

Chapter 9

Prevention programme at construction worksites aimed at improving health and work ability is cost-saving to the employer: results from a cluster RCT

Karen M. Oude Hengel, Judith E. Bosmans, Johanna M. van Dongen,
Paulien M. Bongers, Allard J. van der Beek, Birgitte M. Blatter

Under Review



Abstract

Background: To analyse the cost-effectiveness and financial return of an intervention from an employer's perspective.

Methods: Two hundred ninety-three workers of 15 departments were randomised to the intervention (n=8) or control group (n=7). Data on work ability and health were collected using questionnaires. Sick leave data were obtained from the companies. Both the cost-effectiveness analyses and return on investment analyses were performed from the employer's perspective.

Results: After 12 months, the absenteeism costs were significantly lower in the intervention group compared to the control group. No significant differences in effects were observed after 12 months, meaning that the intervention was not cost-effective in comparison with the control group. The net-benefit was 641, and the intervention generated a positive financial return to the employer.

Conclusion: The intervention in the present study was cost-saving to the employer due to less sickness absenteeism; for each €1 invested in the intervention group €6.4 was gained.

Introduction

As in many industries in Western countries, the working population in the Dutch construction industry is rapidly decreasing and ageing.^{1,2} These demographic changes have serious economic consequences as a shrinking labour force will have to pay for the national pensions of an increasing number of people who are retired. Thus, both government and construction companies face the challenge of keeping both young and old construction workers on their job for a longer period. In order to keep the working lives of construction workers healthy and productive, worksites are increasingly becoming the focus of health promotion programmes.³

As employers are the ones eventually investing in such health promotion programmes, they have a growing interest in the economic evaluations of these programmes.^{4,5} Results of economic evaluations can play an important role in the decision whether or not to invest in worksite health promotion programmes, as they provide a systemic comparison of both the effects and costs of the alternatives (e.g., health promotion programmes and usual care).⁶ Specifically, employers need to gain insight into the potential effects in terms of improved health of their workers compared to their additional investments in order to decide whether the implementation is worthwhile for their company (i.e., cost-effectiveness analyses (CEA)).⁷ This information is becoming even more important when taking into account the limited resources of companies, such as time, facilities and money.⁸ Also, employers increasingly ask whether these programmes generate a positive financial return to the company.⁹ This can be determined with a return on investment analysis (i.e., ROI analysis), in which programme costs are compared to its financial benefits.¹⁰

Until now, two studies have been conducted evaluating the cost-effectiveness and/or financial return of a worksite health promotion programme aimed at blue-collar workers using a randomised controlled trial (RCT).^{11,12} Both studies evaluated the cost-effectiveness of the programme from a societal perspective, whereas Groeneveld et al. (2011) also analysed the net-benefit from that of an employer. Although a societal perspective is mostly advocated for economic evaluations (i.e., all costs and effects are included in the analyses irrespective of who pays for them or benefits from them)⁸, interpreting these results may be difficult for various decisions makers. In the case of worksite

health promotion programmes, the adoption of the employer's perspective (e.g., only costs relevant to the employer are considered) is more appropriate since the final decision about whether or not to invest in such programmes are made by the management of companies.

Therefore, an economic evaluation from an employer's perspective was conducted of an intervention programme in the construction industry in comparison with control. This 6-month intervention aimed to maintain and promote work ability and health in order to support sustainable employability of construction workers.¹³ The present study aims to evaluate both the cost-effectiveness and financial return of an intervention programme in the construction industry versus no intervention.

Methods

Study design and population

An economic evaluation alongside a cluster-randomised controlled trial (RCT) was conducted at all departments of six construction companies, which specialize in house, commercial or industrial building. All workers of these companies who perform actual construction work were invited to participate in the study. Inclusion criteria were: (1) construction workers were able to complete questionnaires written in the Dutch language, and (2) construction workers provided written informed consent. The study protocol was approved by the Medical Ethics Committee of the VU University Medical Center (Amsterdam, The Netherlands). More details on the study have been described elsewhere.¹⁴

Randomisation, blinding and sample size calculation

Cluster randomisation took place at the department level within each company. The randomisation procedure was performed by an independent research assistant, who had no prior information about the departments to ensure concealment of treatment allocation. As the intervention took place at the worksite, the construction workers, their supervisors and trainers could not be blinded to the allocation.

The sample size was calculated based on the number of cases needed to identify an effect on health status. In the present study, health status was

measured by the SF-12. However, as this outcome has rarely been used among the working population, the SF-36 was used for the sample size calculation. Effect sizes of the SF-36 varied between 0.58 and 0.96. Because of the cluster randomisation design, an effect size of 0.40 was considered to be the lower boundary of a medium effect size. This effect size can be detected with two groups of 100 (with a power of 80% and a two-tailed significance level of 5%). Taking a loss to follow-up of about 10% into account, 220 construction workers were needed at baseline.

Intervention and control condition

The six-month intervention consisted of two individual training sessions with a physical therapist to reduce physical workload, an instrument to raise awareness of the importance of rest breaks to reduce fatigue (Rest-Break tool), and two empowerment training sessions to improve the range of influence at the worksite. The four training sessions took place at the worksite within the existing so-called “toolbox education system”. The toolbox education system consists of at least 10 obligatory health and safety training sessions for workers, which have to be organized by employers in the construction industry each year. These training sessions are necessary in the construction industry to obtain an official health and safety certificate.

Both training sessions with the physical therapist lasted approximately 30 minutes per worker. During the first training session, a quick scan questionnaire was administered and followed by a 15-minute observation at the worksite. Based on this, a maximum of three individual recommendations on how to reduce ones physical workload were written down on a pocket-sized card. During the second training session, which took place after four months, the physical therapist discussed the workers’ experiences so far and evaluated the impact of the advice. The Rest-Break tool was introduced to raise awareness about the importance of reducing fatigue by taking flexible rest breaks, and to stimulate workers to actually take them. The Rest-Break tool is a flowchart and consists of four steps: (1) the workers’ expectations about their fatigue at the end of a working day, (2) short-term advice to take mini rest breaks or an additional break of 10 minutes, (3) selection of the possible causes of fatigue, and (4) long-term advice about how to structurally lower fatigue. The workers were asked to fill in the tool on a weekly basis and to discuss the results with their supervisor. The two group training sessions

with the empowerment trainer were organized at the worksite. The sessions were aimed at improving construction workers' influence at the worksite by (1) taking responsibility for their own health, (2) discussing the responsibility for their own behaviour (e.g., taking rest breaks, asking for assistance) with colleagues, and (3) improving communication with their supervisor. During the first training session, workers created a list of topics (e.g., more communication with supervisor, celebration of achieved goals, and less need for recovery) they wanted to change during the intervention period. Finally, they signed an action plan. After four months, the empowerment trainer and workers discussed, and reconsidered the action plan as well as the results that were achieved. More details on the development and content of the intervention have been described elsewhere.¹³ The control group received no intervention at all, besides the regularly obliged training sessions for the Health and Safety certificate.

Effect measures

Primary outcomes in this study were work ability, physical and mental health, and the prevalence of musculoskeletal symptoms. Baseline measurements took place before randomisation. Follow-up measurements were performed at three, six, and 12 months after baseline.

Work ability was measured using the Work Ability Index (WAI), which originally consisted of seven concepts.¹⁵ Because sub-concepts can also be used as a simple indicator for assessing the status of work ability^{16,17}, only two concepts were used in the present study: current work ability (one question), and work ability in relation to job demands (physical and mental job demands by two questions). A total score of the WAI was obtained by adding the weight scores of these individual concepts.¹⁸

Physical and mental health were assessed using the Short-Form Health Survey (SF-12).^{19,20} The SF-12 provided two separate weighted scores for physical and mental health.²¹

The prevalence of musculoskeletal symptoms was measured using the Dutch Musculoskeletal Questionnaire (DMQ), in which workers were asked to rate the occurrence of pain or discomfort in the neck, shoulders, upper and lower back, elbows, wrists/hands, hips/thighs, knees, and ankles/feet during the

previous seven days using a four-point scale (never, sometimes, frequent, and prolonged).²² These regions were grouped into four larger body regions; back (upper and lower back), neck/shoulders, upper extremities (elbows and wrist/hands), and lower extremities (hips/thighs, knees and ankles/feet). For each of the body regions, workers who answered 'frequent' or 'prolonged' on one or more of the questions were classified as having musculoskeletal symptoms in that specific body region, whereas the others were classified as having no musculoskeletal symptoms in that specific body region.

Costs

The economic evaluation was conducted from the employer's perspective. This means that only costs relevant for the companies were considered; notably costs of the intervention, and costs due to productivity losses of the workers.

Intervention costs were valued using the market prices that the six companies have to pay for the intervention. Intervention costs included the costs related to the training sessions with the physical therapist and empowerment trainer (including travel time, training time, and their materials), and material costs (i.e., Rest-Break tool, posters, and pocket-sized advisory cards). The costs of the trainers were based on the commercial rates of the trainers themselves. Material costs were estimated using invoices.

Costs due to paid time of the workers to participate in the intervention program were not included because (i) the training sessions were organized within the existing education system, meaning that companies have to organize at least 10 obligatory health and safety training sessions at the work site for workers to obtain an official health and safety certificate, and (ii) construction workers in the control group received these training sessions as well, but with other topics and purposes.

Costs of productivity losses were divided into costs due to sickness absenteeism and costs due to presenteeism (i.e., lost performance while at work). Currently, no consensus exists regarding the best method to measure and value presenteeism in economic evaluations.²³ Therefore, the main analyses consisted of sickness absenteeism costs only, while presenteeism costs were added to sickness absenteeism costs in one of the sensitivity analyses. Sickness absenteeism data were gathered from continuous registration systems of

the six participating companies. Gross annual salaries of participants were estimated using the average annual salaries of construction workers, which were divided into seven age categories (Economic Institute of the Dutch construction industry, personal communication). Labour costs associated with one hour of sickness absenteeism were calculated by dividing these gross annual salaries including holiday allowances and premiums by the average number of annual working hours for construction workers. Using the Human Capital Approach (HCA)⁸, absenteeism costs were estimated by multiplying the total number of sickness absenteeism hours during follow-up by the hourly labour costs. Presenteeism (i.e. reduced productivity while at work)²⁴ was assessed at baseline, three, six and 12-month follow-up using an item of the World Health Organization and Work Performance Questionnaire (WHO-HPQ).²⁵ Workers were asked to rate their overall work performance during the previous four weeks on an 11-point scale, ranging from “worst performance” (0) to “best performance” (10). Assuming linearity, the average work performance of the participants during the follow-up period was calculated. As presenteeism is conceptualized in the WHO-HPQ as a measure of actual performance in relation to “best performance” (10)^{25,26}, a worker’s average level of presenteeism during follow-up (Presenteeism Score) was calculated using the following formula: $\text{presenteeism score} = (10 - \text{work performance})/10$. Using the HCA, presenteeism was valued by multiplying a worker’s presenteeism score by the number of working hours in the previous follow-up period (working hours minus leave), and multiplying this with the hourly labour cost. Prices were adjusted for the year 2009, as this was the year in which most data were collected. Discounting of costs and effects was not necessary, as the follow-up period of the trial was 12 months.

Statistical analyses

Cost-effectiveness analyses and cost-benefit analyses were performed from the employer’s perspective. Cost-effectiveness is defined as the relationship between nonmonetary health-outcomes (i.e., health, work ability and musculoskeletal symptoms) as a result of the intervention and the monetary value of resources (i.e., intervention costs and sickness absence costs) used during implementation. Cost-benefit is defined as the relationship between costs of the intervention (i.e., intervention costs), and monetary benefits produced by the intervention (i.e., sickness absence costs).^{6,8}

Analyses were performed according to the intention-to-treat principle (i.e., analyses of the trial were based on the initial group assignment). Baseline differences between the intervention and control group were checked using the unpaired Student t-test (continuous variables), and Pearson's chi-square test (dichotomous variables).

Multiple imputation using Fully Conditional Specification and Predictive Mean Matching was used to impute missing cost and effect data.²⁷ An imputation model containing important demographic and prognostic variables was specified to create 30 complete data sets. Effects and costs from the 30 complete data sets were pooled using Rubin's rules.²⁸

Linear regression analyses (i.e., on work ability, physical and mental health as effect measure) and logistic regression analyses (i.e., on musculoskeletal symptoms) were used to compare the effects between the intervention and control group, while adjusting for baseline values. Mean costs differences between the intervention and control group were calculated. To estimate uncertainty bootstrapping with 5000 replications was employed. The Approximate Bootstrap Confidence algorithm (ABC) was used to estimate 95% confidence intervals (CIs) around the cost differences.

To provide a summary measure of the incremental comparison of costs and effects, incremental cost-effectiveness ratios (ICERs) were estimated by dividing the differences in costs over 12 months between the intervention and control group by the difference in effects at 12 months. Bootstrapped incremental cost-effects pairs, were plotted on cost-effectiveness planes (CE-planes) to graphically illustrate the uncertainty surrounding the ICERs.²⁹ CE-planes consist of four quadrants. Each quadrant has a different implication for the decision maker. If an ICER is located in the South-East quadrant (i.e., less expensive and more effective), the intervention can be regarded cost-effective. If an ICER is located in the North-West quadrant (i.e., less effective and more expensive), the intervention cannot be regarded as cost-effective. When ICERs are located either in the North-East quadrant (i.e., more effective and more expensive) or the South-West quadrant (i.e., less effective and less expensive), the choice depends on the so-called "willingness-to-pay". That is, the amount of money decision makers are willing to pay for an additional unit of effect.

For the cost-benefit analyses, costs were defined as the intervention costs and benefits as the difference in monetized productivity loss (i.e., absenteeism costs) between the control group and intervention group during follow-up, with positive benefits indicating reduced spending. Using these costs and benefits, three outcomes were calculated; (1) Net Benefit (NB), (2) Benefit Cost Ratio (BCR), and (3) Return on investment (ROI).³⁰ The NB was calculated by subtracting the intervention costs from the benefits. BCR was calculated by dividing the benefits by the costs, and the ROI by dividing the NB by the costs, and expressed as a percentage. To quantify uncertainty, 95% CIs around the NB were estimated by means of ABC intervals. Financial returns are positive if the following criteria are met: $NB > 0$, $BCR > 1$, and $ROI > 0$.

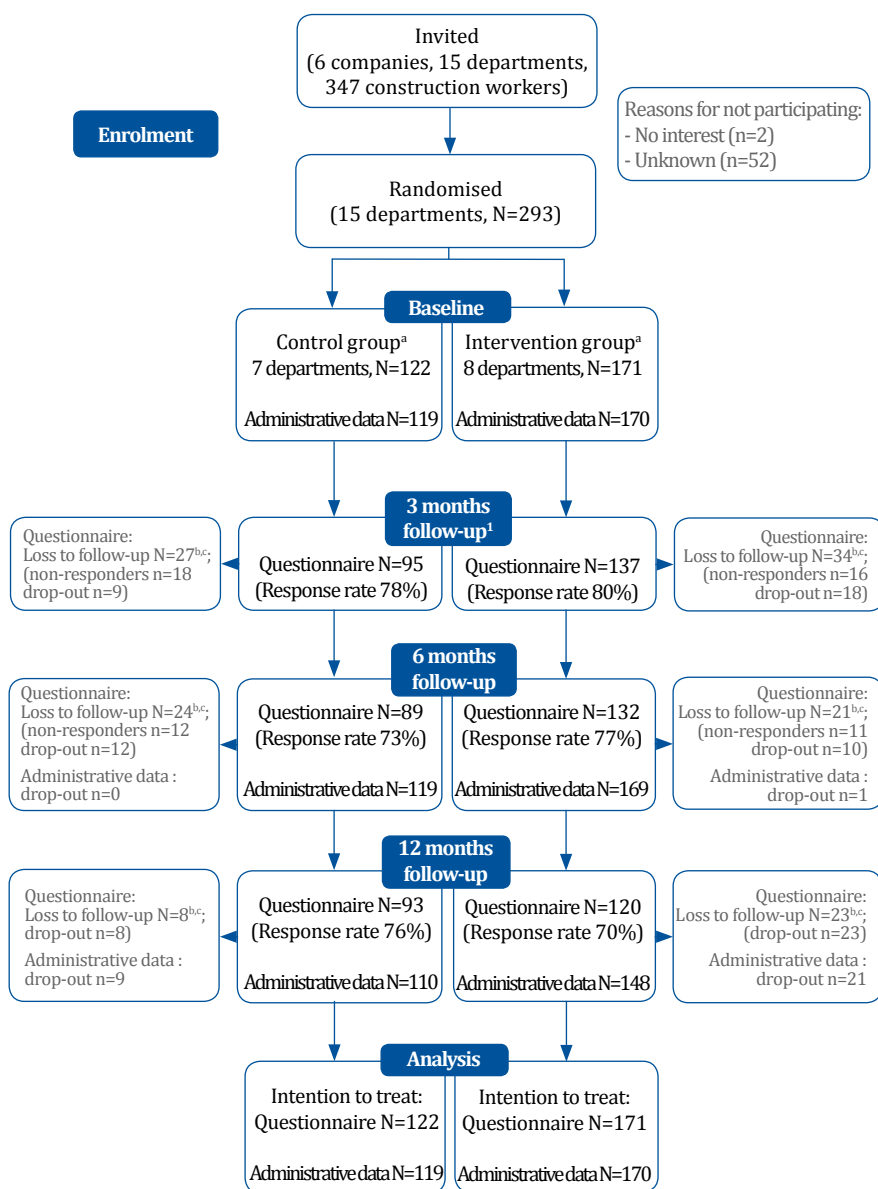
To assess the robustness of the study results, three sensitivity analyses were performed. First, analyses were conducted in which presenteeism costs were also included. Second, analyses were conducted using complete cases only. Third, analyses were performed according to the per-protocol principle; that is only workers in the intervention group who followed three or four training sessions were included in the analyses.

The statistical programme R, v2.14.0 was used to estimate the cost-effectiveness planes, and ABC intervals. All other statistical analyses were performed using PASW version 18.0 (SPSS Inc, Chicago, IL). Statistical significance was set at $p < 0.05$.

Results

Participants

A total of 15 departments from six construction companies participated in the study. After randomisation, eight departments were allocated to the intervention group ($n=171$) and seven departments to the control group ($n=122$; Figure 1). At baseline, workers in the intervention group were higher educated, and had a slightly better mental health compared to workers in the control group (Table 1). Complete follow-up data were obtained from 165 workers (65%) on the effect measures and from 259 workers (88%) on the cost measures. Workers with complete follow-up data reported significantly higher work ability at baseline than workers with incomplete follow-up data (15.9 versus 15.3, respectively).



^aSick leave data were not available for four workers (3 in control group, and 1 in intervention group).

^bWorkers who were loss-to-follow-up due to non-responding were again included in the following measurements.

^cDrop-out was defined as workers that ended participation in follow-up measurements.

Figure 1. Flow diagram of the participants through the phases of the trial

Table 1. Baseline characteristics of the study population

	Control group		Intervention group	
	n=122		n=171	
Individual characteristics				
Age (yr) [mean (SD)]	44.3	(12.7)	41.8	(12.7)
Gender (male) (% [n])	98%	(120)	100%	(171)
Education (% [n])				
Lower education	84%	(103)*	74%	(127)*
Intermediate/higher education	15%	(18)*	26%	(44)*
Missing		(1)		(1)
Profession				
Bricklayer	13%	(16)	23%	(39)
Carpenter	75%	(92)	68%	(116)
Other	12%	(14)	9%	(16)
Outcomes [mean (SD)]				
Work Ability [mean (SD)] ¥	15.6	(2.2)	15.8	(2.0)
Health status [mean (SD)] ¥				
Physical health status	49.4	(8.9)	50.2	(8.2)
Mental health status	53.4	(7.7)*	55.0	(5.5)*
Musculoskeletal symptoms in the past 7 days				
Back [n (%)]	29	(24%)	34	(20%)
Neck/shoulder [n (%)]	15	(13%)	23	(13%)
Upper extremities [n (%)]	16	(13%)	21	(12%)
Lower extremities [n (%)]	22	(19%)	32	(19%)

Abbreviations: yr, years; SD, standard deviation; n, number; * p<0.05, indicating a significant differences between the intervention and control group at baseline; ¥ Higher score indicates a better work ability and a higher physical and mental health score.

Effectiveness

At 12-month follow-up, work ability and physical health decreased slightly in the intervention group compared to the control group, whereas mental health showed a small increase in the intervention group (Table 2). Regarding musculoskeletal symptoms, fewer intervention group workers reported musculoskeletal symptoms for the four body regions compared to their control group counterparts (Table 2). However, none of these differences were significant.

Costs

Mean intervention costs were €118 per construction worker. During follow-up, sickness absenteeism costs were significantly lower in the intervention

group compared to the control group (€-760; 95% CI: -1497; -156). Due to the lower sickness absenteeism costs, total costs (i.e., intervention costs and sickness absenteeism costs) were significantly lower in the intervention group compared to the control group (€-641; 95% CI: -1391; -48).

Cost-effectiveness analyses

The ICER for work ability was €5.243, implying that the employer saved €5.234 per one-point decline in work ability in the intervention group in comparison with the control group (Table 3). ICERs for physical and mental health were 798 and -642, respectively. This means that the employer's saving per one-point decline in physical health was €798, whereas a one-point improvement in mental health saved the employer €642 in the intervention group in comparison with the control group. For musculoskeletal symptoms, ICERs

Table 2. Pooled effects and costs, and differences in mean effects and costs at baseline and 12 months follow-up between the intervention and control group

	Control group		Intervention group		Differences ¹		
	Baseline	Follow-up	Baseline	Follow-up			
Pooled Effects							
	Mean (SEM)	Mean (SEM)	Mean (SEM)	Mean (SEM)	Mean (95% CI)		
Work Ability	15.4 (0.23)	15.1 (0.25)	15.8 (0.15)	15.3 (0.22)	-0.12 (-0.79; 0.54)		
Physical health	49.4 (0.82)	48.9 (0.87)	50.2 (0.64)	48.9 (0.77)	-0.80 (-3.22; 1.61)		
Mental health	53.4 (0.71)	51.8 (0.92)	55.0 (0.44)	54.2 (0.52)	1.00 (-1.15; 3.15)		
	%	n	%	n	% (95% CI)		
Musculoskeletal symptoms							
Back	24%	29	22%	27	20% 34	19% 32	-0.03 (-0.13; 0.07)
Neck/Shoulder	13%	15	17%	23	13% 23	12% 21	-0.05 (-0.14; 0.05)
Upper extremities	13%	16	17%	20	12% 21	11% 19	-0.05 (-0.15; 0.04)
Lower extremities	19%	22	22%	32	19% 32	20% 35	-0.01 (-0.13; 0.10)
Pooled Costs (€)							
	Mean (SEM)	Mean (SEM)	Mean (SEM)	Mean (SEM)	Mean (95% CI)		
Absenteeism costs	-	-	1727 (306)	-	-	968 (146)	-760 (-1497;-156)
Intervention costs	-	-	-	-	118	118	
Total costs	-	-	1727 (306)	-	-	1086 (146)	-641 (-1391; -48)

Abbreviations: n: number; SEM: standard error of the mean CI: confidence intervals. ¹ Mean differences between intervention group and control group at twelve months, adjusted for baseline values and age

Table 3. Results of the cost-effectiveness analyses on work ability, physical and mental health between the intervention and control group after 12 months of follow up

Analysis	Sample size		Outcome	ΔC		Points	ΔE		ICER		Distribution CE-plane (%)		
	Co	Int		€	(95% CI)		(95% CI)	(95% CI)	NE ¹	SE ²	SW ³	NW ⁴	
Main analysis													
Imputed data set	122	171	Work ability	-641	(-1391; -48)	-0.12	(-0.79; 0.54)	5243	1.3	35.3	62.4	1.0	
	122	171	Physical health	-641	(-1391; -48)	-0.80	(-3.22; 1.61)	798	0.8	25.3	72.5	1.4	
	122	171	Mental health	-641	(-1391; -48)	1.00	(-1.15; 3.15)	-642	1.7	80.4	17.6	0.5	
Sensitivity analysis													
Complete cases	72	93	Work ability	-136	(-1101; 462)	-0.27	(-1.07; 0.53)	578	15.3	13.1	49.3	22.2	
	72	93	Physical health	-136	(-1101; 462)	-0.52	(-3.09; 2.06)	280	17.7	18.4	43.5	20.4	
	72	93	Mental health	-136	(-1101; 462)	1.54	(-0.60; 3.69)	-93	33.5	56.6	5.5	4.5	
Per-protocol	122	104	Work ability	-641	(-1411; 24)	-0.25	(-1.01; 0.51)	2573	1.2	24.7	71.8	2.3	
	122	104	Physical health	-641	(-1411; 24)	-0.22	(-3.01; 2.57)	2948	1.7	42.6	53.8	1.8	
Including presenteeism	122	104	Mental health	-641	(-1411; 24)	0.81	(-1.49; 3.12)	-788	2.5	73.7	22.8	1.0	
	122	171	Work ability	-1179	(-2370; -82)	-0.12	(-0.79; 0.54)	9635	0.8	35.9	62.2	1.1	
	122	171	Physical health	-1179	(-2370; -82)	-0.80	(-3.22; 1.61)	1466	0.5	25.7	72.4	1.4	
	122	171	Mental health	-1179	(-2370; -82)	1.00	(-1.15; 3.15)	-1180	1.3	80.5	17.5	0.6	

Abbreviations: C: costs; CI: confidence intervals; E: effects; ICER: incremental cost-effectiveness ratio, CE-plane: cost-effectiveness plane; SA: sensitivity analysis;

¹ refers to the northeast quadrant of the CE-plane, indicating that the intervention is more effective and more costly compared to the control group;

² refers to the southeast quadrant of the CE-plane, indicating that the intervention is more effective and less costly compared to the control group;

³ refers to the northwest quadrant of the CE-plane, indicating that the intervention is less effective and more costly compared to the control group;

⁴ refers to the southwest quadrant of the CE-plane, indicating that the intervention is less effective and less costly compared to the control group.

Note: costs are expressed in 2009 Euros.

Table 4. Results of the cost-effectiveness analyses on musculoskeletal symptoms between the intervention and control group after 12 months of follow-up

Analysis	Sample size		Outcome	AC		ΔE	ICER		Distribution CE-plane (%)			
	Co	Int		€	(95% CI)		%	(95% CI)	NE ¹	SE ²	SW ³	NW ⁴
Main analysis												
Imputed data set												
	122	171	Back	-641	(-1391; -48)	-0.03	(-0.14; 0.07)	20319	1.5	70.6	27.2	0.8
	122	171	Neck/shoulders	-641	(-1391; -48)	-0.05	(-0.13; 0.04)	13868	1.7	81.8	16.0	0.6
	122	171	Upper extremities	-641	(-1391; -48)	-0.05	(-0.14; 0.04)	12113	1.8	85.2	12.6	0.4
	122	171	Lower extremities	-641	(-1391; -48)	-0.01	(-0.13; 0.10)	59716	1.1	55.8	42.0	1.2
Sensitivity analyses												
Complete cases												
	72	93	Back	-136	(-1101; 462)	-0.04	(-0.16; 0.08)	3480	10.5	14.6	48.0	27.0
	72	93	Neck/shoulders	-136	(-1101; 462)	-0.03	(-0.12; 0.07)	5220	12.0	16.4	44.7	26.3
	72	93	Upper extremities	-136	(-1101; 462)	-0.07	(-0.17; 0.04)	2088	4.8	5.5	56.8	32.8
	72	93	Lower extremities	-136	(-1101; 462)	-0.02	(-0.15; 0.10)	6463	13.9	22.9	40.3	22.9
Per-protocol												
	122	104	Back	-641	(-1411; 24)	0.00	(-0.11; 0.11)	-976306	1.5	47.4	48.9	1.9
	122	104	Neck/shoulders	-641	(-1411; 24)	-0.05	(-0.15; 0.07)	12631	2.9	82.3	14.1	0.7
	122	104	Upper extremities	-641	(-1411; 24)	-0.03	(-0.13; 0.07)	19431	2.1	72.5	24.0	1.5
	122	104	Lower extremities	-641	(-1411; 24)	0.00	(-0.12; 0.13)	-595950	1.5	46.9	49.6	2.0
Including presenteeism												
	122	171	Back	-1179	(-2370; -82)	-0.03	(-0.14; 0.07)	79302	0.9	59.9	38.2	1.0
	122	171	Neck/shoulders	-1179	(-2370; -82)	-0.04	(-0.13; 0.04)	24002	1.5	84.1	13.9	0.4
	122	171	Upper extremities	-1179	(-2370; -82)	-0.05	(-0.14; 0.04)	23375	1.5	84.7	13.4	0.4
	122	171	Lower extremities	-1179	(-2370; -82)	-0.01	(-0.13; 0.10)	110135	0.8	55.9	42.3	1.0

Abbreviations: C: costs; CI: confidence intervals; E: effects; ICER: incremental cost-effectiveness ratio; CE-plane: cost-effectiveness plane; SA: sensitivity analysis

¹ refers to the northeast quadrant of the CE-plane, indicating that the intervention is more effective and more costly compared to the control group;

² refers to the southeast quadrant of the CE-plane, indicating that the intervention is more effective and less costly compared to the control group;

³ refers to the northwest quadrant of the CE-plane, indicating that the intervention is less effective and more costly compared to the control group;

⁴ refers to the southwest quadrant of the CE-plane, indicating that the intervention is less effective and less costly compared to the control group;

Note: costs are expressed in 2009 Euros

ranged between 12.133 (upper extremities) and 59.716 (lower extremities; Table 4). These ICERs indicate that the employer will save €12.133 to €59.716 per 1% reduction in the prevalence of musculoskeletal symptoms. Uncertainty around the ICERs is presented by the distribution of the cost-effect pairs among the four quadrants (Tables 3 and 4). For work ability and physical health, the majority of all outcomes, most cost-effect pairs are located in the South-West quadrant, indicating that the intervention is less effective and less expensive. Regarding mental health and musculoskeletal symptoms, the cost-effect pairs are mainly located in the South-East quadrant, indicating the intervention is less expensive and more effective. As the CE-planes were quite similar for all outcomes, only those for work ability and mental health are presented (Figure 2).

Financial return

The ROI analyses indicated that the investment needed for the intervention was €118 and the savings were €760 in absenteeism costs per worker (i.e., a reduction of 8.5 sickness absenteeism days in the intervention group compared to the control group) resulting in a positive net benefit of €641 (95%CI 48;1391; Table 5). Furthermore, for each €1 invested, €6.4 was gained (BCR: 6.4) and a 544% profit was made (ROI: 544%). Therefore, the intervention can be regarded as cost-saving to the employer.

Figure 2. Cost-effectiveness planes for work ability (A) and mental health (B) of the intervention group compared to the control group.

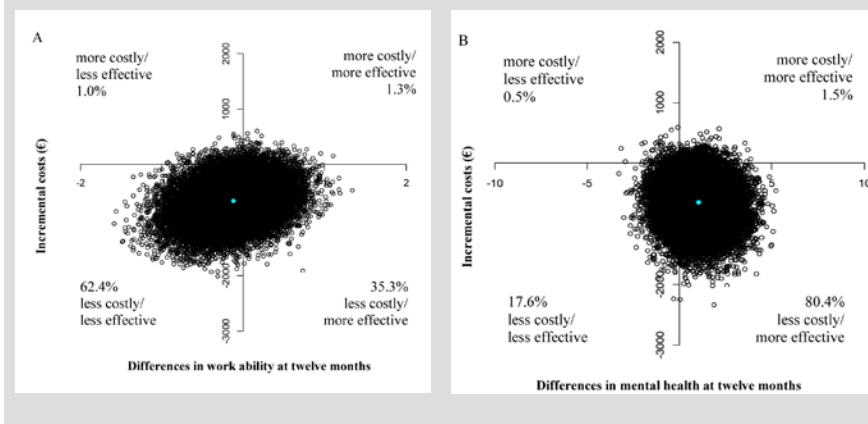


Table 5. Intervention costs, benefits (95% CI), net benefit (NB, (95% CI)), benefit cost ratio (BCR), and return on investment (ROI (%)) per worker

Analysis	Sample size		Costs ¹	Benefits			Financial Return		
	Co	Int		Absenteeism	Presenteeism	Total	NB	BCR	ROI
Main analysis									
Imputed datasets	122	171	118	760 (156;1497)	-	760 (156;1497)	641 (48;1391)	6.4	543
Sensitivity analyses									
Complete cases	72	93	118	254 (-486; 989)	-	254 (-486; 989)	136 (-462;1101)	2.2	115
Per-protocol	122	104	118	760 (74; 1510)	-	760 (74; 1510)	641 (-24;1411)	6.4	543
Including presenteeism	122	171	118	760 (156;1497)	537 (-315; 1429)	1297 (1095;1470)	1179 (82; 2370)	11.0	999

Abbreviations: C: control; I: intervention; CI: confidence intervals; NB: net benefit; BCR: benefit cost ratio; ROI: return on investment; SA: sensitivity analysis.

¹Costs are those costs that were related to the intervention.

Sensitivity analyses

Cost-effectiveness analyses

The results on the cost-effectiveness of the intervention in the sensitivity analyses are presented in tables 3 and 4. No differences were found in effects between the main analyses and the sensitivity analyses. For the per-protocol analyses, results were similar to those of the main analyses, but the cost difference between the two groups was no longer statistically significant. Results of the complete-cases analysis also deviated from the main analyses as the cost difference between the two groups was no longer statistically significant (–€136 (95%CI -462;1101)). If presenteeism costs were included, total costs remained significantly lower in the intervention group compared to the control group (€ -1179 (95%CI (-2370;-82))).

Financial return

The results of the sensitivity analyses on the financial return are presented in Table 5. If the analyses were restricted to the per-protocol analyses (i.e., workers in the intervention group who followed at least three training sessions), the results (NB, BCR, and ROI) remained quite similar to the main analyses. Only the NB (€641 (95%CI -24;1411)) was no longer statistically significant. For the complete-cases analysis, the intervention was no longer statistically significantly cost-saving (NB: €254 (95%CI -486;989); BCR: 2.2, and ROI: 115). If presenteeism costs were included (€537 (95%CI -315;1429)), the intervention remained cost-saving to the employer (NB: €1179 (95%CI 82;2370), BCR: 11 and ROI:999).

Discussion

This study evaluated the cost-effectiveness and financial return of a preventive programme delivered at construction worksites. The results showed that the intervention was cost-saving to the employer, due to reduced sickness absenteeism costs in the intervention group compared with the control group. Specifically, for each €1 invested in the intervention group, €6.4 was gained. However, the intervention cannot be regarded as cost-effective in terms of work ability, physical and mental health, and musculoskeletal symptoms, because the intervention was ineffective for these outcomes in comparison.

An important strength of this study was the pragmatic cluster randomised design. This enabled us to study the cost-effectiveness and financial return of this worksite prevention programme under real conditions and allowed us to prospectively collect all relevant cost and effect data.³¹ Additionally, randomisation was performed at the department level to minimise the risk of contamination. Avoiding contamination is especially important in the construction industry where workers are working at worksites that are temporary and mobile. Another strength is that sickness absence data were retrieved from continuous sickness absence registration systems of the six participating companies, which eliminated information or recall bias, and limited loss-to-follow-up.

Some methodological limitations deserve attention as well. First, the clustering of construction workers within the departments was ignored in the analyses. Economic evaluations of cluster randomised controlled trials require methods that address clustering in both the effects and costs, and adjust for covariates.³² However, methods are not yet fully developed nor does consensus exist about the best method to do so.³³ A second limitation concerns the high loss to follow-up on the outcomes. Complete follow-up data at 12 months (effect measures and cost data) were derived from 128 workers (44%). To account for this, missing data were imputed using the 'fully conditional specification and predictive mean matching', which is acknowledged as a better way to deal with missing data than complete-cases analyses.³⁴ Third, the measurement of presenteeism costs is another limitation. Although presenteeism costs are increasingly being recognised by employers as an important part of productivity-related costs, universal agreement about the most appropriate method for measuring or monetizing them does not exist.^{35,36} Moreover, presenteeism was measured by one single question that covered only the past four weeks, and needed to be extrapolated to the next measurement. Therefore, presenteeism costs were only included in the sensitivity analyses. Fourth, costs indirectly related to the intervention and employer's costs were not included in the present study. Regarding the intervention costs, time spent for discussions about the results of the Rest-Break tool between the workers and supervisors, and the time spent for additional rest breaks are examples of indirect intervention costs. As it is unknown to what extent these discussions and additional rest-breaks took place, these indirect costs were not included in the current economic evaluation. Regarding the financial consequences for

the employers, costs such as, turnover, disability management and workers' compensation costs were not measured in the current study. This should be taken into account when interpreting the present findings.

Comparing our results to those of other studies is hampered by the lack of studies evaluating the financial return and cost-effectiveness of similar interventions from an employer's perspective. Until now, most studies among blue-collar workers evaluated the economic impact of worksite health promotion programme from a societal perspective^{11,12}, were not aimed at primary prevention³⁷, or were not based on a (randomised) controlled trial³⁷. The comparison is also hampered by the fact that policies regarding employee medical costs may differ between countries. To illustrate this, in the United States, employers bear a large part of the medical costs of their employees whereas in the Netherlands (which has a dual-payer system) these accrue to health insurance companies and the government. Hence, the results of the current economic evaluation are mainly of interest for countries with comparable policies.

Remarkably, the results of the present study showed that the employer financially benefits from the intervention (i.e., positive financial return), although the intervention did not improve the work ability or health of the construction workers. The positive financial return was the result of a relatively large difference in sickness absenteeism costs in the intervention group compared to the control group. Several reasons might explain the present finding of a positive financial return in comparison to an absence of effectiveness on any of the outcome measures. The absence of statistically significant differences was in line with the findings for these outcomes at three and six months follow-up (data not shown). First, the baseline scores for work ability and health status were relatively good, indicating that the potential of the intervention for further improvement on these outcome measures is relatively weak (i.e., ceiling effect). Second, the study design was two-armed, which complicated the clarifications of the pathways between the different programme components and the achieved reduction in costs (i.e., black box). A theoretical framework was defined in the development phase of the intervention in which the pathways between an intervention action and an expected change in an outcome measure were described.¹³ For example, we supposed that increasing awareness would lead to a higher intention to take

more rest breaks (lower need for recovery) and, thus, to a change in working techniques (lower physical workload). As a result, a decline in musculoskeletal symptoms and sickness absenteeism was expected. However, as no change in need for recovery and physical workload were found (data not shown), it could be hypothesised that other pathways clarify the reduction in musculoskeletal symptoms and sickness absence. Other factors, such as improved job control or less manual material handling, which were not measured in the present study might have explained the reduction of sickness absence in the intervention group. Third, lower absenteeism cost might be explained by other health complaints than musculoskeletal symptoms and health status as measured in the present study. Unfortunately, because of confidentiality, companies were not allowed to provide causes of sickness absence in detail. Therefore, no additional analyses could be performed on other health outcomes. Finally, it cannot be ruled out that the cost difference is based on coincidence.³⁸

Based on the key findings of the present study, the question arises whether or not to advise employers to implement the intervention in the construction industry. Because most of the ICERs were located in the South-West quadrant, decisions makers themselves need to decide whether the investment in the intervention is worthwhile compared to no intervention for their company. From our point of view, although this study showed some promising results with respect to the financial impact of the intervention to the employer, it is, for several reasons, not recommended yet to implement the current intervention directly on a large scale. First, the prime objective of worksite interventions is to enhance the expected health-related welfare of individuals in the workplace. As the workers' effort, commitment and participation in the current program did not improve their health, the purpose of these training sessions in term of an improved health were not achieved in the current intervention. As the workers' effort, commitment and participation in the current programme did not improve their health, the purpose of these training sessions in term of an improved health were not achieved in the current intervention. This indicates that more research is needed on programs that have benefits for both employer and workers. Second, the sensitivity analyses showed some confusing results. When the analyses were restricted to complete cases only, sickness absenteeism costs were no longer in favour of the intervention group. This may be due to the complete-cases being unrepresentative of the whole study population in term of absenteeism costs. Therefore, it could be

hypothesized that the missing completely at-random assumption (i.e., missing data do neither depend on the unobserved nor the observed data) was not met. This assumption is required for complete-case analyses to provide valid and unbiased results.³⁹ In addition, when per-protocol analyses were performed, no differences in costs and effects were found compared to the main analyses. The lack of impact of the intervention may be due to the fact that a relatively healthy group of construction workers were included in the trial. Third, it should be noticed that, although economic evaluations are useful for companies to decide whether or not to implement an intervention on a wider scale, other benefits, such as an improved company image and workers' commitment to the company, that are difficult to measure and value should be weighted in the decision as well. Because of the reasons mentioned earlier, employers and policy makers should interpret the results of the current study with caution.

Some lessons can be learned from the current study for future researchers who are planning to conduct an economic evaluation from an employers' perspective. First, to support stakeholders (employers, business managers) in deciding which intervention is a worthwhile investment or not, researchers should emphasize more the quality of economic evaluations from an employers' perspective. Following the present study, high quality studies should include a detailed description of the target population and intervention, an explicit statement for the narrowed perspective, and sensitivity analyses.³⁷ Second, we handled missing data by using multiple imputations. As minimising missing data is important in economic evaluations, researchers should also put as much effort as possible in collecting complete datasets. Future researchers should also explore optimal resources for collecting questionnaires and other data to minimise the amount of missing data in RCTs.⁴⁰ Third, presenting the financial return in terms of the NB, BCR, as well as the ROI is recommended as the NB is well known to policy-makers and economists whereas business managers prefer the BCR and ROI.¹⁰ Also, this way of presenting the financial return makes the results easier to interpret and compare for all stakeholders.

Conclusion

The intervention in the present study was cost-saving to the employer due to a reduction in sick leave days. Specifically, for each €1 invested in the intervention group, €6.4 was gained. However, the intervention was not cost-effective in comparison with the control group in terms of work ability, physical and mental health, and musculoskeletal symptoms, due to a lack of effect on these outcomes by the intervention. Despite promising results with respect to the financial return, implementing the intervention in the current form at a larger scale in the Dutch construction industry is not recommended yet.

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