. The counselling involved promoting physical activity and a healthy diet. The control and intervention group were given general information about lifestyle factors but only the intervention group underwent counselling. The study included the following outcome measures: ▪ Physical activity; ▪ Fitness; ▪ Musculoskeletal symptoms; and ▪ Sick leave.	The study found that 12 months after the intervention the reduction in sick leave cost in the intervention group had increased to EUR 635 in favour of the intervention. (This was not found to be statistically significant). The cost effectiveness ratios were as follows: ▪ EUR 5.2 per extra kilocalories per day per employee; ▪ EUR 234 per beat per minute decrease in sub-maximal hear rate.	The reported cost-effectiveness ratios are difficult to interpret. The cost-benefit analysis was a partial analysis as it was from an employer's perspective and did not include all costs and benefits.	This study was conducted in the Netherlands and may be applicable to the UK.

Author, Year, Country	Study design, research type & quality	Research question	Study population and setting	Description of intervention	Main result	Confounders and bias	Applicability to the UK
Shephard RJ (1992) Canada	Cost-benefit CEA -	The aim of this study was to evaluate a long-term impact of a fitness programme in Canada.	The Canada Life Assurance employee fitness study was initiated in 1978. The findings obtained are relatively unique because control data was obtained from a very comparable life assurance company on an adjacent street and follow-up continued for 12 years. The study was set in the centre of Canada's largest city and employees performed office tasks. The gym facility provided had a capacity of 400 employees.	The company renovated a basement area to provide a low-cost 250 metre square gymnasium facility. The average utilisation of the facility was 82%.	The following benefits were reported over a six month period: ▪ Recruitment and employee turnover was found to decrease from 18% per year to 1.8% per year for those employees that were frequent participants; ▪ Absenteeism was reduced in frequent participants by 1.3 days per year; ▪ A 7% gain in the volume of work performed, although those that did not participate (the control office) also demonstrated a 4.3% gain in volume of work; ▪ Medical claims were unchanged in comparison to the control office where they had increased over time. The study found a cost-benefit ratio of 1:6.85.	The authors did not provide details of how the cost-benefit ratio was calculated.	This was a Canadian study and may be applicable to the UK.

Section 6: Excluded Studies

6.1 EXCLUDED STUDIES

Study	Reason for Exclusion
Bartlein B. Success matters. Employers stretching to reduce health care costs. *Nursing matters*. 2004; 15 (3): 15	Cost information not reported.
Baun WB. Abstract; A preliminary investigation: effect of a corporate fitness program on absenteeism and health care cost. *Journal of Occupational Medicine*. 1986; 28 (1):18-22.	Pre-1990.
Bernaards CM, Ariens GAM, Hildebrandt VH. The (cost-)effectiveness of a lifestyle physical activity intervention in addition to a work style intervention on the recovery from neck and upper limb symptoms in computer workers 29. *BMC Musculoskeletal Disorders*. 2006; 7 80-	Reports the effectiveness of an intervention and the cost-effectiveness methodology that will be carried out in future.
Black MW. Effects of a corporate sponsored fitness program on health care costs: a comparison of users and nonusers 34 1995	Thesis – unavailable.
Cope A. An active travel a day keeps the doctor away. The Network. 2006; 4 (Winter): 6,8 9	This is not the primary source.
Cox M. The health and economics of Canadian employee fitness and lifestyle programs 393. *Tri-Fit Inc*. 1991; Toronto, [1991], 4 p.	Unavailable – copyright issues.
Davis MJ. Volunteers, incentives, competitions and other cost-effective strategies for improving transit operators' health. 2004;	Unavailable – insufficient information.
Dinubile NA Sherman C. Exercise and the bottom line promoting physical and fiscal fitness in the workplace: A commentary. *Physician & Sportsmedicine*. 1999; 27 (2):	There are no costs contained in this study.
Dissemination CfRa. A review and analysis of the clinical- and cost-effectiveness studies of comprehensive health promotion and disease management programs in the worksite: 1998-2000 update (Structured abstract) 85. *Database of Abstracts of Reviews of Effects*. 2007; Issue 2, 2007.	Review of studies - not the primary source of data. Further, costs not reported.
Moseti HK. An in-depth analysis of the relationship between employee wellness programs and employee health care costs. *Dissertation Abstracts International Section A: Humanities and Social Sciences*. 1996; 57 (6-A): Dec-	Abstract of a dissertation and only specifies medical costs.
Patton JP. Work-Site Health Promotion - An Economic-Model 243. *Journal of Occupational and Environmental Medicine*. 1991; 33 (8): 868-873.	Example of a Markov model and does not use real data for the modelling.

Shephard RJ. Abstract; Current perspectives on the economics of fitness and sport with particular reference to worksite programmes. *Sports Medicine*. 1989; 7(5):286-309	Review of studies – not the primary source of data.
Shephard RJ. The costs and benefits of exercise: An industrial perspective 284 in Human Kinetics Publishers., Champaign, IL, England, 1990.	Review of studies – not the primary source of data.
Shephard RJ Shephard RJ. A critical analysis of work-site fitness programs and their postulated economic benefits. [Review] [192 refs] 287. *Medicine & Science in Sports & Exercise*. 1992; 24 (3): 354-370.	Review of studies – not the primary source of data.
Stead BA. Worksite health programs: A significant cost-cutting approach 298. Business Horizons. 1994; 37 (6): 73	Does not assess an intervention. However, it does report some companies cost benefit ratios of their own individual schemes.
Stein J. Bodywork. Making it easier to work out at work: companies looking to cut healthcare costs are adding fitness programs to keep employees active and healthy 300. *Los Angeles Times*. 2004; Health: F1, F7.	No cost information reported.

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2. Brown KC, Hilyer, JC Thomas MJ. Cost-effectiveness of a back school intervention for municipal employees. Spine. 1992; 17 (10): 1224-1228.

3. Erfurt JC, Foote A, Heirich MA. The Cost-Effectiveness of Worksite Wellness Programs for Hypertension Control, Weight-Loss, Smoking Cessation, and Exercise. Personnel Psychology. 1992; 45 (1): 5-27.

4. Goetzel RZ, Dunn RL, Ozminkowski RJ, Satin K, Whitehead DA, Cahill K. Differences between descriptive and multivariate estimates of the impact of Chevron Corporation's Health Quest program on medical expenditures. Journal of Occupational & Environmental Medicine. 1998; 40 (6):

5. Oldenburg B, Owen N, Parle M, Gomel M. An Economic-Evaluation of 4 Work-Site Based Cardiovascular Risk Factor Interventions. Health Education Quarterly. 1995; 22 (1): 9-19.

6. Proper KI, de Bruyne MC, Hildebrandt VH, Van der Beek AJ, Meerding WJ, van Mechelen W. Costs, benefits and effectiveness of worksite physical activity counselling from the employer's perspective. Scandinavian Journal of Work, Environment & Health. 2004; 30 (1): 36-46.

7. Shephard RJ. Long term impact of a fitness programme--the Canada Life Study. [Review] [13 refs]. Annals of the Academy of Medicine, Singapore. 1992; 21 (1): 63-68.

APPENDIX A

Literature Search Strategies

A.1 NHS EED Search Strategy

factory or factories or small business*
workplace* or worksite* or workforce*
MeSH workplace explode 1 2
MeSH occupational health explode 1 2
worker* company or companies
human resources or employee* or employer*
#1 or #2 or #3 or #4 or #5
active transport or active travel or active commut*
bicycle* or dance* or gym* or recreation* active* or sport*
walk* to work* OR yoga or physical* activ* or physical* inactiv*
lunch* walk or pilates or karate or judo or Leisure pass*
aerobic* or bicyl* or keep* fit or trim trail* or power walk*
(climb* or us* or walk*) and stair*
fitness and (session* or class* or regime* or program*)
active at work or walking or pedometer* or jog*
subsid* AND (gym* or sport* or leisure* or swim*)
voucher* AND (gym* or sport* or leisure* or swim*)
subsidis* AND (bik* or exercise* or cycl* or bicycle*)
purchas* AND (bik* or exercise* or cycl* or bicycle*)
exercise* AND (program* OR class* OR regime* OR session* OR cycl* OR activ*)
exercise* AND physical*
physical training OR physical education
MeSH running explode 1 2
MeSH leisure activities explode 1 2
MeSH physical fitness explode 1 2
MeSH racquet sports explode 1 2
MeSH motor activity explode 1 2
MeSH football explode 1 2
MeSH jogging explode 1 2
MeSH exercise explode 1 2
Bik* to work*
employee fitness program*
fitness at work
thinkfit
211 hits

A.2 HEED Search Strategy

KW=bicycle OR exercise
KW=occupational health
AX=occupational health
AX=physically active OR physical activity OR physical inactivity
AX=physically inactive
AX=dance* OR gym* OR gymnasium OR sport* OR walk* OR run*
AX=jog* OR football OR swim* OR tennis* OR racquets
AX=fitness AND (class* OR session* OR regime* OR program*)
AX=aerobic OR aerobics
AX=yoga OR pilates OR karate OR judo
AX=(climb* OR us*) AND stair*
AX= physical fitness OR pedometer*
AX=(recreational OR recreation) AND activ*
AX= factory OR employee* OR employer*
AX=company OR companies*
AX= workplace* OR worksite* OR worker* OR workforce*
KW=work
61 hits

A.3 Econlit Search Strategy

S36 (S35 or S27)
S35 (S34 or S33 or S32 or S31 or S30 or S29 or S28)
S34 cycl* to work
S33 walk for health
S32 move for health
S31 thinkfit
S30 fitness at work
S29 employee fitness program*
S28 Bik* to work*
S27 ((S26 and S6))
S26 (S25 or S24 or S23 or S22 or S21 or S20 or S19 or S18 or S17 or S16 or S15 or S14 or S13 or S12 or S8 or S7)
S25 TX (physical training OR physical education)
S24 TX (exercise* AND physical*)
S23 TX (exercise* AND (program* OR class* OR regime* OR session* OR cycl* OR activ*))
S22 TX (purchas* AND (bik* or exercise* or cycl* or bicycle*))
S21 TX (subsidis* AND (bik* or exercise* or cycl* or bicycle*))
S20 TX (voucher* AND (gym* or sport* or leisure* or swim*))
S19 TX (subsid* AND (gym* or sport* or leisure* or swim*))
S18 TX (active at work or walking or pedometer* or jog*)
S17 TX (fitness and (session* or class* or regime* or program*))
S16 TX ((climb* or us* or walk*) and stair*)
S15 TX (aerobic* or bicyl* or keep* fit or trim trail* or power walk*)
S14 TX (lunch* walk or pilates or karate or judo or Leisure pass*)
S13 TX (walk* to work* OR yoga or physical* activ* or physical* inactiv*)
S12 TX (bicycle* or dance* or gym* or recreation* active* or sport*)
S8 TX (active transport or active travel or active commut*)
S7 ((((ZW "RECREATION")) or ((ZW "BICYCLE") or (ZW "BICYCLES"))) or ((ZW "FOOTBALL")))
S6 (S5 or S4 or S3 or S2 or S1)
S5 AB worker*
S4 TI worker*
S3 TX workplace* or worksite* or workforce*
S2 (((ZW "EMPLOYEES")) or ((ZW "EMPLOYEES")))
S1 ((ZW "WORK") or (ZW "WORK ORGANIZATION") or (ZW "WORK, JOB, EMPLOYEES"))
170 hits

APPENDIX B

Health Economic Appraisal Forms

Study identification		Bell *et al.* (1992)
Checklist completed by:		**MWB**
	Evaluation criterion	
1	**Was a well-defined question posed in answerable form?**	The study evaluated the effects of an employee fitness programme on health care costs and utilisation.
1.1	Did the study examine both costs and effects of the service(s) or programme(s)?	The study identified the differences in medical costs between participating and non-participating groups.
1.2	Did the study involve a comparison of alternatives?	The study did not involve a comparison of alternatives.
1.3	Was a viewpoint for the analysis stated and was the study placed in any particular decision-making context?	The viewpoint taken was the employer's perspective.
2	**Was a comprehensive description of the competing alternatives given (that is, can you tell who? Did what? To whom? Where? And how often?)?**	A detailed description of the methodology was given in this study.
2.1	Were any important alternatives omitted?	There did not appear to be any important alternatives omitted.
2.2	Was (should) a do-nothing alternative (be) considered?	A do-nothing alternative was compared in comparison to those that undertook the employee fitness programme.
3	**Was the effectiveness of the programmes or services established?**	The effects were established through: ▪ Hospital stay; ▪ Medical cost; ▪ Medical claims.
3.1	Was this done through a randomised, controlled trial? If so, did the trial protocol reflect what would happen in regular practice?	This was not conducted through an RCT.

3.2	Was effectiveness established through an overview of clinical studies?	The effectiveness was not established through an overview of the clinical studies.
3.3	Were observational data or assumptions used to established effectiveness? If so, what are the potential biases in results?	Before and after observational data were used within this study.
4	**What are the important and relevant costs and consequences for each alternative identified?**	The costs were: ▪ Medical costs.
4.1	Was the range wide enough for the research question to hand?	The overall health benefit was not taken into account in this study.
4.2	Did it cover all relevant viewpoints? (Possible viewpoints include the community or social viewpoint, and those of individuals and third party payers.)	The viewpoint was the employer's perspective.
4.3	Were capital costs, as well ad operating costs, included?	Capital costs and maintenance costs were not included in the study.
5	**Were costs and consequences measured accurately in appropriate physical units (for example, hours of nursing time, number of physician visits, lost work-days, gained life years)?**	The costs and consequences appear to be measured accurately with the use of appropriate physical units.
5.1	Were any of the identified items omitted from measurement? If so, does this mean that they carried no weight in the subsequent analysis?	There do not appear to be any important items omitted from measurement.
5.2	Were there any special circumstances (for example, joint use of resources) that made measurement difficult? Were these circumstances handled appropriately?	There were no special circumstances in this study.
6	**Were costs and consequences valued credibly?**	The source of the medical costs does not appear within the study.
6.1	Were the sources of all values clearly identified? (Possible sources included market values, patient or client preferences and views, policy-makers' views and health professionals' judgements.)	The sources of the medical costs were not included. The price year of the costs was identified on each table.
6.2	Were market values employed for changes involving resources gained or depleted?	This was not necessary in this study.

6.3	Where market values were absent (for example, volunteer labour), or did not reflect actual values (for example, clinic space donated at reduced rate), were adjustments made to approximate market values?	It was not necessary to make adjustments to approximate market values.
6.4	Was the valuation of consequences appropriate for the question posed (that is, has the appropriate type or types of analysis –cost-effectiveness, cost-benefit, cost utility – been selected)?	There could have been a wider measure of the effects on productivity and absenteeism rather than just hospital stay and medical costs.
7	**Were costs and consequences adjusted for differential timing?**	The costs and consequences were not adjusted for differential timing in this study.
7.1	Were costs and consequences which occur in the future 'discounted' to their present values?	The costs and consequences were not discounted in this study.
7.2	Was any justification given for the discount rate used?	The costs and consequences were not discounted.
8	**Was an incremental analysis of costs and consequences of alternatives performed?**	An incremental analysis was not performed in this study.
8.1	Were the additional (incremental) costs generated by one alternative over another compared to the additional effects, benefits or utilities generated?	The overall medical costs and hospital stay were compared for each sub-group of participants and non-participants.

9	**Was allowance made for uncertainty in the estimates of costs and consequences?**	There was no allowance made for uncertainty in the estimates of the costs and the consequences in this study.
9.1	If data on cost or consequences were stochastic, were appropriate statistical analyses performed?	The data was not stochastic.
9.2	Were study results sensitive to changes in the values (within the assumed ranges for sensitivity analysis, or within the confidence interval around the ratio of costs to consequences)?	The authors did not perform any sensitivity analyses.
10	**Did the presentation and discussion of study results include all issues of concern to users?**	There was a fairly thorough discussion of the results, and comparison with previous studies.
10.1	Were the conclusions of the analysis based on some overall index or ratio of costs to consequences (for example, cost-effectiveness ratio)? If so, was the index interpreted intelligently or in a mechanistic fashion?	The conclusions of the analysis were not based on some overall index of the costs to the consequences.
10.2	Were the results compared with those of others who have investigated the same question? If so, were allowances made for potential difference in study methodology?	The results were compared with those of other studies.
10.3	Did the study discuss the generalisability of the results to other settings and patient/client groups?	The generalisability of the results was not discussed in this study.
10.4	Did the study allude to, or take account of, other important factors in the choice or decision under consideration (for example, distribution of costs and consequences, or relevant ethical issues)?	There was discussion of the factors that may have affected the results in this study.
10.5	Did the study discuss issues of implementation, such as the feasibility of adopting the 'preferred' programme given existing financial or other constraints, and whether any freed resources could be re-deployed to other worthwhile programmes?	The implementation of the intervention was not discussed in this study.

Overall assessment of the study	
How well was the study conducted? Code ++,+ or -	+
Are the results of the study directly applicable to the patient group targeted by this guideline?	This was a US study which may be applicable to the UK.

Study identification		Brown *et al.* (1992)
Checklist completed by:		**MWB**
	Evaluation criterion	
1	**Was a well-defined question posed in answerable form?**	The purpose of the study was to report cost/cost-effectiveness findings of ongoing research in those individuals with excessive occupational back injury.
1.1	Did the study examine both costs and effects of the service(s) or programme(s)?	The study included the cost of the intervention Effectiveness was included through measuring the amount of time that the employee was off work through back related problems.
1.2	Did the study involve a comparison of alternatives?	The treatment group was a back school participation programme. The study involved a before and after analysis as well as comparison to a no intervention group.
1.3	Was a viewpoint for the analysis stated and was the study placed in any particular decision-making context?	There was no viewpoint or perspective stated for the analysis.
2	**Was a comprehensive description of the competing alternatives given (that is, can you tell who? Did what? To whom? Where? And how often?)?**	The procedure was explained in the methods section. This stated that the treatment programme involved 6 weeks of exercise and education. This involved strength and flexibility exercises being performed 20 minutes a day for 5 days per week. The occupational health nursing faculty from the local university conducted the back exercise sessions.
2.1	Were any important alternatives omitted?	It does not appear that any were.
2.2	Was (should) a do-nothing alternative (be) considered?	The alternative that was considered was a group of employees who had recently had back problems but did not undergo the treatment sessions.
3	**Was the effectiveness of the programmes or services established?**	The measure of effectiveness was established through the lost time through absenteeism.
3.1	Was this done through a randomised, controlled trial? If so, did the trial protocol reflect what would happen in regular practice?	This was not conducted through an RCT.

3.2	Was effectiveness established through an overview of clinical studies?	The effectiveness was not established through an overview of clinical studies.
3.3	Were observational data or assumptions used to established effectiveness? If so, what are the potential biases in results?	The effectiveness was established through a comparison of the lost time cost and medical costs between the back school treatment group and the control group. The way in which the medical costs are calculated may lead to bias in the results.
4	**What are the important and relevant costs and consequences for each alternative identified?**	
4.1	Was the range wide enough for the research question to hand?	The study included the following costs: ▪ Medical Costs; ▪ Lost Time Costs.
4.2	Did it cover all relevant viewpoints? (Possible viewpoints include the community or social viewpoint, and those of individuals and third party payers.)	The study did not cover a societal viewpoint.
4.3	Were capital costs, as well ad operating costs, included?	Capital costs were not relevant in this study.
5	**Were costs and consequences measured accurately in appropriate physical units (for example, hours of nursing time, number of physician visits, lost work-days, gained life years)?**	Appropriate units were used to measure the costs and consequences: These were calculated through: ▪ Lost time; ▪ Dollar costs; ▪ Number of injuries.
5.1	Were any of the identified items omitted from measurement? If so, does this mean that they carried no weight in the subsequent analysis?	The costs for the intervention were not measured or reported.
5.2	Were there any special circumstances (for example, joint use of resources) that made measurement difficult? Were these circumstances handled appropriately?	No.
6	**Were costs and consequences valued credibly?**	

6.1	Were the sources of all values clearly identified? (Possible sources included market values, patient or client preferences and views, policy-makers' views and health professionals' judgements.)	There was no reference to where the source(s) of the medical fees.
6.2	Were market values employed for changes involving resources gained or depleted?	This is not applicable to this study.
6.3	Where market values were absent (for example, volunteer labour), or did not reflect actual values (for example, clinic space donated at reduced rate), were adjustments made to approximate market values?	Market values were used throughout.
6.4	Was the valuation of consequences appropriate for the question posed (that is, has the appropriate type or types of analysis –cost-effectiveness, cost-benefit, cost utility – been selected)?	This was more a cost consequence study than the title suggests. It would possibly have been more appropriate to use a cost-effectiveness approach.
7	**Were costs and consequences adjusted for differential timing?**	
7.1	Were costs and consequences which occur in the future 'discounted' to their present values?	The costs and consequences were not adjusted for differential timing.
7.2	Was any justification given for the discount rate used?	Discounting was not undertaken.
8	**Was an incremental analysis of costs and consequences of alternatives performed?**	
8.1	Were the additional (incremental) costs generated by one alternative over another compared to the additional effects, benefits or utilities generated?	There was a comparison of the costs and consequences in this analysis
9	**Was allowance made for uncertainty in the estimates of costs and consequences?**	There was no allowance for uncertainty in this study.
9.1	If data on cost or consequences were stochastic, were appropriate statistical analyses performed?	The data were not stochastic.
9.2	Were study results sensitive to changes in the values (within the assumed ranges for sensitivity analysis, or within the confidence interval around the ratio of costs to consequences)?	This could not be identified within the study.

10	**Did the presentation and discussion of study results include all issues of concern to users?**	
10.1	Were the conclusions of the analysis based on some overall index or ratio of costs to consequences (for example, cost-effectiveness ratio)? If so, was the index interpreted intelligently or in a mechanistic fashion?	The results were not based on an index.
10.2	Were the results compared with those of others who have investigated the same question? If so, were allowances made for potential difference in study methodology?	Results were not compared with other studies.
10.3	Did the study discuss the generalisability of the results to other settings and patient/client groups?	The generalisability was not discussed.
10.4	Did the study allude to, or take account of, other important factors in the choice or decision under consideration (for example, distribution of costs and consequences, or relevant ethical issues)?	There were no other issues alluded to in this study.
10.5	Did the study discuss issues of implementation, such as the feasibility of adopting the 'preferred' programme given existing financial or other constraints, and whether any freed resources could be re-deployed to other worthwhile programmes?	Implementation of the worksite programme was not discussed in this study.
Overall assessment of the study		
How well was the study conducted? Code ++,+ or -		-
Are the results of the study directly applicable to the patient group targeted by this guideline?		This was a US study and results may be applicable.

Study identification		Erfurt *et al.* (1992)
Checklist completed by:		**MWB**
	Evaluation criterion	
1	**Was a well-defined question posed in answerable form?**	The study's purpose is well defined. Its aim is to comparing the cost effectiveness of four worksite wellness interventions.
1.1	Did the study examine both costs and effects of the service(s) or programme(s)?	The study examined a comprehensive list of costs and the consequences by considering the combined risk reduction of four different health risks.
1.2	Did the study involve a comparison of alternatives?	The study involved comparing four alternative worksite wellness schemes, namely: ▪ Site A: Health Education model; ▪ Site B: Physical fitness facility; ▪ Site C: Health education and follow-up counselling; ▪ Site D: Health education, follow-up counselling and plant organisation.
1.3	Was a viewpoint for the analysis stated and was the study placed in any particular decision-making context?	The viewpoint was the employer's perspective.
2	**Was a comprehensive description of the competing alternatives given (that is, can you tell who? Did what? To whom? Where? And how often?)?**	The methodology includes a thorough description of the alternatives, the number of employees at each site and what each of the different interventions involves.
2.1	Were any important alternatives omitted?	There were no obvious important alternatives omitted.
2.2	Was (should) a do-nothing alternative (be) considered?	A do-nothing alternative should not have been considered in this study.
3	**Was the effectiveness of the programmes or services established?**	The programme effectiveness was measured as the reduction in the targeted risks and prevention of relapse based upon the re-screening data for the employees.

3.1	Was this done through a randomised, controlled trial? If so, did the trial protocol reflect what would happen in regular practice?	This was not performed through a randomised controlled trial.
3.2	Was effectiveness established through an overview of clinical studies?	The effectiveness was established by a screening of employees' reduction in the risk factors.
3.3	Were observational data or assumptions used to established effectiveness? If so, what are the potential biases in results?	The study examines different levels of risks. For example, for blood pressure two different levels are examined, high and moderate blood pressure.
4	**What are the important and relevant costs and consequences for each alternative identified?**	The relevant costs included for each site were: ▪ The cost of the health educator; ▪ The cost of the wellness counsellors; ▪ The company paid costs for health improvements; ▪ The costs of the initial screening to identify employees with targeted risks. The consequences included which were captured by the different risks related to: ▪ High blood pressure; ▪ Diagnosed hypertensive with blood pressure under control; ▪ Overweight by 20% or more; ▪ Smoked cigarettes; ▪ Reported being an ex-smoker; ▪ Needing regular exercise.
4.1	Was the range wide enough for the research question to hand?	The range was wide enough for the original research question.

4.2	Did it cover all relevant viewpoints? (Possible viewpoints include the community or social viewpoint, and those of individuals and third party payers.)	The study did not include all costs. For example, the costs paid out-of-pocket by the participating employees were not estimated.
4.3	Were capital costs, as well ad operating costs, included?	The capital costs of gym equipment were included in the analysis.
5	**Were costs and consequences measured accurately in appropriate physical units (for example, hours of nursing time, number of physician visits, lost work-days, gained life years)?**	The costs and consequences were measured appropriately in this study.
5.1	Were any of the identified items omitted from measurement? If so, does this mean that they carried no weight in the subsequent analysis?	The costs omitted do not carry any weight when it is assumed that the analysis is from the employer's perspective.
5.2	Were there any special circumstances (for example, joint use of resources) that made measurement difficult? Were these circumstances handled appropriately?	There were no special circumstances in this study.
6	**Were costs and consequences valued credibly?**	The costs and consequences appear to be valued correctly. They are valued at 1988 prices.
6.1	Were the sources of all values clearly identified? (Possible sources included market values, patient or client preferences and views, policy-makers' views and health professionals' judgements.)	The sources of values were stated in the footnotes of the costing tables.
6.2	Were market values employed for changes involving resources gained or depleted?	Market values were not employed.
6.3	Where market values were absent (for example, volunteer labour), or did not reflect actual values (for example, clinic space donated at reduced rate), were adjustments made to approximate market values?	It was not necessary in this study to adjust for absent market values.

6.4	Was the valuation of consequences appropriate for the question posed (that is, has the appropriate type or types of analysis –cost-effectiveness, cost-benefit, cost utility – been selected)?	The number of risks included was appropriate. It may be viewed as less appropriate to combine the risk factors as they are not all independent of one another.
7	**Were costs and consequences adjusted for differential timing?**	The costs and consequences were not adjusted for differential timing.
7.1	Were costs and consequences which occur in the future 'discounted' to their present values?	Costs and consequences were not discounted.
7.2	Was any justification given for the discount rate used?	Costs and consequences were not discounted.
8	**Was an incremental analysis of costs and consequences of alternatives performed?**	An incremental analysis in the form of the cost per risk reduced was reported for each of the sites.
8.1	Were the additional (incremental) costs generated by one alternative over another compared to the additional effects, benefits or utilities generated?	The alternatives were compared against Site A which was seen to be the baseline.
9	**Was allowance made for uncertainty in the estimates of costs and consequences?**	Allowance was not made for uncertainty. Sensitivity analyses were not presented.
9.1	If data on cost or consequences were stochastic, were appropriate statistical analyses performed?	Costs and consequences were not stochastic.
9.2	Were study results sensitive to changes in the values (within the assumed ranges for sensitivity analysis, or within the confidence interval around the ratio of costs to consequences)?	This could not be established. Sensitivity analyses were not presented in this study.
10	**Did the presentation and discussion of study results include all issues of concern to users?**	The discussion was from the perspective of the employer.

10.1	Were the conclusions of the analysis based on some overall index or ratio of costs to consequences (for example, cost-effectiveness ratio)? If so, was the index interpreted intelligently or in a mechanistic fashion?	The cost-effectiveness index included was the cost per percent reduction in risk for each of the four sites. There was a thorough discussion of the index results.
10.2	Were the results compared with those of others who have investigated the same question? If so, were allowances made for potential difference in study methodology?	The results were not compared. This may be explained by the limited number of cost-effectiveness studies in this area.
10.3	Did the study discuss the generalisability of the results to other settings and patient/client groups?	The study did not discuss the generalisability of the results.
10.4	Did the study allude to, or take account of, other important factors in the choice or decision under consideration (for example, distribution of costs and consequences, or relevant ethical issues)?	The study discussed the other costs that may need to be taken into account from the individual employee perspective.
10.5	Did the study discuss issues of implementation, such as the feasibility of adopting the 'preferred' programme given existing financial or other constraints, and whether any freed resources could be re-deployed to other worthwhile programmes?	The issues of implementation of the different interventions were not addressed in this study.
Overall assessment of the study		
How well was the study conducted? Code ++,+ or -		+
Are the results of the study directly applicable to the patient group targeted by this guideline?		This is a US study which may be generalisable to the UK.

Study identification		Goetzel *et al.* (1998)
Checklist completed by:		**MWB**
	Evaluation criterion	
1	**Was a well-defined question posed in answerable form?**	The aim of this study was to consider alternative methods for evaluating the impact of Chevrons Corporations Health Quest Fitness Centre programme on medical expenditures, comparing descriptive and multivariate research designs.
1.1	Did the study examine both costs and effects of the service(s) or programme(s)?	The study examined both medical costs and the effects of participating and not participating in a Health Quest programme.
1.2	Did the study involve a comparison of alternatives?	The study did not involve a comparison of alternatives.
1.3	Was a viewpoint for the analysis stated and was the study placed in any particular decision-making context?	The viewpoint was not stated. However it appears to be from both the employer's and employee's perspectives.
2	**Was a comprehensive description of the competing alternatives given (that is, can you tell who? Did what? To whom? Where? And how often?)?**	A description of the alternatives was not necessary in this study.
2.1	Were any important alternatives omitted?	There did not appear to be any important alternatives omitted.
2.2	Was (should) a do-nothing alternative (be) considered?	The two groups were those who participated in the Health Quest health and fitness programme and those who were non-participants.

3	**Was the effectiveness of the programmes or services established?**	The effectiveness was not directly established. The outcome measure was the level of medical expenditure over a period of 2 years.
3.1	Was this done through a randomised, controlled trial? If so, did the trial protocol reflect what would happen in regular practice?	This was not conducted through a RCT. The study used a multivariate approach to control for confounding factors when considering different levels of participation and the level of medical expenditure.
3.2	Was effectiveness established through an overview of clinical studies?	The effectiveness was not established through an overview of clinical studies.
3.3	Were observational data or assumptions used to established effectiveness? If so, what are the potential biases in results?	The medical expenditures were calculated through a logistic participation regression equation and an ordinary least squares regression of those that had medical expenditure.
4	**What are the important and relevant costs and consequences for each alternative identified?**	Medical expenditure by different level of participant.
4.1	Was the range wide enough for the research question to hand?	The range was wide enough for solely considering the effects upon medical expenditures.
4.2	Did it cover all relevant viewpoints? (Possible viewpoints include the community or social viewpoint, and those of individuals and third party payers.)	The study did not consider a societal viewpoint.
4.3	Were capital costs, as well ad operating costs, included?	It was not appropriate to include capital costs in this study.
5	**Were costs and consequences measured accurately in appropriate physical units (for example, hours of nursing time, number of physician visits, lost work-days, gained life years)?**	The costs and consequences appear to be measured accurately.

5.1	Were any of the identified items omitted from measurement? If so, does this mean that they carried no weight in the subsequent analysis?	There did not appear to be any items omitted from measurement.
5.2	Were there any special circumstances (for example, joint use of resources) that made measurement difficult? Were these circumstances handled appropriately?	There were no special circumstances in this study. However, this study did not use the standard methodology of a cost-effectiveness study or a cost-benefit study.
6	**Were costs and consequences valued credibly?**	The medical costs were adjusted for confounding factors. Although unobservable variables may still have led to bias in the overall medical costs for the different groups of participants.
6.1	Were the sources of all values clearly identified? (Possible sources included market values, patient or client preferences and views, policy-makers' views and health professionals' judgements.)	The sources are reported under the 'Sample' section of the Study.
6.2	Were market values employed for changes involving resources gained or depleted?	All expenditures were adjusted for the impact of inflation by transforming them into 1996 dollar equivalents using the GDP implicit price deflator.
6.3	Where market values were absent (for example, volunteer labour), or did not reflect actual values (for example, clinic space donated at reduced rate), were adjustments made to approximate market values?	This was not necessary within this study.
6.4	Was the valuation of consequences appropriate for the question posed (that is, has the appropriate type or types of analysis –cost-effectiveness, cost-benefit, cost utility – been selected)?	The consequences were only valued in terms of the effect upon medical expenditures.
7	**Were costs and consequences adjusted for differential timing?**	There was no adjustment for differential timing of the costs and consequences in this study.
7.1	Were costs and consequences which occur in the future 'discounted' to their present values?	Costs and consequences were not discounted.

7.2	Was any justification given for the discount rate used?	Costs and consequences were not discounted.
8	**Was an incremental analysis of costs and consequences of alternatives performed?**	An incremental analysis was not performed in this study.
8.1	Were the additional (incremental) costs generated by one alternative over another compared to the additional effects, benefits or utilities generated?	The estimated cost-saving of participating was reported.
9	**Was allowance made for uncertainty in the estimates of costs and consequences?**	There was no allowance for uncertainty.
9.1	If data on cost or consequences were stochastic, were appropriate statistical analyses performed?	The data were not stochastic.
9.2	Were study results sensitive to changes in the values (within the assumed ranges for sensitivity analysis, or within the confidence interval around the ratio of costs to consequences)?	No sensitivity analyses were performed in this study.
10	**Did the presentation and discussion of study results include all issues of concern to users?**	It appears that most of the issues have been considered. The study includes a fairly comprehensive limitations section.
10.1	Were the conclusions of the analysis based on some overall index or ratio of costs to consequences (for example, cost-effectiveness ratio)? If so, was the index interpreted intelligently or in a mechanistic fashion?	The conclusions were based on the overall cost savings from the different levels of participation.
10.2	Were the results compared with those of others who have investigated the same question? If so, were allowances made for potential difference in study methodology?	The results were not compared with other studies. However, this may be due to the fact that there are few studies currently published that asses the cost-effectiveness of workplace physical activity interventions.
10.3	Did the study discuss the generalisability of the results to other settings and patient/client groups?	The study did not discuss the generalisability of the results.
10.4	Did the study allude to, or take account of, other important factors in the choice or decision under consideration (for example, distribution of costs and consequences, or relevant ethical issues)?	The study did allude to the limitations of the methodology used.

10.5	Did the study discuss issues of implementation, such as the feasibility of adopting the 'preferred' programme given existing financial or other constraints, and whether any freed resources could be re-deployed to other worthwhile programmes?	The implementation of the intervention was not discussed within this study.
Overall assessment of the study		
How well was the study conducted? Code ++,+ or -		+
Are the results of the study directly applicable to the patient group targeted by this guideline?		This was a US study. The results may not be generalisable to the UK due to the different systems on medical expenditures in these two countries.

Study identification		Oldenburg *et al.* (1995)
Checklist completed by:		**MWB**
	Evaluation criterion	
1	**Was a well-defined question posed in answerable form?**	The aim of the study was to produce an economic evaluation of the intervention programmes, focusing on the costs of producing initial composite risk factor changes in a 12 month period.
1.1	Did the study examine both costs and effects of the service(s) or programme(s)?	The study examined both the costs and effects of four worksite risk reduction programmes.
1.2	Did the study involve a comparison of alternatives?	The study involved the comparison of four alternatives.
1.3	Was a viewpoint for the analysis stated and was the study placed in any particular decision-making context?	A viewpoint for the analysis was not stated in the study.
2	**Was a comprehensive description of the competing alternatives given (that is, can you tell who? Did what? To whom? Where? And how often?)?**	The effectiveness evidence is based on the measurement of risk scores for a group of employees who were randomly assigned to the different worksite interventions.
2.1	Were any important alternatives omitted?	It does not appear that any important alternatives were omitted.
2.2	Was (should) a do-nothing alternative (be) considered?	A do nothing alternative was not considered.
3	**Was the effectiveness of the programmes or services established?**	All participants were assessed at baseline and at 3, 6 and 12 months following baseline assessment. The outcomes assessed were: ▪ BMI; ▪ Percentage fat; ▪ Blood pressure (Systolic and diastolic); ▪ Serum cholesterol; ▪ Smoking status; ▪ Aerobic capacity.

3.1	Was this done through a randomised, controlled trial? If so, did the trial protocol reflect what would happen in regular practice?	Twenty eight stations with 12 or more employees were randomly selected for the study. 488 employees were approached to participate in the study.
3.2	Was effectiveness established through an overview of clinical studies?	The effectiveness was assessed by allocation to four groups: ▪ Health risk assessment (HRA); ▪ Risk Factor Education (RFE); ▪ Behavioural counselling (BC); ▪ Behavioural counselling plus incentives (BCI).
3.3	Were observational data or assumptions used to established effectiveness? If so, what are the potential biases in results?	The outcome information was fed into a risk equation to provide a composite risk score.
4	**What are the important and relevant costs and consequences for each alternative identified?**	The important costs: ▪ Staffing costs; ▪ Travel costs for assessors; ▪ Consumables; ▪ Employer's costs. The outcomes measures which were used in the composite logistic regression were: ▪ BMI; ▪ Percentage fat; ▪ Blood pressure (Systolic and diastolic); ▪ Serum cholesterol; ▪ Smoking status; ▪ Aerobic capacity.
4.1	Was the range wide enough for the research question to hand?	The range was wide enough for the research question in hand.

4.2	Did it cover all relevant viewpoints? (Possible viewpoints include the community or social viewpoint, and those of individuals and third party payers.)	The employer viewpoint was taken.
4.3	Were capital costs, as well ad operating costs, included?	The costs of materials were included in the analysis.
5	**Were costs and consequences measured accurately in appropriate physical units (for example, hours of nursing time, number of physician visits, lost work-days, gained life years)?**	The costs and consequences were measured accurately in appropriate units.
5.1	Were any of the identified items omitted from measurement? If so, does this mean that they carried no weight in the subsequent analysis?	Individual time costs.
5.2	Were there any special circumstances (for example, joint use of resources) that made measurement difficult? Were these circumstances handled appropriately?	There were no special circumstances in this study.
6	**Were costs and consequences valued credibly?**	Time costs were valued at a rate per hour for the individuals.
6.1	Were the sources of all values clearly identified? (Possible sources included market values, patient or client preferences and views, policy-makers' views and health professionals' judgements.)	The sources of values were occasionally identified.
6.2	Were market values employed for changes involving resources gained or depleted?	It was not necessary to apply values to changes in resources in this project.
6.3	Where market values were absent (for example, volunteer labour), or did not reflect actual values (for example, clinic space donated at reduced rate), were adjustments made to approximate market values?	Adjustments were not made to approximate market values.
6.4	Was the valuation of consequences appropriate for the question posed (that is, has the appropriate type or types of analysis –cost-effectiveness, cost-benefit, cost utility – been selected)?	The valuation of the consequences involved the production of a composite risk measure for CVD. There may be biases introduced by the choice of measures included in the composite risk function and this may bias the results.

7	**Were costs and consequences adjusted for differential timing?**	The costs and consequences were not adjusted for differential timing.
7.1	Were costs and consequences which occur in the future 'discounted' to their present values?	There was no discussion of future discounting.
7.2	Was any justification given for the discount rate used?	There was no discussion of future discounting.
8	**Was an incremental analysis of costs and consequences of alternatives performed?**	There was an incremental cost per health risk unit calculated.
8.1	Were the additional (incremental) costs generated by one alternative over another compared to the additional effects, benefits or utilities generated?	The effects were compared with the Health Risk Assessment (HRA).
9	**Was allowance made for uncertainty in the estimates of costs and consequences?**	The authors perform sensitivity analysis.
9.1	If data on cost or consequences were stochastic, were appropriate statistical analyses performed?	The costs and consequences were not stochastic.
9.2	Were study results sensitive to changes in the values (within the assumed ranges for sensitivity analysis, or within the confidence interval around the ratio of costs to consequences)?	The study contained sensitivity analyses around variation in the interventions costs for the best- and worst-case scenarios. The changes in the cost per effect were found not to be very sensitive to changes in the assumptions.
10	**Did the presentation and discussion of study results include all issues of concern to users?**	The discussion was comprehensive and highlighted some of the limitations surrounding the cost assumptions.
10.1	Were the conclusions of the analysis based on some overall index or ratio of costs to consequences (for example, cost-effectiveness ratio)? If so, was the index interpreted intelligently or in a mechanistic fashion?	The conclusions were based upon the cost per health risk unit. This was interpreted and compared between the different types of intervention.
10.2	Were the results compared with those of others who have investigated the same question? If so, were allowances made for potential difference in study methodology?	The study included a comparison of methodologies employed in other studies and the potential effects upon the results.

10.3	Did the study discuss the generalisability of the results to other settings and patient/client groups?	The generalisability was touched on but not explicitly discussed within the study.
10.4	Did the study allude to, or take account of, other important factors in the choice or decision under consideration (for example, distribution of costs and consequences, or relevant ethical issues)?	The authors commented on how the effectiveness of the interventions could be improved on through the marketing and conduct of the programme.
10.5	Did the study discuss issues of implementation, such as the feasibility of adopting the 'preferred' programme given existing financial or other constraints, and whether any freed resources could be re-deployed to other worthwhile programmes?	The study had a section on implications for practice. Within this section the authors touched on the practicality of implementing such interventions.
Overall assessment of the study		
How well was the study conducted? Code ++,+ or -		+
Are the results of the study directly applicable to the patient group targeted by this guideline?		This was an Australian study which may be applicable to the UK.

Study identification		Proper *et al.* (2004)
Checklist completed by:		**MWB**
	Evaluation criterion	
1	**Was a well-defined question posed in answerable form?**	The objective of this study was to evaluate the impact of worksite physical activity counselling using cost-benefit and cost-effectiveness analysis.
1.1	Did the study examine both costs and effects of the service(s) or programme(s)?	The study addressed the costs and effects of a worksite fitness counselling programme.
1.2	Did the study involve a comparison of alternatives?	There was a control group and an alternative group who received the workplace counselling.
1.3	Was a viewpoint for the analysis stated and was the study placed in any particular decision-making context?	The employer's perspective was used in this economic evaluation.
2	**Was a comprehensive description of the competing alternatives given (that is, can you tell who? Did what? To whom? Where? And how often?)?**	The study involved a comparison of those who received physical activity counselling and those that did not (control).
2.1	Were any important alternatives omitted?	There do not appear to be any important alternatives omitted.
2.2	Was (should) a do-nothing alternative (be) considered?	A do-nothing alternative was considered in this study.
3	**Was the effectiveness of the programmes or services established?**	The effectiveness of the programme and services were established by a RCT.
3.1	Was this done through a randomised, controlled trial? If so, did the trial protocol reflect what would happen in regular practice?	The effectiveness was obtained through a RCT. The randomisation protocol was explained and reflects what would happen in practice.
3.2	Was effectiveness established through an overview of clinical studies?	The effectiveness was established through a RCT.
3.3	Were observational data or assumptions used to established effectiveness? If so, what are the potential biases in results?	Observational data were not used in this study.

4	**What are the important and relevant costs and consequences for each alternative identified?**	The outcomes included in the analysis were sick leave, physical activity, fitness and musculoskeletal symptoms.
4.1	Was the range wide enough for the research question to hand?	The range appears to be wide enough for the research question to hand.
4.2	Did it cover all relevant viewpoints? (Possible viewpoints include the community or social viewpoint, and those of individuals and third party payers.)	The study includes an employer viewpoint. Strictly speaking the cost-benefit estimates are cost-effectiveness estimates as they do not include the full societal costs and benefits which are required for a true cost-benefit analysis.
4.3	Were capital costs, as well ad operating costs, included?	There were no capital costs associated with the intervention.
5	**Were costs and consequences measured accurately in appropriate physical units (for example, hours of nursing time, number of physician visits, lost work-days, gained life years)?**	The costs and consequences appear to be measured appropriately.
5.1	Were any of the identified items omitted from measurement? If so, does this mean that they carried no weight in the subsequent analysis?	There were no items omitted from measurement.
5.2	Were there any special circumstances (for example, joint use of resources) that made measurement difficult? Were these circumstances handled appropriately?	There were no special circumstances in this study.
6	**Were costs and consequences valued credibly?**	The costs and consequences were valued credibly.
6.1	Were the sources of all values clearly identified? (Possible sources included market values, patient or client preferences and views, policy-makers' views and health professionals' judgements.)	The costs were based on market values but their source(s) was not explicitly stated in the study.
6.2	Were market values employed for changes involving resources gained or depleted?	This was not necessary within this study.

6.3	Where market values were absent (for example, volunteer labour), or did not reflect actual values (for example, clinic space donated at reduced rate), were adjustments made to approximate market values?	This was not necessary within this study.
6.4	Was the valuation of consequences appropriate for the question posed (that is, has the appropriate type or types of analysis –cost-effectiveness, cost-benefit, cost utility – been selected)?	The valuation of the consequences valued was appropriate.
7	**Were costs and consequences adjusted for differential timing?**	Costs and consequences were not adjusted for differential timing.
7.1	Were costs and consequences which occur in the future 'discounted' to their present values?	The costs and consequences were not discounted.
7.2	Was any justification given for the discount rate used?	Discounting did not take place within this study.
8	**Was an incremental analysis of costs and consequences of alternatives performed?**	An incremental cost-effectiveness index was used and a cost-benefit ratio.
8.1	Were the additional (incremental) costs generated by one alternative over another compared to the additional effects, benefits or utilities generated?	The study produced both a cost-benefit ratio and a cost-effectiveness index. The cost-effectiveness per extra kilocalorie per day per employee and per beat per minute decrease in maximal heart rate.
9	**Was allowance made for uncertainty in the estimates of costs and consequences?**	The authors of the study performed sensitivity analyses.
9.1	If data on cost or consequences were stochastic, were appropriate statistical analyses performed?	Bootstrapping was used in the estimation of the uncertainty surrounding the costs. The study conducted three sensitivity analyses: ▪ Elasticity of labour and production; ▪ Inputting data for the missing values; ▪ Cost of participants associated with the loss of work time.

9.2	Were study results sensitive to changes in the values (within the assumed ranges for sensitivity analysis, or within the confidence interval around the ratio of costs to consequences)?	The sensitivity analyses did not appear to make a substantial difference to the results obtained.
10	**Did the presentation and discussion of study results include all issues of concern to users?**	The presentation and discussion of the results was very comprehensive, with useful cost-effectiveness planes presented.
10.1	Were the conclusions of the analysis based on some overall index or ratio of costs to consequences (for example, cost-effectiveness ratio)? If so, was the index interpreted intelligently or in a mechanistic fashion?	The conclusions were based upon the cost-effectiveness ratios.
10.2	Were the results compared with those of others who have investigated the same question? If so, were allowances made for potential difference in study methodology?	The results were compared with a few other studies. However, this was difficult for the authors as there are limited studies that evaluate the cost-effectiveness of physical activity workplace interventions.
10.3	Did the study discuss the generalisability of the results to other settings and patient/client groups?	The generalisability of the results was not discussed.
10.4	Did the study allude to, or take account of, other important factors in the choice or decision under consideration (for example, distribution of costs and consequences, or relevant ethical issues)?	The limitations of the analysis were stated. The authors acknowledged that the analysis was a 'partial cost-benefit analysis'. They also used cost-effectiveness analysis as another tool to analyse the results of the trial.
10.5	Did the study discuss issues of implementation, such as the feasibility of adopting the 'preferred' programme given existing financial or other constraints, and whether any freed resources could be re-deployed to other worthwhile programmes?	The study did not discuss the implementation of the counselling physical activity intervention.
Overall assessment of the study		
How well was the study conducted? Code ++,+ or -		+
Are the results of the study directly applicable to the patient group targeted by this guideline?		This study was conducted in the Netherlands and may be applicable to the UK.

Study identification		Shephard (1992)
Checklist completed by:		**MWB**
	Evaluation criterion	
1	**Was a well-defined question posed in answerable form?**	The aim was defined to evaluate the long term impact of a fitness programme in Canada.
1.1	Did the study examine both costs and effects of the service(s) or programme(s)?	Employee recruitment and employee turnover were the effectiveness measures used in this study. The main costs that were included were the gym equipment and the operating and maintenance costs.
1.2	Did the study involve a comparison of alternatives?	The study considered a before and after comparison of the introduction of the fitness programme.
1.3	Was a viewpoint for the analysis stated and was the study placed in any particular decision-making context?	The employer's viewpoint was taken in this study.
2	**Was a comprehensive description of the competing alternatives given (that is, can you tell who? Did what? To whom? Where? And how often?)?**	The competing alternatives were not described within this study.
2.1	Were any important alternatives omitted?	There do not appear to be any important alternatives omitted from the study.
2.2	Was (should) a do-nothing alternative (be) considered?	The study considered the before and after effects of introducing an employee fitness scheme.
3	**Was the effectiveness of the programmes or services established?**	The effectiveness was established for each of the different effect measures. However, there was little discussion regarding how the measurements were taken.
3.1	Was this done through a randomised, controlled trial? If so, did the trial protocol reflect what would happen in regular practice?	This was not conducted through a RCT.

3.2	Was effectiveness established through an overview of clinical studies?	The effectiveness was not established through an overview of clinical studies.
3.3	Were observational data or assumptions used to established effectiveness? If so, what are the potential biases in results?	Assumptions were made to generate some effectiveness results.
4	**What are the important and relevant costs and consequences for each alternative identified?**	The relevant costs were: • Gymnasium and equipment cost; • Operating cost; • Maintenance cost. The relevant consequences were: • Absenteeism; • Productivity; • Health Benefits; • Industrial Injuries.
4.1	Was the range wide enough for the research question to hand?	The range of the consequences and costs was wide enough for the original research question.
4.2	Did it cover all relevant viewpoints? (Possible viewpoints include the community or social viewpoint, and those of individuals and third party payers.)	A societal viewpoint was not taken in this study.
4.3	Were capital costs, as well ad operating costs, included?	The capital costs and maintenance costs of the gym equipment were included in this study.
5	**Were costs and consequences measured accurately in appropriate physical units (for example, hours of nursing time, number of physician visits, lost work-days, gained life years)?**	The costs and consequences appear to be measured accurately in this study.

5.1	Were any of the identified items omitted from measurement? If so, does this mean that they carried no weight in the subsequent analysis?	There do not appear to be any important items omitted.
5.2	Were there any special circumstances (for example, joint use of resources) that made measurement difficult? Were these circumstances handled appropriately?	There are no special circumstances in this study.
6	**Were costs and consequences valued credibly?**	It is difficult to identify from the study whether the costs and consequences were valued credibly because of the very short section on the cost-effectiveness and the cost-benefit ratio.
6.1	Were the sources of all values clearly identified? (Possible sources included market values, patient or client preferences and views, policy-makers' views and health professionals' judgements.)	The cost source was not always referenced but the authors gave the price year frequently.
6.2	Were market values employed for changes involving resources gained or depleted?	This was not necessary in this study.
6.3	Where market values were absent (for example, volunteer labour), or did not reflect actual values (for example, clinic space donated at reduced rate), were adjustments made to approximate market values?	It was not necessary to approximate market values.
6.4	Was the valuation of consequences appropriate for the question posed (that is, has the appropriate type or types of analysis –cost-effectiveness, cost-benefit, cost utility – been selected)?	The cost-benefit analysis was a partial analysis.
7	**Were costs and consequences adjusted for differential timing?**	The costs and consequences were not adjusted for differential timing.
7.1	Were costs and consequences which occur in the future 'discounted' to their present values?	The costs and consequences were not discounted.

7.2	Was any justification given for the discount rate used?	The costs and consequences were not discounted. And there was therefore no justification of the discount rate used.
8	**Was an incremental analysis of costs and consequences of alternatives performed?**	A cost-benefit ratio was provided in the study.
8.1	Were the additional (incremental) costs generated by one alternative over another compared to the additional effects, benefits or utilities generated?	The return on each dollar invested was reported in the study.
9	**Was allowance made for uncertainty in the estimates of costs and consequences?**	There was no allowance for uncertainty.
9.1	If data on cost or consequences were stochastic, were appropriate statistical analyses performed?	The data was not stochastic.
9.2	Were study results sensitive to changes in the values (within the assumed ranges for sensitivity analysis, or within the confidence interval around the ratio of costs to consequences)?	The authors did not perform sensitivity analysis in this study.
10	**Did the presentation and discussion of study results include all issues of concern to users?**	The discussion of the results was very short and did not cover all issues.
10.1	Were the conclusions of the analysis based on some overall index or ratio of costs to consequences (for example, cost-effectiveness ratio)? If so, was the index interpreted intelligently or in a mechanistic fashion?	The conclusions were not based on the cost-benefit ratio.
10.2	Were the results compared with those of others who have investigated the same question? If so, were allowances made for potential difference in study methodology?	The results were not compared with other studies.
10.3	Did the study discuss the generalisability of the results to other settings and patient/client groups?	The authors did not discuss the generalisability of their results.
10.4	Did the study allude to, or take account of, other important factors in the choice or decision under consideration (for example, distribution of costs and consequences, or relevant ethical issues)?	The authors alluded to the future challenges of assessing the costs and benefits.

10.5	Did the study discuss issues of implementation, such as the feasibility of adopting the 'preferred' programme given existing financial or other constraints, and whether any freed resources could be re-deployed to other worthwhile programmes?	The study did not discuss the implementation of the intervention.
Overall assessment of the study		
How well was the study conducted? Code ++,+ or -		-
Are the results of the study directly applicable to the patient group targeted by this guideline?		This was a Canadian study and may be applicable to the UK.