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The Effects of Workplace Physical Activity Programs in Musculoskeletal Pain: A Systematic Review

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Abstract

Objectives: To review the effectiveness of Physical Activity (PA) interventions in the workplace to reduce musculoskeletal pain in employees.

Methods: Four databases (PubMed, EBSCO, Web of Science, and Cochrane) were searched for trials among employees for the period of January 1990 and March 2013, which included comparison groups that assessed physical activity programs, musculoskeletal pain. We examined articles with comparison groups that assessed Physical Activity programs and musculoskeletal pain.

Results: We can see in the several studies a significant evidence of pain decrease in intervention groups in studies of general pain and in neck and shoulder pain. The few studies covering low back pain and arms, elbows, wrists, hands or fingers pain do not present sufficient statistical significant evidence.

Conclusion: There is consistent evidence that workplace PA interventions significantly reduce general musculoskeletal pain and neck and shoulders pain. More studies are required to provide clarification of the effectiveness of work related PA interventions in musculoskeletal disorders and related pain.

Keywords: Physical activity; Pain; Workers; Systematic review

Introduction

Technological advances after the Industrial Revolution had a decisive influence on the way of life and human health. The division of labour in sectors and the consequent "obligation" of the worker to perform a task repetitively during the work day or stay for long periods of time in a posture causes pain, physical discomfort and musculoskeletal disorders (MSDs) [1,2]. The World Health Organization (WHO) characterizes the injuries related to work has multifactorial diseases because they involve a broad of different causes and risk factors, such as: ergonomics, work organization, workplace environment, physical, psychological and social changes [3].

MSDs are injuries or dysfunctions affecting muscles, bones, nerves, tendons, ligaments, joints, cartilages and spinal discs; which include sprains, strains, tears and connective tissue injuries [4,5]. In this context musculoskeletal health represents not only specific disorders, but also the continuum of normal and abnormal age-related physiological modifications in muscle, bone, and joint function, in addition to fitness-related performance capacity concerning strength, mobility, and bend over muscle mass.

Concerning musculoskeletal functioning and pain symptoms among the working population the prevalence of subjective complaints is high in the Nordic European countries: 35% reported low back pain, 3% reported pain in the arms/shoulders, 32% reported neck pain, 22% reported pain in the upper back and 21% reported pain in their feet [6].

From a public health point of view workplace health promotion (WHP) initiatives are a very important concern [7]. WHP are designed to promote health by reducing health risks and actively preventing the beginning of disease. They typically include interventions and programs designed to decrease stress, high blood pressure and cholesterol, excess of body weight, smoking and alcohol consumption, improve nutrition, and increase physical activity (PA) and fitness levels. Some of them also offer cancer screening, health risk appraisals, cooking classes and a variety of health education activities. Reviews of the effectiveness of many of these interventions have shown mainly positive results [8]. Moreover, WHP have demonstrated improvements in the leading global risk factors for chronic disease, which has led to their increasing role in chronic disease prevention [9]. Indeed, in the last 20 years, the number of health promotion programs in workplace settings has continued to grow. This growth can be attributed to the increased awareness of the advantages of having quality health promotion programs available for employees [10]. Therefore companies consider that these programs can reduce employee health care costs, disability, and staff renewal rate; aid in recruiting new workers; enhance the company image; and improve employee productivity [11]. Skilled employees who are well compensated, have pleasant work environments, and enjoy their work can still have very low productivity when they are absent from work because of poor health [11].

In the literature there are some well-documented effective initiatives that included diet programs for reducing weight and PA programs for improving physical capacity and reduce musculoskeletal pain among workers [12-15]. PA interventions improve muscle strength, stretching and postural control such as coordination training which may be particularly relevant for preventing osteoarticular deterioration and musculoskeletal pain in workers [12-16].

PA and multidisciplinary interventions (e.g. diet and ergonomics) seem to have a positive effect on the prevention of some MSDs, and comprehensive treatment interventions seem have an effect on sick

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leave, costs and prevention of new episodes of pain and physical discomfort and consequently MSDs [17-19]. It appears that there are advantages in adopting active lifestyles, both at individual and professional/employment [20].

Generally, health promotion programs are having some success in reducing employee health risks, but changing human lifestyles is really an arduous assignment [14,21].

PA intervention programs may have a positive impact both in the perspective of the employee and in the perspective of the employer. Therefore, it is necessary to analyse the effects these programs may have in real workplace settings. Several studies have been developed focusing on workplace interventions based on different health promotion strategies. PA interventions in workplaces may have specific objectives for individuals(Sjögren, 2006) and employers, namely:

- For the individual - improve functionality, physical endurance, muscle strength, joint mobility and self-image, reduce localized pain, depression and social isolation, correct poor posture, increase bone density, self-esteem, maintain autonomy, relieve stress.
- For the employer - increase productivity, improve the institutional image, and reduce turnover, absenteeism and medical costs [18].

In this context, the aim of this study was to examine whether PA intervention in workplace reduce musculoskeletal pain in employees compared with employed without intervention program by the revision of randomized controlled systematically review the effectiveness of PA interventions (Tables 1 and 2).

Methods

Data sources and searches

A literature search was conducted in April 2017 in the following

References	Study details	Intervention details	Outcome measures	Main findings
[23]	Exercise group: n =58	Exercise program: Coordination exercises were included throughout the session. The session ended with a "warm-down" and specific stretching exercises.	Back pain	This study has shown that a weekly exercise program has resulted in a reduction of sick leave for people with relatively short (<50 days) episodes of back pain. The majority of patients who develop chronic back pain have previously had repeated short episodes of back pain. This study demonstrated that it is possible to reduce sick leave by 50%; therefore, it is probable that the number of patients developing chronic back pain can also be reduced.
	Control group: n =53	Additional exercise and Cardiovascular fitness, 1 hour per week during working period for six months.	Cardiovascular fitness	
	Mean age = 41 years old (intervention group); 42 years old (control group)			
	Duration of the intervention= 18months			
[24]	N=76	Self-report questionnaires concerning job stress, job satisfaction and trait anxiety. The procedure was repeated for the POST test in December, following the train were filled out by each subject alone and returned the day after.	Aerobic capacity	Aerobic exercise resulted in significantly increased aerobic capacity.
	Age range= 25-67 years old	An aerobic training session, lasting for 55 minutes, was given two times/day (The programmes aimed at improving physical capacity, muscle strength, flexibility, and relaxation of neck, back and shoulder muscles. Level and intensity were modified to meet the capability of each individual and the particular group. The exercise was dynamic and rhythmical at moderate intensity.) Stress Management Training. A cognitive behavioural stress management programme was offered to the second group, concurrently during the day, with the same frequency and duration as the physical exercise programme (55 mind3 per week).The control group was not offered any programme during the study, but was promised participation in an exercise programme after three months.	Well-being	Improved feelings of well-being and significantly decreased complaints of muscle pain.
[25]	Mean age = 33 ±9 years old	The Feldenkrais Intervention (F-group) had as aims the increased body awareness, coordination, and control. The Feldenkrais intervention includes a certain pedagogic approach, which has been labelled somatic education that emphasises learning based on the experience of the individual subject. In consequence, the terms "instructor" and "student" are used instead of "therapist" and "patient." The intervention was done individually four times and in a group (7 to 8 subjects per group) 12 times.	Neck	The intervention was associated with significant positive changes in the complaints from the neck and shoulders (i.e., the neck-shoulders-index) while tendencies to worsening was found for the C-group. Neck and shoulders complaints in the previous 7 days decreased significantly in the F-group. The PT- and C-groups generally had higher prevalence of complaint for the other prevalence periods. Neck complaints in the previous 7 days increased in the two other groups, while shoulder complaints in the previous 7 days were unchanged. The changes in sick leave were not significantly different across groups but in the intervention groups, sick leave tended to decrease while the opposite tendency was found in the C-group. The study showed significant positive changes in complaints after the intervention but not after the physiotherapy intervention
	Duration of the intervention= 16 weeks	In the Control Regime (C-group) no intervention was made for the subjects randomized to this group.	Shoulders (prevalence, pain intensity, sick leave, and disability in leisure and work roles)	

[16]	n= 102 women Mean age = 38 years Duration of the intervention= one-hour sessions, three times a week for ten weeks.	Women were randomized to strength, endurance, co-ordination and non-training groups. Strength training group Endurance training group. Co-ordination training group Non-training group. All group activities were performed during working hours, except for subjects in shift work for which training sessions could occur during leisure time. All training sessions started with a 15-min warming up, followed by 40 min of specific exercises. Strength and endurance training sessions ended with stretching of exercised muscles while training sessions for the body awareness group ended with a 5 min verbal summary of individual experiences.	Trapezius myalgia	The study indicates that regular exercises with strength, endurance or co-ordination training of neck/shoulder muscles might alleviate pain for women with work-related trapezius myalgia.
[26]	n = 282	Female nursing aides and assistant nurses working in the home-care services, were randomly assigned to one of three groups for: (1) individually designed physical training programme (exercises were individually adapted and individual goals were formulated), (2) work-place stress management, (3) control group (participants were requested to live as usual)	Musculoskeletal disorders	The results revealed no significant differences between the three groups.
	Aged to 24-60 years old		Neck, shoulder and back pain	However, improvements in low back pain were registered within both intervention groups for up to 18 months. Perceived physical exertion at work was reduced in the physical training group. Improvements in neck and shoulder pain did not differ within the three groups.
	Duration of follow-up= 12 and 18 months.		Pain-drawing	Dissatisfaction with work-related, psychosocial factors was generally increased in all groups.
[27]	n=183	183 hospital employees with chronic low back pain (LBP) were randomly assigned either to back school (Comparison group), or three months supervised physical training including a back school (exercise group).	Low back pain.	Supervised physical training effectively improved functional capacity and decreased LBP and disability up to one-year follow-up. The subject's positive evaluation of the treatment effect at ten-year follow-up suggests a long-term benefit of training.
	Mean age = 38±8 years old (intervention group) and 39±10 years old (control group)	Various measurements of functional ability were performed and subjects completed questionnaires on self-rated pain, disability, and general well-being before treatment, immediately after intervention, and at 6 months follow-up. At one-year and at ten-years follow-up participants evaluated treatment effectiveness.		
	Duration of the intervention= three months			
[28]	n=53 (43 women and 10 men)	The cross-over design consisted of physical exercise intervention (15 weeks) and no intervention (15 weeks).	Headache	Physical exercise intervention resulted in a slight, but statistically significant, decrease in the intensity of headache and neck symptoms, as well as an increase in the extension strength of the upper extremities.
	Mean age = 47.1 years old	The subjects (n=53) were office workers who reported headache (n=41) symptoms in the neck (n=37) or shoulders (n=41), which had restricted their daily activities during the last 12 months. Pain symptoms were measured using the	Intensity of symptoms in the neck and shoulders	The intervention had no effect on the intensity of shoulder symptoms or the flexion strength of the upper extremities. Specific exercise may be clinically important to alleviate headache and neck symptoms.
	Duration of the intervention= 15 weeks	Borg CR10 scale and muscular strength with a 5RM test.	Extension and flexion strength of the upper extremities	
[22]	n = 36	The subjects were office workers, who self-reported low back symptoms, which restricted their daily activities during the last 12 months.	Intensity of low back symptoms	The active component of the intervention, light resistance training, resulted in a slight, but statistically significant, decrease in the intensity of low back symptoms ($p = 0.020$). At the average training time of 5 minutes per working day (25 min/week) the average decrease during the 15-week period.
	Mean age = 47.1 years old	Low back symptoms were measured using the Borg CR10 scale.		A physical exercise intervention, which included daily light resistance training, conducted during the working day affected low back symptoms in a positive direction among symptomatic office workers.
	Duration of the intervention= 15 weeks	The cross-overdesign consisted of one intervention period of light resistance training and guidance and no training and no guidance of 15 weeks duration.		
[29]	Were done 3 groups: specific resistance training (SRT, n = 180), all-round physical exercise (APE, n = 187), and reference intervention (REF, n = 182)	Physical tests were performed and questionnaires answered at pre-, mid- and post intervention. The main outcome measures were compliance, changes in maximal muscle strength, and changes in intensity of neck/shoulder pain (scale 0–9) in those with and without pain at baseline.	Neck/shoulder pain in office workers	Compliance was highest in SRT but generally decreased over time. SRT and APE caused increased shoulder elevation strength, were more effective than REF to decrease neck pain among those with symptoms at baseline, and prevent development of shoulder pain in those without symptoms at baseline.
	Aged to 45-49 years old			
	Duration of the intervention= 1 year			

[30]	n = 192 study group and 192 control group	Study group: educational and physical programme.	Neck and shoulder pain	This study suggests that an educational and physical programme reduces headache and neck and shoulder pain in a working community.
	Aged to 35-53 years old	The primary end-point was the change in frequency of headache and neck and shoulder pain expressed as the number of days per month with Pain. The number of days of analgesic drug consumption was also recorded. Diaries completed for the whole 8 months were available for 169 subjects in the study group and 175 controls.		
	Duration of the intervention= 8months			
[18]	n = 40	The intervention group participated in an Integrated Health Programme twice weekly during working hours. The programme consisted of physical exercise, stress management training, health information and an examination of the participants' workplace.	Reduce sick leave	There were no statistically significant effects on sick leave or health related quality of life. The intervention group reported fewer neck complaints compared to the control group, but otherwise there were no effects on subjective health complaints. The subjective effects were large and highly statistically significant, the intervention group reporting improvement in health, physical fitness, muscle pain, stress management, maintenance of health and work situation. The Integrated Health Programme was not effective in reducing sick leave and subjective health complaints, but may be of use to employers wanting to increase employee job satisfaction and well-being.
	Age= not reported	The control group was offered the same intervention after the project was finished.	Subjective health complaints	
	Duration of the intervention= 9 months			

CAL- calisthenics program; BS- Back school; LBP- low back pain; MMCBT multimodal cognitive behavioural treatment; SRT- specific resistance training; APE- all-round physical exercise; REF- reference intervention

Table 1: Characteristics and outcome measures of intervention studies examining the association between PA programs and musculoskeletal pain.

First Author and Publication Year	Was the study population adequately described? (i.e. were the important characteristics of the randomized participants described, e.g. age, gender?)	Was there intention to treat analysis used? (i.e. were all participants who were randomized included in follow-up and analysis?)	Were the participants allocated using random number tables, coin flip, computer generation?(RCT)	Was the randomization process concealed from the investigators?	Was an estimated effect size reported? (e.g. mean diference)	Was precision of effect size estimated? (confidence intervals)	Were summary data presented in sufficient detail to permit alternative analysis or replication?
[16]	Y	N	N	NA	N	N	Y
[29]	Y	Y	Y	Y	NR	N	Y
Donchin, 1990	Y	Y	NA	Y	Y	N	N
Genaidy, 1995	Y	Y	NR	Y	N	N	Y
[24]	Y	Y	NA	Y	Y	N	Y
Gundewall, 1993	Y	Y	NA	Y	Y	N	Y
Haldorsen, 1998	Y	Y	NR	Y	NR	Y	Y
Hartfiel, 2012	Y	Y	NR	Y	NR	Y	Y
[26]	Y	Y	NR	Y	Y	N	Y
[23]	Y	Y	NR	Y	NR	N	Y
Larsen, 2002	Y	Y	NR	Y	NR	N	Y
Linton, 2000	Y	Y	Y	Y	Y	N	Y
[25]	Y	Y	NR	Y	N	N	Y
[27]	Y	Y	Y	Y	NR	N	Y
[30]	Y	Y	NA	NA	N	Y	Y
[28]	Y	Y	NR	Y	NR	N	Y
[2]	Y	Y	NR	Y	NR	N	Y
[18]	Y	Y	NR	Y	Y	Y	Y
[33]	Y	Y	Y	Y	Y	Y	Y

Y – yes; N- no; NR – not reported; NA – not applicable
* Included in meta-analysis

Table 2: Risk Bias Summary.

databases: PubMed, EBSCO, Web of Science, and Cochrane for the period of 1990 to 2017. Only studies that focus on effectiveness of Physical Activity (PA) interventions in the workplace to reduce musculoskeletal pain in employees were considered given the study aim.

Additionally, articles were identified through reference searches of recent literature reviews. The articles with comparison groups that aimed to decrease musculoskeletal pain through PA programs were examined. The key words used were ("physical activity") AND ("work") AND ("pain") AND ("trial" OR "random*"). Additionally, the references of some review articles were considered to identify potential interesting studies not found in the electronic search. Citations were entered into the reference management software EndNote, version X6 (Thomson Reuters, Carlsbad, CA, USA).

Study selection

The titles and abstracts of studies identified in the electronic searches (1675 reports) were examined by two authors (IS) in order to remove duplicates and irrelevant reports. The first screening based on available full access and duplicates text criteria resulted in 1345 records. Following the criteria for inclusion were titles and abstracts. Four investigators (IMS, SA) independently evaluated articles for inclusion based on title and abstract review, and then full text review. A fourth investigator (JM) served as tie breaker in case of discrepancy. Studies were included if they had a control or other comparison group and evaluated outcomes of comprehensive worksite wellness programs (i.e., multiple wellness components focused on health promotion or disease and pain prevention). We excluded opinion and theory articles, articles without a comparison group and those written in non-English language.

Data extraction and quality assessment

Data extraction was completed using a coding frame to record information on a range of details. We extracted type of intervention, setting, and research design from each study. Programs and worksites were classified by musculoskeletal pain type outcome. The major categories of variables coded included source characteristics (e.g. country, publication year), study design (e.g. number of participants, follow-up length, randomization, and intent-to-treat analysis), sample characteristics (e.g. gender, age, health and/or functional status), intervention (e.g. type, frequency and duration of the interventions), variables and outcome measures (mean differences and standard deviations). The methodological quality of the studies was assessed an adaptation of the Cochrane risk of bias assessment tool. We categorized the quality of the design in relation to controlled trials with random assignment, prospective studies with non-randomly assigned comparison groups, and observational designs with internal comparison groups (e.g., participants vs. nonparticipants). Assessment of risk of bias in included studies namely: sequence generation, allocation concealment, blinding, incomplete outcome data, and selective outcome reporting is presented in Table 1. 'Yes' indicates low risk of bias, 'No' indicates high risk of bias and 'Not Reported' indicates unclear or unknown risk of bias.

Results

A total of 12 studies were identified for inclusion in the review (Figure 1). The search of PubMed, EBSCO, Web of Science, and Cochrane databases provided a total of 1675 citations. After adjusting for available full access and duplicates text criteria 1345 citations remained. Of these, based on eligible criteria 1319 were excluded after reviewing the abstracts and titles remained 26 citations. Of these, 7 studies were not RCT. According to the qualitative criteria 7 articles did not reach them, thus, only 12 remained to the systematic review.

In Table 1 were presented the characteristics and outcome measures of intervention studies examining the association between PA programs and musculoskeletal pain (Figure 1).

Discussion

In a analysis of twelve studies the findings suggested that there is moderate quality of evidence that workplace PA interventions significantly reduce general musculoskeletal pain. Additionally, there is low quality of evidence that workplace PA interventions significantly reduce low back (Maul, Läubli, Oliveri, & Krueger, 2005)and arms, elbows, wrists and hands/fingers pain [22-28]. These results can be related with the lack of studies. Globally, these results provide evidence favouring PA intervention programs, in labour context, in diminishing self-reported musculoskeletal pain [26]. These findings emphasize the on-going interest for research in this area and the rationale for this review.

PA and multidisciplinary interventions (e.g. diet and ergonomics) seem to have a positive effect on the prevention of some MSDs, and comprehensive treatment interventions seem have an effect on sick leave, costs and prevention of new episodes of pain and physical discomfort and consequently MSDs [17-31]. It appears that there are advantages in adopting active lifestyles, both at individual and professional/employment [14,20].

PA intervention is a helpful feature to consider when dealing with some issues currently experienced by companies. However, some evidence suggests that PA interventions in the workplace may not have a significant positive impact in bio psychosocial factors particularly, in reducing musculoskeletal disorders and associated symptoms (i.e. pain) [25,28]. Such results may be influenced by small sample studies and other constrains associated with the implementation of controlled trials to assess health interventions in workplaces. In this context, this review may contribute to evidence based practice of the prevention of MSDs and pain [16,26].

Conclusion

Despite its limitations, this is the literature review to focus on workplace interventions for populations with general musculoskeletal pain; there is consistent evidence that workplace PA interventions significantly reduce general musculoskeletal pain [16] mostly in some specific body regions such as: neck and shoulders [29,26,25,30].

Although it is important to target the general work health promotion efforts, workplace interventions (e.g. PA interventions) may be more beneficial if they purposively recruit and serve at-risk employees (e.g., to address conditions that may reduce work productivity, absenteeism, and healthcare costs) [24]. Findings from this review highlight the diverse strategies used to improve health and wellbeing in workplace settings.

More studies are required to provide clarification of the effectiveness of work related PA interventions in musculoskeletal disorders and related pain in body regions.

Implications for practice

This review showed that interventions focusing on improving workplace PA are moderately effective in reducing musculoskeletal pain of employees.

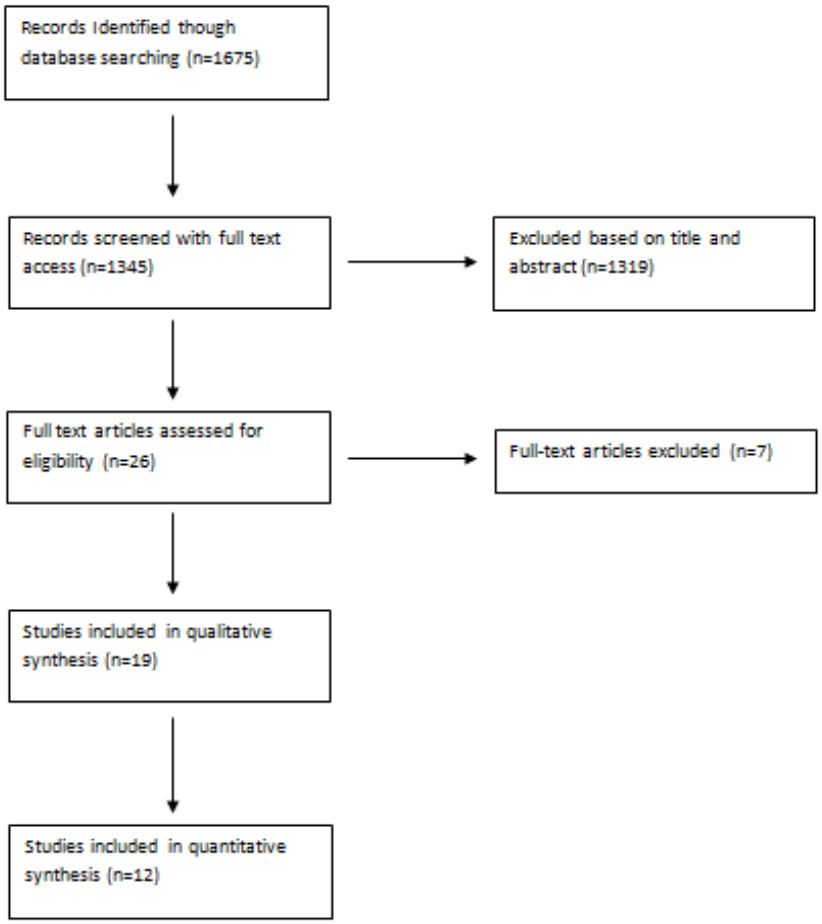

Figure 1: Systematic review.

These effects can be generalized to the worksite setting. However, we were not able to assess differences among subgroups of employees. Nevertheless, the prevention must be considered. The effect of musculoskeletal pain prevention on a population level may be substantial, but the influence and perceptible benefits on the health of generally persons is quite small. For one person to have advantage, many people have to change their behaviour [32]. Moreover, a public health policy report in the Netherlands determined that a broad implementation of PA in combination with dietary interventions may realistically reduce the prevalence rate of overweight by 1–3 percentage points and the prevalence of inactivity by 1–2 percentage points over 5 years. In this line, it was estimated that 15 000 to 41 000 diabetes cases, 17 000 to 40 000 heart disease cases, and 43 000 to 100 000 musculoskeletal disorders can be prevented during the next 20 years [1,32,33].

Consequently, these studies support the use of PA interventions, to prevent and decrease musculoskeletal disorders and related pain among workers.

Implications for researchers

The efficacy of workplace PA interventions in achieving small reductions of musculoskeletal pain that was showed in this study seems reasonably credible, and more convincing than in previous reviews. Moreover, when more studies are available, we may find more PA components that contribute to reducing musculoskeletal pain. In addition, better evidence is needed to understand the impact of incentives for program participation, behaviour change, and risk factor reduction. Investigations should also examine the impact of interventions on important worksite-related outcomes that influence worker productivity, including absenteeism, stress levels, and job satisfaction.

Future studies will need to be based on strong evaluation designs, sufficient follow-up, detailed report randomization procedures, blinding procedures, co-intervention and intention-to-treat analysis, in order to gain insight in methodological quality.

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Declarations of Interest

The authors declare that no conflict of interest was present.

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