Worksite health promotion in the construction industry

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Chapter 6

The effect of a health promotion intervention for construction workers on work-related outcomes: results from a randomised controlled trial

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Abstract

Purpose: The objective of the present study is to investigate the effects of a worksite health promotion intervention on musculoskeletal symptoms, physical functioning, work ability, work-related vitality, work performance, and sickness absence.

Methods: In a randomised controlled design, 314 construction workers were randomised into an intervention group (n=162) receiving personal coaching, tailored information and materials, and a control group (n=152) receiving usual care. Sickness absence was recorded continuously in company records, and questionnaires were completed before, directly after the 6-month intervention period, and 12 months after baseline measurements. Linear and logistic regression analyses were performed to determine intervention effects.

Results: No significant changes at 6 or 12 months follow-up were observed in musculoskeletal symptoms, physical functioning, work ability, work-related vitality, work performance, and sickness absence as a result of the intervention.

Conclusions: This study shows that the intervention was not statistically significantly effective on secondary outcomes. Although the intervention improved physical activity, dietary, and weight-related outcomes, it was not successful in decreasing musculoskeletal symptoms and improving other work-related measures. Presumably, more multifaceted interventions are required to establish significant change in these outcomes.

Introduction

Workers in the construction industry are often exposed to physically demanding work tasks. These include, amongst others, the lifting of heavy loads and working in awkward postures. High physical work demands increase the risk for the development of musculoskeletal symptoms [1,2]. In blue collar construction workers musculoskeletal disorders (MSD) are the most prevalent work-related health problem [3,4]. In addition, in the Netherlands, the workforce in physically demanding work is aging and the risk of MDS also increases with age [5,6]. As such, MSD are a major cause for sickness absence, work disability, early exit from work, and are related to lower work performance, and consequently constitute an extensive social, medical as well as economic problem [7,8].

The prevalence of overweight and obesity in construction workers is higher than in the general adult population [9-11]. Both MSD and a high BMI are negatively associated with several work-related outcomes, but are also associated with each other [12-16]. Since both factors are highly prevalent in blue collar construction workers, these might contribute to the high risk for developing health disorders and associated adverse work-related outcomes compared to workers in other industries and the general population [17,18]. This emphasises the importance to reduce the burden of overweight and obesity in this particular group of workers.

Both diet and physical activity are considered of importance in achieving and maintaining a healthy body weight [19,20]. Worksite health promotion programmes aimed at physical activity and diet were found to be effective on weight-related outcomes [21-23]. Moreover, workplace health promotion programs that improve physical activity levels have been shown to also reduce the risk on MSD [24]. A lifestyle intervention among those with jobs involving moderately heavy or heavy work also showed a reduction in prevalence of low back pain [25]. Although intervention studies with MSD as primary outcome have not often been targeted at lifestyle factors, there is evidence from observational studies suggesting that health promotion should be considered in the prevention of MSD [26-29]. Beneficial effects on work-related outcomes, including sickness absence, productivity and work ability, have been reported resulting from preventative measures targeted at healthy lifestyle [30-33]. Consequently, implementation of worksite programmes targeted at lifestyle factors may be a promising strategy to improve worker health and other outcomes relevant to employers.

In the Vitality in Practice (VIP) in Construction study it was hypothesised that a worksite health promotion intervention, aiming at improving physical activity and diet, could positively change body weight related outcomes, musculoskeletal symptoms and work-related measures [34]. The aim of the present study was to evaluate whether the intervention programme for blue collar construction workers reduced musculoskeletal symptoms, limitations in physical functioning and sickness absence, and increased work-related vitality, work performance and work ability.

Methods

Study design and population

The effectiveness of the programme was assessed in a randomised controlled trial (RCT). The research population consisted of consenting blue collar employees of a construction company. All employees who attended a non-compulsory periodic health screening (PHS) and who were not on sick leave for more than 4 weeks prior to the PHS were eligible for inclusion. In total, 314 participants were recruited over a 15-month period (March 2010 to June 2011), and randomised to an intervention (n=162) or control group (n = 152). Participants completed questionnaires at baseline (T0), at 6 months (T1), and at 12 months (T2). Written informed consent was obtained from participants before enrolment in the study.
The study design and procedures were approved by the Medical Ethics Committee of the VU University Medical Center, and the trial has been registered in the Netherlands Trial Register (NTR, www.trialregister.nl): NTR2095.

Randomisation, blinding and sample size

Following baseline measurements, participants were randomly assigned to either the intervention or the control group by a computer generated list using SPSS 15 (SPSS Inc. Chicago, Illinois, USA). The randomization was prepared and performed by an independent researcher. Whereas participants could have been aware of the allocated arm, data collectors and analyst were kept blinded to the allocation. The sample size was calculated to identify an effect on body weight (Viester et al., 2012). Based on that calculation in each study group (intervention and control) 130 participants were needed at follow-up.

Intervention

The intervention programme aimed at the prevention and reduction of overweight and musculoskeletal symptoms, and was developed and implemented via the Intervention Mapping protocol [34,35]. The full programme has been described previously [34]. In short the intervention consisted of an on-site lifestyle coaching program tailored to the participant's weight status (BMI and waist circumference), physical activity level, and stage-of-change. The intervention program focused on improving (vigorous) physical activity levels and healthy dietary behaviour. The programme consisted of tailored lifestyle information, lifestyle coaching sessions, exercise instructions, and the 'VIP in construction toolbox'. This toolbox consisted of an overview of the company's health promoting facilities, a waist circumference measuring tape, a pedometer, a BMI card, a calorie guide, healthy recipes, and a lifestyle knowledge test.

The intervention was delivered face-to-face and via telephone by personal health coaches (PHC) who were trained specifically for the study. Face-to-face coaching sessions took place at the worksite during working hours. An overview of the timing and duration of the contacts is presented in table 1. Participants additionally received "Personal Energy Plan" (PEP) forms to record their goals and action plans, and to be used during the follow-up health coaching sessions. Intervention providers were not involved in the outcome assessment.

Table 1 Coaching contact schedule

PHC contact schedule	2 weeks	1 month	2 months	3 months	4 months
Pre-contemplation stage	Intake (60 min face-to-face)	Follow-up 1 (30 min; telephone)	Follow-up 2 (15 min; telephone)		Follow-up 3 (15 min; telephone)
Contemplation/ Preparation stage	Intake (60 min face-to-face)		Follow-up 1 (30 min; telephone)	Follow-up 2 (15 min; telephone)	
Action/maintenance stage	Intake (30 min face-to-face)			Follow-up 1 (10 min telephone)	

PHC = personal health coach

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The control group received care as usual and was only contacted for the baseline and follow-up measurements.

Outcome measures

The present study investigated the effectiveness of the intervention on musculoskeletal symptoms, physical functioning and work-related outcomes (work ability, work performance, work-related vitality, and sickness absence). Sickness absence data were obtained from the company's registration system after follow-up measurements were completed. All other data were obtained using questionnaires.

Health-related measures

Musculoskeletal symptoms

The prevalence of musculoskeletal symptoms during the past three months was assessed using the Dutch Musculoskeletal Questionnaire (DMQ), which has been validated for different body regions [36]. The occurrence of pain or discomfort was rated on a four-point scale (never, sometimes, frequently, and prolonged). For the current analysis the measure was dichotomized; answer categories 'frequently' or 'prolonged' were classified as having musculoskeletal symptoms, whereas categories 'never' or 'sometimes' were classified as having no musculoskeletal symptoms. Body regions were grouped into back (upper and lower back), neck/shoulders, upper extremities (elbows and wrist/hands), and lower extremities (hips/thighs, knees, and ankle/feet).

Physical functioning

Physical functioning was measured using a sub-scale of the RAND-36, evaluating functional status [37,38]. The RAND-36 cluster on role limitations caused by physical problems consists of 4 items, and ranges from 0-100 points (higher scores indicating less limitations), with a score of 79.4 considered average [38]. The RAND-36 health survey is a widely adopted, and reliable and valid measurement of health-related quality-of-life [39]. In the present study, the validated Dutch version was used.

Work-related measures

Work ability was assessed with the Work Ability Index (WAI) [40-42]. The WAI covers 7 dimensions; current work ability, work ability in relation to job demands, number of current diseases, work impairment due to diseases, sickness absence days during past 12 months, own prognosis of work ability in next two years, and mental resources. Total scores over all dimensions range from 7–49, with 4 categories: poor (7-27 points), moderate (28-36 points), good (37-43 points), excellent (44-49 points).

Work-related vitality, defined as vigour, was assessed through a subscale of the Utrecht Engagement Scale (UWES) that refer to high levels of energy and resilience, the willingness to invest effort, not being easily fatigued, and persistence in the face of difficulties [43]. The answers were rated on a 7 point scale from never (0) to daily (6). The mean score of the items resulted in the work-related vitality score, with a higher score indicating a better work-related vitality.

Work performance was measured using a single item from the Health Work Performance Questionnaire (WHO-HPQ)[44,45] asking workers to report their overall work performance on a 10-point scale over the past four weeks.

Sickness absence data were collected directly from company records. For the analysis, cumulative sickness absence data over 6-month periods were used (pre-, during-, and post-intervention). Sickness absence has a skewed distribution with a substantial fraction clustered at the value zero. Therefore, sickness absence was dichotomized into no or short-term sickness absence (<=7 days), and long-term sickness absence (> 7 days).

Statistical analysis

The analysis was conducted with all available subjects at 6 and 12 months of follow-up. All available data of the participants, regardless of whether or not they actually (fully) received the intervention, were used for analysis. Data on potential confounders and effect modifiers were assessed through the baseline questionnaire and included age, smoking status, education level, and marital status. For all variables potential baseline differences were checked between intervention and control group.

Linear and logistic regression analyses were performed for the different outcome measures, both with 6-month and 12-month follow-up as the dependent variables. Analyses were adjusted for the baseline levels. Analyses were performed using SPSS 20.0 (SPSS Inc. Chicago, Illinois, USA). For all analyses, a two-tailed p-value of <0.05 was considered statistically significant.

Results

In total, 314 workers responded to the baseline questionnaire. At 12 months follow-up, 83% of the participants completed all measurements; 22 workers of the control group (14%) and 31 workers of the intervention group (19%) did not complete all follow-up measurements. Figure 1 presents the flow chart of the participants throughout the trial. Baseline characteristics are presented in table 2. No differences between groups were found for key variables.

Table 2 Baseline characteristics

	All	Intervention	Control
Number of participants	N= 314	N= 162	N= 152
Age, mean (SD)	46.6 (9.7)	46.3 (9.9)	47.0 (9.5)
Current musculoskeletal symptoms			
Back (%)	28.3 (89/314)	32.7 (53/162)	23.7 (36/152)
Neck/shoulder (%)	20.1 (63/314)	20.4 (33/162)	19.7 (30/152)
Upper extremity (%)	13.4 (42/314)	15.4 (25/162)	11.2 (17/152)
Lower extremity (%)	28.7 (90/314)	29.6 (48/162)	27.6 (42/152)
BMI (kg/m^2)	27.4 (3.7)	27.3 (3.5)	27.4 (3.9)
Normal (<25) (%)	30.0	29.2	30.9
Overweight (25-29.9) (%)	47.3	50.9	43.4
Obese (>30) (%)	22.7	19.9	25.7
Smoking (Yes, %)	29.4	29.0	29.7

Table 3 shows complete cases intervention effects on work-related vitality, work performance, work ability, and physical functioning. For all outcome measures, a positive value for B, which represents the estimate (unstandardised coefficient) resulting from the regression analyses, can be interpreted as a positive intervention effect. No statistically significant differences were found for any of the outcome variables after 6 and 12 months of follow-up.

Table 3 Intervention effects for work-related vitality, work performance, and work ability after 6 and 12 months follow-up

	Intervention group (mean, SD)	Control group (mean, SD)	B	95%CI	p-value
Work-related vitality					
N	113	110			
Baseline	4.98 (0.90)	4.99 (1.04)			
6 months	5.01 (0.94)	4.83 (1.08)	0.19	(-0.02 ; 0.40)	0.081
12 months	4.82 (1.12)	4.82 (1.10)	0.01	(-0.22 ; 0.23)	0.938
Work performance					
N	113	116			
Baseline	7.6 (1.1)	7.9 (1.0)			
6 months	7.7 (0.8)	7.6 (1.2)	0.13	(-0.13 ; 0.38)	0.340
12 months	7.5 (1.4)	7.6 (1.4)	-0.08	(-0.45 ; 0.28)	0.656
Work ability					
N	99	93			
Baseline	40.6 (5.3)	40.8 (4.9)			
6 months	41.3 (4.1)	40.7 (5.2)	0.72	(-0.33 ; 1.77)	0.177
12 months	41.3 (4.7)	40.9 (5.1)	0.53	(-0.59 ; 1.65)	0.348
Physical functioning					
N	127	125			
Baseline	88.6 (25.3)	87.8 (26.7)			
6 months	88.0 (27.6)	88.0 (25.0)	-0.29	(-6.38 ; 5.79)	0.925
12 months	86.2 (28.7)	85.4 (28.8)	0.45	(-6.21 ; 7.10)	0.895

Musculoskeletal symptoms

The intervention did not result in statistically significant effects on musculoskeletal symptoms (table 4). Although for back symptoms at 6 and 12 months follow-up (OR 0.69, 95%CI: 0.36-1.36, and 0.76, 95%CI: 0.38-1.52, respectively) and lower extremity symptoms at 12 months (OR 0.61, 95%CI: 0.32-1.16) the odds ratios were in favour of the intervention group, differences reached no statistical significance.

Sickness absence

Table 5 shows mean days of sickness absence in the past 6 months and table 3 presents the course of sickness absence for the study group, dichotomized into no or short term, and long-term sickness absence. Directly following the intervention, the 6-month prevalence of long-term sickness absence was lower in the intervention group than in the control group. At 12 months sickness absence was slightly higher in the intervention group compared to the control group. However, at both 6 and 12 months the between group differences were not statistically significant.

Table 4 Intervention effects (OR (95%CI) or B (95%CI)) for musculoskeletal symptoms and sickness absence after 6 and 12 months follow-up

	Intervention group		Control group		OR	95%CI
	N	%	N	%		
Musculoskeletal symptoms						
Back symptoms						
Baseline	39	30.2	32	24.8		
6 months	25	19.8	30	23.4	0.69	(0.36; 1.36)
12 months	23	18.6	25	19.4	0.76	(0.38; 1.52)
Neck/shoulder symptoms						
Baseline	21	16.2	27	20.9		
6 months	20	15.8	24	18.8	0.92	(0.46; 1.84)
12 months	21	16.2	23	17.8	1.02	(0.50; 2.10)
Upper extremity symptoms						
Baseline	17	13.3	16	12.5		
6 months	12	9.6	11	8.7	1.18	(0.46; 2.98)
12 months	13	10.2	13	10.2	0.98	(0.42; 2.28)
Lower extremity symptoms						
Baseline	35	27.1	37	28.9		
6 months	31	24.6	29	22.8	1.16	(0.62; 2.19)
12 months	26	20.2	36	28.1	0.61	(0.32; 1.16)
Sickness absence						
Baseline						
No or short-term (<=7days)	87	69.0	94	72.9		
Long-term	39	31.0	35	27.1		
6 months					**0.86**	**(0.47; 1.58)**
No or short-term (<=7days)	100	79.4	100	77.5		
Long-term	26	20.6	29	22.5		
12 months					**1.19**	**(0.66; 2.15)**
No or short-term (<=7days)	94	74.6	101	78.3		
Long-term	32	25.4	28	21.7		

Table 5 Average number of sickness absence days for the intervention and the control group during 6 month periods before the baseline and follow-up measurements.

	Intervention				Control			
	N	Mean	SD	Median	N	Mean	SD	Median
Baseline	126	11.1	21.8	2.0	129	8.4	17.6	0
6 months	126	7.7	21.8	0	129	7.5	20.2	0
12 months	126	8.5	20.6	0	129	7.5	16.9	0

Discussion

The aim of this study was to evaluate the effectiveness on secondary outcomes of a health promotion intervention aiming at increasing physical activity and improving dietary behaviour in construction workers. No significant short- or long-term intervention effects were found on musculoskeletal symptoms, physical functioning, work-related vitality, work performance, work ability, or sickness absence. These findings will be discussed for the different outcome measures.

Musculoskeletal symptoms

The lack of observed statistically significant intervention effects on musculoskeletal symptoms is in line with other intervention studies in the construction sector [46-48]. Overall in the present study, the prevalence of workers reporting musculoskeletal symptoms declined. For back and lower extremity symptoms, odds ratios were in favour of the intervention group, although not statistically significant. Since sample size calculations were performed to determine effects on the study's primary outcome measure (body weight), for other outcome measures the study could have been underpowered.

In the current study it was hypothesised that an improvement in physical capacity through increased physical activity, and a decrease in workload through a reduction of overweight, would be effective in preventing or reducing musculoskeletal symptoms.
Although it is still not clear what type of exercise should be recommended, several reviews support the use of exercise as an effective strategy for the prevention or treatment of musculoskeletal conditions, including a wide range of interventions, such as increasing general physical activity levels, general exercise, and specific body-region exercises for strength and flexibility [49,50]. The current intervention consisted of a combination of exercise prescription and coaching on improving physical activity levels, which implied that participants self-selected their physical activity goals. Although an increase in vigorous physical activity in the intervention group was found, this may not have been exercise or physical activity selected for the purpose to prevent or reduce musculoskeletal symptoms, and might as a result not have been the most appropriate type of activity or exercise to reduce or prevent specific symptoms. Additionally, the increase in physical activity levels may not have led to sufficient physical capacity improvements to be effective on musculoskeletal symptoms.
Presumably, the effects on outcomes related to body weight, as found in this study, were not substantial enough to have a direct effect on MSD. Another explanation could be that the intervention period was not long enough for effects on MSD to occur. However, prevention of body weight gain or reducing excess body weight could have future effects by lowering both systemic and metabolic risk factors. Systemic risk factors include a combination of mechanical load on weight bearing joints and work postures. Obesity is one of the components of the

metabolic syndrome, and metabolic risk factors are increasingly being recognised as a possible cause of MSD [51,52].

To reduce or prevent musculoskeletal symptoms it has been suggested that multi-component interventions are potentially more effective [53]. In these programmes exercise or training interventions are combined with components addressing environmental and/or organisational issues. For example, the physical and psycho-social work environment has been recognised as risk factors for MSD in the construction sector. This is supported by findings from interviews with employees during the development of the present study as well as in the study of Oude Hengel et al. [34,54]. Combining health and lifestyle promotion with efforts to decrease workload and/or change working conditions is probably necessary for programs to be effective.

Work-related vitality, physical functioning, work performance, and work ability

In addition to the explanation of the lack of effect as described in the section on musculoskeletal symptoms, the initially high scores for work-related vitality, physical functioning and WAI could explain the lack of further detectable increase in these outcomes, i.e. a ceiling effect. For work-related vitality, this was also found in previous studies [55]. The lack of effect on the WAI in the current study is in accordance with previous studies on work ability [48,56,57]. The average baseline WAI score of 40.7 was only slightly higher compared to the average score of Finnish men in the same age group and engaged in physical work [58], and scores ranging from 37 to 43 are regarded as good work ability. For the physical functioning dimension of the SF-36, baseline values of the study population largely exceeded norm values of a reference population.

Sickness absence

With regard to sickness absence, the lack of effects is in line with other studies among blue collar worker [48,59]. During the trial period, several factors in addition to illness, which are related to sickness absence, may have influenced the results. Not all absence can be attributed to sickness; sickness absence has been associated with, for example, socioeconomic factors, organisational features, job content and attitudes to work [60]. This is especially of concern when using total sickness absence data, compared to absence related to a specific condition, such as MSD. The current economic recession, that strongly affected the construction sector during the trial period, may have distorted effects on total sickness absence or patterns of sickness absence. Stress, increased (perceived) workload, and fear of job-loss are factors that might have played a larger role under these circumstances during the study period.

For all outcome measures, the lack of intervention effects can in part be attributed to the level of implementation of the program. In a process evaluation of the program it was concluded that the extent to which the program was implemented as intended was modest [61]. Although participants' satisfaction with the program and dose delivered by the health coaches was high, exposure and fidelity were not optimal. The compliance to the coaching sessions was acceptable, but the implementation of the exercise component was not successful. Although approximately two thirds of the participants indicated to have done the exercises, only a small percentage exercised regularly as prescribed by the program.

The trial findings could be applicable to a larger population of manual labour workers. The intervention was implemented in a diverse group of blue collar workers with comparable participation rates for the subunits of the construction company. However, when generalizing the results from the specific setting of the RCT to a larger worker population, it should be taken into account that compared to the original population older workers were slightly overrepresented in the study population [61].

Strengths and limitations

Strengths of the study include the randomised controlled trial design, and obtaining sickness absence data from company records. The use of sickness absence data from company records is preferred since it is more accurate than data gathered via self-report [62].

Some limitations have to be addressed as well. First, power calculation was performed on the primary outcome measure of the study, i.e. body weight. As a result, group sizes might have been below the required number to establish inter-group differences for other study outcomes. Further, missing data on items of the work ability index resulted in a reduced number of complete cases. For participants who did not complete all 7 items, the index could not be determined. With exception of sickness absence, all outcome measures were obtained using self-report which may lead to over- or under-estimations of the outcomes. Finally, although contamination of the control group participants was expected to be minimal, since only intervention participants had access to coaching and the toolbox, it could not be completely ruled out. Behaviour change in colleagues working at the same worksites could have influenced control participants.

Implications for practice and future research

Maintaining a healthy and productive workforce depends on a wide variety of factors. It is recommended that future interventions aiming to improve work-related outcomes also include organisational and/or environmental components to more effectively target factors related to work ability and performance.

Theoretically, improving physical capacity (i.e. improving muscle function or increasing oxidative capacity) by increasing physical activity and exercise might prevent or reduce musculoskeletal symptoms. In the present study we did not include measures to monitor possible effects of increased physical activity levels on physical capacity. To increase knowledge on the relevance of increasing physical capacity in this group of workers and to contribute to insight into optimal type, duration and intensity of exercise, future studies should include such measures related to physical capacity.

Conclusion

The results of this RCT did not show effects of the programme on musculoskeletal symptoms, physical functioning, work-related vitality, work performance, work ability, or sickness absence. Although the intervention programme improved physical activity levels, dietary outcomes, and weight-related outcomes at 6 months, it was not successful in improving other health-related and work-related outcomes. In conclusion, for all outcome measures in the present paper it could be argued that they are affected by additional factors to those included in the current conceptual model of the study [34]. Based on the results of the present study, organisations attempting to improve worker health- and work-related outcomes should provide additional program components. Although a non-significant decline in musculoskeletal symptoms was observed, without co-intervening on (psycho-social) organisational aspects in a more multifaceted intervention, the potential of improving these outcomes by health promotion is probably limited.

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