doi: 10.1111/j.1467-789X.2011.00925.x

Obesity Management

Systematic review on the financial return of worksite health promotion programmes aimed at improving nutrition and/or increasing physical activity

J. M. van Dongen[1,2,3], K. I. Proper[1,3], M. F. van Wier[1,2,4], A. J. van der Beek[1,3], P. M. Bongers[1,3,5], W. van Mechelen[1,3] and M. W. van Tulder[1,2,4]

[1]Body@Work, Research Center for Physical Activity, Work and Health, TNO-VU University Medical Center, Amsterdam, the Netherlands; [2]Department of Health Sciences and the EMGO+ Institute for Health and Care Research, Faculty of Earth and Life Sciences, VU University Amsterdam, Amsterdam, the Netherlands; [3]Department of Public and Occupational Health and the EMGO+ Institute for Health and Care Research, VU University Medical Center, Amsterdam, the Netherlands; [4]Department of Epidemiology and Biostatistics and the EMGO+ Institute for Health and Care Research, VU University Medical Center, Amsterdam, the Netherlands; [5]TNO Healthy Living, Hoofddorp, the Netherlands

Received 3 May 2011; revised 26 July 2011; accepted 26 July 2011

Address for correspondence: Ms JM van Dongen, Health Economics and Health Technology Assessment Unit, Department of Health Sciences, Faculty of Earth and Life Sciences, Room T-517, De Boelelaan 1085, 1081 HV Amsterdam, the Netherlands.
E-mail: j.m.van.dongen@vu.nl

Summary

This systematic review summarizes the current evidence on the financial return of worksite health promotion programmes aimed at improving nutrition and/or increasing physical activity. Data on study characteristics and results were extracted from 18 studies published up to 14 January 2011. Two reviewers independently assessed the risk of bias of included studies. Three metrics were (re-)calculated per study: the net benefits, benefit cost ratio (BCR) and return on investment (ROI). Metrics were averaged, and a *post hoc* subgroup analysis was performed to compare financial return estimates between study designs. Four randomized controlled trials (RCTs), 13 non-randomized studies (NRSs) and one modelling study were included. Average financial return estimates in terms of absenteeism benefits (NRS: ROI 325%, BCR 4.25; RCT: ROI –49%, BCR 0.51), medical benefits (NRS: ROI 95%, BCR 1.95; RCT: ROI –112%, BCR –0.12) or both (NRS: ROI 387%, BCR 4.87; RCT: ROI –92%, BCR 0.08) were positive in NRSs, but negative in RCTs. Worksite health promotion programmes aimed at improving nutrition and/or increasing physical activity generate financial savings in terms of reduced absenteeism costs, medical costs or both according to NRSs, whereas they do not according to RCTs. Since these programmes are associated with additional types of benefits, conclusions about their overall profitability cannot be made.

Keywords: Dietary behaviour, financial return, physical activity, worksite health promotion.

obesity reviews (2011) **12**, 1031–1049

Introduction

An imbalance between energy intake (nutrition) and output (physical activity) among the population has led to an increased prevalence of overweight, obesity and their attributable diseases (e.g. type 2 diabetes, and cardiovascular disease) (1). Nowadays, 33.8% of US adults are obese (body mass index ≥ 30) and the combined prevalence of overweight and obesity is 68.0% (body mass index ≥ 25) (2). In the UK, the combined prevalence of overweight and obesity is 57% in adult women and 65% in adult men (3).

Next to the toll that overweight and obesity take on the health and well-being of individuals, they impose a substantial economic burden in terms of healthcare costs and lost productivity (1,4–7). For example, obesity-related medical payments are estimated to account for 5% of

health insurance expenditures among US businesses with employer-provided health insurance (*5*). The estimated US national costs of obesity attributable absenteeism range from $3.38 billion to $6.38 billion per year (*6*).

Employers bear the financial consequences of reduced productivity. In countries with employer-provided health insurance (e.g. the USA), they also bear a large part of the financial consequences of increased medical spending. Therefore, employers may financially benefit from implementing worksite health promotion programmes (WHP programmes) aimed at weight gain prevention among their workforce by improving nutrition and/or increasing physical activity (*8*). In addition, the worksite provides a useful setting for implementing these programmes since employees spend the majority of their waking hours at the worksite (*9*), large enterprises often have the infrastructure available to offer such programmes at relatively low costs (*10*), and organizational and social support can be made available when behaviour change efforts are attempted (*11*).

Worksite health promotion programmes aimed at improving nutrition and/or increasing physical activity were found to be effective in reducing body fat and body weight (*12–14*). Employers, however, may like to know whether these programmes generate a positive financial return. A useful way for communicating the financial ramifications of a given programme is a 'return on investment' analysis (ROI analysis), a form of investment analysis often used in business administration in which programme costs are compared to its resulting financial benefits (*15*).

Several efforts have been undertaken to summarize the literature on the financial return of WHP programmes (*8,9,16,17*). Estimated financial returns, as defined by averted medical costs, productivity-related costs or both, ranged from $1.4 to $4.6 per dollar spent (*8,17*). Furthermore, medical costs were found to decrease by $3.3, and absenteeism costs by $2.7 per dollar spent (*9*). Most of these reviews, however, did not adjust for the different methodologies used in the included studies to estimate the financial return and a risk of bias assessment was often missing. Furthermore, these reviews focused on WHP programmes in general, instead of programmes aimed at improving nutrition and/or increasing physical activity in particular. Therefore, the present study aims to critically appraise and summarize the current evidence on the financial return of WHP programmes aimed at improving nutrition and/or increasing physical activity, compared to usual care (including no intervention) or a cut-down version of the programme.

Methods

Inclusion criteria

English, Dutch, German and French-written studies evaluating the financial return of WHP programmes aimed at improving nutrition and/or increasing physical activity in the working population were eligible for inclusion. The WHP programme should be compared to usual care (including no intervention) or a cut-down version of the programme. Studies should contain a ROI analysis, assessing and presenting both programme costs and its resulting benefits. Benefits, defined as programme outcomes converted to monetary values, should be directly measured or modelled based on primary data. Benefits related to WHP programmes are mostly defined in terms of averted medical and productivity-related costs (*18*). Examples of productivity-related costs are costs associated with absenteeism and reduced productivity at work (presenteeism) (*18*). No limitations were set as to the perspective of the ROI analysis (e.g. employer's and societal perspective), programme format (e.g. assessment, counselling and exercise programme), worksite characteristics (e.g. age, gender, occupation, proportion of full-time employees and number of employees) and follow-up duration. Studies targeting employees with chronic conditions (e.g. diabetes and cardiovascular diseases), long-term sick-listed employees, retirees or children were excluded.

Search strategy

To identify relevant studies, eight electronic databases (EMBASE, MEDLINE, SPORTDiscus, PsycINFO, NIOSHTIC-2, NHSEED, HTA and Econlit) were searched for studies published from inception to 14 January 2011. An information specialist of the VU University Medical Center was consulted to develop and run the search strategy. Databases were searched on participant/setting type (e.g. 'Workplace', 'Employee' and 'Workforce'), intervention type (e.g. 'Health Promotion', 'Lifestyle'), intervention aim (e.g. 'Exercise', 'Physical Activity', 'Nutrition' and 'Diet') and study design (e.g. 'Return on Investment', 'Cost Effectiveness'). A broad search strategy was used so that the results could be used for both the present study and a review on the cost-effectiveness of WHP programmes aimed at improving nutrition and/or increasing physical activity (van Dongen *et al.*, unpublished data). An example of the EMBASE search can be found in Table 1. The electronic search was supplemented by searching references of relevant review articles (*9–12,16,17,19–26*) and those of the retrieved full texts. Articles were also identified from the authors' own literature databases. To identify unpublished studies, authors of included studies which were published during the last decade, were contacted. During the search, a 'search diary' was maintained consisting of keywords used, searched databases and search results. Titles and abstracts of the retrieved studies were stored in an electronic database using Reference Manager 11.0 (ISI Research Soft Inc., Berkeley, CA, USA).

Table 1 EMBASE search strategy

Combined search	#1 AND #2 AND #3 AND #4 NOT #5
#1 intervention type	'health promotion'/exp OR 'harm reduction'/exp OR 'high risk behavior'/exp OR 'risk reduction'/exp OR 'health behavior'/de OR 'primary prevention'/exp OR 'secondary prevention'/exp OR 'occupational health'/exp OR health:ab,ti OR intervention:ab,ti OR 'life style':ab,ti OR lifestyle:ab,ti OR prevention:ab,ti OR preventive:ab,ti OR 'risk factor':ab,ti OR 'risk factors':ab,ti NOT 'rehabilitation'/exp
#2 intervention aim	'fitness'/exp OR 'exercise'/exp OR 'physical activity'/exp OR 'sport'/exp OR fitness:ab,ti OR exercis*:ab,ti OR sport*:ab,ti OR 'physical activity':ab,ti OR 'diet'/exp OR 'nutrition'/exp OR diet*:ab,ti OR nutrition*:ab,ti OR food:ab,ti OR vegetable*:ab,ti OR fruit*:ab,ti OR 'weight reduction'/exp OR 'cholesterol'/exp OR 'hypertension'/exp OR cholesterol:ab,ti OR hypertensi*:ab,ti
#3 participant/ setting type	'manpower'/exp OR 'workplace'/exp OR employ*:ab,ti OR worker*:ab,ti OR workplace*:ab,ti OR 'work site':ab,ti OR personnel*:ab,ti OR workforce:ab,ti OR staff:ab,ti
#4 study design	'economic evaluation'/exp OR 'economic evaluation':ab,ti OR 'economic analysis':ab,ti OR (cost:ab,ti OR costs:ab,ti AND (benefit*:ab,ti OR utilit*:ab,ti OR effective*:ab,ti OR minimi?ation:ab,ti)) OR ROI:ab,ti OR 'return on investment':ab,ti
#5 limits	'newborn'/exp OR 'child'/exp OR 'adolescent'/exp NOT 'adult'/exp

Study selection

On the basis of abstracts and titles, two reviewers (J. v. D. and K. P.) independently determined the eligibility of the retrieved studies. If studies met the inclusion criteria or uncertainty remained about inclusion, full texts were retrieved. All full texts were read and checked for eligibility. To resolve disagreements between the two reviewers regarding inclusion of a study, a consensus procedure was used. A third reviewer (M. v. W.) was consulted when disagreements persisted; this was necessary in two occasions.

Data extraction

Data were extracted on study design (e.g. perspective, research design, setting and follow-up duration), characteristics of the study population (e.g. participants and job characteristics), programme focus (e.g. improving nutrition, increasing physical activity or both), programme format (e.g. assessment, educational/informational, behavioural, exercise, environmental and incentive components), measurement and valuation methods of costs and benefits, and study results (e.g. reported costs, benefits and ROI outcomes). One reviewer (J. v. D.) extracted data using a pre-designed data extraction form. Ten percent of the extracted data was checked by a second reviewer (K. P.). No disagreements were identified between reviewers. If articles did not contain sufficient information on study results, authors were contacted for additional information. Research designs were classified into three categories (i) randomized controlled trials (RCTs); (ii) non-randomized studies (NRSs) comparing data between an intervention and a self-selected or matched control group and (iii) modelling studies.

Risk of bias assessment

An instrument assessing the risk of bias of ROI analyses does not exist. Therefore, the Consensus Health Economic Criteria list (CHEC list) was used, representing a minimum set of methodological criteria addressing internal and external validity aspects of economic evaluations (27,28). If a CHEC list item was not adequately performed, or if insufficient information about the performance regarding that item was available in the article or in related materials, the item was scored as negative (27). The CHEC list includes six items related to costs and benefits. Costs were defined as programme costs and outcomes as benefits. The CHEC list does not include items for assessing modelling studies. Therefore, two items of the BMJ checklist were added ('Details of any model used are given' and 'The choice of model used and the key parameters on which it is based are justified') (29). Two reviewers (J. v. D. and K. P.) independently assessed the risk of bias of included studies. If one of the reviewers was a (co-)author of a study, M. v. W. or M. v. T. acted as the second reviewer. A third reviewer (M. v. W. or M. v. T.) was consulted when disagreements remained, which happened three times.

Data synthesis

To provide a complete picture of the financial return, three ROI metrics were (re-)calculated for each intervention evaluated in the included studies: net benefits (NB), benefit cost ratio (BCR) and ROI (30,31).

$$\mathrm{NB} = \mathrm{Benefits} - \mathrm{Costs}$$

$$\mathrm{BCR} = \frac{\mathrm{Benefits}}{\mathrm{Costs}}$$

$$\mathrm{ROI}\,(\%) = \frac{\mathrm{Benefits} - \mathrm{Costs}}{\mathrm{Costs}} \times 100$$

Costs were calculated as the difference in programme costs between the intervention and control groups (incre-

mental costs). Benefits were calculated as the difference in monetized outcome measures (e.g. absenteeism and medical costs) between the intervention and control groups during follow-up and, if available, subtracted by their difference before the intervention (incremental benefits). All monetized outcome measures presented in the article and other related materials were included. If a study did not provide incremental costs and benefits, they were calculated based on figures and tables. Consumer price indices (32) and purchasing power parities (33) were used to standardize costs and benefits to annual costs per participant in 2010 US dollars.

Costs and benefits beyond 1 year have to be discounted to correct for the fact that people place greater value on something that they have today than on something that they will have in the future (29,31). However, cost and benefits are usually reported as a total and not per year, making it impossible to apply a discount rate (34). Therefore, discounting was not standardized in this study. For those studies that reported discounted costs and/or benefits as their main results, these were the costs and benefits that were presented and used for the recalculations. For those studies that did not discount costs beyond 1 year, no additional discounting was performed.

Since ROI metrics are highly dependable on the number and type of included benefits, benefit-standardized financial return estimates were calculated per intervention. If, e.g. both medical and absenteeism benefits were included in a ROI analysis, three types of benefit-standardized financial return estimates were calculated: including medical benefits, including absenteeism benefits and including both.

Standard deviations of financial return estimates are often lacking (28,34), which makes statistically pooling impossible. To summarize the results of the included studies and to compare the results of the present review with those of previous reviews, BCRs and ROIs were averaged. One reviewer (J. v. D.) carried out the data analyses, which were all checked by a second reviewer (M. v. W.).

Subgroup analysis

A *post hoc* subgroup analysis was performed comparing the average BCRs and ROIs between study designs. In addition, the differences in ROI between study designs were depicted graphically using scatter plots.

Results

Literature search and study selection

The electronic search yielded 3,835 results. After removing 605 duplicates, 3,230 titles and abstracts were screened for inclusion and 47 full texts were retrieved. Thirty-one additional full texts were retrieved after screening references of relevant review articles and the retrieved full texts. After reading those 78 full texts, 16 articles were identified that met the inclusion criteria. Additionally, two unpublished articles were identified from the authors' own databases. Contacting authors of included studies did not yield any results. Eventually, 18 studies were included in the review (Fig. 1).

Study characteristics

Thirteen NRSs (15 interventions) (35–47), four RCTs (five interventions; (48–50); Gussenhoven *et al*., unpublished data) and one modelling study (one intervention) (51) were included in the review (Table 2). Ten studies ((40–42;45–50); Gussenhoven *et al*., unpublished data) were performed from the employer's perspective, indicating that only costs and benefits to the employer were included in the ROI analysis (52). Eight studies (35–39,43,44,51) did not state their perspective. Fourteen studies (35–39,41–47,49,51) were carried out in the USA, three ((48,50); Gussenhoven *et al*., unpublished data) in the Netherlands and one (40) in the UK. Two studies (38,45) evaluated the financial return of a physical activity intervention and 16 ((35,37,39–44,46–51,53); Gussenhoven *et al*., unpublished data) that of a comprehensive WHP programme aimed at improving nutrition and increasing physical activity as well as other unhealthy lifestyle behaviours, such as smoking and alcohol consumption. In general, interventions consisted of a (self-)assessment, educational/informational, behavioural, exercise, environmental and/or an incentive component. In the majority of the studies, the control group received no intervention (35–40,42,45–47,51). The length of the interventions varied from 6 months to 5 years (median: 23.7 months, mean: 21.1 months). Financial returns were estimated during the first years after implementation and over a somewhat longer period than the intervention lasted (follow-up: 6 months to 5 years, median: 24 months, mean: 25.1), because four studies ((39,48,50); Gussenhoven *et al*., unpublished data) had a follow-up beyond the intervention period. Absenteeism benefits were provided by 13 studies (15 interventions; (37,38,40,43–50,53); Gussenhoven *et al*., unpublished data), medical benefits by 11 studies (13 interventions; (35,38,39,41,42,44,46,48,49,51); Gussenhoven *et al*., unpublished data), and absenteeism as well as medical benefits by 6 studies (9 interventions; (38,44,46,48,49); Gussenhoven *et al*., unpublished data). Three of them (three interventions) also provided presenteeism benefits (40,49,51).

Risk of bias assessment

Reviewers disagreed on 58 of the 344 items (17%). Disagreements were mainly due to misreading and different

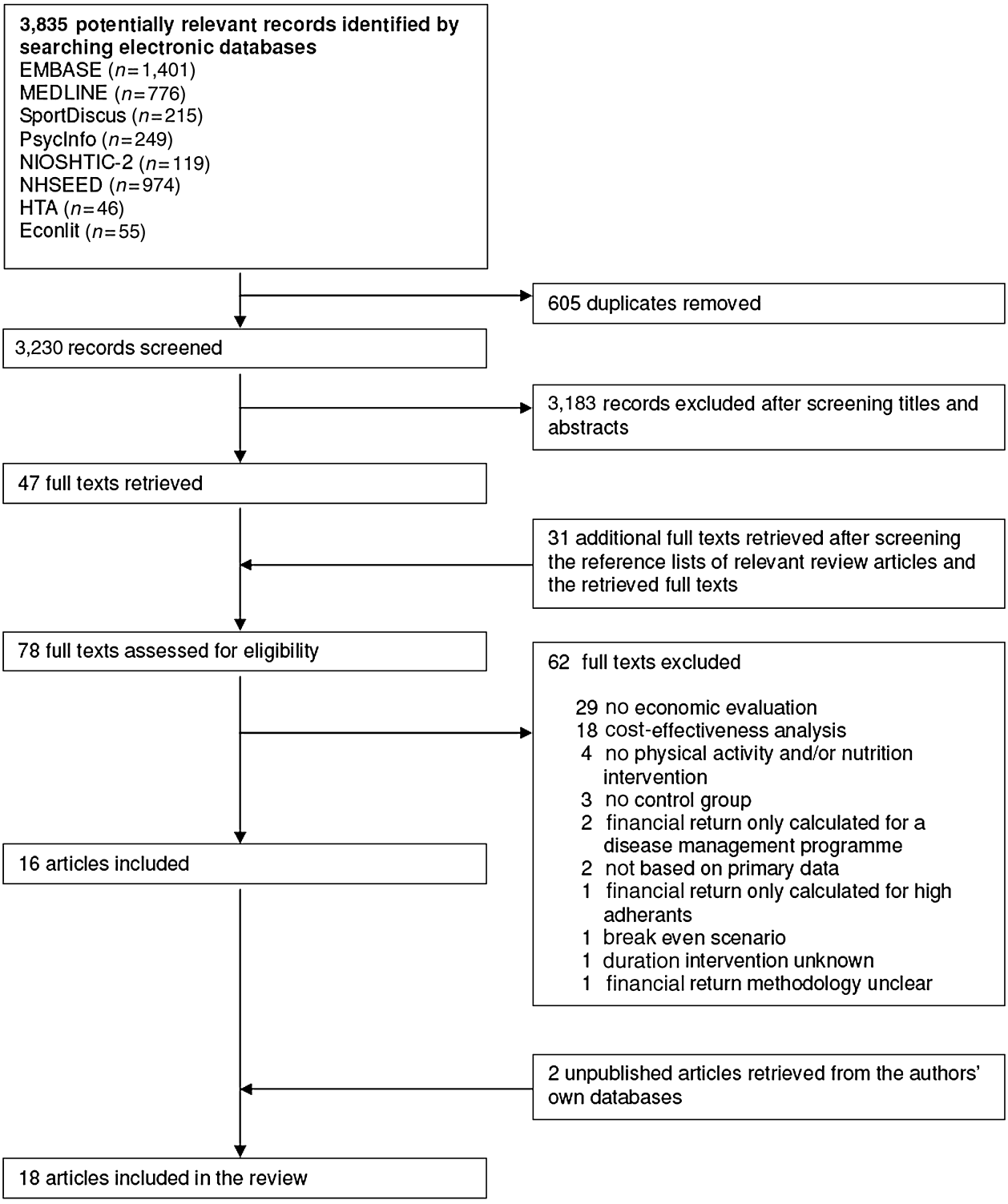

Figure 1 Flow chart for inclusion of studies.

Table 2 Characteristics of the included studies ($n = 18$)

Study	Study details	Population	Intervention and control conditions	Programme focus & format(s)	Included costs and benefits	
Non-randomized studies						
Wood *et al.* (47)	Perspective: employer Setting: USA, 1984 (baseline), 1985–1986 (follow-up) Length intervention: 2 years Follow-up: 2 years	1,075 field sales employees I: 688 C: 387	I: *comprehensive health promotion intervention*: HRA + feedback, every 3 months participants are required to complete one of three optional lifestyle activities (fitness, nutrition and weight control, safety, stress management, recreation, relaxation and entertainment, smoking, chemical use, interpersonal relations, cancer prevention, positive thinking, goal setting), incentive programmes, quarterly newsletter C: none	Focus: PA & diet I: a, b, c, f C: –	In USD (reference year not stated) *Intervention costs*: valued using budget expenditures	*Absenteeism benefits*: number of days missed because of a health condition based on disability absence data multiplied by an average wage rate
Shore *et al.* (45)	Perspective: employer Setting: USA, 1985 (baseline), 1985–1986 (follow-up) Length intervention: 6 months Follow-up: 6 months	Ambulance and management employees I: 134 C: not stated	I: *physical activity intervention*: fitness assessment + feedback, individual exercise programme, incentive programme C: none	Focus: PA I: a, d, f C: –	In USD (reference year not stated) *Intervention costs*: valued using budget expenditures	*Absenteeism benefits*: not stated
Schultz *et al.* (43)	Perspective: not stated Setting: USA, 1995 (baseline), 1996–2000 (follow-up) Length intervention: 5 years Follow-up: 5 years	4,189 employees of a manufacturing company I: 2,596 C: 1,593	I: *comprehensive health promotion intervention*: HRA, on-site health screening, on-site and telephonic wellness programmes, medical office visit vouchers, a telephonic nurse counselling line, quarterly newsletters C: quarterly newsletters	Focus: PA & diet I: a, b, c, f C: b	In USD (reference year not stated) *Intervention costs*: valued using budget expenditures	*Absenteeism benefits*: number of days missed because of a health condition based on disability absence data, multiplied by an average wage rate
Aldana (53)	Perspective: not stated Setting: USA, 2001–2002 Length intervention: 2 years Follow-up: 2 years	4,710 school district employees I: 2,401 (1,224 [1 year], 1,177 [2 years]) C: 2,309	I: *comprehensive health promotion intervention*: programme website, health challenges (11 types), incentive programmes C: none	Focus: PA & diet I: b, c, f C: –	In USD (reference year not stated) *Intervention costs*: valuation method not stated	*Absenteeism benefits*: actual wages paid to the participants on days missed because of a health condition

Table 2 *Continued*

Study	Study details	Population	Intervention and control conditions	Programme focus & format(s)	Included costs and benefits	
Bertera (37)	Perspective: not stated Setting: USA, 1984 (baseline), 1985–1986 (follow-up) Length intervention: 2 years Follow-up: 2 years	43,888 employees of a manufacturing company I: 29,315 C: 14,573	I: *comprehensive health promotion intervention*: environmental interventions (healthy food choices (cafeteria/vending machines) and blood pressure and weight machines/scales), health promotion activity committees, HRA + feedback, group sessions and/or individual consultation, 4- to 10-week health educational class cycles, bimonthly health and fitness magazine, health challenges, incentive programmes C: none	Focus: PA & diet I: a, b, c, e, f C: –	In 1986 USD *Intervention costs*: micro-costed, valued using tariffs	*Absenteeism benefits*: actual wages paid to the participants on days missed because of a health condition
Mills *et al.* (40)	Perspective: employer Setting: UK, 2004 (baseline), 2005 (follow-up) Length intervention: 1 year Follow-up: 1 year	1,508 employees of a manufacturing company I: 266 C: 1,242	I: *comprehensive health promotion intervention*: HRA + feedback, personalized web portal (articles/assessments/interactive behaviour change programmes), biweekly tailored emails, newsletters, health promotional literature, four on-site seminars C: none	Focus: PA & diet I: a, b, c C: –	In USD (reference year not stated) *Intervention costs*: valued using budget expenditures	*Absenteeism benefits*: self-reported days missed because of a health condition, measured by the WHO-HPQ, multiplied by an average wage rate *Presenteeism benefits*: self-reported on-the-job productivity, measured by the WHO-HPQ, multiplied by an average wage rate
Gettman (38)	Perspective: not stated Setting: USA, 1982–1983 Length intervention: 2 years Follow-up: 2 years	778 (1982) & 707 (1983) employees of an oil and gas exploitation and production company 1982: I 453; C 325 1983: I 442; C 265	I: *physical activity intervention*: exercise facility (headquarters), health club membership or home exercise programmes (field offices) C: none	Focus: PA I: d C: –	In USD (reference year not stated) *Intervention costs*: valued using budget expenditures	*Absenteeism benefits*: actual wages paid to the participants on days missed because of a health condition *Medical benefits*: healthcare costs, paid by the employer, determined from claim records

Table 2 *Continued*

Study	Study details	Population	Intervention and control conditions	Programme focus & format(s)	Included costs and benefits	
Shi (44)	Perspective: not stated Setting: USA, 1988 (baseline), 1989 (follow-up) Length intervention: 1 year Follow-up: 1 year	1,188 utility company employees I-low: 301 I-medium: 295 I-high: 180 C: 412	I-low: *comprehensive health promotion intervention*: HRA, bimonthly newsletter, health resource centre, self-care books I-medium: *comprehensive health promotion intervention*: HRA, bimonthly newsletter, health resource centre, self-care books, behaviour change workshops/classes, Division Health Wise team I-high: *comprehensive health promotion intervention*: HRA, bimonthly newsletter, health resource centre, self-care books, behaviour change workshops/classes, Division Health Wise team, case management, environmental policy C: HRA, bimonthly newsletter	Focus: PA & diet I-low: a, b I-medium: a, b, c I-high: a, b, c, e C: a, b	In 1988 USD *Intervention costs*: micro-costed, valued using tariffs	*Absenteeism benefits*: self-reported days missed because of a health condition, multiplied by an average wage rate *Medical benefits*: self-reported healthcare utilization, multiplied by cost prices
Stave *et al.* (46)	Perspective: employer Setting: USA, 1996 (baseline), 1998–2000 (follow-up) Length intervention: 3 years Follow-up: 3 years	3,962 employees of a pharmaceutical company I: 1,275 C: 2,687	I: *comprehensive health promotion intervention*: contracts for good health and programme attendance, self-assessment to measure 'readiness for change', on-site health education seminars, marketing strategies C: none	Focus: PA & diet I: a, b, f C: –	In 2000 USD *Intervention costs*: valuation method not stated	*Absenteeism benefits* : actual wages paid to the participants on days missed because of a health condition *Medical benefits*: healthcare costs, paid by the employer, determined from claim records

Table 2 *Continued*

Study	Study details	Population	Intervention and control conditions	Programme focus & format(s)	Included costs and benefits	
Ozminkowski *et al.* (42)	Perspective: employer Setting: USA, 1994–1997 (baseline and follow-up) Length intervention: 23.33 months Follow-up: 23.33 months	22,838 bank employees I: 11,194 C: 11,644	I: *Comprehensive health promotion intervention*: HRA • low-risk HRA participants: feedback, general health education and self-care materials, programme telephone line • high-risk HRA participants: feedback, three additional HRA questionnaires + feedback, recommendations for action, health education materials, books and videos, telephone counselling, audio library and health tapes C: none	Focus: PA & diet I: a, b, c C: –	In 1996 USD *Intervention costs*: valued using budget expenditures	*Medical benefits*: healthcare costs, paid by the employer, determined from claim records
Naydeck *et al.* (41)	Perspective: employer Setting: USA, 2001 (baseline), 2002–2005 (follow-up) Length intervention: 4 years Follow-up: 4 years	3,784 insurance company employees I: 1,892 C: 1,892	I: *comprehensive health promotion intervention*: HRA, biometric screening, online health education programmes, health education classes, telephone counselling, individual coaching, biometric screening, various 6- to 12-week campaigns to increase fitness participation and awareness of disease preventions strategies, fitness centre, health promotion campaigns, incentive programmes C: none	Focus: PA & diet I: a, b, c, d, e, f C: –	In 2005 USD *Intervention costs*: micro-costed, valued using tariffs and depleted sources	*Medical benefits*: healthcare costs, paid by the employer, determined from claim records

Table 2 *Continued*

Study	Study details	Population	Intervention and control conditions	Programme focus & format(s)	Included costs and benefits	
Aldana *et al.* (35)	Perspective: not stated Setting: USA, 1987–1988 (baseline), 1989–1990 (follow-up) Length intervention: 2 years Follow-up: 2 years	680 city employees I: 340 C: 340	I: *comprehensive health promotion intervention*: HRA, counselling, contracts, incentive programmes, additional medical examinations for high-risk subjects, 1-h exercise instruction class, monthly health seminars, bimonthly newsletter C: none	Focus: PA & diet I: a, b, c, d, f C: –	In 1990 USD *Intervention costs*: valuation method not stated	*Medical benefits*: healthcare costs, paid by the employer, determined from claim records
Gibbs *et al.* (39)	Perspective: not stated Setting: USA, 1978–1982 Length intervention: 6 months, optional to participate more than once Follow-up: 57 months	1,559 employees of a health insurance company I: 667 C: 892	I: *comprehensive health promotion intervention*: publicity and health risk education, HRA + feedback & referral, telephone follow-up, group programmes (nutrition, weight reduction, smoking cessation & fitness), individual therapy (alcohol and drug abuse) C: publicity and health risk education	Focus: PA & diet I: a, b, c C: b	In USD (reference year not stated) *Intervention costs*: micro-costed, valued using tariffs and depleted sources	*Medical benefits*: healthcare costs, paid by the employer, determined from claim records
Randomized controlled trials						
Proper *et al.* (50)	Perspective: employer Setting: NL, 2000–2002 Length intervention: 9 months Follow-up: 18 months	299 civil servants I: 131 C: 168	I: *comprehensive health promotion intervention*: 9-month counselling programme (seven face-to-face sessions), health education materials C: health education materials	Focus: PA & diet I: b, c C: b	In euros (reference year not stated) *Intervention costs*: micro-costed, valued using tariffs and depleted sources	*Absenteeism benefits*: number of days missed because of a health condition based on disability absence data, multiplied by an average wage rate

Table 2 *Continued*

Study	Study details	Population	Intervention and control conditions	Programme focus & format(s)	Included costs and benefits	
(Gussenhoven *et al.*, unpublished data)	Perspective: employer Setting: NL, 2004–2005 Length intervention: 6 months Follow-up: 1 year	1,386 *overweight* employees from seven variable types of companies I-phone: 462 I-Internet: 464 C: 460	I-phone: *comprehensive health promotion intervention*: ring binder containing 10 health education modules (lifestyle information and techniques for changing behaviour), telephone counselling, pedometer, health education materials + oral instructions I-Internet: *comprehensive health promotion intervention*: website containing 10 health education modules (lifestyle information and techniques for changing behaviour), email counselling, pedometer, health education materials + oral instructions C: health education materials + oral instructions	Focus: PA & diet I-phone: b, c I-Internet: b, c C: b	In 2004 euros *Intervention costs*: micro-costed, valued using tariffs and depleted sources	*Absenteeism benefits*: number of days missed because of a health condition based on disability absence data, multiplied by an average wage rate *Medical benefits**: self-reported healthcare utilization, valued using Dutch standard costs
Groeneveld *et al.* (48)	Perspective: employer Setting: NL, 2007–2009 Length intervention: 6 months Follow-up: 1 year	573 construction workers with an *elevated CVD risk* I: 293 C: 280	I: *comprehensive health promotion intervention*: 6-month counselling programme (three face-to-face sessions / four telephone contacts), periodical health screening, health education materials C: periodical health screening, health education materials	Focus: PA & diet I: a, b, c C: a, b	In 2008 euros *Intervention costs*: micro-costed, valued using tariffs and depleted sources	*Absenteeism benefits*: self-reported days missed because of a health condition, multiplied by an average wage rate *Medical benefits*†: self-reported healthcare utilization, valued using Dutch standard costs

Table 2 *Continued*

Study	Study details	Population	Intervention and control conditions	Programme focus & format(s)	Included costs and benefits	
Meenan *et al.* (49)	Perspective: employer Setting: USA, 2005–2006 (baseline), 2006–2008 (follow-up) Length intervention: 2 years Follow-up: 2 years	6,958 hotel employees I: 3,346 C: 3,612	I: *comprehensive health promotion intervention*: HRA + feedback/advice, environmental interventions (electronic sign messages, healthier food choices, management support, other negotiated environmental changes), monthly newsletter, contests, weekly on-site health promotion groups and more intense weekly off-site health promotion groups for obese employees C: HRA + feedback/advice	Focus: PA & diet I: a, b, c, e, f C: a, b	In 2008 USD *Intervention costs*: micro-costed, valued using tariffs and depleted sources	*Absenteeism benefits*: self-reported days missed because of a health condition, measured by the WHO-HPQ, multiplied by an average wage rate *Medical benefits*: medical costs were calculated as a function of (1) the proportion of the participants with a chronic condition; (2) monthly rate of employee turnover; (3) proxies of current medical costs and (4) proxies of the annual dollar value of a unit change in BMI *Presenteeism benefits*: self-reported on-the-job productivity, measured by the WHO-HPQ, multiplied by an average wage rate
Modelling studies						
Baker *et al.* (51)	Perspective: not stated Setting: USA, 2006–2007 Length intervention: 1 year Follow-up: 1 year	850 employees from 119 variable types of companies I: 850 C: artificial controls	I: *comprehensive health promotion intervention*: HRA, up to 48 telephonic counselling sessions + supportive materials, personal health improvement plan, exercise planning support, nutrition education, web-based health tracker, health improvement website including educational materials C: none	Focus: PA & diet I: a, b, c, d C: –	In 2007 USD *Intervention costs*: valuation method not stated	*Medical benefits*: medical expenditures for employees with a certain health risk, based on the Thomas Reuters MarketScan database *Presenteeism benefits*: on-the-job productivity losses linked to having a certain health risk as found in the literature

*Personal communication with the authors.

†Presented in the article as part of a cost-effectiveness analysis from the societal perspective.

Programme format(s): a, (self-)assessment; b, education/information; c, behavioural; d, exercise programme; e, environment; f, incentives.

BMI, body mass index; C, control group; CVD, cardiovascular disease; HRA, health risk assessment; I, intervention group; NL, the Netherlands; PA, physical activity; WHO-HPQ, Health and Work Performance Questionnaire of the World Health Organization.

Table 3 Risk of bias assessment of included studies using the Consensus Health Economic Criteria (CHEC) list and BMJ checklist

Items	Studies scoring 'Yes' (No. [%])		
	RCTs ($n = 4$)	NRSs ($n = 14$)	Overall ($n = 18$)
CHEC list			
(1) Study population	3	3	6 (33)
(2) Competing alternatives	4	2	6 (33)
(3) Research question	1	9	10 (56)
(4) Study design	4	13	17 (94)
(5) Time horizon	4	14	18 (100)
(6) Perspective	4	6	10 (56)
(7) Costs identified	4	12	16 (89)
(8) Costs measured	4	1	5 (28)
(9) Costs valued	1	1	2 (11)
(10) outcomes identified	1	0	1 (6)
(11) Outcomes measured	3	13	16 (89)
(12) Outcomes valued	3	12	15 (83)
(13) Incremental analysis	3	12	15 (83)
(14) Discounted	3	4	7 (39)
(15) Sensitivity analysis	3	3	6 (33)
(16) Conclusions	4	13	17 (94)
(17) Generalizability	1	2	3 (17)
(18) Conflict of interest	1	2	3 (17)
(19) Ethical and distributional issues	0	0	0 (0)
BMJ checklist			
(20) Model details	NA	1	1 (100)
(21) Model and key parameters	NA	1	1 (100)

NA, not applicable; NRS, non-randomized study; RCT, randomized controlled trial.

interpretations of the CHEC list items. Nine out of 19 CHEC list items (47%) were fulfilled by more than 50% of the studies and seven items (37%) by more than 75%, indicating that the risk of bias of the included studies was high. RCTs, however, had a lower risk of bias compared to NRSs. On average, they fulfilled almost 13 out of 19 CHEC list items (68%), whereas NRSs fulfilled almost 9 (47%) (Table 3). In five studies ((41,48–50); Gussenhoven *et al*., unpublished data) costs were measured appropriately in physical units, and of these two, (41,49) valued them appropriately by calculating them based on depleted sources and stating their reference year. One study (49) appropriately collected benefits to the chosen perspective (employer's perspective). At a minimum, these comprise medical, absenteeism and presenteeism benefits in countries with employer-provided health insurance (e.g. US). In countries with nationalized health insurance or health service programmes (e.g. the Netherlands and the UK), the last two apply (54). Seven studies ((39,41,42,48,49,51); Gussenhoven *et al*., unpublished data) appropriately discounted costs and benefits by converting them to a single year based on a motivated discount rate. Sensitivity analyses were performed in six studies ((41,42,44,48,49); Gussenhoven *et al*., unpublished data).

Costs and benefits

Average annual programme costs per participant ranged from \$11 to \$1,075 (median: \$155, $n = 21$). Average annual absenteeism and medical benefits per participant ranged from –\$113 to \$1,384 (median: \$324, $n = 15$) and –\$82 to \$554 (median: \$187, $n = 13$) respectively. One study (46) included absenteeism and medical benefits in the total benefits and could therefore not be presented separately. Average annual presenteeism benefits per participant ranged from \$2 to \$1,528 (median: \$158, $n = 3$) (Table 4, columns 2–5).

Financial return

The NB ranged from –\$451 to \$2,757 (median; \$91, $n = 21$), indicating the amount of money gained after costs were recovered. The BCR ranged from –0.76 to 18.84 (median: 1.42, mean: 3.76, SD: 5.36), indicating the amount of money returned per dollar invested. The ROI ranged from –176% to 1,784% (median: 42%, mean: 276%, SD: 536%), indicating the percentage of profit per dollar invested (30). The financial return was positive in 14 out of 21 interventions (NB > 0, BCR > 1 and ROI > 0) (Table 4, column 7).

Table 4 Costs, benefits and financial return of the included studies (2010 US dollars)

Study	Costs ($)	Benefits ($)				Financial return NB ($) (ROI [%]; BCR)				
		Absenteeism	Presenteeism	Medical	Total	Total	Absenteeism	Medical	Presenteeism	Absenteeism & Medical
Non-randomized studies										
Wood *et al.* (47)	123	348			348	225 (184; 2.84)	225 (184; 2.84)			
Shore *et al.* (45)	664	937			937	273 (41; 1.41)	273 (41; 1.41)			
Schultz *et al.* (43)	103	305			305	201 (195; 2.95)	201 (195; 2.95)			
Aldana* (53)	66	1,033			1,033	967 (1,460; 15.6)	967 (1,460; 15.6)			
Bertera (37)	73	104			104	31 (42; 1.42)	31 (42; 1.42)			
Mills *et al.* (40)	155	1,384	1,528		2,912	2,757 (1,784; 18.84)	1,129 (795; 8.95)		1,373 (888; 9.88)	
Gettman* (38)	1,075	504		477	980	–94 (–9; 0.91)	–571 (–53; 0.47)	–598 (–56; 0.44)		–94 (–9; 0.91)
Shi (44)										
I-low	11	–2		13	11	–0.1 (–1; 0.99)	–13 (–117; –0.17)	2 (16; 1.16)		–0.1 (–1; 0.99)
I-medium	21	152		99	251	230 (1,129; 12.29)	131 (646; 7.46)	79 (383; 4.83)		230 (1,129; 12.29)
I-high	213	324		187	511	298 (140; 2.40)	111 (52; 1.52)	–26 (–12; 0.88)		298 (140; 2.40)
Stave *et al.* (46)	127	See total		See total	987	860 (677; 7.77)				860 (677; 7.77)
Ozminkowski *et al.* (42)	119			554	554	435 (364; 4.64)		435 (364; 4.64)		
Naydeck *et al.* (41)	155			198	198	42 (27; 1.27)		42 (27; 1.27)		
Aldana *et al.* (35)	107			187	197	91 (85; 1.85)		91 (85; 1.85)		
Gibbs *et al.** (39)	469			248	248	–221 (–47; 0.53)		–221 (–47; 0.53)		
Mean (SD)							ROI: 325 (497) BCR: 4.25 (4.97)	ROI: 95 (178) BCR: 1.95 (1.78)		ROI: 387 (501) BCR: 4.87 (5.01)
Randomized controlled trials										
Proper *et al.** (50)	385	680			680	295 (77; 1.77)	295 (77; 1.77)			
Gussenhoven *et al.*, unpublished data)*										
I-phone	256	–113		–82	–195	–451 (–176; –0.76)	–369 (–144; –0.44)	–338 (–132; –0.32)		–451 (–176; –0.76)
I-Internet	227	166		–66	100	–127 (–56; 0.44)	–61 (–27; 0.73)	–293 (–129; –0.29)		–127 (–56; 0.44)
Groeneveld *et al.** (48)	730	364		81	445	–285 (–39; 0.61)	–365 (–50; 0.50)	–649 (–89; 0.11)		–285 (–39; 0.61)
Meenan *et al.* (49)	139	–0.2	2	5	6	–132 (–95; 0.05)	–139 (–100; –0.001)	–134 (–97; 0.03)	–136 (–98; 0.02)	–140 (–97; 0.03)
Mean (SD)							ROI: –49 (84) BCR: 0.51 (0.84)	ROI: –112 (22) BCR: –0.12 (0.22)		ROI: –92 (61) BCR: 0.08 (0.61)
Modelling studies										
Baker *et al.** (51)	331		158	229	387	55 (17; 1.17)		–102 (–31; 0.69)	–174 (–52; 0.48)	
All studies										
Mean (SD)						ROI: 276 (536) BCR: 3.76 (5.36)	ROI: 200 (440) BCR: 3.00 (4.40)	ROI: 22 (168) BCR: 1.22 (1.68)	ROI: 246 (557) BCR: 3.46 (5.57)	ROI: 174 (438) BCR: 2.74 (4.38)

Blank cells indicate that a specific type of benefit was not presented by an article.

*Benefits are not corrected for baseline, but calculated as the difference in costs between the intervention and control group during follow-up.

BCR, benefit cost ratio; NB, net benefits; NRS, non-randomized study; RCT, randomized controlled trial; ROI, return on investment.

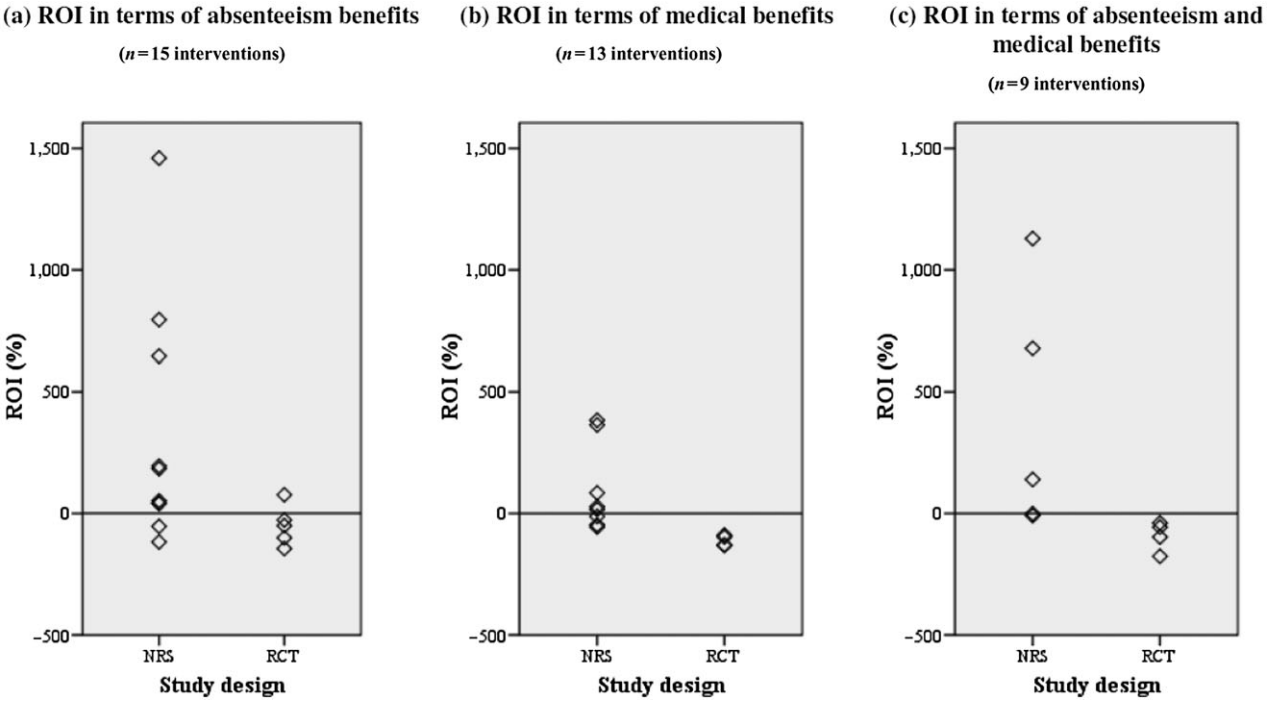

Figure 2 Distribution of return on investments (ROIs) in terms of (a) absenteeism, (b) medical and (c) both absenteeism and medical benefits of non-randomized studies (NRSs) and randomized controlled trials (RCTs). A ROI of more than 0 indicates that the financial profitability is positive. Note that the number of interventions is higher than the number of studies, because some studies included more than one intervention.

Benefit-standardized financial return

On average, benefit-standardized ROIs and BCRs were positive, indicating that WHP programmes aimed at improving nutrition and/or increasing physical activity generate financial savings during the first years after implementation. For example, the average ROI in terms of absenteeism benefits was 200% (SD: 440%), in terms of medical benefits 22% (SD: 168%), in terms of presenteeism benefits 246% (SD: 557%), and in terms of both absenteeism and medical benefits 174% (SD: 438%) (Table 4, columns: 8–11).

Subgroup analysis

Average benefit-standardized ROIs and BCRs were positive in NRSs, but negative in RCTs (Table 4, columns: 8–11). For example, the average ROI in terms of absenteeism benefits was 325% (SD: 497%) in NRSs, but –49% (SD: 84%) in RCTs. This indicates that WHP programmes aimed at improving nutrition and/or increasing physical activity generate financial savings during the first years after implementation according to NRSs, whereas they do not pay for themselves in terms of absenteeism benefits, medical benefits or both according to RCTs. The average ROI and BCR in terms of presenteeism benefits could not be compared between study designs, since presenteeism benefits were only provided by three studies. The differences in ROI between NRSs and RCTs are depicted graphically in Fig. 2.

Discussion

This review critically appraised and summarized the current evidence on the financial return of WHP programmes aimed at improving nutrition and/or increasing physical activity. On average, the financial return in terms of absenteeism benefits, medical benefits or both were positive during the first years after implementation. This is in accordance with previous reviews (9,16,17,53) concluding that WHP programmes should be considered as an effective method for reducing employee-related expenses (16,17,53) and producing positive financial returns in terms of absenteeism and medical benefits (9). A subgroup analysis, however, revealed that the average financial return estimates were positive due to the inclusion of NRSs; they were positive in NRSs, but negative in RCTs. This is in line with previous findings indicating that NRSs of healthcare interventions tend to result in larger estimates of effect compared to RCTs (55). These findings also support researchers arguing that the cost savings and high ROI estimates found in WHP studies are likely the result of selection bias (11). Selection bias arises when allocation methods other than randomization are used, meaning that the intervention and

control group are unlikely to be comparable (56). Consequently, it is difficult to attribute any differences found in outcomes between both groups to the intervention and to rule out the possibility that they were biased by baseline differences in group characteristics or confounders (e.g. motivation to change health) (57). It has been argued that results of RCTs may not reflect 'real-life' effectiveness, since they evaluate the efficacy of programmes in well-controlled experimental circumstances. However, although other research designs can add to the existing knowledge on WHP programmes, RCTs are the 'gold standard' for investigating their effectiveness untainted by bias (58,59).

The overall risk of bias of the included studies was high. Few studies explicitly stated the perspective of their ROI analysis and properly measured and valued costs and benefits. More than half of the studies did not state the reference year of their monetary outcomes, which limits their interpretation. In addition, an incremental analysis of costs and benefits was not performed in all studies. One study (35), for example, included the decrease in medical costs of both the intervention and control group in their benefit estimate, resulting in an overestimation of the financial return. Furthermore, although economic analyses require that assumptions are made (28), few studies conducted a sensitivity analysis and hardly any of the studies reported on the uncertainty around their financial return estimates. To quantify the precision, non-parametric bootstrapping can be used as a statistical technique for dealing with the highly skewed nature of cost data (28,52). These findings are not unique to the present review. A systematic review appraising the methodological quality of economic evaluations of occupational health and safety interventions also concluded that most of them had a high risk of bias (28). Using the results of ROI analyses with a high risk of bias to advise companies, however, may lead to inappropriate business decisions (28). Therefore, the methodological quality of ROI analyses in WHP programme research should be improved. This can be achieved by developing a methodological guideline for ROI analyses. Furthermore, since NRSs had a higher risk of bias compared to RCTs, the discrepancies found between their financial return estimates may also be explained by types of bias other than selection (e.g. performance, detection, attrition and reporting bias) (56).

The results of the present review indicate that financial return estimates derived from NRSs should be interpreted with caution. RCTs with a low risk of bias indicate that WHP programmes aimed at improving nutrition and/or increasing physical activity do not pay for themselves in terms of reduced absenteeism costs, medical costs or both during the first years after implementation. This is in contrast with the conclusions of previous reviews (9,16,17,53). An explanation for this discrepancy may be that the previous reviews were mainly based on NRSs, which might have confounded their results as well.

Several strengths of the present review are noteworthy. First, to improve comparability among the included studies, costs and benefits were standardized to annual costs per participant in 2010 dollars and ROI metrics were (re-)calculated per study using the same methodology. Second, when reporting the financial return of WHP programmes, economists and policy makers prefer the NB, whereas the BCR and ROI are more familiar to business managers (60). By providing all three of them, the results of the present review can be easily interpreted by all stakeholders. In addition, this makes the results easily comparable with those of other studies, since different ROI metrics are used in the literature to estimate the financial return of WHP programmes. Third, the present study was the first review on the financial return of WHP programmes in which subgroup analyses were performed to compare financial return estimates of RCTs and NRSs, yielding substantial differences.

A first limitation concerns the fact that none of the interventions were solely aimed at improving nutrition and only two of them were solely aimed at increasing physical activity. Therefore, the present review examined the financial return of WHP programmes aimed at improving nutrition and/or increasing physical activity in general. Further research is needed to investigate whether financial returns vary between interventions with a different focus (i.e. improving nutrition, increasing physical activity or both). Additionally, only the financial return in terms of absenteeism and/or medical benefits were compared between RCTs and NRSs. WHP programmes, however, are suggested to provide additional types of financial benefits, such as reduced presenteeism, turnover, disability management and workers' compensation costs (16,54). Presenteeism benefits were only presented in three studies, which likely resulted from the fact that a 'gold standard' for measuring and valuing presenteeism does currently not exists. The other three types of financial benefits were not presented at all (61). Consequently, conclusions about the overall profitability of WHP programmes aimed at improving nutrition and/or increasing physical activity can not be made. Furthermore, WHP programmes may yield intangible benefits (e.g. improved reputation or increased worker satisfaction) (34), which were not reported by any of the studies. Since intangible benefits may also be important drivers of business decisions (34), it is advisable to report them alongside ROI analyses or to conduct a cost-effectiveness analysis in which the total incremental costs are compared to the incremental intangible benefits. Furthermore, the varying number and type of benefits included in the studies indicate that consensus should be reached about a minimum set of benefits to be included in ROI analyses of WHP programmes. Another limitation may be that no requirements were set as to programme format, subject and worksite characteristics, intervention length and follow-up duration.

Consequently, NRSs and RCTs may differ with respect to these characteristics contributing to the discrepancies found in financial return estimates between both study designs. For example, the follow-up duration of NRSs was, on average, longer than that of RCTs. Since WHP programme costs are more costly at the start while health benefits accumulate gradually (9), this may have resulted in lower financial return estimates in the RCTs. Therefore, conclusions about the extent to which financial return estimates were overestimated in NRSs cannot be made. It is also important to mention that US employers bear a large part of the medical costs of their employees, whereas in Europe these accrue to the government or insurance companies. As a result, ROI analyses from the employer's perspective conducted in the USA and Europe are limited in their comparability. To provide information that would be useful to both sides of the Atlantic, benefit-standardized financial return estimates were calculated, including financial returns in terms of absenteeism benefits, medical benefits and both. Benefit-standardized financial returns in terms of medical benefits assume that no benefits accrue in terms of reduced absenteeism costs and vice versa for financial returns in terms of medical benefits. Thus, US employers are informed by the total benefits, whereas European employers are informed by the productivity-related benefits and European governments and insurance companies by the medical benefits. An advantage of this approach is that RCTs and NRSs could be compared, without distortion resulting from differences in the jurisdictions in which they were conducted. It should be noted that no corrections were made for transatlantic differences in healthcare costs. Per capita spending on health care in the USA is double that of most European countries, leaving more room for reductions in medical costs in the USA than in Europe (62). This may have influenced the differences found between RCTs and NRSs as all but one of the NRSs were performed in the USA, whereas all but one of the RCTs were performed in Europe. Nevertheless, in accordance with the overall results, financial returns were negative in the RCT conducted in the USA, whereas those of the NRSs conducted in the USA were on average positive.

Conclusion

During the first years after implementation, WHP programmes aimed at improving nutrition and/or increasing physical activity generate financial savings in terms of reduced absenteeism costs, medical costs or both according to NRSs, whereas they do not according to RCTs. However, since these programmes are associated with additional types of benefits, conclusions about their overall profitability cannot be made. Therefore, more ROI analyses should be performed that are based on RCTs and include a consensus-based set of financial benefits.

Conflict of Interests Statement

None declared.

Acknowledgements

We thank Marijke Mol for her contribution in developing the search strategy.

References

1. Yach D, Stuckler D, Brownell KD. Epidemiologic and economic consequences of the global epidemics of obesity and diabetes. *Nat Med* 2006; **12**: 62–66.
2. Flegal KM, Carroll MD, Ogden CL, Johnson CL. Prevalence and trends in obesity among US adults, 1999–2000. *JAMA* 2002; **288**: 1723–1727.
3. Donaldson L. On the state of the public health: annual report of the chief medical officer for England 2002. Department of Health, 2003.
4. Finkelstein EA, Trogdon JG, Cohen JW, Dietz W. Annual medical spending attributable to obesity: payer-and service-specific estimates. *Health Aff (Millwood)* 2009; **28**: w822–w831.
5. Thompson D, Edelsberg J, Colditz GA, Bird AP, Oster G. Lifetime health and economic consequences of obesity. *Arch Intern Med* 1999; **159**: 2177–2183.
6. Trogdon JG, Finkelstein EA, Hylands T, Dellea PS, Kamal-Bahl SJ. Indirect costs of obesity: a review of the current literature. *Obes Rev* 2008; **9**: 489–500.
7. van Duijvenbode DC, Hoozemans MJM, van Poppel MNM, Proper KI. The relationship between overweight and obesity, and sick leave: a systematic review. *Int J Obes* 2009; **33**: 807–816.
8. Goetzel RZ, Juday TR, Ozminkowski RJ. What's the ROI? A systematic review on return of investment (ROI) studies of corporate health and productivity management initiatives. *AWPH's Worksite Health* 1999; **6**: 12–21.
9. Baicker K, Cutler D, Song Z. Workplace wellness programs can generate savings. *Health Aff (Millwood)* 2010; **29**: 304–311.
10. National Institute for Health and Clinical Excellence (NICE). *Workplace Health Promotion: How to Encourage Employees to Be Physically Active*. NICE: London, 2007.
11. Goetzel RZ, Ozminkowski RJ. The health and cost benefits of work site health-promotion programs. *Annu Rev Public Health* 2008; **29**: 303–323.
12. Anderson LM, Quinn TA, Glanz K, Ramirez G, Kahwati LC, Johnson DB *et al*. The effectiveness of worksite nutrition and physical activity interventions for controlling employee overweight and obesity: a systematic review. *Am J Prev Med* 2009; **37**: 340–357.
13. Groeneveld IF, Proper KI, van der Beek AJ, Hildebrandt VH, van Mechelen W. Lifestyle-focused interventions at the workplace to reduce the risk of cardiovascular disease – a systematic review. *Scand J Work Environ Health* 2010; **36**: 202–215.
14. Verweij LM, Coffeng J, Van Mechelen W, Proper KI. Meta-analyses of workplace physical activity and dietary behaviour interventions on weight outcomes. *Obes Rev* 2011; **12**: 406–429. doi: 10.1111/j.1467-789X.2010.00765.x.
15. Cavallo D. Using return on investment analysis to evaluate health promotion programs: challenges and opportunities. *Health Promot Econ Issue Briefs* 2006; **1**: 1–4. RTI-UNC Center of Excellence. [WWW document]. URL http://www.rti.org/pubs/issuebrief_3.pdf (accessed 12 October 2010).

16. Chapman LS. Meta-evaluation of worksite health promotion economic return studies: 2005 update. *Am J Health Promot* 2005; **19**: 1–11.
17. Soler RE, Leeks KD, Razi S, Hopkins DP, Griffith M, Aten A *et al*. A systematic review of selected interventions for worksite health promotion: the assessment of health risks with feedback. *Am J Prev Med* 2010; **38**(Suppl. 1): S237–S262.
18. Sexner S, Gold DB. Calculating the economic return of health and productivity programs. In: Pronk NP (ed.). *ACSM's Workplace Health Handbook*. Human Kinetics: Minneapolis, MN, 2009, pp. 165–174.
19. Pelletier KR. A review and analysis of the health and cost-effective outcome studies of comprehensive health promotion and disease prevention programs at the worksite: 1991–1993 update. *Am J Health Promot* 1993; **8**: 50–62.
20. Pelletier KR. A review and analysis of the health and cost-effective outcome studies of comprehensive health promotion and disease prevention programs at the worksite: 1993–1995 update. *Am J Health Promot* 1996; **10**: 380–388.
21. Pelletier KR. Clinical and cost outcomes of multifactorial, cardiovascular risk management interventions in worksites: a comprehensive review and analysis. *J Occup Environ Med* 1997; **39**: 1154–1169.
22. Pelletier KR. A review and analysis of the clinical and cost-effectiveness studies of comprehensive health promotion and disease management programs at the worksite: 1995–1998 update (IV). *Am J Health Promot* 1999; **13**: 333–345, iii.
23. Pelletier KR. A review and analysis of the clinical- and cost-effectiveness studies of comprehensive health promotion and disease management programs at the worksite: 1998–2000 update. *Am J Health Promot* 2001; **16**: 107–116.
24. Pelletier KR. A review and analysis of the clinical and cost-effectiveness studies of comprehensive health promotion and disease management programs at the worksite: update VI 2000–2004. *J Occup Environ Med* 2005; **47**: 1051–1058.
25. Pelletier KR. A review and analysis of the clinical and cost-effectiveness studies of comprehensive health promotion and disease management programs at the worksite: update VII 2004–2008. *J Occup Environ Med* 2009; **51**: 822–837.
26. Proper KI, Van Mechelen W. *Effectiveness and Economic Impact of Worksite Interventions to Promote Physical Activity and Healthy Diet*. WHO Press: Geneva, 2008.
27. Evers S, Goossens M, de Vet H, van Tulder M, Ament A. Criteria list for assessment of methodological quality of economic evaluations: consensus on health economic criteria. *Int J Technol Assess Health Care* 2005; **21**: 240–245.
28. Uegaki K, de Bruijne MC, Lambeek L, Anema JR, van der Beek AJ, van Mechelen W *et al*. Economic evaluations of occupational health interventions from a corporate perspective – a systematic review of methodological quality. *Scand J Work Environ Health* 2010; **36**: 273–288.
29. Drummond MF, Jefferson TO. Guidelines for authors and peer reviewers of economic submissions to the BMJ. *BMJ* 1996; **313**: 275–283.
30. Phillips JJ. *Return on Investment in Training and Performance Improvement Programs*, 2nd edn. Elsevier: Burlington, VT, 2003.
31. Stone PW. Return-on-investment models. *Appl Nurs Res* 2005; **18**: 186–189.
32. U.S. Bureau of Labor Statistics. [WWW document]. URL http://www.bls.gov (accessed 1 December 2010).
33. Organisation for Economic Co-operation and Development (OECD). StatExtracts. OECD Selected Data. [WWW document]. URL http://stats.oecd.org/Index.aspx (accessed 1 December 2010).
34. Verbeek J, Pulliainen M, Kankaanpaa E. A systematic review of occupational safety and health business cases. *Scand J Work Environ Health* 2009; **35**: 403–412.
35. Aldana SG, Jacobson BH, Harris CJ, Kelley PL, Stone WJ. Influence of a mobile worksite health promotion program on health care costs. *Am J Prev Med* 1993; **9**: 378–383.
36. Aldana SG, Merrill RM, Price K, Hardy A, Hager R. Financial impact of a comprehensive multisite workplace health promotion program. *Prev Med* 2005; **40**: 131–137.
37. Bertera RL. The effects of workplace health promotion on absenteeism and employment costs in a large industrial population. *Am J Public Health* 1990; **80**: 1101–1105.
38. Gettman LR. Cost/benefit analysis of a corporate fitness program. *Fitness Bus* 1986; **1**: 11–17.
39. Gibbs JO, Mulvaney D, Henes C, Reed RW. Work-site health promotion: five-year trend in employee health care costs. *J Occup Environ Med* 1985; **27**: 826–830.
40. Mills PR, Kessler RC, Cooper J, Sullivan S. Impact of a health promotion program on employee health risks and work productivity. *Am J Health Promot* 2007; **22**: 45–53.
41. Naydeck BL, Pearson JA, Ozminkowski RJ, Day BT, Goetzel RZ. The impact of the Highmark employee wellness programs on 4-year healthcare costs. *J Occup Environ Med* 2008; **50**: 146–156.
42. Ozminkowski RJ, Dunn RL, Goetzel RZ, Cantor RI, Murnane J, Harrison M. A return on investment evaluation of the Citibank, N.A., health management program. *Am J Health Promot* 1999; **14**: 31–43.
43. Schultz AB, Lu C, Barnett TE, Yen LT, McDonald T, Hirschland D *et al*. Influence of participation in a worksite health-promotion program on disability days. *J Occup Environ Med* 2002; **44**: 776–780.
44. Shi L. Health promotion, medical care use, and costs in a sample of worksite employees. *Eval Rev* 1993; **17**: 475–487.
45. Shore G, Prasad P, Zroback M. Metrofit: a cost-effective fitness program. *Fitness Bus* 1989; **4**: 147–153.
46. Stave GM, Muchmore L, Gardner H. Quantifiable impact of the contract for health and wellness: health behaviors, health care costs, disability, and workers' compensation. *J Occup Environ Med* 2003; **45**: 109–117.
47. Wood EA, Olmstead GW, Craig JL. An evaluation of lifestyle risk factors and absenteeism after two years in a worksite health promotion program. *Am J Health Promot* 1989; **4**: 128–133.
48. Groeneveld IF, van Wier MF, Proper K, Bosmans JE, Van Mechelen W, van der Beek A. Cost-effectiveness and cost-benefit of a lifestyle intervention for workers in the construction industry at risk for cardiovascular disease. *J Occup Environ Med* 2011; **56**: 610–617.
49. Meenan RT, Vogt TM, Williams AE, Stevens VJ, Albright CL, Nigg C. Economic evaluation of a worksite obesity prevention and intervention trial among hotel workers in Hawaii. *J Occup Environ Med* 2010; **52**(Suppl. 1): S8–S13.
50. Proper KI, de Bruyne MC, Hildebrandt VH, van der Beek AJ, Meerding WJ, van Mechelen W. Costs, benefits and effectiveness of worksite physical activity counseling from the employer's perspective. *Scand J Work Environ Health* 2004; **30**: 36–46.
51. Baker KM, Goetzel RZ, Pei X, Weiss AJ, Bowen J, Tabrizi MJ *et al*. Using a return-on-investment estimation model to evaluate outcomes from an obesity management worksite health promotion program. *J Occup Environ Med* 2008; **50**: 981–990.
52. Drummond MF, Sculpher MJ, Torrance GW, O'Brien BJ, Stoddart GL. *Methods for the Economic Evaluation of Health Care Programmes*, 3rd edn. Oxford University Press: New York, 2005.

53. Aldana SG. Financial impact of health promotion programs: a comprehensive review of the literature. *Am J Health Promot* 2001; **15**: 296–320.
54. Nicholson S, Pauly MV, Polsky D, Baase CM, Billotti GM, Ozminkowski RJ *et al*. How to present the business case for healthcare quality to employers. *Appl Health Econ Health Policy* 2005; **4**: 209–218.
55. Kunz R, Vist G, Oxman AD. Randomisation to protect against selection bias in healthcare trials. *Cochrane Database Syst Rev* 2007; Issue 2. Art. No. MR000012.
56. Higgins JPT, Altman DG. Chapter 8. Assessing risk of bias in included studies. In: Higgins JPT, Green S (eds). *Cochrane Handbook for Systematic Reviews of Interventions*, Version 5.0.1 (updated September 2008). The Cochrane Collaboration; 2008 [WWW document]. URL http://www.igh.org/Cochrane/tools/Ch08_Bias.pdf (accessed 15 December 2010).
57. Linden A. Identifying spin in health management evaluations. *J Eval Clin Pract* 2011. doi: 10.1111/j.1365-2753.2010.01611.x/pdf (accessed 10 February 2011).
58. Driessen MT, Anema JR, Proper KI, van der Beek AJ. Authors' response: RCTs of ergonomic interventions. *Occup Environ Med* 2010; **67**: 218–219.
59. Begg C, Cho M, Eastwood S, Horton R, Moher D, Olkin I *et al*. Improving the quality of reporting of randomized controlled trials. The CONSORT statement. *JAMA* 1996; **276**: 637–639.
60. Ozminkowski RJ, Goetzel RZ. Getting closer to the truth: overcoming research challenges when estimating the financial impact of worksite health promotion programs. *Am J Health Promot* 2001; **15**: 289–295.
61. Lofland JH, Pizzi L, Frick KD. A review of health-related workplace productivity loss instruments. *PharmacoEconomics* 2004; **22**: 165–184.
62. Reinhardt UE, Hussey PS, Anderson GF. U.S. health care spending in an international context. *Health Aff (Millwood)* 2004; **23**: 10–25.