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Factors for adherence to a physical activity promotion program in the workplace: a systematic review

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Abstract

Introduction The health benefits of physical activity (PA) are now widely accepted and proven. Promoting PA in the workplace is therefore of major public health interest, but is limited by employees' adherence.

Method A systematic review was therefore carried out to identify factors for adherence to PA promotion program in the workplace (primary outcome); health outcomes were to be regarded as secondary outcomes. Four databases, PubMed, Web of Science, Cochrane Central Register of Controlled Trials (Cochrane CRCTs) and PsycInfo were searched to find all pertinent articles published from 2000 until June 2024. Only randomized controlled trials (RCTs) and clinical trials were selected.

Results More than 9000 publications were analyzed and 91 were retrieved. Two main types of study were identified: 46 non-supervised PA programs (NSPAPs) supported by socio-cognitive theories, and 45 supervised (tailored) programs (SPAPs). Concerning the primary outcome, the main factors identified for adherence were the levels of baseline PA, health and motivation of the individual; intervention individualization at the interventional level; and work environment quality at the organizational level. This review highlighted significant health benefits in both types of study, with effect sizes ranging from small to large.

Discussion Assessing these factors for adherence emerges as an essential prerequisite before implementing a PA promotion program in the workplace. According to our results, implementing NSPAPs, supported by socio-cognitive theories, is rather complex, and such programs can be difficult to operationalize in their entirety; consequently, coach-supervised PAPs based on RCT programs tend to be more effective.

Conclusion Our results prove the short and medium-term beneficial effect on health of PAP in the workplace based on rigorous methodology such as RCTs. Management's support through work organization and the follow-up of actions in the long term are an essential factor for adherence to these programs. Finally, we suggest what this literature review contributes for future research or entrepreneurial and/or political projects. In fine, new models of working time will have to be considered.

Keywords Physical activity, Workplace, Management, Health, Social, Cognitive

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Introduction

Physical activity is defined as all body movements produced by the activation of skeletal muscles and resulting in an energy expenditure greater than the resting metabolism [1, 2]. It provides a large number of health benefits to individuals: reduction in chronic non-communicable diseases such as coronary heart disease, stroke, diabetes, certain cancers, depression, anxiety, or obesity [3–5]; primary prevention of more than 35 chronic diseases [6]; and first-line treatment for more than 24 chronic non-communicable diseases [7]. These benefits are now widely accepted, and are found in all individuals, regardless of their gender, age or comorbidities [8–10], even for modest physical activity levels [11]. Despite the WHO's guidelines on physical activity [12], it is clear that the physical activity level of most individuals is insufficient [13, 14]. In France, fewer than 50% of individuals aged 15 to 78 can be considered sufficiently active, with three quarters of the population failing to reach the 10,000 daily step target; indeed, while 36 million people stated that they had engaged in at least one physical or sports activity in the year, only 14 million of them practiced activity more than once a week [15]. Physical inactivity (not reaching the recommended physical activity levels [16]) results in a significant health decline in populations, through the increase in a number of chronic non-communicable diseases [17–21]. It may well even be the cause of one in six all-cause deaths worldwide [22]. There is also an increase in sedentary behaviors, defined as a state of wakefulness characterized by an energy expenditure < 1.5 times the resting energy expenditure (1.5 MET) [23], with deleterious effects on health different from those due to physical inactivity [24, 25], and present regardless of the physical activity level of the individual [26–28]. The harmful effects of sedentary behavior are very difficult to overcome through the practice of physical activity: indeed, > 60 min of moderate-to-high intensity physical activity per day are needed to overcome > 8 h of seated position per day [29]. In France, people in their forties spend an average of 12 h a day in a seated position during working days, and about nine hours during non-working days, with a total of more than 70% of the population spending more than eight hours a day seated [30].

The decrease in physical activity level and the concomitant increase in sedentary behaviors have been rising in developed countries for several decades. The forecasts of a 2012 study suggested that the average physical activity level in the United Kingdom would reach 153 MET hours per week by 2020, and 140 MET hours per week by 2030 [31]. The significant work changes observed since the industrial revolution appear to be one of the major causes of this phenomenon. An increase by > 20% in sedentary occupations was observed in the United States between 1960 and 2008, with a concomitant drop in physically active occupations [32]. The same is true in France, where working adults now spend more than ten hours a day seated during the working day and 7.58 h during non-working days with a concomitant increase in screen time [33]. Moreover, the association between sedentary behaviors and the type of work (office work, manual work, work in a care setting, etc.) is clearly demonstrated, with office workers spending 66% of their waking time in a seated position, compared to 59% for all workers, and barely 47% for manual workers [34]. The health of workers is thus impaired, with more cases of obesity, absenteeism, depression and anxiety among the most sedentary workers [24, 35–38].

The workplace has thus become the main target of health promotion policies [5], and even appears to be the ideal place to fight against sedentary behaviors and promote physical activity. Indeed, due to the time spent by employees in the workplace and the possibility of involving the employer and the social network of the company in the process, the chances of success of programs promoting physical activity and fighting sedentary behavior are enhanced [39]. Thus, many barriers are overcome, in particular the lack of time and proximity [40], with lack of time being the first limitation to the implementation of regular physical activity reported by employees [41]. The employer also becomes a major lever, whether at the material, organizational or financial level [42, 43]. Finally, the benefits for the company are well documented, with an increase in productivity [43, 44] and a drop in absenteeism [22] and health costs [45]. Finally, the benefits for the companies are often questioned, with a potential increase in productivity [43, 44], a drop in absenteeism [22], an impact on healthcare costs [45], provided that the programs are based on a high-quality methodology.

Physical activity promotion programs in the workplace have therefore been widely developed in recent years. Through its recommandations, the World Health Organisation encouraged two main categories of physical activity promotion programs [5, 12]: tailored physical activity programs, supervised by a coach (SPAPs) and/or non-supervised physical activity programs (NSPAPs), essentially based on motivational/socio-cognitive theories. According to Väänänen et al. [46], we distinguished three types of NSPAP: (a) informative programs, (b) behavioral programs; and (c) motivational programs supported by socio-cognitive theories (Fig. 1).

(a) Informative programs deliver messages to employees about the benefits of physical activity through working groups, seminars, posters and newsletters, and have been shown to be effective in boosting physical activity levels and reducing sedentary behaviors [47–49].

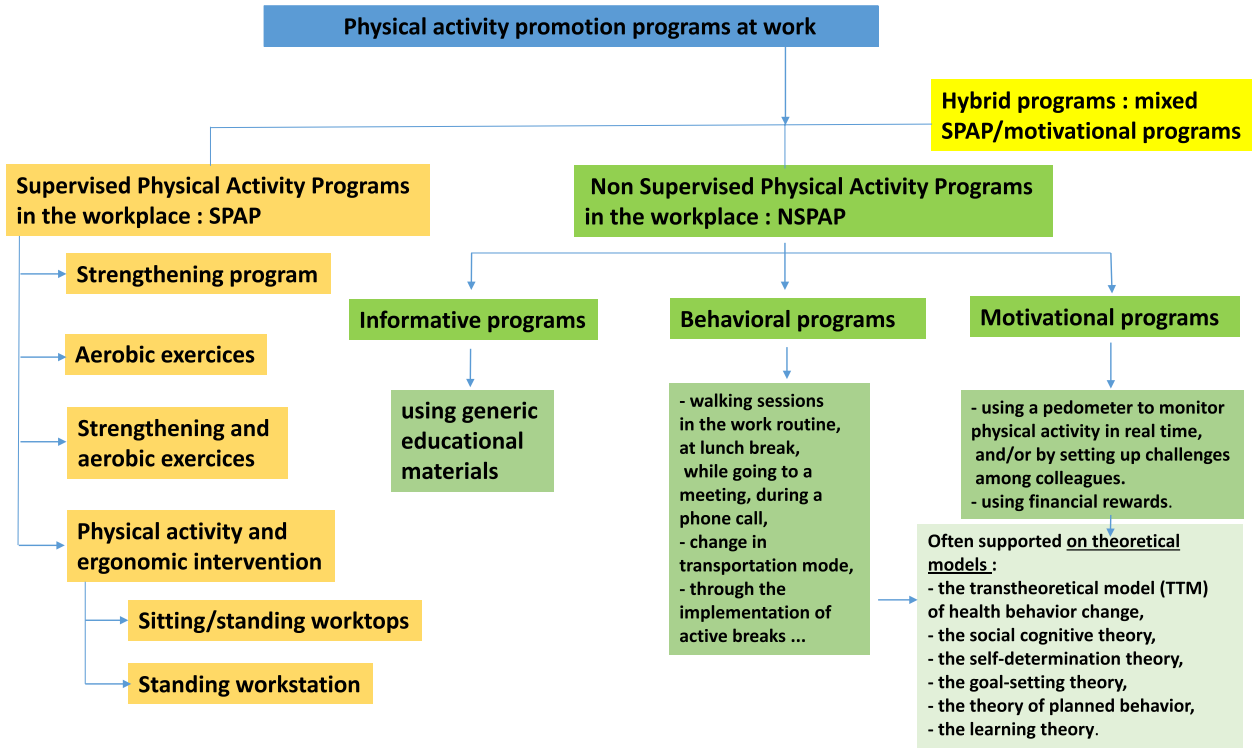

Fig. 1 Physical activity promotion programs in the workplace. Based on Global action plan on Physical Activity 2018–2030: more active people for a healthier world [Internet]. World Health Organization; 2018 [notified 3 sept 2021]. 101p. https://apps.who.int/iris/handle/10665/272722.and Väänänen et al. 2022. Workplace physical activity practices in real-life: A scoping review of grey literature for small- and medium-sized enterprises. Eur J Public Health 32:1, i22–i27

(b) Behavioral programs consist in the development of behavioral strategies by employees, allowing them to include more physical activity in their daily lives while decreasing their sedentary behaviors. This can be done by the progressive implementation of walking sessions in the work routine (at lunch break, while going to a meeting, during a phone call…) [50], through a change in transportation mode [51–54], or through the implementation of active breaks (short interruptions of the usual work tasks to practice simple physical exercises of moderate intensity, for example via an application sending messages at regular intervals encouraging the user to leave the seated position) [55–57]. The effectiveness of such programs is mainly seen in the increase in cumulative physical activity level during the day, with a lesser effect on sedentary time, even though it is known that for an equivalent sedentary time, the interruption of long sedentary periods is beneficial for health [58–60]. Effectiveness may be improved by individualized counseling and support provided during individual interviews, helping employees when choosing physical activity, setting progressively increasing goals, or monitoring their activity level [61–63].

(c) Motivational programs include a motivational component, for example by using a pedometer to monitor physical activity in real time [64, 65], or by setting up challenges among colleagues [66–68]. As lack of motivation is the second most important barrier to physical activity reported by employees [41], it is easy to understand the importance of this motivational component. In some programs, motivation has been targeted through symbolic, material or even financial rewards [69–71], with significant effectiveness.

The development of (b)/(c) components may be supported by theoretical models, such as the transtheoretical model of health behavior change [72], social cognitive theory [73], self-determination theory [74], goal-setting theory [75], theory of planned behavior [76], learning theories [77], self-reguation theory [78], behavior change wheel [79], or motivational interviewing [80, 81]. The reliability of these models has been discussed with divergent results, although the interest of such models has been repeatedly emphasized [82–85].

Supervised Physical Activity Programs (SPAP) may differ in many types of exercises: a) specific muscle strengthening exercises, probably effective on the prevalence of

musculoskeletal disorders; b) aerobic exercises, such as endurance, that could also be beneficial at the musculoskeletal, cardiovascular and metabolic levels [85–88].

Yet the abundance of physical activity programs in the workplace should not obscure their limitations. For instance, the impact on sedentary behaviors seems limited; a Cochrane meta-analysis (Shrestha N., 2018) finds a reduction in seated time of less than 30–60 mn per day [89], whereas the mean sedentary time may exceed ten hours per day [33]. Another Cochrane meta-analysis (Parry SP., 2019) found no impact for reducing musculosketal disorders [90]. On the other hand, the above-mentioned physical activity programs rarely include more than one hour of additional cumulative physical activity per week, whereas a minimum of 60 min of moderate-intensity daily activity (brisk walking at 5–6 km/h, or cycling for pleasure at 16 km, for instance) is needed to significantly counteract the effects of sedentary behaviors [29].

Meta-analyses show contradictory results, with certain interventions demonstrating efficacy on shoulder pain, but no effect on lower back or upper limb pain [91]; certain interventions demonstrate no effect on metabolic risk factors, and only a small effect on the prevention of mental health disorders, but strong evidence was found for the prevention of musculoskeletal disorders through workplace interventions, especially resistance exercise training [92].

Secondly, numerous publications have shown that physical activity promotion programs in the workplace have failed to target the employees who needed them most, i.e., the most sedentary, least active, and with the worst health indicators; and that most participating employees were already physically active and healthy [93–97].

Thirdly, the adherence of employees appears to be the main limiting factor for such programs. The adherence rate is often $\leq$50% [98], both in terms of participation in physical activity sessions as part of physical activity programs [99–102] and the use of tools provided as part of NSPAPs [103, 104]. It should also be noted that this adherence rate decreases during the course of the interventions, thus highlighting the progressive disinterest of employees, despite a fairly satisfactory initial participation [99, 102].

Only a few research studies have attempted to analyze this low adherence, and even fewer have identified its causes. As stressed by Genin PM. et al., most studies, rather than trying to understand the determinants of the employees'low adherence, prefer to use different incentive methods to maintain an acceptable participation level (e.g., financial incentives), without real success [105]. It is therefore necessary, before considering the development of any new physical activity promotion program, to try to understand the factors promoting or preventing the adherence of employees.

Research hypothesis

H1: Factors influencing an exercise program at work depend on:

1. Individual factors
2. Intervention factors related to the type of exercise program
3. Organizational factors

H2: Physical activity programs can have a beneficial effect on health.

Aim of the study

A systematic review was therefore carried out to:

1: identify factors for adherence to a physical activity promotion program in the workplace (primary outcome);

2: Identify the health effects based on the type of program, and specify, if possible, the effect size (secondary outcome).

So the study aims to provide an overview of the current state of knowledge, help entrepreneurial and/or political new projects, establish a framework for new research.

Method

Selection criteria

We aimed to include all relevant original research studies with a quantitative design.

Filters were applied. The first filter was the publication date, which had to be comprised among 2000 and june 2024. The second filter was the type of study conducted: clinical trial and/or randomized controlled trial. Studies had to be written in English, internationally published, and peer-reviewed. We did not include studies with purely qualitative design, studies only reporting descriptive statistics, dissertations, book chapters, or theoretical work such as editorials, short communications, or conference abstracts.

Search strategy and study selection

The Institute of Medicine guidelines for completing systematic reviews were used and reporting of findings followed PRISMA guidelines [106, 107]. Electronic databases searched for studies published between 2000 through June 2024 included PubMed, Web of Science, PsycINFO, and Cochrane CRCTs. All aspects of the review process were completed by two researchers (DT, QG). Titles and abstracts of all articles were screened

for applicability. If the article appeared to meet the review's inclusion criteria, the full article was reviewed and assessed to ensure that it met the criteria for inclusion. All discrepancies were reviewed by the same two researchers and consensus was met regarding the eligibility of the study. For each article included in this review, all references were reviewed for inclusion criteria. The keywords included the two main concepts: physical activity and workplace.

The algorithm and selected MeSH Terms included in the database were: physical activity intervention [MeSH Terms]) OR physical activity program OR physical exercise [MeSH Terms] OR training [MeSH Terms] OR resistance training [MeSH Terms] OR endurance training [MeSH Terms] AND workplace [MeSH Terms] OR worksite [MeSH Terms] OR employees [MeSH Terms] OR workers [MeSH Terms] AND compliance [MeSH Terms].

This query allowed the retrieval of the maximum number of scientific publications dealing with both physical activity and the workplace. Filters were applied. The first filter was the publication date, which had to be comprised between 2000 and 2024. The second filter was the type of study conducted: clinical trial and/or randomized controlled trial. We found no meta-analysis concerning our primary outcome for this review.

In addition to the references obtained through this search, references of interest cited by or citing the retrieved publications, or presented as similar to them were also analyzed.

Inclusion and exclusion criteria

The inclusion and exclusion criteria for the publications followed the PICO method in accordance with Richardson WS [108], and were therefore based on the study population, the intervention type, the type of assessment performed by the authors, and the selected endpoint. They also took into account the analysis of adherence and factors for adherence performed by the authors. Further, we included populations consisting of employed workers (public and private sector). We excluded studies of self-employed and/or students.

Manuscript selection

DT and QG analyzed the selected papers independently in the screening and eligibility steps to compare the selected/not selected articles; in the case of disagreement over the quality of the article or the lack of precision in the inclusion criteria, the articles were excluded (Fig. 2). The publications retrieved were sorted by year. This allowed the grouping of publications on the same study, and the rapid identification of papers published by the same research team. Firstly, the titles were analyzed to exclude all publications that were clearly unrelated to physical activity or the workplace. The abstracts of the publications were all then read, to exclude further publications. When it was not possible to exclude a publication based on its title and abstract, the full text was read to search for exclusion criteria, which included a lack of information about the design of the study, the number of participants, the type of work environment, the study's duration, and/or the theoretical model used to develop the intervention. The publication was included in the final analysis only after the full text was read (Fig. 2).

When reviewing the different publications, CG and DT grouped the references related to the same study, and analyzed them together. For each publication selected, detailed criteria of inclusion were necessary: a) study design, b) number of participants, b) type of work environment, c) study duration, d) the theoretical model used to develop the intervention, e) description of the intervention. These data were compiled on two tables according to the type of intervention: non-supervised physical activity program (NSPAP) (Table 1) or supervised physical activity program (SPAP) (Table 2). For NSPAPs, we specified whether the intervention was based on a socio-cognitive theory and its model (such as TTM, SCT…).

We also identified the tools and means used: individualized adjustment of the intervention content, use of pedometers, individual counseling and financial incentives in particular. For SPAP programs, we specified whether the exercise sessions took place in the workplace, whether they were supervised by a sports educator, and whether their content was adapted to an individual level. Then, for each of the publications, we indicated the reported adherence, either in terms of participation in the different components of the intervention (e.g., website access, participation in motivational interviews, participation in physical activity sessions), or in terms of changes in physical activity (e.g., changes in the number of daily steps, changes in sedentary behaviors, increase in physical activity level).

We then identified the different factors for adherence reported by the authors, classifying them into three categories: individual (employee-specific), interventional (physical activity promotion program-specific) and organizational (workplace-specific) factors. This classification has already been used and validated elsewhere [109]. For each of these factors, the type of association with adherence was specified (positive, negative, neutral).

Risk of bias and quality of evidence

In order to estimate the Quality Index [QI]: [Min = 0, Max = 5], we assessed and reported the methodological risk of bias of the included studies in accordance with the Cochrane Handbook (Higgins, 2011) and the guidelines of the Cochrane Consumers and

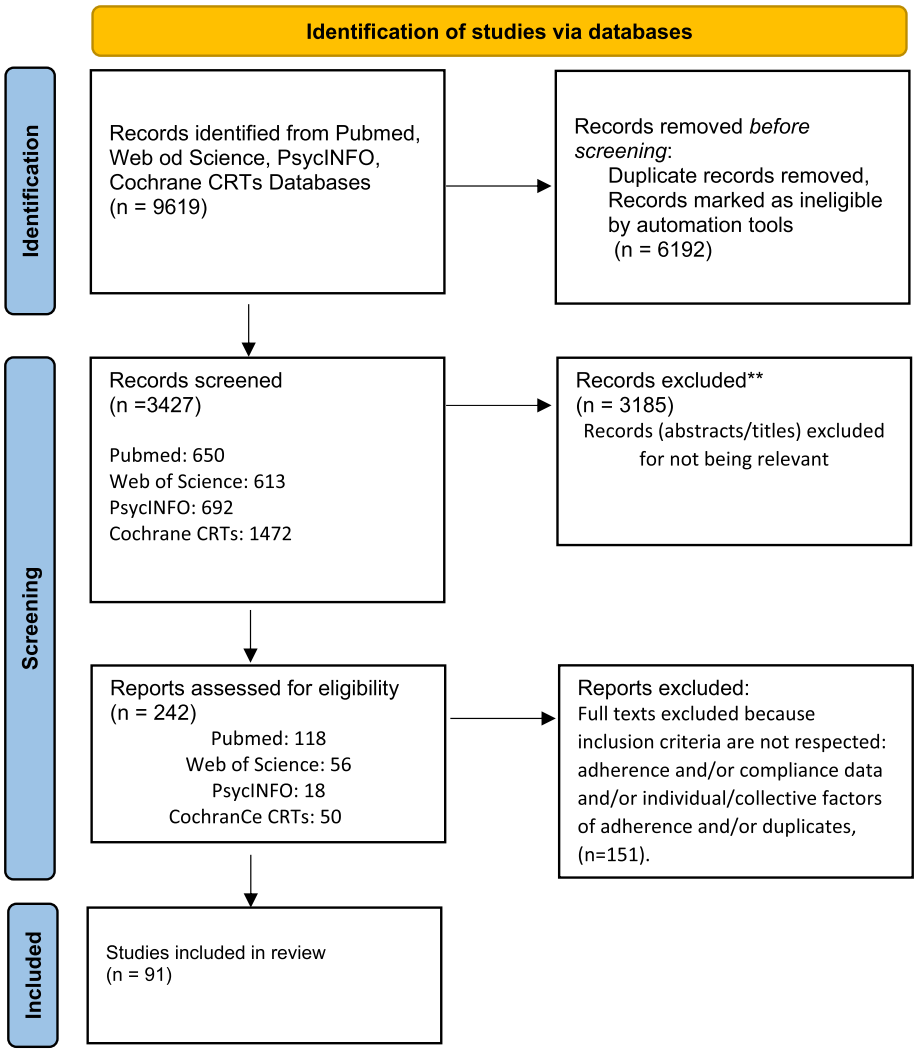

Fig. 2 Article selection flowchart. *From:* Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. https://doi.org/10.1136/bmj.n71

Communication Review Group (Ryan, 2013), which recommend the explicit reporting of the following individual elements for randomized controlled trials: random sequence generation; allocation sequence concealment; blinding (participants, personnel); blinding (outcome assessment); completeness of outcome data; selective outcome reporting. We assigned the following scores according to the number of limitations described: one major limitation: QI =4; two limitations: QI =3; three limitations: QI =2, and so on. Within Supplementary Files 1 and 2, we added columns describing the results (adherence factors, outcomes and effect size), and a column describing a quality index [QI] taking into account the studies' limitations.

Results

The total number of records retrieved was 9619. Finally, we included 91 publications that met the inclusion and exclusion criteria (Fig. 2). The systematic review allowed for the identification of two main types of studies. There were 46 publications on non-supervised physical activity programs (NSPAP) and 45 on supervised physical activity programs (SPAP). The features of each publication are presented in Tables 1 and 2.

Results for employees' adherence, outcomes, potential limitations, study quality and effect sizes (when they are indicated on the manuscript) are reported in Supplementary Files 1–2. Studies with significant outcomes results are described in Tables 3, 4 and 5, Figs. 3, and 4.

Table 1 Non-Supervised Physical Activity Programs (NSPAP) in the workplace

Reference	Summary of the intervention	Study design	Participants number	Intervention duration	Theoretical model
1. Marshall AL. Print vs website PA programs: a randomized trial. 2003	Behavioral program with dissemination of educational materials (strategies); motivational program through the dissemination of motivational messages; non-individualized content, no counseling session	Interventional, comparative, randomized study Comparison among the use of paper-based (letters, booklet) vs computer-based messages (mails, recalled website)	*N* = 655 (office workers) Allocated to Print intervention: *N* = 328 Allocated to Web intervention: *N* = 327	8 weeks	TTM
2. Proper KI. Effect of individual counseling on PA fitness and health: a RCT in a workplace setting. 2003	Individualized informative and behavioral program through counseling sessions (strategies, goals, information)	Interventional, comparative, randomized study Comparison among the entire incentive program *vs* written information about lifestyle factors only	*N* = 299 (3 workplaces, municipal office workers) IG: incentive program *N* = 131 CG: information *N* = 168	9 months	TTM
3. Chan CB. Health benefits of a pedometer-based PA intervention in sedentary workers. 2004	Motivational program with the use of a pedometer; individualized behavioral program with the setting up of goals and strategies, counseling sessions; and informative program with educational materials during working groups	Interventional, non-comparative study	*N* = 177 (public administration office workers)	12 weeks	No theoretical framework
4. Hallam JS. The Long-Term Impact of a Four-Session Work-Site Intervention on Selected SCT Variables Linked to Adult Adherence. 2004	Instructional intervention composed of four 60-min sessions delivered across 2 weeks, to assess SCT variables linked to exercise behavior	Three SCT variables were measured for all observations: (1) outcome-expectancy value, (2) exercise self-efficacy, and (3) the use of self-regulation strategies for exercise	*N* = 210 (service-type industry) IG: N = 95 CG: *N* = 115	12 months	SCT
5. Plotnikoff RC. Efficacy of an E-mail intervention for the promotion of PA and nutrition behavior in the workplace context. 2005	Motivational program: dissemination of non-individualized motivational messages	Interventional, comparative, randomized study. The IG received one PA and one parallel nutrition message per week for 12 weeks. The CG received no weekly messages	*N* = 2 121 (5 workplaces) IG: *N* = 1566 CG: *N* = 555	12 weeks	SCT, TTM, Theory of Planned Behavior

Table 1 (continued)

Reference	Summary of the intervention	Study design	Participants number	Intervention duration	Theoretical model
6. Griffin-Blake CS. Evaluation of social-cognitive vs stage-matched, self-help PA interventions at the workplace. 2006	Individualized (depending on the group), informative, behavioral and motivational program through the dissemination of educational materials (awareness, strategy, strengthening of motivation)	Interventional, comparative, randomized study. Comparison among the program adjusted individually vs the generic program (no individual adjustment): participants were randomly assigned into either (a) the self-help exercise program based on the TTM or (b) the self-help exercise program based on SCT	*N* = 208 (university staff) TTM group: *N* = 115 SCT group: *N* = 93	1 month	TTM vs SCT
7. Plotnikoff RC. The efficacy of stage-matched and standard public health materials for promoting PA in the workplace: the PA Workplace Study (PAWS). 2007	Individualized, informative, behavioral and motivational program through the dissemination of educational materials, awareness, strategy, strengthening of motivation (TTM group) vs standard group	Interventional, comparative, randomized study. Comparison among the TTM program adjusted individually (stage-matched group) vs the generic program (no individual adjustment). Five motivationally targeted booklets were developed for the stage-matched group. The standard group received PA Guide and handbook	*N* = 507 (3 companies, office workers) Staged match group: *N* = 115 Standard intervention (CPAG): *N* = 176 CG: *N* = 166	12 months	TTM
8. Opdenacker J. Effectiveness of face-to-face vs telephone support in increasing PA and mental health among university employees. 2008	Individualized behavioral program, based on counseling sessions (goal and strategy setting up); informative program through the dissemination of educational materials (brochure)	Interventional, comparative, randomized study Comparison of a behavioral program delivered by phone *vs* by face-to-face interview	*N* = 90 (university staff) Allocated to face-to-face group: *N* = 33 Allocated to telephone support: *N* = 33	3 months	SCT
09. Dishman RK. Move to Improve: A Randomized Workplace Trial to Increase PA. 2009	Informative program with educational materials; behavioral program with setting up of goals and strategies; motivational program with pedometer, material rewards, team building with challenges	Interventional, comparative, randomized study Comparison among the entire incentive program *vs* the informative program alone (newsletter)	*N* = 1 442 (16 workplaces, office workers) IG: *N* = 885 CG: *N* = 557	12 weeks	Goal-setting theory
10. Dishman RK. Dose relations among goal setting, theory-based correlates of goal setting and increases in PA during a workplace trial. 2010	Nested study, ref. n°9 (Dishman RK, 2009)	Originality of the study: this study examined mediators/moderators of the outcomes of PA interventions and the dose relation of goal setting with PA	*N* = 1 442 (16 workplaces, office workers) IG: N = 885 CG: *N* = 557	12 weeks	Goal-setting theory

Table 1 (continued)

Reference	Summary of the intervention	Study design	Participants number	Intervention duration	Theoretical model
11. Samuels TY. A randomized controlled trial of continuous activity, short bouts, and a 10,000 steps guideline in inactive adults. 2011	Behavioral program through setting up of daily PA goals; motivational program through the use of a pedometer; no individual adjustment; no counseling session	Interventional, comparative, randomized study Comparison among groups with goal of 10,000 steps/day + pedometer *vs* 30 min of activity per day *vs* at least 3 sessions of 10 min of PA	*N* = 50 (university employees) 3 groups are compared after randomization: G1: 10. 000 steps: *N* = 18 G2: 30 mn of PA: *N* = 17 G3: 3 × 10 mn of PA: *N* = 15	5 weeks	SCT
12. Mc Eachan RRC. Testing a workplace PA intervention: a cluster randomized controlled trial. 2011	Informative program with educational materials; motivational program through encouraging messages and setting up of challenges; implementation of the program by facilitators	Interventional, comparative, randomized study Comparison among the incentive program *vs* the CG	*N* = 1 260 (5 public organizations, 44 worksites) Intervention worksites: 22 G: *N* = 668 CG: *N* = 606	3 months	Theory of planned behavior
13. Robroek SJW. Cost-effectiveness of a long-term Internet-delivered worksite health promotion programme on physical activity and nutrition: a cluster RCT. 2012	Incitative program using the internet to promote health behavior change: extensive computer-tailored advice on self-reported PA and fruit and vegetable intake	Interventional, comparative, randomized study Comparison among the incentive program vs the CG	*N* = 924 IG: *N* = 465 CG: *N* = 459	12 months	No theoretical framework
14. Gazmararian JA A randomized prospective trial of a worksite intervention program to increase PA. 2013	Allowance of paid time for practicing PA; support for a fitness club membership	Interventional, comparative, randomized study. Comparison among different combinations of the incentive program (4 different groups) *vs* the CG	*N* = 410 60 university departments randomized into five groups, with a CG (*N* = 70)	9 months	SCT
15. Hunter RF. PA loyalty cards for behavior change: a quasi-experimental study. 2013	Motivational program using a pedometer in the workplace, financial rewards (PAL scheme); behavioral program with goal setting up and educational materials (website)	Comparison among the program with *vs* without rewards. In the CG, participants used a PA loyalty card (PAL card) to self-monitor PA levels over the 12-weeks intervention period but did not collect points or earn rewards	*N* = 406 (2 buildings, office workers) Incentive group: *N* = 199 CG: *N* = 207	6 months	Learning theory
16. Van Hoecke AS. Long-term effectiveness and mediators of a need-supportive PA coaching among Flemish sedentary employees. 2013	Individualized behavioral program, based on counseling sessions, with setting up of goals and strategies	Interventional, comparative, randomized study Comparison among the incentive program (sedentary employees guided by a personal PA coach) *vs* a CG	*N* = 122 (university employees) Coaching group: *N* = 92 CG: *N* = 34	4 months + one-year follow up	Self-determination theory

Table 1 (continued)

Reference	Summary of the intervention	Study design	Participants number	Intervention duration	Theoretical model
17. Viester L. Process evaluation of a multifaceted health program aiming to improve PA levels and dietary patterns among construction workers. 2014	Individualized behavioral program through counseling sessions (strategies, goals); motivational program with use of a pedometer; informative program (dissemination of educational materials)	Interventional, comparative, randomized study Comparison among the incentive program (face-to-face and phone coaching contacts provided by personal health coaches (PHCs)) *vs* a CG	*N* = 314 (construction workers) IG: *N* = 162 CG: *N* = 152	6 months	TTM
18. Bale JM Effect of the Work Environment on Using Time at Work to Exercise. 2015	Interventional RCT with quality control. Allowance of paid time for practicing PA on workplace	In two groups, every individual received both a gym membership and 30 min for exercise per workday. One of the two groups received education materials throughout the study period. Guidelines for taking the 30 min were explained in oral, written, and e-mail format	*N* = 188 30 university departments randomized on two groups Gym +Time: *N*= 129 Gym +time +educ: *N* = 119	9 months	SCT
19. Lippke S A Computerized Lifestyle Application to Promote Multiple Health Behaviors at the Workplace: Testing Its Behavioral and Psychological Effects. 2015	Individualized, informative, behavioral and motivational program through the dissemination of educational materials (awareness, strategy, strengthening of motivation)	Interventional, comparative, randomized study Comparison among the entire individualized program *vs* informative program (generic educational materials)	*N* = 560 (shiftworkers, track workers, train drivers, ticket inpectors, 45% with a physical occupation) Stage matched intervention: *N* = 498 Active control condition: N = 62	1 month	TTM
20. Macniven R. Does a corporate worksite PA program reach those who are inactive? Findings from an evaluation of the Global Corporate Challenge. 2015	Motivational program: use of a pedometer and achievement of a challenge (as a team), motivational messages	Interventional, non-comparative study Assessment of the evolution of the PA level within the study population	*N* = 587 (office workers) No CG	16 weeks	No theoretical framework
21. Mainsbridge CP. The Effect of an e-Health Intervention Designed to Reduce Prolonged Occupational Sitting on Mean Arterial Pressure. 2015	Educational and interactive e-health software program, prompting employees to engage in a brief bout of short burst PA periodically (13 weeks)	RCT, e-health intervention Primary outcome: Mean Arterial Pressure (MAP)	*N* = 29 (desk-based employees from a Department of Police and Emergency Management) IG = 11 CG = 18	13 weeks	TTM

Table 1 (continued)

Reference	Summary of the intervention	Study design	Participants number	Intervention duration	Theoretical model
22. Mansi S. Investigating the effect of a 3-month workplace-based pedometer-driven walking programme on health-related quality of life in meat processing workers: a feasibility study within a RCT. 2015	Intervention participants utilized a pedometer and educational material, a step calendar to self-monitor their activity	Single-blinded RCT Participants were required to walk to accumulate at least 30 mn of moderate intensity activity for at least 5 days/week during work and/or leisure time	*N* = 58 (large meat processing plant) IG = 29 CG = 29	12 weeks	Self-Regulation Theory
23. Lawton R. Intervention fidelity and effectiveness of a UK worksite physical activity intervention funded by the BUPA Foundation, UK. 2015	Fidelity analysis as part of a large matched-pair cluster randomized controlled trial of a worksite physical activity intervention (AME for Activity)	The nine key components of the intervention called 'AME (Awareness, Motivation and Environment) for activity' were: a launch week, interactive leaflets, posters, a knowledge quiz, team challenges, reminders, letters of management support, newsletters and fridge magnets to allow self-monitoring of PA	*N* = 1260 IG = employees in the Local Council (*N* = 443) CG = employees in 4 other worksites: hospital, bus company, government organization, university (*N* = 611)	3 months + 9 months follow up	Theory of planned behavior
24. Finkelstein EA. Effectiveness of activity trackers with and without incentives to increase PA (TRIPPA): a RCT. 2016	Motivational program with the use of a pedometer and financial rewards (depending on the group); individualized informative and behavioral program through the dissemination of educational materials (awareness, strategies, goals)	RCT. Participants were assigned to one of four study groups: control (no tracker or incentives), activity tracker and website (Fitbit), tracker plus charitable incentives (charity), and tracker plus cash incentives (cash)	*N* = 800 (15 companies, office workers) Fitbit: 203 Charity: 199 Cash incentives: 197 CG: 206	6 months + 6 months follow-up	No theoretical framework
25. Carr LJ. Total Worker Health Intervention Increases Activity of Sedentary Workers 2016	Ergonomic Program promoting PA, using a portable seated elliptical machine, an i-Pod Touch to track participant's daily pedaling progress	Overweight/obese adults working in sedentary desk jobs were randomized to: (1) a health protection–only group (HPO, n = 27); or (2) an integrated health protection/health promotion group (HP/HP, n = 27)	*N* = 60 (Large private Company) IG (HP/HP) = 30 CG(HPO) = 30	16 weeks	SCT
26. Chaélat-Valayer E. Long-term effectiveness of an educational and physical intervention for preventing low-back pain recurrence: a RCT. 2016	RCT investigating the effect of a light exercise program, initiated in the workplace and continued at home, in reducing recurrence of LBP (Low Back Pain) episodes among healthcare workers	The intervention comprised three steps: (i) a 2-h education session about LBP (Low back Pain) prevention, (ii) five weekly 90-min exercise training sessions in the workplace, and (iii) a home-based self-managed exercise program	*N* = 342 (Health care workers from ten hospitals) IG = 171 CG = 171	2 years	No theoretical framework

Table 1 (continued)

Reference	Summary of the intervention	Study design	Participants number	Intervention duration	Theoretical model
27. Taylor WC. Impact of Booster Breaks and Computer Prompts on PA and Sedentary Behavior Among Desk-Based Workers: A Cluster-RCT. 2016	RCT investigating the effect of a Booster Break program. The Booster Break was implemented with an exercise physiologist, PA specialist with behavioral sciences training, instructional designer, health educator, and videographer	3-armed, cluster RCT at 4 worksites. IG1 = Booster Break arm: stretching, strengthening, and aerobic movements, followed by a 60-s meditation. Daily worksite sessions lasted 13 to 15 min during one 15-min break IG2 = computer-prompt arm	*N* = 185 (office workers) IG1 = 76 IG2 = 61 CG = 48	6 months	SCT
28. Aittasalo M. Moving to business—changes in PA and sedentary behavior after multilevel intervention in small and medium-size workplaces. 2017	Information campaign set up by working groups (company employees)	Interventional, non-comparative study Assessment of the evolution of the PA level of the participants	*N* = 396 12 companies in all sectors with less than 250 employees	1 year	No theoretical framework
29. Raedeke TD. High Vs Low Theoretical Fidelity Pedometer Intervention Using Social-Cognitive Theory on Steps and Self-Efficacy. 2017	Motivational program: use of a pedometer, with the formation of walking groups; behavioral program with goal and strategy setting up within the walking groups	RCT, IG (High Fidelity Program): use a pedometer, weekly group walk followed by a meeting to discuss cognitive behavioral strategies targeting self-efficacy. CG (Low theoretical Fidelity Program): met for a group walk, use a pedometer as a motivational tool and to monitor steps	*N* = 62 (university employees) Allocated to High Fidelity Program (*N* = 32) Allocated to Low Fidelity Program (*N* = 30)	10 weeks	SCT
30. Losina E. Implementation of a workplace intervention using financial rewards to promote adherence to physical activity guidelines: a feasibility study. 2017	Financial incentive program based on SCT theory: B. and Women's Wellness (B-Well) program. No control arm Secondary outcomes included Fitbit-wear adherence and factors associated with meeting CDC guidelines more consistently	Participants were rewarded for increasing their MVPA by 10% from the previous week or for meeting the Centers for Disease Control and Prevention (CDC) PA guidelines (150 min of MVPA per week). Primary outcome was the % of participants meeting weekly MVPA goals and CDC PA guidelines	*N* = 300 (sedentary hospital employees)	26 weeks	SCT
31. Hunter RF. Association among time preference, present-bias and PA: implications for designing behavior change interventions. 2018	Nested study. (Ref n°15; Hunter RF, 2013) Specific objective was to determine whether the"present time"interest may influence the PA level	Comparative, randomized study. PAL scheme vs CG "Discount rate" and "present-bias" parameters are studied	*N* = 176 (2 buildings, office workers) IG (PAL-scheme): *N* = 95 from [*N* = 199] New CG: N = 111	12 weeks	Learning theory

Table 1 (continued)

Reference	Summary of the intervention	Study design	Participants number	Intervention duration	Theoretical model
32. Hunter RF. Effectiveness and cost-effectiveness of a loyalty scheme for PA behaviour change maintenance: results from a cluster RCT. 2018	Nested study (Ref n°15; Hunter RF, 2013) Specific objective was to determine cost-effectiveness of the PAL loyalty scheme	Interventional, comparative, randomized study Comparison among the program with *vs* without rewards	*N* = 853 (9 workplaces, 27 clusters, office workers) IG: *N* = 457 CG: *N* = 396	12 months	Learning theory
33. Reed JL. The Impact of Web-Based Feedback on PA and Cardiovascular Health of Nurses Working in a Cardiovascular Setting: A Randomized Trial. 2018	Motivational program with the use of a pedometer and setting up of challenges Participants were asked at baseline and every 2 weeks to self-set goals to increase daily pedometer steps and the weekly number of 10-min blocks of MVPA	Interventional, comparative, randomized study Comparison of the program completion as an individual *vs* as a group of friends *vs* as a team of colleagues	*N* = 76 (care setting: nurses) Allocated to Individual intervention: *N* = 25 Allocated to Friend intervention: *N* = 25 Allocated to Team intervention: N = 25	6 weeks	Self-determination continuum theory
34. Park J. Motivational Interviewing for Workers with Disabling Musculoskeletal Disorders: Results of a Cluster Randomized Control Trial 2018	Cluster RCT with claimants attending an occupational rehabilitation facility	Six clinicians provided Motivational Interviewing (MI) in addition to the standard functional restoration program and formed an intervention group. Claimants were predominantly employed (72.7%), males (63.2%), with moderate levels of pain and disability (mean pain VAS = 5.0/10 and mean Pain Disability Index = 48/70)	*N* = 728 (injured workers receiving workers' compensation and undergoing work rehabilitation) IG: *N* = 367 CG: N = 361	7 months	Motivational Interviewing theory
35. Gremaud AL. Gamifying Accelerometer Use Increases Physical Activity Levels of Sedentary Office Workers. 2018	The purpose of this study was to test the efficacy of MapTrek for increasing daily steps and moderate-intensity steps over 10 weeks in a sample of sedentary office workers	MapTrek is a mobile health platform that gamifies Fitbit use for the purpose of promoting physical activity. Each participant received a Fitbit Zip to wear daily throughout the intervention. Participants were randomized to either a: Fitbit-only group (FB) or Fitbit + MapTrek group (MT)	*N* = 146 (office workers) IG: *N* = 73 CG: *N* = 72	10 weeks	Self-determination continuum theory

Table 1 (continued)

Reference	Summary of the intervention	Study design	Participants number	Intervention duration	Theoretical model
36. Murray JM. Predicting Outcomes from Engagement With Specific Components of an Internet-Based PA Intervention With Financial Incentives: Process Analysis of a Cluster Randomized Controlled Trial. 2019	Nested study. Ref n°15, Hunter RF, 2013 Specific objectives were to determine: (1) whether engagement in specific intervention components predicted PA, (2) targeted mediators, (3) predictors of website non usage	Interventional, non-comparative study Assessment of the commitment level of the participants in the intervention	*N* = 457 (19 clusters, office workers) No CG	6 months	Learning theory
37. Lee SH. The Effects of a Mobile Wellness Intervention with Fitbit Use and Goal Setting for Workers. 2019	Individualized behavioral program with goal setting up and counseling sessions with the use of a pedometer and motivational messages	Interventional RCT study. Incentive program (mobile wellness intervention using Fitbit, goal setting, brief counseling and motivational text messaging for workers) *vs* use of a pedometer alone	*N* = 82 (two workplaces, plant workers) IG: *N* = 41 CG: *N* = 41	12 weeks	Self-determination continuum theory
38. Brunet J. Motivation Predicts Change in Nurses' PA Levels During a Web-Based Worksite Intervention: Results From a Randomized Trial. 2020	Nested study, ref n°33 (Reed JL, 2018)	Originality: this second study examined mediators/moderators (such as commitment, self-efficacy and intention) of the outcomes of PA and the dose relation of goal setting with PA	*N* = 76 (care setting: nurses)	6 weeks	Self-determination continuum theory
39. Murray JM Mechanisms of PA behavior change in an incentive-based intervention: mediation analysis. 2020	The PAL Scheme program integrated a novel PA remote tracking system with web-based monitoring and evidence-based behaviour change tools (i.e. self-monitoring, goal-setting)	Participants were encouraged by financial incentives to undertake 150 min/week of PA which is in line with current guidelines	(public sector, office-based employees) *N* = 853 IG = 457 CG = 396	6 months	Learning theory
40. Thøgersen-Ntoumani C Feasibility and preliminary effects of a peer-led motivationally embellished workplace walking intervention: A pilot cluster randomized trial (the START trial). 2020	Individualized behavioral program with goal setting up (3000 steps i.e., equivalent to a 30 mn moderate intensity walk) and counseling sessions with the use of a pedometer and motivational messages	Incentive program: all participants were provided with a Fitbit Zip and information on health benefits of walking. IG had access to a mobile phone app incorporating behavior change techniques and had a peer leader trained in a motivationally supportive communication style	*N* = 97 (8 worksites, office workers) IG: *N* = 50 CG: *N* = 47	16 weeks	Self-determination continuum theory

Table 1 (continued)

Reference	Summary of the intervention	Study design	Participants number	Intervention duration	Theoretical model
41. Metcalfe RS. Time-efficient and computer-guided sprint interval exercise training for improving health in the workplace: a randomised mixed-methods feasibility study in office-based employees. 2020	Mixed methods, quantitative and qualitative, to investigate the feasibility, acceptability and effectiveness of a short duration, High-intensity Exercise Intervention (REHIT) when applied unsupervised in a workplace setting	IG completed three exercise sessions per week. The 10-min exercise sessions consisted of low-intensity cycling (60 W) and one (first session) or two (all other sessions) brief'all-out'sprints (10 s. in week 1; 15 s. in weeks 2–3 and 20 s. in the final 3 weeks). The primary outcome was the change in maximal aerobic capacity (V̇O2 max). Secondary outcomes were adherence and acceptability	*N* = 29 (office-workers) IG = 16 CG = 13	6 weeks	No theoretical framework
42. Welsh A. Process evaluation of a workplace-based health promotion and exercise cluster randomised trial to increase productivity and reduce neck pain in office workers: a RE-AIM approach. 2020	RE-AIM (reach, effectiveness, adoption, implementation, maintenance) framework: randomised trial comparing an "ergonomic plus exercise intervention" to an "ergonomic plus health promotion intervention"	Qualitative and quantitative approach. The EET group (IG) received strength training for 20 min, three days each week (one supervised, two unsupervised) for 12 weeks, while the EHP (CG) group received a one hour facilitated health promotion information session each week for 12 weeks	*N* = 753 (industry network, public/private sector, government-operated businesses and one university, 14 organizations, office personnels, 19% were managers) IG = 367 CG = 373	12 weeks + 12-month follow up	No theoretical framework
43. Fernandez La Puente de Battre MD. What it takes to recruit 77 subjects for a one-year study on active commuting. 2020	Motivational program with the use of financial incentives: 50- euro vouchers for bicycle shop, 24-h public transport tickets	GISMO study, randomized controlled monocentric trial	*N* = 73 (hospital) IG: *N* = 51 CG: *N* = 22	53 days	No theoretical framework
44. Morris A. Sit Less and Move More—A multi-component intervention with and without height-adjustable workstations in contact centre call agents: a pilot RCT. 2021	Multi-component intervention to sit less and move more, with (SLAMM +) and without (SLAMM) height-adjustable workstations, in contact centre call agents	After randomisation, a height-adjustable workstation to individual desk was provided for SLAMM + agents (IG). Mixed-methods assessed response, recruitment, retention, attrition and completion rates, adverse effects, trial feasibility, acceptability, and effectiveness on worktime sitting	*N* = 59 (call centers) IG = 30 CG = 29	10 months	Behavior change wheel

Table 1 (continued)

Reference	Summary of the intervention	Study design	Participants number	Intervention duration	Theoretical model
45. Tosta Maciel RRB. Does tutor's support contribute to a telehealth program that aims to promote the quality of life of office workers? A cluster randomized controlled trial. 2021	Motivational program The objective is to evaluate the effectiveness of a telehealth program in the workplace that was made available in two ways: a conventional telehealth program (CG) and a telehealth care program with tutors: nutritionists, psychologist and physiotherapists (IG)	The communication instrument was Moodle. Nine audiovisual sessions were performed and addressed to the all participants: 1) musculoskeletal health (walking program, back school, muscle relaxation, work related musculoskeletal diseases), 2) healthy diet (eating and commensality, ultra-processed food and food labeling, oils and fats), 3) mental health (meaning of work and burn out)	*N* = 326 (18 clusters, office workers, computer users from a public university) IG = 178 CG = 148	6 months	e-Health education program, based on "socio-interactionist theory"
46. Althammer SE. Comparing Web-Based and Blended Training for Coping With Challenges of Flexible Work Designs: Randomized Controlled Trial. 2023	Flexible work designs (FWDs), such as flextime, telework, and mobile work, provide workers with temporal and spatial flexibility. This study hypothesized that a blended intervention, combining web-based self-training and face-to-face elements should increase social support and adherence compared with web-based interventions	3-armed randomized controlled trial with 2 IGs and a waitlist CG This study also evaluated the effectiveness of an intervention in improving the recovery, work-life balance, and well-being of workers with flexible work designs (FWDs) compared with a waitlist CG	*N* = 373 (researchers, doctorate, technical college, master, bachelors'degree). Having a leadership position: 25% (94/373 at T2 = 4 weeks post-intervention) IG: *N* = 194 IG1: allocated to web-based intervention: *N* = 198 IG2: allocated to blended intervention: *N* = 196 CG: *N* = 179	4 weeks	self-determination theory

Abbrevations: RCT Randomized controlled trial, *IG* Intervention group, *CG* Control group, *MVPA* Moderate to vigorous physical activity, *PA* Physical activity, *SCT* Social cognitive theory, *TTM* Transtheoretical model of health behavior change, *Ref* Reference

Table 2 Supervised physical activity programs with coaching sessions (SPAP) in the workplace

Reference	Summary of the intervention	Study design	Participants number; (): type of work, worksite	Intervention duration	Theorical Model
1. Nichols JF. Impact of a worksite behavioral skills intervention. 2000	PA program: supervised PA sessions in the workplace (following behavioral sessions); PA sessions at a local fitness club (paid membership, supervision depending on the group) PA incentive program: goal and strategy setting up, feedback	Interventional, comparative, randomized study Comparison among the combination of the two programs *vs* non-supervised fitness club membership	*N* = 60 (two workplaces, office workers) IG: *N* = 29 CG: *N* = 31	12 weeks + 3-month follow up	SCT TTM
2. Nurminen E. Effectiveness of a worksite exercise program with respect to perceived work ability and sick leaves among women with physical work. 2002	RCT using guided exercise intervention to evaluate the effectiveness of a worksite exercise program on perceived work ability and the occurrence of sick leave among women with physically demanding work	RCT with supervised PA sessions in the workplace, 26 sessions, 1 h/week over 8 months	*N* = 260 (laundry women workers, 11 production units of a laundry company) IG: *N* = 127 CG: *N* = 133	8 months + Follow-up at 3, 8 and 15 months	-
3. Brox JI. Health-related quality of life and sickness absence in community nursing home employees: controlled trial of physical exercise. 2005	Fitness program: weekly session of light group exercise lasting for 1 h. The intervention was founded on an aerobic fitness model supervised by experienced instructors. Classes regarding physical exercise, nutrition and stress management were offered to the IG	Interventional, comparative, randomized study Comparison among the combination of fitness program supervised by experienced instructors and classes *vs* ordinary activity	*N* = 129 (nursing home for the elderly) IG: *N* = 65 CG: *N* = 64	6 months	-
4. Atlantis E. Worksite intervention effects on physical health: a RCT. 2006	PA program: supervised PA sessions in the workplace, during working hours (paid) PA incentive program: behavioral (seminars, individual interviews) and motivational (dissemination of material rewards) program	Interventional, comparative, randomized study IG: supervised exercises including aerobic (20 min duration 3 days/week) and weight training (30 min, 2–3 days/week), and dietary/health education (delivered via group seminars)	*N* = 73 (casino employees, one site) IG: *N* = 36 CG: *N* = 37	24 weeks	-
5. Brand R. Effects of a physical exercise intervention on employees'perceptions quality of life: a RCT. 2006	PA program: supervised, physical exercise sessions, outside of the working hours (unpaid)	Interventional, comparative, randomized study Comparison among the PA program *vs* the CG 26 sessions. One session per week guided by a fitness coach and conducted in a small group training situation. Voluntary additional sessions	*N* = 177 (office and blue-collar workers, 3 companies) IG: *N* = 88 CG: *N* = 89	13 weeks + 3-month follow-up	-

Table 2 (continued)

Reference	Summary of the intervention	Study design	Participants number; (): type of work, worksite	Intervention duration	Theorical Model
6. Andersen LL, A Randomized Controlled Intervention Trial to Relieve and Prevent Neck/Shoulder Pain. 2008	PA program: supervised PA sessions in the workplace, 1 h per week during working hours Behavioral program with counseling sessions, setting up of goals and strategies	Interventional, comparative, randomized study Comparison among a Specific Resistance Training program (SRT group) *vs* a All-Round Physical Exercise program (APE) increasing level of PA during both leisure and at work, *vs* control group (REF) through improved workplace ergonomics, stress management	*N* = 549 (office workers) SRT: *N* = 180 APE: *N* = 187 REF: *N* = 182	1 year	-
7. Zebis MK. Implementation of neck/shoulder exercises for pain relief among industrial workers: a RCT. 2011	Interventional, comparative, randomized study. Comparison among the strength training program program *vs* the CG. The primary outcome was changes in self-reported neck and shoulder pain intensity	High intensity strength training program during working hours: the training regime consisted of three sessions per week, each lasting 20 min. The training group performed high-intensity specific strength training locally for the neck and shoulder muscles with 4 different dumbbell exercises and 1 exercise for the wrist extensor muscles	*N* = 537 (Laboratory technicians) IG: *N* = 282 CG: *N* = 255	20 weeks	-
8. Andersen CH. Influence of frequency and duration of strength training for effective management of neck and shoulder pain: a randomized controlled trial. 2012	PA program: supervised PA sessions in the workplace, during working hours	Interventional, comparative, randomized study Comparison among a program with once-weekly supervised sessions (1 WS group: 60 mn) *vs* 3 supervised sessions per week (3 WS group: 3 × 20 mn) *vs* 9 supervised sessions per week (9 WS group:9 × 7 mn) *vs* control (REF group)	*N* = 447 (office workers) 1 WS: *N* = 116 3 WS: *N* = 126 9 WS: *N* = 106 REF: *N* = 101	20 weeks	-
9. Jørgensen MB. Implementation of physical coordination training and cognitive behavioral training interventions at cleaning workplaces-secondary analyses of a randomized controlled trial. 2012	Secondary study, datas from FINALE program (Holtermann et al., 2010). PA program: supervised PA sessions in the workplace. Incentive program: non-individualized informative and behavioral program (working groups)	Qualitative and quantitative approach among an interventional, comparative, randomized study [comparison among the physical coordination training program (PCT group) *vs* the cognitive training behavioural program (CTBr group) *vs* control (REF group)]. The objective is to explain adherence/dropout factors	*N* = 294 (women cleaners) PCT group: *N* = 95 CTBr group: *N* = 99 REF group: *N* = 100	12 weeks	CBTT

Table 2 (continued)

Reference	Summary of the intervention	Study design	Participants number; (): type of work, worksite	Intervention duration	Theorical Model
10. Van Wormer JJ. Is baseline PA a determinant of participation in worksite walking clubs? Data from the Health Works Trial. 2012	PA program: implementation of walking clubs in the workplace	Interventional, non-comparative study, data from the RCT Health-Works program Assessment of the evolution of the PA level of the participants within IG	*N* = 642 (6 workplaces, office, care and manual workers)	2 years	-
11. Pedersen MM. Influence of self-efficacy on compliance to workplace exercise. 2013	Nested study, ref. n°7 (Zebis MK, 2011)	The purpose was to determine the influence of self-efficacy on compliance to specific strength exercises during working hours	*N* = 537 (Laboratory technicians) IG: *N* = 282 CG: *N* = 255	20 weeks	-
12. Andersen LL. Cardiovascular Health Effects of Internet-Based Encouragements to Do Daily Workplace Stair-Walks: Randomized Controlled Trial. 2013	Single-blind randomized controlled trial to determine the effect on cardiovascular health of email-based encouragements	Participants were randomly assigned (2:1 ratio) to an email group receiving weekly email-based encouragements to walk the stairs for 10 min a day or to a control group receiving weekly reminders to continue their usual physical activities. The examiner was blinded to group allocation	*N* = 160 (Large administrative company) IG: *N* = 106 CG: *N* = 54	10 weeks	-
13. Gram B. Effect of training supervision on effectiveness of strength training for reducing neck/shoulder pain and headache in office workers: cluster RCT. 2014	PA program: supervised PA sessions in the workplace, during working hours (paid) (depending on the group). Secondary study; Ref. n°8, Andersen CH, 2012	Interventional, comparative, randomized study Comparison among a program with 3 weekly supervised sessions (3 WS group) vs 3 weekly minimal-supervised sessions (3MS group) vs REF	*N* = 341 (office workers) 3 WS: *N* = 126 MS: *N* = 124 REF: *N* = 101	20 weeks	-
14. Tudor-Locke C. Implementation and adherence issues in a workplace treadmill desk intervention. 2014	Randomized crossover control trial Pilot study in a real workstation environment	Participants in the IG were required to use the treadmill desk for 45 min twice a day, during the defined period, depending on the cohort they were in (3 or 6 months)	*N* = 41 (health insurance workplace) IG: *N* = 21 CG: *N* = 20	6 months (cohort 1). New inclusion period of 3 months (cohort 2)	-
15. Mair JL. Benefits of a worksite or home-based bench stepping intervention for sedentary middle-aged adults– a pilot study. 2014	Crossover clinical trial. The objective of the study was that the participants must reach 9 min per day of stair climbing exercise, at least 3 days per week, at home or at work	Before the study, a measurement was made on the studied parameters * (baseline), then the participants had their 4 weeks of training and the final measurement was made * cardiorespiratory fitness, body composition, lower limb muscle strength	*N* = 62 IG: *N* = 31 (11 training at home, 20 training in the workplace), CG: *N* = 31	4 weeks	-

Table 2 (continued)

Reference	Summary of the intervention	Study design	Participants number; (): type of work, worksite	Intervention duration	Theorical Model
16. Mortensen P Effects of Workplace Strength Training for Neck/Shoulder/ Arm Pain among Laboratory Technicians: Natural Experiment with 3-Year Follow-Up. 2014	1-year RCT with high-intensity strength training for prevention and treatment of neck, shoulder, arm pain; with 3-year follow-up. Secondary study, ref. n°7 (Zebis MK, 2011)	High-intensity strength training program: The training regime consisted of three sessions per week, each lasting 20 min. The training group performed high-intensity specific strength training locally for the neck and shoulder muscles with 4 different dumbbell exercises and 1 exercise for the wrist extensor muscles	*N* = 537 (laboratory technicians) IG: *N* = 282 CG: *N* = 255 Private sector: *N* = 361 Public sector: *N* = 161	1 year + 3-year follow-up	-
17. Zebis MK. Time-Wise Change in Neck Pain in Response to Rehabilitation with Specific Resistance Training: Implications for Exercise Prescription. 2014	Secondary analysis of a parallel-group cluster randomized controlled trial. Women with neck pain were included in the present analysis	The training group performed specific resistance training for the neck/shoulder muscles with 4 different dumbbell exercises, front raise, lateral raise, reverse flies and shrugs, during 20 mn three times a week; the CG received advice to stay active. Participants of both groups registered neck pain intensity (0–100 mm VAS) once a week	*N* = 131 (two large industrial production units) IG = 77 CG = 54	20 weeks	-
18. Dalager T. Does training frequency and supervision affect compliance, performance and muscular health? A cluster RCT. 2015	PA program: supervised PA sessions in the workplace, during working hours (paid) (depending on the group). Nested study, ref n°8 (Andersen CH, 2012)	Interventional, comparative, randomized study Comparison among a program with 1 WS group *vs* 3 WS group *vs* 9 WS group *vs* 3MS group *vs* control (REF group)	*N* = 573 (office workers) 1 WS: *N* = 116 3 WS: *N* = 126 9 WS: *N* = 106 3MS: *N* = 124 REF: *N* = 101	20 weeks	-
19. Bredahl TVG. When Intervention Meets Organisation, a Qualitative Study of Motivation and Barriers to Physical Exercise at the Workplace. 2015	Nested study. ref n°8, Andersen CH, 2012	Qualitative approach: semi-deductive, thematic, and structured interviews conducted on IG	*N* = 18 out of the 573 participants randomized to one of the IG (office workers)	20 weeks	-
20. Jakobsen MD, Effect of workplace- vs home-based physical exercise on musculoskeletal pain among healthcare workers: a cluster RCT. 2015	PA program: supervised PA sessions in the workplace, during working hours (paid) (depending on the group); combined with a behavioral and motivational program (individual counseling sessions). Informative and behavioral program (educational materials and sports equipment)	Interventional, comparative, randomized study Comparison among a comprehensive PA program (WORK group) *vs* an informative program alone (HOME group)	*N* = 200 (Health care setting, 9 clusters) WORK group: *N* = 111 HOME group: *N* = 89	10 weeks	-

Table 2 (continued)

Reference	Summary of the intervention	Study design	Participants number; (): type of work, worksite	Intervention duration	Theorical Model
21. Andersen LL. Effect of physical exercise on workplace social capital: Cluster RCT. 2015	Nested study, ref n°20 (Jakobsen MD, 2015)	Originality: investigates the effect of physical exercise on social capital at work	*N* = 200	10 weeks	-
22. Mayer JM. Impact of a supervised worksite exercise program on back and core muscular endurance in firefighters. 2015	PA program: supervised PA sessions in the workplace, during working hours (paid)	Interventional, comparative, randomized study Comparison among the PA program *vs* the CG Outcomes: back and core muscular endurance was assessed with the Biering-Sorensen test and plank test	*N* = 96 (professional firefighters) IG: *N* = 54 CG: *N* = 42	24 weeks	-
23. Korshoj M. Does aerobic exercise improve or impair cardiorespiratory fitness and health among cleaners? A cluster RCT. 2015	PA program: supervised PA sessions in the workplace, during working hours (paid)	Interventional, comparative, randomized study Comparison among the PA (4 months, 2 × 30 mn high intensity > 60% VO2 max, supervised aerobic exercises) program *vs* reference (REF). Outcomes: cardiorespiratory fitness (VO2 max), aerobic workload, bpm, sleeping and systolic body pression	*N* = 116 (women cleaners) Aerobic Exercises: *N* = 57 REF: *N* = 59	4 months	-
24. Rasotto C. A Tailored Workplace Exercise Program for Women at Risk for Neck and Upper Limb Musculoskeletal Disorders. 2015	A 6-month, twice-weekly exercise program was introduced that was tailored to the specific needs of the participants	Randomized by 6 blocks of 10, control trial, two-armed, interventional	*N* = 60 (industry manual workers) IG: *N* = 30 CG: *N* = 30	6 months	-
25. Dalager T. Implementing intelligent physical exercise training at the workplace: health effects among office workers-a RCT. 2016	Intelligent physical exercise training (IPET) program: supervised physical exercise sessions in the workplace, during working hours (paid), adjusted to each individual's profile and Incentive program ("with health ambassadors")	Interventional, comparative, randomized study. Comparison among the entire program *vs* the CG. IG received 1-h supervised high-intensity program every week within working hours, and was recommended to perform 30-min of moderate intensity physical activity 6 days a week during leisure	*N* = 389 (6 companies, office workers) IG: *N* = 194 CG: *N* = 195	1 year	-
26. Cuthbert CA. The Effects of Exercise on Physical and Psychological Outcomes in Cancer Caregivers: Results from the RECHARGE RCT. 2016	RCT examining the effects of a 12-week exercise program on quality of life (Short Form 36 v2), psychological outcomes, PA levels, and physical fitness in caregivers to cancer patients	The goal was to achieve 150 min of aerobic exercise per week in bouts of 10 min or more, and 2 days per week of resistance exercises for each of the major muscle groups	*N* = 77 (health care workers) IG: *N* = 38 CG: *N* = 39	12 weeks	-

Table 2 (continued)

Reference	Summary of the intervention	Study design	Participants number; (): type of work, worksite	Intervention duration	Theorical Model
27. Justesen JB. Effect of Intelligent Physical Exercise Training on Sickness Presenteeism and Absenteeism Among Office Workers. 2017	Nested study, ref n°25 (Dalager T, 2009)	Here, the aim of this study was to investigate the effect of IPET on presenteeism and absenteeism among office workers	*N* = 389 (6 companies office workers) IG: *N* = 194 CG: *N* = 195	1 year	-
28. Jakobsen MB. Factors affecting pain relief in response to physical exercise interventions among healthcare workers. 2017	Nested study, ref n°20 (Jakobsen MD, 2015)	Originality: authors focused on musculoskeletal pain adjusted with training adherence	*N* = 200	10 weeks	-
29. Matsugaki R. Effectiveness of workplace exercise supervised by a physical therapist among nurses conducting shift work: A RCT. 2017	PA program: supervised PA sessions in the workplace	Interventional, comparative, randomized study Comparison among a program with supervision (SG) vs without supervision (VG group) Outcomes: VOmax, muscle strength, high density lipoprotein cholesterol and depressive symptom	*N* = 30 (care setting) SG, supervised group: *N* = 15 CG: *N* = 15	12 weeks	-
30. Lowe BD. Evaluation of a Workplace Exercise Program for Control of Shoulder Disorders in Overhead Assembly Work. 2017	PA program: supervised PA sessions in the workplace, during working hours (paid)	Interventional, comparative, randomized study Comparison among the PA program *vs* the CG Outcomes: SRQ (shoulder rating questionnaire), DASH (Discomfort of the Arm Shoulder and Hand), and Nordic questionnaire	*N* = 76 (two companies, plant workers) IG: *N* = 41 CG: *N* = 35	6 months	-
31. Keading T. Whole-body vibration training as a workplace-based sports activity for employees with chronic low-back pain. 2017	The IG group use whole-body vibration training 2.5 times a week. Randomized and controlled trial. Randomization is conducted by central fax stratified for sex	The sessions were 15 min long, divided into 5 sets of 60 to 120 s. The sessions were built progressively in frequency = from 10 to 30 Hertz, amplitude = from 1.5 to 3.5 mm, and in duration so that the body gets used to it	*N* = 41 IG = 21 CG = 20	3 months	-

Table 2 (continued)

Reference	Summary of the intervention	Study design	Participants number; (): type of work, worksite	Intervention duration	Theorical Model
32. Murray M Self-administered physical exercise training as treatment of neck and shoulder pain among military helicopter pilots and crew: a randomized controlled trial; 2017	Randomized, parallel-group, single-blind, interventional, controlled trial Comparison of pain with and without prior muscle training	Training program: participants completed a 20-week program of strength, endurance, and coordination exercises targeting the neck and shoulder muscles. Sessions were 3× 20 min per week. Each participant received a training bag containing resistance bands, a head harness, exercise handles, and a manual detailing the exercises. Motivational posters were placed in squadron rooms and tweets were posted on the training homepage to encourage participants. Training videos were also available online	*N* = 69 (31 pilots, 38 crew member) IG = 35 (exercise-training group) CG = 34 (reference group)	20 weeks	-
33. Genin P.M. Employees' adherence to worksite PA programs: Profiles of compliers vs non-compliers. 2018	PA program: supervised PA sessions in the workplace Nested study: data from Genin PM et al. Effect of a 5-Month Worksite PA Program on Tertiary Employees Overall Health and Fitness. J Occup Environ Med.2017;59(2): e3-e10	Interventional, comparative, randomized study. Comparison among 2 PA programs *vs* the CG 1° Novice group (NOV): started the worksite PA program at the beginning of the study. 2° Experienced group (EXP): participants engaged in the worksite PA program for the last 2 years a (minimum of 2× 45 mn/week). 3° CG (CON): engaged in less than 150 mn moderate PA/week for at least one year and not motivated to start the worksite PA program	*N* = 95 (office workers) NOV: *N* = 37 EXP: *N* = 36 CG: *N* = 22	10 months	-
34. Genin P.M. Effect of Work-Related Sedentary Time on Overall Health Profile in Active *vs* Inactive Office Workers. 2018	PA program: supervised PA sessions in the workplace Nested study: datasfrom Genin PM et al. Effect of a 5-Month Worksite PA Program on Tertiary Employees Overall Health and Fitness. J Occup Environ Med.2017;59(2): e3-e10	Quasi experimental study Comparison PA program among active employees *vs* inactive employees	*N* = 193 (office workers) Inactive group: *N* = 98 Active group: *N* = 95	5 months	-

Table 2 (continued)

Reference	Summary of the intervention	Study design	Participants number; (): type of work, worksite	Intervention duration	Theorical Model
35. Corbett DB. The effects of a 12-week worksite PA intervention on anthropometric indices, blood pressure indices, and plasma biomarkers of cardiovascular disease risk among university employees. 2018	PA program: supervised PA sessions in the workplace, during working hours (paid) PA incentive program: use of a pedometer (goal = 10,000 steps/day)	Interventional, non-comparative study 12-week PA intervention (60 min, 3 day/week). Each supervised session included aerobic and muscle-strengthening exercises. Participants were given the goal of 10,000 steps per day and categorized as compliers (≥ 10,000 steps per day) or non-compliers (< 10,000 steps per day)	*N* = 50 (university employees) No CG	12 weeks	-
36. Hunter JR. Exercise at an onsite facility with or without direct exercise supervision improves health-related physical fitness and exercise participation: An 8-week RCT with 15-month follow-up. 2018	PA program: supervised physical exercise sessions in the workplace (depending on the group)	Interventional, comparative, randomized study Comparison among the program with *vs* without supervision	*N* = 50 (university staff) IG: *N* = 25 CG: *N* = 25	8 weeks + 15-month follow-up	-
37. Lidegaard M. Effects of 12 months aerobic exercise intervention on work ability, need for recovery, productivity and rating of exertion among cleaners: a worksite RCT. 2018	Nested study, ref n°23 (Korshoj M, 2015)	Interventional, comparative, randomized study Comparison among the intervention program (8 months, high intensity aerobic exercises) *vs* a reference group (REF) Outcomes: cardiorespiratory fitness (VO2 max), aerobic workload, bpm, sleeping and systolic blood pressure	*N* = 116 (women cleaners) Aerobic Exercises: *N* = 57 CG: *N* = 59	4-month supervised program, + 8-month partially supervised program	-
38. Faes Y. Stochastic Resonance Training Improves Balance and Musculoskeletal Well-Being in Office Workers: A Controlled Preventive Intervention Study. 2018	Longitudinal randomized-controlled trial Resonance whole-body vibration (SR-WBV) was expected to improve surefootedness, sense of balance over time, and musculoskeletal well-being	The training group was instructed to complete 3 stochastic resonance whole-body vibration (SR-WBV) 10 mn exercises every week for 4 weeks, the control group received no treatment	*N* = 62 (office workers) IG: *N* = 36 CG: *N* = 26	4 weeks	-
39. Krebs S. Effects of a Worksite Group Intervention to Promote PA and Health: The Role of Psychological Coaching. 2019	PA program: supervised PA sessions in the workplace PA incentive program: behavioral program with group sessions	Interventional, comparative, randomized study. Comparison among the combination of a"practical" PA program combined with a "theoretical" (psychological) coaching component (PA + C) *vs* the "practical" (PA) component alone	*N* = 213 (employees from industrial companies) PA + C: *N* = 108 CG: N = 105	4 weeks + 6 months + 12-month Follow-up	TTM, SCT

Table 2 (continued)

Reference	Summary of the intervention	Study design	Participants number; (): type of work, worksite	Intervention duration	Theorical Model
40. Johnston V. Feasibility and impact of sit-stand workstations with and without exercise in office workers at risk of low back pain: A pilot comparative effectiveness trial. 2019	Participants were provided with a sit-stand workstation (options were an electric height adjustable desk or a desktop height adjustable platform) IG completed a physiotherapist-supervised progressive resistance exercise programme to strengthen core muscles	Two-armed, randomized, interventional trial. Comparison of 2 groups of office workers at risk; one with a"sit-stand"desk without an exercise program, and the second with this same desk and a progressive resistance exercise program	*N* = 29 (office workers) IG: *N* = 16 (desk + exercise) CG: *N* = 13 (desk)	4 weeks	-
41. Stenner HT. Effects of six-month personalized endurance training on work ability in middle-aged sedentary women: a secondary analysis of a RCT. 2020	The aim of the training intervention was to perform 210 min of endurance training a week (20–60 min units for at least 3 days per week) over 6 months. Participants in the IG were able to complete part of their training during their working hours (full-time staff 60 min per week and part-time staff 30 min per week) at the in-house workplace health club	PA program based on work ability (Work Ability Index [WAI]), and peak oxygen uptake (VO2peak) evaluation For individualized training, the participants in the IG received heart rate ranges based on the lactate threshold (approx. 60–80% of the estimated max. heart rate) for their respective activities, such as cycling, rowing and walking	*N* = 291 (hospital employees*) IG: *N* = 146 CG: *N* = 145 *Medical and technical workers (33%), administration (27%), nurs-ing (19%) and physician/scient-ist (12%)	6 months	-
42. Eather N. Integrating high intensity interval training into the workplace: The Work-HIIT pilot RCT. 2020	The study design was a randomized controlled trial (RCT) with a wait-list control group. Participants were asked to attend 2–3 researcher-facilitated HIIT sessions/week (weeks 1–8)	Sessions included a 2-min gross-motor warm-up, followed by various combinations of aerobic and muscular fitness exercises lasting 8 min (using 30:30 s work: rest intervals). During weeks 5–8, the work to rest ratio changed to 40 secs:20 secs throughout the 8-min workout. If a participant didn't attend at least two sessions in a given week, the facilitator contacted them directly to check on their health status	*N* = 47 (University employees) IG: *N* = 24 CG: *N* = 23	8 weeks	-

Table 2 (continued)

Reference	Summary of the intervention	Study design	Participants number; (): type of work, worksite	Intervention duration	Theorical Model
43. Perez-Bilbao T. Effects of an Eight-Week Concurrent Training Program with Different Effort Character over Physical Fitness, Health-Related Quality of Life, and Lipid Profile among Hospital Workers: Preliminary Results 2021	This RCT aimed to determine the effects of two programs of eight weeks of concurrent training (CT) with different "effort character" (EC) over muscle strength (MS), cardiorespiratory fitness (CRF), functional mobility (FM), health-related quality of life (HRQoL), and lipid profile (LP) among hospital workers	The exercise intervention consisted of 60–90 min CT sessions two times per week on non-consecutive days across eight weeks, with the performance of endurance and strength training in the same session. The endurance training program was performed using a treadmill. Each participant's endurance training intensity was calculated as the target heart rate (THR) based on the subject's age and predicted maximum heart rate	*N* = 14 (hospital workers) IG: *N* = 7 CG: *N* = 7	8 weeks	-
44. Higham SM. Effects of Concurrent Exercise Training on Body Composition, Systemic Inflammation and Components of Metabolic Syndrome in Inactive Academics; a Randomised Controlled Trial. 2023	This randomized controlled trial investigated the effect of 14 weeks of concurrent exercise training (CT) on components of metabolic syndrome, body composition, insulin resistance and markers of systemic inflammation in inactive academics	CT performed supervised training at an onsite facility 3 times per week for 14 weeks and cardiometabolic health was assessed pre- and post-intervention. Aerobic capacity was measured via a metabolic cart. Dual Energy X-ray Absorptiometry measured fat mass, lean mass and central adiposity. Fasting blood samples were analysed for interleukin- 6 (IL- 6), tumor necrosis factor-alpha (TNF-α), Homeostatic Model Assessment for Insulin Resistance (HOMA-IR), glucose, and lipid profile	*N* = 59 ("inactive" academics) IG: *N* = 29 CG: *N* = 30	14 weeks	-

Table 2 (continued)

Reference	Summary of the intervention	Study design	Participants number; (): type of work, worksite	Intervention duration	Theorical Model
45. Brandt T. The MedXFit-study – CrossFit as a workplace health intervention: a one-year, prospective, controlled, longitudinal, intervention study. 2024	Prospective, controlled intervention design Employees were invited to participate in intervention group (IG) or control group (CG) on their own preferences. Inclusion criteria were a predominantly sedentary occupation and execution of less than two muscle and/or mobility enhancing training sessions per week at the time of enrolling	The IG did a CrossFit training of 1 h at least twice a week. Mobility, strength, well-being, and back issues were measured at the beginning, after 6, and 12 months. Participants in the CG were free to choose any other activities offered at the same time (e.g., circuit training, meditation, full body stability training). Adherence, behavioral change and maintenance qualities were evaluated based on the COM-B system and presence of behavior maintenance motives	*N* = 82 (Military and civilian staff) IG: *N* = 55, CG: *N* = 34	12 months	-

Abbrevations: PA Physical activity, *IG* Intervention group, *CG* Control group, *SCT* Social cognitive theory, *TTM* Transtheoretical model of health behavior change, *CBTT* Cognitive behavioral therapy theory, *Ref* Reference, *RCT* Randomized controlled trial

Table 3 NSPAP RCT program results: high quality RCT with significant effect size results

Intervention duration	Reviewed RCT Programs	Min–Max number of participants/RCT group	Min–Max Adherence (IG) at the end of the program	Compliance at the end of program (min–max rates)		Significant Effects Size: increase PA and/or motivation and/or health outcomes
				IG	CG	
1–2 months	7	29–655	48–97%	60–100%	76–99%	7/7
3 months	7	29–2121	51–100%	64–98%	48–98%	6/7
4–6 months	9	60–800	25–100%	60–100%	58–100%	6/9
9 months—1 year	5	188–853	45–85%	54–95%	25–93%	5/5
2 years	1	342	72%	84%	88%	1/1
Total	29	29–2121	25–100%	54–100%	25–100%	25/29(46)

RCT Randomized controlled trial, *IG* Interventional group, *CG* Control group

Physical activity program interventions description

Forty-six randomized controlled trials (RCTs) assessed an NSPAP implemented in the workplace

All these interventions were comparative studies, except for three that were longitudinal [110–112]. Most of these interventions included more than 100 participants, and five [113–117] included over 1,000 individuals. In most cases, the participants were office workers. Three included exclusively manual workers [67, 118, 119] and four interventions were conducted in a care setting [69, 120–122].

There were also studies conducted in any type of work environment setting, usually with a multicenter enrollment and a large number of participants [110, 113–115, 117, 118, 123–133]. Other studies included a small number of subjects, fifty or less [134–137].

Regarding intervention duration, only a few interventions lasted over one year. The studies by Aittasalo M. et al. [110], Plotnikoff RC et al. [125] Robroek SJW et al. [138] and Hallam JS et al. [139], lasted one year. The remaining interventions lasted from a few weeks to a few months, with a total of 75% of interventions lasting ≤6 months.

Twelve interventions included an informative program systematically combined with a behavioral or motivational component, except for one intervention [110]. In about half of the cases, the informative program was clearly separate from the behavioral/motivational programs, while other interventions mixed the different components, for example individual interviews [111, 124] or guides/booklets provided to employees [69, 123, 125, 130, 134, 140, 141].

Seventeen interventions included a behavioral program, which mainly consisted of PA objectives that increased progressively over the course of the intervention, combined with behavioral strategies to achieve them more easily. The goals were defined and their evolution was assessed on an individual basis during the intervention, in particular during individual interviews with "facilitators" [111, 115, 118, 119, 125, 140, 142].

Sixteen interventions included an incentive component, mostly in the form of self-monitoring of PA using a pedometer. Pedometer data could be used to adjust the behavioral component of the program [67, 71, 110–114, 118–121, 126–128, 132, 134, 143, 144], to set up challenges [112–114, 119, 120], or to obtain material and financial rewards [69, 71, 113, 114, 126–128, 143].

Table 4 SPAP RCT Program Results: high-quality RCT with significant effect size results

Intervention duration	Reviewed RCT Programs	Min–Max number of participants	Min–Max Adherence (IG) at the end of the program	Compliance at the end of the program (min–max rates)		Significant outcomes: Increase PA, and Health outcomes
				IG	CG	
1–2 months	10	29–213	26–96%	60–96%[a]	59–100%	10/10[b]
3 months	6	30–294	45–85%	59–100%	17–99%	6/6
4–6 months	9	59–537	33–81%	52–87%	69–97%	9/9
9 months- 1 year	3	82–389	56–78%	53–72%	69–82%	3/3
Total	28	29–537	26–96%	52–100%	17–99%	28/28(45)

RCT Randomized controlled trial, *IG* Interventional group, *CG* Control group

[a] Compliance was also evaluated 15 months after the end of program for one RCT: IG(SUP): 15/25 (60%) vs CG(CON): 19/25 (76%) (Supplementary File 2; ref. n°36; Hunter JR, 2018)

[b] With maintenance effect at 6 months and 12 months follow-up for one RCT (Supplementary File 2; ref. n°39; Krebs S, 2019)

Table 5 Key differences between SPAP and NSPAP based on effect sizes (Cohen's d & η^2)

Aspect	NSPAP (Non-Supervised)	SPAP (Supervised)
Large Effect Sizes ($d > 0.8$ or $\eta^2 \geq 0.14$)	- Mansi S. (2015): Step count (d = 1.94), self-reported PA (d = 2.57) - Metcalfe RS. (2020): VO2 max (d = 1.4) - Samuels TY. (2011): 10,000-step goal (d = 1.1) - Hallam JS. (2004): Exercise days per week ($\eta^2 = 0.56$), self-regulation ($\eta^2 = 0.64$) - Mainsbridge CP. (2015): MAP reduction ($\eta^2 = 0.67$)	- Brandt T. (2024): Mobility (d = 3.3), Strength (d = 1.7—2.5) - Eather N. (2020): Standing jump (d = 1.12), HIIT self-efficacy (d = 1.57), Sleep (d = 1.05) - Hunter JR. (2018): Cardiorespiratory fitness, knee flexion strength ($\eta^2 = 0.16$—0.41)
Medium Effect Sizes ($0.5 < d \leq 0.8$ or $0.06 \leq \eta^2 < 0.14$)	- Gazmararian JA. (2013): d = 0.61—0.80 - Raedeke TD. (2017): d = 0.73—0.77 - Dishman RK. (2009): $d \geq 0.60$ - Hallam JS. (2004): Self-efficacy ($\eta^2 = 0.06$)	- Nichols JF. (2000): Energy expenditure (d = 0.98), Moderate-intensity PA (d = 0.71) - Matsugaki R. (2017): VO2 max (d = 0.76), Strength (d = 1.34) - Cuthbert CA. (2016): Mental health (d = 0.74), PA levels (d = 0.80) - Mair JL. (2014): Cardiorespiratory fitness (d = 0.71) - Stenner HT. (2020): VO2peak ($\eta^2 = 0.09$)
Low Effect Sizes ($d \leq 0.5$ or $\eta^2 < 0.06$)	- Plotnikoff RC. (2005): $d \leq 0.2$ - Hunter RF. (2013, 2018): d = 0.3, $R^2 = 0.56$—0.76, SRMR close to zero - Brunet J. (2020): $\eta^2 = 0.022$	- Jakobsen MD. (2015): Pain reduction (d = 0.31) - Higham SM. (2023): Fat mass (d = 0.109), VO2peak (d = 0.296) - Brand R. (2006): Quality of life (d = 0.27), Psychological well-being (d = 0.23) - Krebs S. (2019): PA ≥ 45 min/week [%]: $\mathfrak{n}^2 = 0.032$, significant increase PA level in the IG vs CG: 43 vs 36 min/week at baseline, 71 vs 77 min/week, at the end of the program; 95 vs 70 min/week, with maintenance effect at 6 months and 12 months after the end of program

Abbreviations: PA Physical activity, *MAP* Mean arterial pressure, *MVPA* Moderate/vigorous physical activity MET minutes, *BMI* Body Mass Index, *IG* Interventional Group, *CG* Control Group, *ES* Effects Size, *d* Cohen's *d* value, $\mathfrak{n}^2$ Eta Squared value, R^2 Squared multiple correlation ($R^2 = 1$ – residual sum of square/total sum of square), *SRMR* Standardized Root Mean Square Residual (range from zero to 1.0 with well fitting models obtaining values less than 0.05 (Byrne, 1998; Diamantopoulos and Siguaw, 2000), values as high as 0.08 are deemed acceptable (Hu and Bentler, 1999)

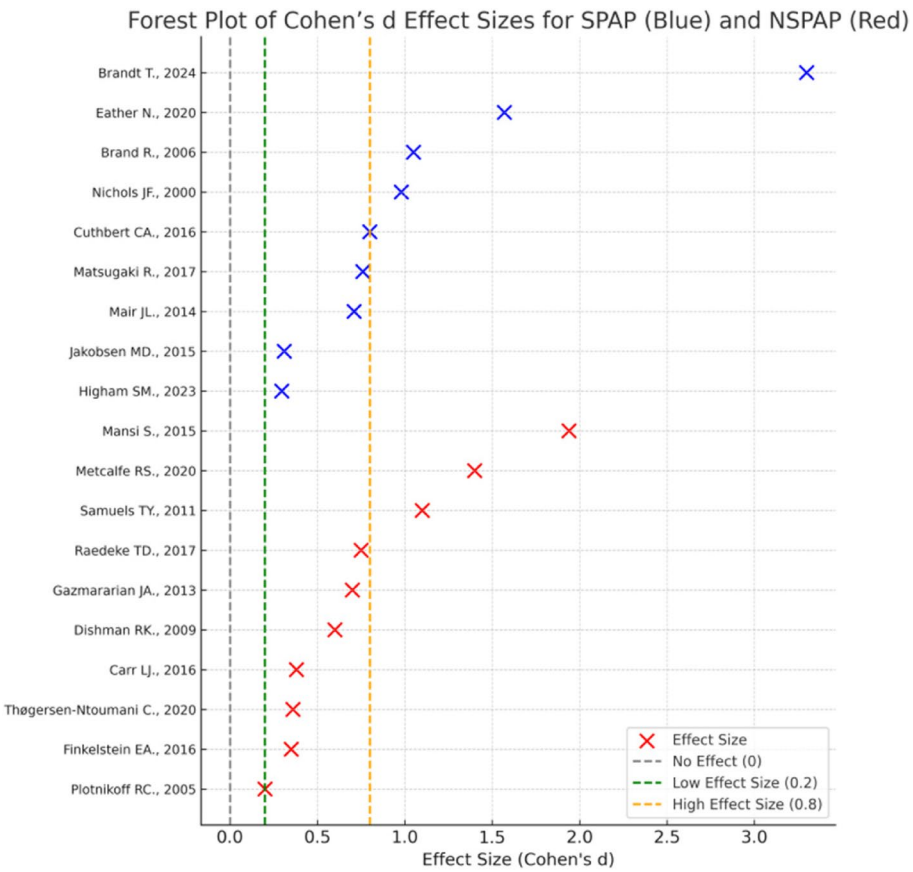

Fig. 3 Forest Plot illustrating the distribution of Cohen's d effect sizes for SPAP and NSPAP RCT

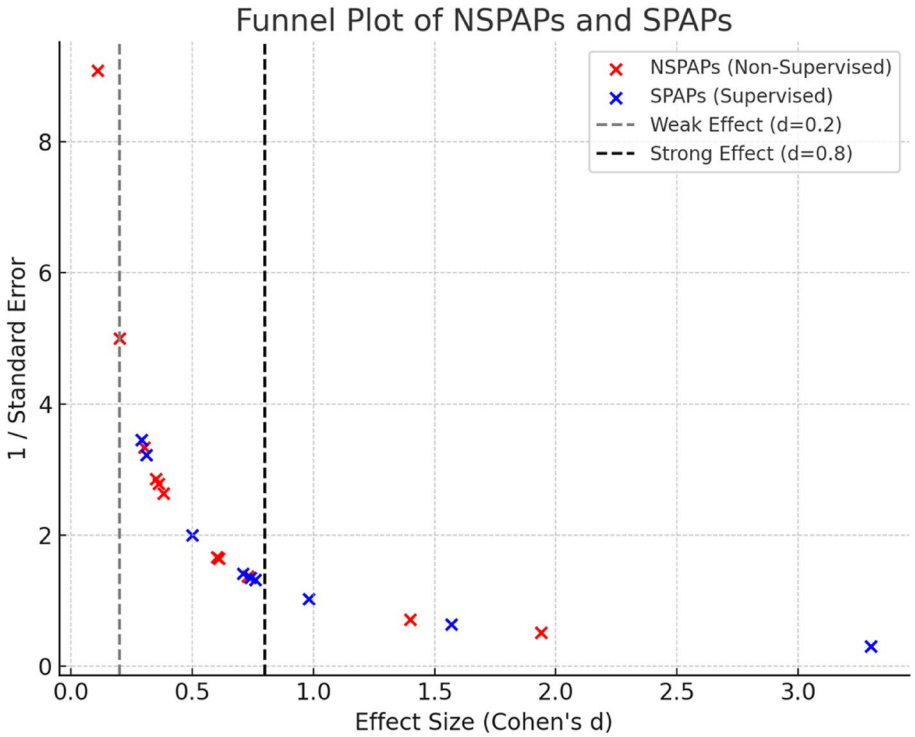

Fig. 4 Funnel plot illustrating the distribution of Cohen's d effect sizes and standard error for SPAP and NSPAP group

Thirty seven interventions (81%) were based on a theoretical model

The most frequently used theoretical model is the social cognitive theory (SCT), nine interventions [69, 129, 130, 134, 139, 144–147]; six interventions were based on the transtheoretical model of health behavior change (TTM), [119, 123–125, 141, 148]; two on SCT/TTM combined [116, 140]; six studies were based on the learning theory [71, 121, 126, 127, 143, 149], seven studies on the self-determination continuum theory [118, 120, 121, 132, 142, 150, 151] two studies on the goal-setting theory [113, 114], two studies on the theory of planned behavior [114, 132], and one study combined SCT, TTM and theory of planned behavior [116]. One intervention was based on the behavior change wheel [152], one intervention was based on the socio-interactionist theory [131], and one intervention was based on the motivational interviewing theory [153].

For three interventions, the theoretical model was not used to design the intervention, but only to assess some of the endpoints [121, 126, 134].

Forty-five RCTs assessed an SPAP (tailored program) implemented in the workplace

All these studies were comparative, except for two that were longitudinal [135, 154]. Thirty-five studies compared an intervention group (IG) to a control group (CG), receiving either no intervention or a minimal intervention (e.g., a single message encouraging participants to participate in sufficient PA), while six studies compared different PA programs with each other [106, 155–159]. Three studies were nested studies from RCTs [109, 160, 161]; one study was a nested study from a RCT with a qualitative approach [109].

Twenty-one studies included fewer than 100 employees, five included more than 500 employees [154–156, 162, 163], and the others included an intermediate population of a few hundred participants.

Twenty-six studies were conducted in office worker populations, one in office care and manual workers [154], nine in manual worker populations such as laboratory technicians [162–164], women cleaners [157, 165, 166], industrial sectors [164, 165, 167], seven in a healthcare setting[136, 161, 168–172], others on military and/or civilian staff [173–175], university employees [88, 135, 137], university home and work place training [176], casino employees [177], and sitting workers [178].

Eighty-three per cent of the interventions lasted ≤ 6 months, and five interventions lasted ≥ 1 year [154, 155, 160, 179, 180].

With two exceptions [109, 176], all the proposed interventions consisted of PA sessions in the workplace, during the working time (or counted as working time),

and were supervised by a professional sports educator. They mainly differed in their organizational mode:

All were strictly organized (training volume, intensity, type of exercises, session timing and group composition were determined by the experimental protocol and assigned to the participants), one had a flexible organization [109] that left the employees freedom regarding most of the protocol's components (choice of exercises, session timing, training volume and intensity, etc.), whilst the others were characterized by an intermediate organization (freedom for certain components, constraints for others).

Two intervention programs [181, 182] were based on two socio-cognitive theories (TTM and SCT). One intervention program [157] was based on cognitive behavioral theory.

Two interventions combined an incentive component with PA sessions, such as material rewards [177] or the use of a pedometer [135].

Adherence analysis

Adherence was assessed differently across studies, with most NSPAPs quantifying adherence in terms of changes in PA, such as changes in the number of daily steps during the intervention [109, 116, 119, 128, 141, 169, 183, 184], whereas SPAP programs assessed adherence in terms of participation in sessions, volume of exercices performed, anthropometric/cardiorespiratory parameters, blood pressure, plasma biomarkers or ergonomic office layout [135, 163, 175, 181, 182, 185].

The impact of the baseline PA level on adherence was assessed in fourteen publications (eight assessing a NSPAP, six assessing a SPAP), with a positive correlation in nine publications: five assessing an NSPAP [69, 112, 121, 129, 141] and four assessing an SPAP [106, 135, 167, 186]. PA level at baseline was not significantly correlated with adherence in three NSPAP studies [110, 111, 113] and two SPAP studies [154, 177].

Eleven studies analyzed the relationship between the baseline health level and adherence (four assessing an NSPAP and six assessing an SPAP).

Six publications found a positive correlation: four concerning NSPAPs [115, 124, 129, 130] and two concerning SPAPs [106, 165]. Five publications found no significant correlation: three assessing an NSPAP [110, 112, 126], and two assessing an SPAP [158, 177]. One study found a negative correlation due to musculoskeletal disorders at baseline [158].

The association between adherence and the change in employees'health status during the intervention was also analyzed in ten studies. One study assessed an NSPAP and showed a positive correlation [146]. Eight studies assessed SPAPs, and six found a positive correlation [105, 109, 137, 160, 161, 173] while two found no significant correlation [155, 158].

The impact of the baseline Self-efficacy on participants'adherence was assessed in nine studies (seven studies on NSPAPs and two on SPAPs). Self-efficacy at baseline was found to be a positive factor for adherence in three studies (NSPAP: [127, 129]; SPAP: [156]), while one study (SPAP: [163]) found no significant correlation.

Five studies (NSPAP: [114, 116, 118, 139, 142]) highlighted a positive correlation between increased self-efficacy and adherence to the NSPAP, while one study (NSPAP: [128]) found no significant correlation between increased self-efficacy and the employees'adherence.

One study showed that external motivation ("I feel under pressure from my family/friends to exercise") and identified motivation ("I value the benefits of exercise") increased PA level until week three [121].

Based on TTM or SCT theory, two studies showed that being at a stage of change, as close as possible to "maintenance stage", correlated with good adherence [119, 140], while another study showed that "having an inactive/precontemplation status" at baseline increased PA level [141].

The effect on adherence of the intervention's behavioral components was assessed in five NSPAP and two SPAP programs. In three NSPAPs [118, 124, 144], the presence of a behavioral program was associated with increased adherence; the other studies found no significant correlation.

The impact on adherence of a motivational program was assessed in four studies (on NSPAPs). One study [134] assessed the association between self-monitoring of PA using pedometers and adherence and found a positive correlation. Two studies assessed the association between adherence and financial rewards in the long-term follow-up [128, 143] and found no significant correlation. One study [120] assessed the effect of challenges on adherence and found no significant correlation.

Four publications (NSPAP programs) assessed the effect of adapting the intervention according to the principles of theoretical models. One study (SCT model) found significantly higher adherence among employees who participated in a program that was adapted to closely follow social cognitive theory [144], while another study (TTM model) highlighted that the stage-matched intervention outperformed the active control condition for physical activity, nutrition and psychological variables (physical activity intention, nutrition intention, nutrition planning) [123]. Two studies, however, found no significant correlation between the adaptation of the program to the employees'stage of change (transtheoretical model) and adherence [125, 140].

Four SPAP programs [136, 137, 156, 159] *assessed the impact of session supervision on the employees'adherence* and found no significant correlation. Yet it is interesting to observe that "minimal exercise supervision" could have a significant effect on health during a 20-week intervention [159].

Two studies found a positive correlation between strict session organization and the employees'adherence [155, 168], whereas one study highlighted that unexpected events in the program (absence of the instructor, change in instructor) led to negative correlation [157].

Several studies found a positive correlation between the flexibility of session organization and the employees'adherence [109, 130, 150, 152, 157, 187].

Twenty-three studies included an assessment of the relationship between occupational organizational factors and the employees'adherence

Eight studies on NSPAPs [113, 117, 122, 127, 130, 131, 142, 146] and eight on SPAPs [109, 154, 155, 157, 168, 169, 177, 188], assessed the impact of the working environment, and found a positive correlation. Workload was found to be a negative factor for adherence (lesser adherence with greater workload) in two studies (SPAP: [109], NSPAP: [130]).

Comparative analysis of the systematic review results

The analyzed studies fall into two categories: supervised physical activity programs (SPAP) and non-supervised physical activity programs (NSPAP). SPAPs involve direct supervision by a coach or an organizational structure, whereas NSPAPs rely on autonomous interventions such as motivational messages or tracking tools. Supervised and unsupervised studies show results of high variability in terms of adherence and compliance (Tables 3, and 4). In the latter, adherence varies based on initial motivation and organizational support, while individualized adjustments can improve effectiveness despite implementation complexity (Hallam JS, 2004; Opdenacker J, 2008; Dishman RK, 2009; Andersen CH, 2012).

The factors influencing adherence to physical activity programs fall into three categories. Individual factors include the initial level of physical activity (Macniven R, 2015; Losina E, 2017; Genin PM, 2018; Corbett DB, 2018; Brunet J, 2020), motivation, and self-efficacy (Hallam JS, 2004; Kaewthummanukul T, 2006; Dishman RK, 2010), as well as the use of behavioral tracking tools such as pedometers (Finkelstein EA, 2016; Murrray JM, 2019 and 2020). Interventional factors show that programs with regular support and progressive goals promote better adherence (Dishman RK, 2010; Raedeke TD, 2017). Finally, organizational factors play a crucial role: management involvement, work schedule adjustments significantly increase participation (Gazmararian JA, 2013; Bale JM, 2015).

The measured effects of interventions include physical health, psychological and social well-being, and organizational impact. Physical activity increases by an average of 10–20% in MET-minutes per week, and sedentary behavior decreases (Plotnikoff RC, 2005; Opdenacker J, 2008). Cardiovascular benefits are observed, such as a 5% reduction in BMI and a 10 mmHg decrease in blood pressure (Proper KI, 2003; Mainsbridge CP, 2015). Psychologically, stress decreases by 20%, while professional engagement increases by 15% (McEachan RRC, 2011; Jakobsen MD, 2015). Finally, organizational effects include a 10% reduction in absenteeism and a 5–10% perceived increase in productivity (Nurminen E, 2002; Justesen JB, 2017; Welsh A, 2020; Stenner HT, 2020).

SPAP programs show high-effect-size (Hunter JR. (2018), Brandt T. (2024), Eather N. (2020)). NSPAP interventions are more variable—some programs show large effects (e.g., step count, VO2 max), but many are low to moderate in impact. η^2 values for self-regulation ($\eta^2 = 0.64$) and MAP reduction ($\eta^2 = 0.67$) in NSPAP studies suggest that behavioral-focused interventions can be effective without supervision (Table 5).

SPAP leads to better physiological Improvements, while NSPAP enhances behavioral outcomes. SPAP programs show greater improvements in strength, mobility, and cardiovascular fitness. NSPAP programs with high adherence (e.g., Hallam JS. 2004) show significant behavioral changes but may lack the physiological benefits of structured, supervised training. Large η^2 values in self-efficacy ($\eta^2 = 0.06$) and motivation ($\eta^2 = 0.022$) in NSPAP suggest stronger psychological engagement, but not necessarily lasting physical changes.

NSPAP (Non-Supervised Programs) show greater variability but includes some of the largest effect sizes observed (Mansi S. (2015): Step count ($d = 1.94$), self-reported PA ($d = 2.57$) Metcalfe RS. (2020): VO2 max ($d = 1.4$), Samuels TY. (2011): 10,000-step goal ($d = 1.1$). Hallam JS (2004) and Mainsbridge CP (2015) reported $\eta^2 > 0.5$, indicating very large effects on exercise adherence and health indicators. Hunter RF (2018), $\eta^2 = 0.06$, indicate a moderate effect on physical activity maintenance. Murray JM (2019), $\eta^2 = 0.54$, indicating a large effect related to engagement with intervention components (Table 5).

Studies like Hunter RF. (2018) reported R^2 values of 0.56—0.76, indicating a strong intervention model, even though Cohen's d effect sizes were small. Brunet J. (2020) ($\eta^2 = 0.022$) and Krebs S. (2019) confirm that low-magnitude effects exist even in well-structured interventions ($\eta^2 = 0.006$). Dropout rates remain high in NSPAP,

suggesting that long-term behavioral change without supervision is more challenging (Table 5).

Conclusion and limitations: supervised (SPAP) vs. non-supervised (NSPAP) RCTs

SPAP interventions produce more consistent, higher effect sizes (both d and η^2), particularly for physiological health outcomes. The structured supervision ensures better adherence but does not always lead to the highest effect sizes (Figs. 3–4).

NSPAP interventions can be effective in behavioral change and self-regulation but are highly variable and often lack long-term adherence (Figs. 3–4).

Eta Squared (η^2) data confirms that some NSPAP programs (e.g., Hallam JS. 2004, Mainsbridge CP. 2015) achieve strong results, particularly in self-efficacy and adherence.

R^2 and SRMR suggest some NSPAP models are well-structured but experience high dropout rates.

SPAP confirmed physical health improvements, while NSPAP interventions show higher variability but can produce very large effect sizes when engagement is strong (e.g., Hallam, Mainsbridge, Murray). However, they also risk lower long-term adherence due to the lack of supervision.

The main limitations of the analyzed studies include, the lack of long-term follow-up, methodological heterogeneity, wide variability on results, and the lack of exploration of cultural or sectoral differences (Taylor, 2016; Losina, 2017; Fernandez La Puente de Battre, 2020; Metcalfe, 2020; Eather, 2020; Perez-Bilbao, 2021). To improve future research, it would be recommended to integrate additional indicators of motivation and perceived barriers, deepen the analysis of organizational impact, and compare program effects across different professional contexts (Bredahl, 2015; Krebs, 2019; Murray, 2020; Stenner, 2020; Welsh, 2020; Higham, 2023).

Discussion

The objectives we set for this study have been achieved, namely that:

Firstly, our review confirmed two main types of interventions/programs/RCT: supervised/tailored PA programs and non-supervised PA programs. Supervised studies tend to show better results. This is probably explained by the greater complexity of the implementation of the programs based on different socio-cognitive theories. Moreover, we have excluded from these tables studies with very low participation rates [172, 189] or studies showing a non-statistically significant trend towards improved health or aerobic capacity [150].

Secondly, based on our literature review, the main factors for adherence emerge as baseline PA level, health level, individual self-efficacy, the use of a behavioral component consisting of individual counseling, the individual adaptability of the program at the intervention level, the workload, and the quality of the working environment at the organizational level: these key results are summarized in Table 6.

Thirdly, our review highlighted two parameters used in a differentiated or undifferentiated way in RCTs: *adherence* and *compliance*. We therefore considered that *adherence* was the commitment of employees to participate in sports activities (with or without incentive methods) within or outside the company. *Compliance* refers to the number of subjects still present in the study at the end of the intervention program, compared to the number of subjects included in the study after randomization. We therefore chose to consider these two parameters in our result tables.

Individual factors

Baseline PA level was found to be a positive factor for adherence in most publications included in this review. This finding is in line with the literature: employees who participate the most in PA programs are those who already have a good PA level [93–95]. However, this finding can be balanced, especially with respect to PA programs. Indeed, the studies that found a positive correlation between baseline PA level and adherence assessed PA programs consisting of high-intensity exercises from the beginning of the intervention, with little or no individualized support. Conversely, a study that found a significant effect on physical health assessed programs consisting of moderate-intensity exercises, such as walking sessions, that were accessible to most people [154]. Thus, while it clearly appeared that PA promotion programs were more likely to be adopted by employees who were already physically active, it was possible to achieve the same adherence in inactive employees provided that the programs were well adapted; indeed, inactive employees were more inclined to participate in workplace.

PA programs that did not require taking part in a specific class or attendance at a gym and which involved accessible activities like walking.

The baseline health level (before the intervention) was also identified as a positive factor for adherence. This is consistent with several previous studies that have found that employees participating in PA promotion programs were healthier than those who did not [93, 94, 96, 197, 198]. However, some interventions included in this review showed conflicting results, including programs specifically targeting distinct health problems such as musculoskeletal disorders [158, 162] and programs with individual counseling and support sessions [111, 177].

Table 6 What this literature review contributes, and what this literature review has to offer for future research, or entrepreneurial and/or political projects

What this literature review contributes	Main references: authors, years	Ref. number
• Adherence Factors		
PAP adherence is correlated with baseline PA level	SPAP	
	Brand R, 2006;	[167],
	Genin PM, 2018;	[186],
	Corbett DB, 2018	[135]
	NSPAP	
	Marshall AL, 2003; Gazmariaran JA, 2013;	[129, 141],
	Macniven R, 2015; Losina E, 2017;	[69, 112],
	Brunet J, 2020	[121]
Management, psychosocial factors (work autonomy, work place, workload and interpersonal relationships at work) played a central role in employees'participation in a PA promotion program.Example of organizational actions (Stenner HT, 2020): *personal guidance and regular contact between participants and the supervisor were likely to be helpful for strong compliance*.Example of organizational actions (Dishman RK, 2009): 1. *Senior management endorsement*. 2. *Joint employee–management steering committees*. 3. *Group and organizational goals and incentives* for each worksite. 4. *Environmental prompts* such as parking and walking, taking walk breaks, and climbing.	SPAP	
	Atlantis E, 2006; Andersen LL, 2008;	[155, 177]
	Van Wormer JJ, 2012; Jørgensen MB, 2012;	[154, 157]
	Bredahl TVG, 2015, Andersen LL, 2015;	[109, 188]
	Jakobsen MD, 2015; Stenner HT, 2020.	[168, 169]
	NSPAP:	
	Dishman RK 2009;	[113]
	Van Hoecke AS 2013;	[142]
	Bale JM, 2015; Lawton R, 2015;	[117, 130]
	Carr JL, 2016; Chaélat-Valayer E, 2016;	[122, 146]
	Murray JM, 2019.	[127]
	Tosta Maciel RRB, 2021	[131]
Short time PA program could promote adherence to PA "Adherence to the short-burst office-based PA (10 mn per day) are facilitated by educational lectures, instructions on performing appropriate workplace PA, and information on how to use the intervention software". Mainsbridge, 2015	Mainsbridge, 2015; Taylor WC, 2016,	[147, 148]
	Thøgersen-Ntoumani C,2020; Metcalfe RS, 2020	[132, 190]
There is a positive correlation between the work organization's flexibility and/or stability and the employees'adherence High staff turnover negatively impacts retention and completion rate	Jørgensen MB, 2012; Andersen LL, 2013 Bale JM, 2015; Bredahl TVG, 2015; Morris AS, 2021; Tosta Maciel RRB, 2021 Althammer SE, 2023	[157, 187], [109, 130], [152], [131], [150]
Self-efficacy appeared to be a leading factor for adherence (self-efficacy is the belief that an individual has the ability to perform a task)	Hallam JS, 2004; Kaewthummanukul T, 2006; Dishman RK, 2010	[139, 191], [114]
Financial incentive programs did not improve adherence/PA outcomes	Hunter RF, 2013 Finkelstein EA, 2016; Murray JM, 2019, 2020	[143] [127, 128, 149]
Financial incentive programs could improve adherence « Financial incentives do not necessarily diminish more internal forms of motivation when delivered as part of a complex multicomponent behavior change intervention»	Fernandez La Puente de Battre MD, 2020	[192]
Adherence/compliance at the RCT endpoint might be better in the control group	Fernandez La Puente de Battre MD, 2020; Raedeke TD, 2017	[192], [144]
Programs such as Work-HIIT, REHIT, which required very little time, space, or resources provide support for those programs to be trialled in other workplace settings	Mair JL, 2014, Metcalfe RS, 2020, Eather N, 2020;	[176], [88, 190]
Most RCTs show a drop in adherence at the end of the intervention	Finkelstein EA, 2016	[128]
A low level of adherence could be explained by a lack of privacy, absences, rigidity of the schedules	Tudor-Locke C, 2014	[193]
• Positive Health Outcomes Factors		
Interventions should be implemented for at least 3 months, with a goal of at least 5 h per week	Stenner HT, 2020	[169]
Long-distance follow-up is necessary to sustain the positive effect	Morris AS, 2021	[152]

Table 6 (continued)

What this literature review contributes	Main references: authors, years	Ref. number
Health effects (blood pressure, body fat, respiratory capacity, well-being) are confirmed in supervised (tailored) and unsupervised studies based on social-cognitive theories	Mc Eachan RRC, 2011 Stenner HT, 2020 Metcalfe RS, 2020 Althammer SE, 2023 Higham SM, 2023	[115], [169], [190], [150], [174]
Expected effect size on health outcomes are medium to large according to high quality RCT results "Cardio-metabolic risk improved in the intervention group only with a large effect size (Cohen's d = 0.36). Autonomous motivation increased in both conditions IG/CG. Step counts, standing, and sitting time, or well-being are improved on the IG with a low effect size". Thøgersen-Ntoumani C, 2020	SPAP: Nichols JF, 2000; Brand R, 2006; Jakobsen MD, 2015; Matsugaki, 2017; Hunter JR, 2018; Faes Y, 2018; Krebs S, 2019; Stenner HT, 2020 NSPAP: Mansi S, 2015; Mainsbridge, 2015; Carr LJ, 2016; Raedeke TD, 2017; Thøgersen-Ntoumani C, 2020	[167, 182], [136, 168], [137, 184], [181], [169] [67, 146, 148] [132]
Supervised/Tailored RCT interventions during work significantly improve neck, scapular, elbow, wrist and/or musculoskeletal pain	Andersen LL, 2008; Zebis MK, 2011; Jørgensen MB, 2012; Andersen CH, 2012; Rasotto C, 2013; Gram B, 2014; Zebis MK, 2014; Dalager T, 2015; Jakobsen MB, 2015,2017; Murray M, 2017; Faes Y, 2018	[155, 162] [157, 158, 194], [159, 195], [156, 161, 168], [175, 184]
Non-supervised RCTs improve Return to Work after work muskulo-skeletal disorders	Park J, 2018	[153]
Supervised/Tailored RCT interventions during work significantly improve low back pain	Keading T, 2017 Johnston V, 2019 Brandt T, 2024	[178], [196], [180]
Projects involving at least one hour of moderate-to-high-intensity physical activity per day within the company, combined with a leisure activity, seems the most balanced	Mansi S, 2015	[67]
Worksite interventions that include environmental supports like "activity-permissive workstations" are more effective than those that do not	Carr LJ, 2016	[146]
Wearable fitness trackers such as Fitbit and MapTrek can help improve performance initially, but there is a rapid decline in their effectiveness over time during the intervention	Gremaud AL, 2018	[174]
E-Health education programs for workers should include flexibility of content and low expectations regarding compliance with deadlines for participation in activities	Tosta Maciel RRB, 2021	[131]
E-Health education programs may be effective in improving office workers' quality of life, PA, general health	Tosta Maciel RRB, 2021	[131]
Website non-usage/attrition predictors are: low perceived availability of PA in the workplace, financial incentive, low EuroQol Health index; Pedometer use predictors are: regulation, self-efficacy, perceived workplace environment safety	Murray JM, 2019,2020	[127, 149]
Motivational Interviewing Interventions could help Return To Work for claimants attending an occupational rehabilitation	Park J, 2018	[153]
Therefore, interventions should be part of a broader, long-term corporate and/or political project with or without direct supervision	Hunter JR, 2018; Tripodi D, 2025	[137], BMC Public Health

In both cases, it is likely that employees with the poorest health status were more aware of the benefits of participating in such programs, either because they felt directly concerned or because the intervention content could be adapted to them [199]. In the literature, we noted that the interventions that successfully targeted employees with the poorest health status [119, 157, 200] were characterized by adapted communication before the beginning of the intervention, highlighting the link between physical inactivity and work-related health problems as well as the expected benefits of such an intervention.

Improvement in health indicators during the intervention was also significantly associated with adherence. Indeed, it may be considered that good adherence increases the effectiveness of the intervention and thus enhances improvement in health indicators related to the practice of PA (body mass index, VO_2, resting heart rate, and so on). It may also be considered a phenomenon of

positive reinforcement: a significant and early improvement in certain health indicators encourages the employee to continue participating in the intervention, for example by increasing comfort when practicing the exercises (improved exertion tolerance, reduced musculoskeletal disorders). An early improvement in indicators was associated with a higher adherence in the long term after the intervention [105, 186] or even remotely [201]. The improvement in health indicators also increased the benefits of PA perceived by employees, as confirmed by a literature review that observed that the perceived health benefits of PA directly correlated with employees'participation [191].

Self-efficacy appeared to be another leading factor for adherence. Since self-efficacy is the belief that an individual has the ability to perform a task [73], this seems consistent. The importance of self-efficacy in the practice of PA has been shown in several studies, and a literature review has even concluded that self-efficacy was the best predictor for employees'participation in PA in the workplace [191, 202–205]. There was also a phenomenon of positive reinforcement, with a correlation between increased self-efficacy and adherence. This finding is supported by the social cognitive theory, according to which the main component of self-efficacy is self-control or a control experience, i.e., success in past personal experiences [109]. Thus, successfully initiating PA from the start of the intervention could be a control experience, reinforcing the employees'self-efficacy and thus their motivation to continue the promotion program.

The level of the employees'stage of change, according to the transtheoretical model was not significant, either in terms of the impact of the employees'initial stage of change on their adherence, or in terms of the impact of intervention adaptation based on the stage of change at baseline [206]. The five stages of change correspond to different levels of determination to change a behavior, and are thus considered by several authors as important levers to increase the effectiveness of PA promotion programs in the workplace [207–211]. However, it was observed that the stage of change primarily determined the initiation of a behavior change, i.e., the initial commitment to a PA promotion program in the workplace, rather than maintaining this new behavior, i.e., the adherence to the program [138]. Taking into account the initial stage of change is therefore insufficient, and it is especially important to adapt to the evolution in the stage of change during the promotion program.

Interventional factors

Individualizing the intervention, whether through individual counseling sessions, flexibility in the organization of exercise sessions, or adjustment of session supervision, is associated with better adherence of the participants. This finding was reported by several authors [212, 213]. The other features of the intervention, such as session supervision, location of the intervention or the existence of material rewards, only had a significant impact on employees'adherence if they allowed the intervention to be better adjusted to the individual level.

The use of financial incentives was not identified as a significant factor for adherence. Studies assessing programs based on financial incentives showed a positive influence on the participants'motivation: according to the authors, financial incentives strengthened intrinsic motivation (i.e., motivation based on what individuals consider to be good for them, independently of external views), contrary to what is usually found in the literature [71, 143]. However, the authors also reported that financial incentives did not increase the long-term adherence of employees showing high sensitivity to immediate benefits [143]. The literature also showed that the increase in activity level directly correlated with the period during which the financial incentives were paid, with a sharp decrease as soon as their payment stopped [70].

The use of a pedometer or accelerometer, especially when combined with real-time self-monitoring of PA levels, was associated with higher employee adherence [134]. Van Hoye et al. showed that the feedback provided by the pedometer was most effective in increasing PA when combined with individualized counseling sessions [214]. This individual support helped participants to know what to do with this feedback, and to adapt their behaviors as best as possible.

Organizational factors

An original result of this review is that it highlights the work environment as a major determinant of adherence to physical activity programs. Some studies had already shown the predominant role of social-cognitive factors, support by supervisors, colleagues, friends or family [215, 216].

The quality of the working environment, particularly in terms of interpersonal relationships, work organization and workload, was a significant factor for adherence. Management, psychosocial factors (work autonomy, work pace, workload and interpersonal relationships at work) played a central role in employees'participation in a PA promotion program such as NSPAP [113, 117, 122, 127, 130, 131, 142, 146] or SPAP [109, 154, 155, 157, 168, 169, 177, 188]. Their quality explained the highly variable influence of co-workers and management, found in this review, bringing to the fore a negative influence in the case of impaired psychosocial factors, and a positive

influence in the case of high-quality psychosocial factors. Strong social support, particularly in its functional component (when employees feel they are being supported by their professional environment), was thus a powerful factor for adherence. Recent investigations highlighted that a training adherence threshold of 70% has been recommended to attain clinically meaningful benefits and that it is important to implement initiatives before and during an intervention to maintain motivation [183, 189]. A favorable psychosocial environment and strong social support require the employees'involvement in the implementation of PA programs in the workplace, the open involvement of management in promoting PA, and the implementation of a corporate policy that openly supports PA.

Physical work load

According to the results of our analysis, physical workload was associated with poorer employee adherence. The accumulation of physical fatigue owing to work tasks together with participation in PA exercises was a fairly obvious explanation for this phenomenon, as suggested by Korsohj et al., who found that a PA program based on intensive aerobic exercises, implemented in maintenance workers with high workload, was accompanied by a rise in employees'blood pressure [165].

As a conclusion, we suggested below, in Table 6, what this literature review contributes for future research or entrepreneurial and/or political projects.

Limitations of the study

The main limitation of our review is the evaluation of the potential limits of each study. We used the Cochrane guide for randomized controlled trials (RCTs) as a model, but interventional studies in the human and social sciences, although they may allow for randomization, do not always allow for blinding of the participants, or blinding the results throughout the study. For this reason, our quality index ranges from 1 to 4. For real RCTs, the score varies from 2 to 4. For non-RCT studies, the score ranges from 1 to 2, in an"arbitrary"way, because of the lower level of evidence. However, our results remain consistent with the existing literature, as discussed in the synthesis of results.

In addition, although broad categories of intervention were identified, the type of intervention could vary greatly from one study to another. Thus, for the same type of program, the frequency and duration of PA sessions could vary; the frequency of counseling sessions and the type of exercises or the educational material content were rarely the same.

Others have emphasized the need to improve the design of studies aimed at assessing the effectiveness of different PA promotion interventions in the workplace, in particular to be able to assess the relative effectiveness of various programs (PA *vs.* informative/educational strategy *vs.* counselling/support strategy according to their classification) [13]. Indeed, this was difficult to do in our review, because the analysis of interventional factors for adherence was challenging due to the broad heterogeneity in study methodology.

The choice of the endpoints, and especially their measurement method, was also highly heterogeneous. This was especially the case for PA, that was, depending on the studies, measured directly by an accelerometer or assessed using a self-questionnaire, measured on an ad hoc or continuous basis, and expressed in different units.

The methodology for data collection could also change from one study to another, compromising the reproducibility of results.

Finally, the aims of the studies were also highly heterogeneous. Some studies aimed at increasing PA level, some at improving the cardiorespiratory condition of the employees, and others at improving well-being at work. This obviously influenced the study protocol, methodology, choice of endpoints, etc. and affected the comparability of the results from one study to another. In addition, only a few interventions were designed to directly assess specific factors for adherence, in this case the baseline PA level. Other studies (NSPAP: [71, 114, 121, 126, 153]; SPAP: [109, 157, 160, 161, 163, 188]) investigated specific factors for adherence, but as part of nested/secondary analyses of interventions designed for a different objective. In all other studies, these assessments were marginal, and the authors paid little attention to the results. Another systematic review [98] has found the same results, highlighting that too few studies have assessed the influence of health, lifestyle and organizational factors on the participation of employees in health promotion programs in the workplace. The scientific value of the determinants of adherence reported by the authors was therefore, according to them, significantly reduced. The same is true in our review, where some of the publications included were not based on a robust and rigorous methodology, limiting the level of evidence of the results.

Perspectives

Currently, PA promotion programs in the workplace are complex, demanding onerous implementation (creation of sports structures, changes in the employees'work schedule, involvement of external stakeholders) requiring a great deal of resources (human, material and financial) for very limited results. The purpose of these programs is often unclear, as they target sedentary behaviors, physical and mental health, well-being in the workplace or even productivity, while a PA program has little impact

on any of these factors. Thus, the determinants of sedentary behaviors are inherent to the nature of the work itself that will not be changed by a PA program. The same is true for musculoskeletal disorders, that are mainly caused by the physical constraints of the position (repetitive movements, carrying of loads, prolonged static position, etc.) that remain unchanged after a PA promotion program. Finally, well-being in the workplace is above all determined by the workload, the precariousness of the work, poor psychosocial relationships, and not, or only marginally, by a lack of PA. These enthusiastic but totally inappropriate goals for a PA promotion program in the workplace overlook the inability of these programs to sustainably increase the PA levels of all employees. As already pointed, few studies have attempted to understand the determinants of the employees'adherence to these programs. It is therefore necessary to focus PA promotion programs in the workplace on the employees'adherence, from the outset of the designing of such programs.

To this end, the factors for adherence identified in this review should be assessed prior to the development of any PA promotion program, in order to better tailor it to the different profiles of employees in the company. This could be achieved by administering a standardized questionnaire, which would therefore assess the levels of PA, health and motivation, and more specifically self-efficacy. The employees'expectations regarding the type of program offered should also be assessed. Based on the data from this review, it would be necessary to assess the benefits of exercise supervision, the organization (location, timing, group, etc.) of the sessions, the type of exercises proposed, and the need for individualized support (counseling sessions). Finally, the quality of the working environment, and more specifically the quality of psychosocial factors and social support within the company, should be assessed. Specifically, strengthening empowering leadership for managers, employees, interns, and students [217, 218].

"And to venture further": The establishment of such programs (e.g., SPAPs vs NSPAPs) might also prompt a collective, societal, entrepreneurial, and political reorganization of working hours and/or work schedules. With the rise of AI, should we remain committed to a traditional weekly work model (35 h, 39 h, 40 h, 50 h in certain countries…)? Might we not envision travel times, workdays, or schedules confined to the morning or the afternoon alone? Could we not also imagine, for instance, the possibility of"shifting the hours of students/apprentices/teachers (starting early in the morning) away from those of employees/managers (beginning later in the morning)?"These ideas, we believe, deserve thoughtful debate, as they hold the potential to breathe new life into our so-called industrialized societies, all in pursuit of enhancing the collective well-being.

Conclusion

This literature review showed that a number of factors determine the adherence of employees to PA promotion programs. Until now, these factors for adherence were poorly taken into account in the design of these programs, reducing their effectiveness.

It is now necessary to develop practical tools for occupational health stakeholders so that they can help companies to implement an effective and sustainable PA promotion policy. The primary goal of such a policy should be to increase the PA level of as many employees as possible, since the solution to other health issues in the modern workplace cannot be reduced solely to promoting physical activity. Hybrid models combining supervised and non-supervised elements could help balance adherence with flexibility, with long follow up. Future research should evaluate the sustainability of PA behavior changes beyond 12 months. In fine, new models of work time will have to be considered.

Supplementary Information

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Supplementary Material 1.

Supplementary Material 2.

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Authors' contributions

When reviewing the different publications, QG and DT grouped the references related to the same study and analyzed them together. For each publication selected, the study design, number of participants, type of work environment, study duration, theoretical model used to develop the intervention, and a summary of the intervention content were reported. QG and DT identified the different factors for adherence reported by the authors, classifying them into three categories: individual (employee-specific), interventional (PA promotion program-specific) and organizational (workplace-specific) factors. For each of these factors, the type of association with adherence was specified (positive, negative, neutral). LMA and LMO helped with literature review methodology. DT directed QG's doctoral thesis and the writing of the manuscript. DT completed tables, adding results and quality evaluation according to Cochrane's guidelines. FL and GF-B provided methodological assistance for the reviewing of the manuscript. All the authors reviewed the manuscript.

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Data availability
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Declarations

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Not applicable.

Consent for publication
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Competing interests
The authors declare no competing interests.

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