

Review

Promoting physical activity in the workplace: A systematic meta-review

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Abstract: Introduction: Physically active (PA) people have a lower risk of various diseases, compared to those with sedentary lifestyles. Evidence on the effects of PA promoting programs in the workplace is large, and several systematic reviews (SR) and/or meta-analyses (MA) have been published. However, they have failed to consider factors that could influence interventions. This paper aimed to classify and describe interventions to promote PA in the workplace based on evidence from SR/MA. **Method:** A literature search for SR/MA was done using PubMed, Web of Science, and Science Direct (January 2006-February 2015). Quality assessment of SR/MA was performed using AMSTAR. The PRECEDE-PROCEED model was used for classifying the interventions into predisposing, enabling, reinforcing, environment, and policy domains of focus. **Results:** Eleven SR/MA included 220 primary studies, of which 139 (63%) were randomized controlled trials. Of 48 interventions identified, 22 (46%) and 17 (35%) focused on predisposing or enabling employees to have more PA, respectively. Of the 22 predisposing factors, 6 were information delivery, 5 were self-motivation, and 11 were program training. The enabling approaches were 12 instrument resources and 5 health service facilities. The reinforcing approaches were 4 incentive and 3 social support. The remaining interventions focused on the environmental development and policy regulation. **Conclusions:** This systematic meta-review classified interventions using appropriate framework and described the intervention pat-

tern.

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Introduction

Workplace health promotion programs are designed to increase physical activity (PA) and improve workers' dietary habits. The World Health Organization and World Economic Forum¹⁾ have indicated that the workplace is an ideal setting to implement promotion programs to reduce obesity, diabetes, and cardiovascular disease risk factors in the workforce. The significance of health promotion in the workplace was updated in 1995 in a joint International Labor Organization/World Health Organization session on occupational health²⁾.

Previous research has evaluated workplace health promotion programs in terms of a focus on nutrition³⁻⁵⁾, PA⁶⁻⁹⁾, stress management¹⁰⁻¹²⁾, and tobacco cessation^{13,14)}. Of particular interest, the workplace has the potential of reaching a significant proportion of employed adults¹⁵⁾, and this group of adults spends a large proportion of their time at work. Therefore, the workplace is an ideal target area to promote health behaviors of worker populations and to conduct repeated multilevel interventions to influence health behavior.

Several systematic reviews (SR) and/or meta-analyses (MA) evaluated numerous interventions that promoted PA in the workplace¹⁶⁻²⁰⁾. However, they still failed to consider the factors that could be used designate such interventions. Therefore, this meta-review aims to classify and describe the intervention factors to promote PA in the workplace based on the evidence from systematic re-

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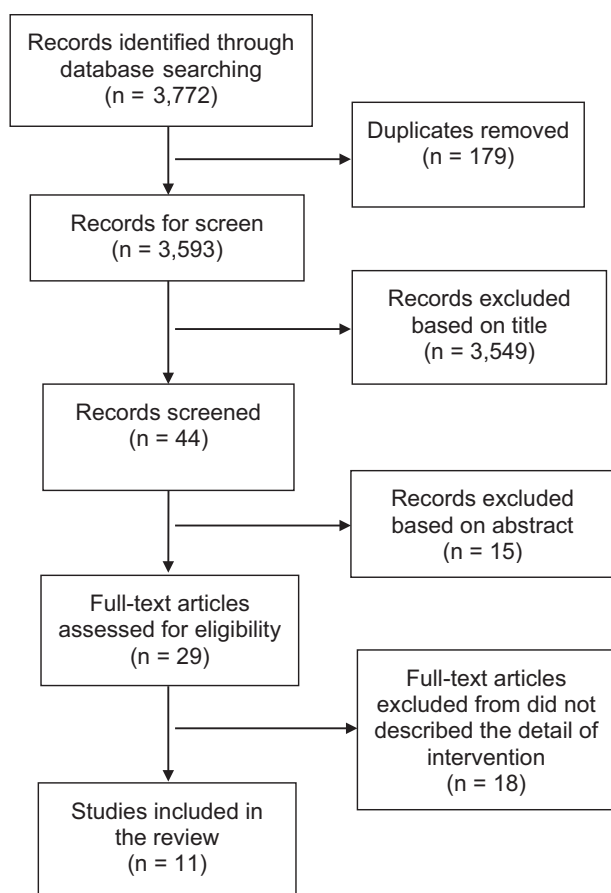


Fig. 1. Flowchart of Systematic Search Findings

views. The findings of this study could be used to uncover the intervention factors to optimize improvements in PA in workplace settings.

Methods

Search Strategy

This meta-review was performed following the published guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)²¹. Candidate articles to be used in the review were initially screened and selected from published SR/MA archived in PubMed, Web of Science, and Science Direct data bases from January 2006 through February 2015. The candidate articles were retrieved from the databases using the following search terms: (“employee” OR worker OR “white collar” OR “white collar” OR “blue collar” OR “blue-collar” OR “workplace” OR “worksites”) AND (“physical activity” OR “physical activities” OR “exercise” OR “physical exercise” OR “physical fitness” OR “physical education and training” OR “motor activity” OR “program” OR “programs” OR “intervention” OR “interventions”) AND (“systematic review” OR “meta-analysis”).

Selection Process

Titles and abstracts of the candidate articles were screened by the two investigators for relevant published articles to be used for this meta-review. The screened articles were chosen based on inclusion and exclusion criteria; any duplicated articles were rejected. Criteria for the candidate articles to be selected were (a) systematic reviews or meta-analysis articles that included randomized control trial, quasi-experimental, or observational studies, (b) published in English, and (c) the article focuses on PA. Candidate articles were excluded from the study when the articles did not describe details of PA intervention programs.

Quality Assessment

An empirically developed checklist called AMSTAR²² was used to assess the quality of the final selected articles. The AMSTAR questionnaire is composed of 11 items and each item can have a score of either 0 or 1 depending upon whether the article met the AMSTAR criteria. The AMSTAR score of 4 or less is considered to be low quality, 5 to 8 is considered to be moderate, and 9 or greater is considered to be a good methodological quality article²³. Assessment of the data quality of the selected articles was conducted and verified by independent co-researchers, any disagreements were resolved through discussion.

Data Extraction and Analysis

Data extracted from the articles included: study design, population, and intervention characteristics. All data were presented using a narrative summary of the results. Extracted intervention characteristics were categorized according to the PRECEDE-PROCEED model²⁴.

Results

We reviewed 3,772 candidate articles. After removing 179 duplicated articles, 3,549 and 15 articles were excluded based on title and abstract, respectively (Fig. 1). Full text documents of the remaining 29 articles were retrieved and underwent quality assessment.

Eleven published articles were evaluated²⁵⁻³⁵. Eight articles were classified as SR^{25-28,30,31,34,35}, two as MA^{29,33}, and one as both SR and MA articles³². These reviews analyzed 235 primary studies (PS) and 220 PS related to PA, of which 139 were randomized controlled trials (RCT), 23 non-randomized controlled trials (non-RCT), 15 cohort, 11 quasi-experimental, eight pre-post intervention, six studies of controlled trial, prospective randomized trials, and randomized trials (RT), three non-randomized trials (non RT) and cross-sectional studies were evaluated.

Study Quality

The median AMSTAR score of the 11 articles was 9. Six reviews were of good quality^{27,29-31,33,35}, four reviews

Table 1. Study Characteristics of Included Studies

Authors (Year)	Type of study	No. studies reviewed	No. studies related PA in workplace	AMSTAR score (quality)
Abraham & Graham-Rowe (2009)	Systematic review & Meta-analysis	37	37	8 (moderate)
Robroek et al. (2009)	Systematic review	23	21	8 (moderate)
Groeneveld et al. (2010)	Systematic review	31	24	8 (moderate)
Verweij et al. (2011)	Meta-analysis	22	21	10 (good)
Barr-Anderson (2011)	Systematic review	11	11	8 (moderate)
Freak-Poli et al. (2013)	Systematic review	4	4	11 (good)
Wong et al. (2012)	Systematic review	13	12	9 (good)
Gudzune et al. (2013)	Systematic review	9	9	9 (good)
Rongen et al. (2013)	Meta-analysis	18	14	10 (good)
Zacharia et al. (2013)	Systematic review	9	9	3 (low)
Malik et al. (2014)	Systematic review	58	58	9 (good)

were of moderate quality^{25,26,28,32}, and one review was of low quality³⁴. The inter-rater reliability for agreement on review quality was high (Kappa 0.82)³⁶. The most common reasons of point deduction were (1) no included and excluded studies were listed (9 studies), (2) publication bias was not assessed (8 studies), and (3) conflict of interest was not declared (4 studies) (Table 1).

Population Characteristics

Review sample sizes ranged from 1,809 to 76,465. Nine reviews^{25-30,32,33,35} listed details about workplace settings which were as follows:

1. Health service included health insurance, dentistry, home care services, ambulance service, public dental health organization, and hospital.
2. Government included postal services, NASA / Johnson Space Center, government offices, legal offices, taxation offices, socio-cultural organizations, fire brigade stations, public sector, police force, career army personnel, municipal services, and civil service.
3. Company/workplace/ industry/factory included pharmaceutical industries, national business, telephone company, automotive manufacturing plants, chemical industries, food corporations, commercial services, bank, bus company, business corporation, printing company, and building company.
4. Educational institutions included universities, colleges, and schools.
5. Private sector included casinos, and laundry services.

Intervention Characteristics

Interventions aimed to change multiple behaviors. There was a mix of nutrition/dietary programs^{26-30,33-35}; stress (mental health) management programs³⁴; weight control programs^{27,33}; and smoking cessation programs^{27,28,33}. Each primary study (PS) may have used one

or more interventions.

We classified the intervention factors by using the PRECEDE-PROCEED model²⁴. The intervention factors could be classified into five domains: Predisposing, Enabling, Reinforcing, Policy Regulatory, and Environmental Development.

Predisposing Domain

Predisposing domain aims to change knowledge, skills, and attitudes to PA. These could be influenced by the different forms of information delivery: mass media, education, teaching, training, counselling, and guidance³⁷. Therefore, this domain can be classified into three components as information delivery, self-motivation, and program training. We found nine reviews from 270 PS had used predisposing interventions²⁶⁻³⁴.

Component 1: Information Delivery

This component contained all interventions that used knowledge and information such as health education/information, lectures, information provision, behavior demonstration, counselling/advice, professional contact/coach visits, and cognitive restructuring. In this component, most interventions used counselling/advice (40/114), information provision/behavior demonstration (37/114), and health education/health information (29/114) respectively. Two good quality reviews^{30,33} suggested counselling. Rongen et al. concluded that counselling was less effective, while Gudzune et al. found combining personalized counselling with the promotion of a healthy lifestyle may be a promising strategy.

Component 2: Self-motivation

This component concerns a person's perception of his ability to engage in PA³⁷ and is described in terms of goal setting, self-monitoring/self-management, action planning, set grade task, and scope of planning. About 82 PS used this component with goal setting (40/82) and self-monitoring/self-management (21/82) being the most com-

mon interventions, respectively, in this group. One moderate quality review³²⁾ suggested goal setting may enhance fitness gains.

Component 3: Program Training

Program training enabled people to participate in teaching, training, and guidance. A total of 11 training programs related to fitness, physical exercise, aerobic dancing program, strength training, muscle relaxation, walking, lifestyle, resistance training, stress management, time management, and biking. The bulk of these programs were physical exercise programs (31/74) while strength training, muscle relaxation, resistance training, time management, and bike programs accounted for fewer programs. One moderate quality review²⁸⁾ concluded that an exercise program was strong evidence for a positive intervention effect on body fat but had no effect on a hip circumference. Nevertheless, one good quality review³³⁾ suggested exercise programs did not influence the effect of workplace health promotion programs.

Enabling Domain

Enabling domain targeting individuals and communities aimed to increase availability and accessibility of resources or services that facilitate motivation to change behavior. All review studies had used enabling interventions²⁵⁻³⁵⁾. A total 17 enabling interventions from 132 PS could be classified into two components: instrument resource and health service facilities.

Component 1: Instrument Resource

This component included the devices for recording, measuring, or controlling, especially devices functioning as part of a control system. Most of the interventions used instrument resources for matching one's ability to perform PA. Instrument resources in this study were pedometer/accelerometer, print material, weight watcher, diary, measuring tape, message, work book/lock book/booklet, video, email, webpage/website/web-based, CD-ROM, and intranet. It was found that 75 PS had used instrument resources. The results showed print material (24/75) and pedometer/accelerometer (11/75) were the most common instruments used to promote PA. One low quality review³⁰⁾ showed using internet-based instruments in the workplace appeared to be effective.

Component 2: Health Service Facility

This component describes government systems or private organizations that provide facilities for particular types of activities, or for providing things that people need. The health facility interventions included coaching, feedback, barrier identification/problem solving, using follow-up prompts, and health assessment/screening/checks. Fifty-seven PS used health service facilities. The findings also showed that most interventions consisted of health assessment/screening/health checks and feedback.

Reinforcing Domain

Reinforcing domain interventions targeting individuals and communities aimed to reinforce the desired behavior change using social support, economic rewards, and changing social norms.

Ten review studies used reinforcing interventions^{25-32,34,35)}. A total of seven interventions from 42 PS were in this component. These could be classified as incentive and social support.

Component 1: Incentive

This component encourages a person to do something. Incentive interventions were campaign / competition, prizes, money/financial incentive, and rewards. Rewards offered the greatest incentive, while prizes and money/financial incentives were the least useful for promoting PA.

Component 2: Social Support

Social support was described in terms such as encouraged/promote/motivation, family support, group meeting/group support. The results showed family support was the most useful in this group. One good quality review²⁷⁾ concluded encouragement activities can increase PA.

Policy Regulatory Domain

Policy interventions are implemented as procedures or protocols and generally adopted by the board within an organization. Two reviews^{25,35)} used policy regulatory. The policy regulatory domain concerns organizational action as the administrators support the project at all steps. The committee was responsible for implementation, weekly contact with project staff, and arranging PA breaks during work. One moderate quality review²⁵⁾ proposed that promotional strategies at organizations may be more sustainable.

Environmental Development Domain

Environmental development intervention is defined as a change of environment caused by PA processes. Six reviews^{25,27,29-31,35)} described interventions that used environmental development, such as using postcards in places with high employee traffic (e.g., break rooms, bathrooms, and points where a choice is offered such as elevators and stair wells), forming lunchtime walking or cycling groups, promoting stairway signs, indoor and outdoor walking routes, walking groups, and environmental restructuring. One good quality review²⁹⁾ recommended environmental modification could prevent weight gain.

All interventions and frequencies are summarized in Table 2. The majority of the interventions involved more than one domain. Predisposing domain was the most common reused either as a single domain intervention or a part of multiple domain interventions (Table 3).

Discussion

This review sought to classify and describe various in-

Table 2. Intervention Factors to Promote Physical Activity in the Workplace

Domain	Interventions
Predisposing	
Information Delivery (114PS from 6 Interventions)	Counseling/Advice (40PS), Providing information/demonstrate the behavior (37PS), Health education/Health information (29PS), Lecture (5PS), Professional contact/Coach visit (2PS), Cognitive restructuring (1PS)
Self-motivation (82 PS from 5 Interventions)	Goal setting (40PS), Self-monitoring/Self-management (21PS), Action planning (11PS), Set grade task (5PS), Coping planning (5PS)
Program Training (74 PS from 11 Interventions)	Physical exercise program (31PS), Fitness program (12PS), Aerobic dancing program (10PS), Walking program (9PS), Lifestyle program (4PS), Stress management program (3PS), Muscle relax training (1PS), Strength training exercise (1PS), Resistance training program (1PS), Time management program (1PS), Bike program (1PS)
Enabling	
Instrument Resource (75 PS from 12 Interventions)	Print material (24PS), Pedometer/Accelerometer (11PS), Email (10PS), Webpage/Website/ Web-base (10PS), Work book/Lock book/Booklet (9PS), Message (3PS), Video (2PS), Diary (2PS), CD-ROM (1PS), Weight watcher (1PS), Measuring tape (1PS), Intranet (1PS)
Health Service Facilities (57 PS from 5 Interventions)	Health assessment/Screening/Health Check (20PS), Feedback (18PS), Barrier identification/ Problem solving (10PS), Using follow up prompts (7PS), Coaching (2PS)
Reinforcing	
Incentive (16 PS from 4 Interventions)	Rewards (12PS), Campaign/Competition (10PS), Prize (2PS), Money check/Financial incentive (2PS)
Social Support (26 PS from 3 Interventions)	Family support (14PS), Encouraging/Promote/Motivation by other people (10PS), Group meeting/Group support (2PS)
Policy Regulatory	Organizational action included administrators supported the project all steps, the committee was responsible for implementation, weekly contact with project staff, and arranging physical activity breaks during work (5PS)
Environmental Development	Environmental development such as motivating to use postcards, implementing different environmental interventions, promoting stairway signs, indoor and outdoor walking routes, and walking groups (15PS)

interventions to promote PA in the workplace into five domains according to the PRECEDE-PROCEED model. This is the first published meta-review that collectively appraises Predisposing, Enabling, Reinforcing, Policy Regulatory, and Environmental Development interventions to promote PA in the workplace. The results demonstrated that most interventions used predisposing factors, especially the information delivery component. It confirms that using information has been found to influence individuals' health behavior in a positive way³⁸. Goal setting and counselling were the most common interventions in the Predisposing domain. Goals have been shown to be most effective when they are important to the individual, when the individual can see their progress, and when they receive positive feedback about progress toward their goal³⁹. Many interventions used goal setting as a strategy to encourage PA. When combined with goal setting, performance feedback, and review of goals, self-monitoring has been shown to be an effective component of interventions to promote PA⁴⁰. These results were congruent with previous studies. An earlier review showed that goal setting could be useful for effective health behavior changes in this population⁴¹.

Interventions in the Enabling domain were instrument resources and health service facilities. These can influence access to PA facilities. According to the results, most interventions in this domain were printed materials, health assessment/screening/health check, feedback, and pedometers/accelerometers, respectively. Printed materials are widely used. Previous studies have shown that printed materials provided in the workplace lead to an increase in PA^{42,43}. Health assessment and feedback were common strategies, while pedometers/accelerometers are instruments that aid self-awareness. A pedometer is easy to use, low cost, can display step count to monitor feedback, and is easy to interpret. A study concluded pedometer is the most popular intervention to increase PA in the workplace⁴⁴.

Reinforcing interventions were incentives and social support. There was a positive association between social support from family, peers, friends, and program staff⁴⁵ on PA. Moreover, the results also demonstrated that the Policy Regulatory and Environmental Development interventions were effective. These two domains were used to promote PA in the workplace. A previous study found Environmental characteristics could be improved by

Table 3. Intervention Patterns to Promote Physical Activity in the Workplace

Author (year)	Total primary studies (PS)	Intervention domains	Main conclusions
Wong et al. (2012)	12	Predisposing alone (4 PS); Enabling alone (2PS); Predisposing plus Enabling (1PS); Predisposing plus Reinforcing (1PS); Predisposing plus Enabling plus Reinforcing (2PS); Predisposing plus Environmental change (1PS); Predisposing plus Reinforcing plus Environmental change (1PS)	Encouraging activities increase PA by 15.6% compared with a 3.4% who were given print materials and counselling and men who attended PA class significantly increased their PA by 7.3% compared the control group.
Rongen et al. (2013)	14	Predisposing alone (10 PS); Enabling alone (1PS); Predisposing plus Enabling (2PS); Predisposing plus Enabling plus Reinforcing (1PS)	Workplace health promotion programs were more effective when there were at least weekly contacts. Counselling with including personal advice was found to be less effective. Exercise program or educational component did not influence the effect of workplace health promotion programs.
Freak-Poli et al. (2013)	4	Predisposing plus Enabling (1PS); Predisposing plus Enabling plus Reinforcing (1PS); Predisposing plus Enabling plus Environmental change (1PS); Predisposing plus Reinforcing plus Environmental change plus Policy regulatory (1PS)	Multi-component health promotion programs that incorporate a pedometer can improve PA.
Malik et al. (2014)	58	Predisposing alone (23 PS); Reinforcing alone (1PS); Predisposing plus Enabling (6PS); Predisposing plus Reinforcing (7PS); Enabling plus Reinforcing (1PS); Predisposing plus Enabling plus Reinforcing (4PS); Predisposing plus Reinforcing plus Environmental change (1PS); Predisposing plus Enabling plus Environmental change (1PS); Predisposing plus Enabling plus Environmental change (1PS); No behavior change techniques identified (14 studies)	Overall the results are inconclusive. There is still a need for more well-designed studies to fully determine the effectiveness of workplace interventions for increasing PA.
Gudzune et al. (2013)	9	Enabling alone (1PS); Predisposing plus Enabling (2PS); Predisposing plus Reinforcing (1PS); Predisposing plus Enabling plus Reinforcing (1PS); Predisposing plus Enabling plus Environmental change (3PS); Predisposing plus Enabling plus Reinforcing plus Environmental change (1PS)	Personalized PA counselling along with the promotion of healthy lifestyle changes in the environment maybe a promising strategy.
Groeneveld et al. (2010)	24	Predisposing alone (11 PS); Enabling alone (1PS); Predisposing plus Enabling (8PS); Predisposing plus Reinforcing (3PS); Predisposing plus Enabling plus Reinforcing (1PS)	Most interventions were individual counselling, group education and supervised exercise. Interventions such as advice, self-help materials, environmental changes, or monetary incentives were investigated only sporadically. Exercise program was strong evidence for a positive intervention effect on body fat and no effect on hip circumference. No intervention effect on systolic blood pressure, diastolic blood pressure, serum lipids, and blood glucose.
Verweij et al. (2011)	21	Predisposing alone (7 PS); Enabling alone (1PS); Predisposing plus Enabling (5PS); Predisposing plus Reinforcing (2PS); Predisposing plus Enabling plus Reinforcing (5PS); Predisposing plus Environmental change (1PS)	Interventions including an environmental domain could be prevented weight gain.

Table 3. Intervention Patterns to Promote Physical Activity in the Workplace (continued)

Author (year)	Total primary studies (PS)	Intervention domains	Main conclusions
Robroek et al. (2009)	21	Predisposing alone (10 PS); Reinforcing (2PS); Predisposing plus Enabling (9PS)	Mean participation level were difference between studies aimed at PA and studies aimed at multiple behaviors reached statistical significance.
Zacharia et al. (2013)	9	Enabling alone (5PS); Predisposing plus Enabling (2PS); Enabling plus Reinforcing (1PS); Predisposing plus Enabling plus Reinforcing (1PS)	Effective as traditional methods and more effective than no intervention.
Abraham & Graham-Rowe (2009)	37	Predisposing alone (13PS); Enabling alone (8PS); Reinforcing alone (3PS); Predisposing plus Enabling (8PS); Predisposing plus Reinforcing (3PS); Predisposing plus Enabling plus Reinforcing (2PS)	Worksite interventions targeting PA specifically as opposed to general lifestyle change were found to be more effective whether evaluated in terms of increased fitness or increased self-reported. Walking as opposed to other forms of PA were also more effective Tailored information or instructions were not found to be more effective, but goal setting may enhance fitness gains.
Barr-Anderson (2011)	11	Predisposing alone (6PS); Environmental change alone (1PS); Policy regulatory alone (2PS); Predisposing plus Enabling plus Environmental change plus Policy (1PS); Enabling plus Reinforcing plus Environmental change plus Policy regulatory (1PS)	PA promotion strategies at the organizational level may be more sustainable.

means of policy change⁴⁶. In summary, interventions to improve physical activity have been focusing on at least one of the factors in the PRECEDE-PROCEED model. In particular, multidisciplinary interventions are the most efficient to increase PA habits of a population⁴⁷. However, no study used all intervention domains and this fact is highlighted to suggest the need for further research and future studies.

Limitations

This systematic meta-review used secondary source data by gathering and interpreting primary studies but might be unable to identify all intervention factors because of the different details of primary studies. However, comparing interventions that were highly effective and concern multiple components would be useful for future research.

Conclusions

This systematic meta-review classified interventions using appropriate frameworks. Future research that investigates PA should concern itself with interventions that significantly promote PA in the workplace, including a focus on the size of workplaces. This would be more advantageous in helping to promote interventions and adapting them to various workplaces.

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