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Worksite Physical Activity Interventions and Obesity: A Review of European Studies (the HOPE Project)

Anne Vuillemin[a,b], Cyrus Rostami[a], Lea Maes[c], Eveline Van Cauwenberghe[d], Frank J. Van Lenthe[e], Johannes Brug[f], Ilse De Bourdeaudhuij[d], Jean-Michel Oppert[a,g]

[a] Nutritional Epidemiology Unit, UMR U557 Inserm, U1125 Inra, Cnam, Université Paris 13, CRNH IdF, Bobigny,
[b] Nancy-University, University Paul Verlaine Metz, University Paris Descartes, EA 4360 Apemac, Nancy, France
[c] Department of Public Health,
[d] Department of Movement and Sport Sciences, Ghent University, Belgium
[e] Department of Public Health, Erasmus University Medical Centre Rotterdam
[f] EMGO Institute for Health and Care Research, VU University Medical Centre, Amsterdam, the Netherlands
[g] Department of Nutrition, University Pierre et Marie Curie, Pitie-Salpêtriere Hospital (AP-HP), Centre for Research on Human Nutrition Ile-de-France (CRNH IdF), Paris, France

Keywords

Physical activity · Obesity · Intervention studies · Worksite · External validity.

Summary

Objective: Our aim was to review the effectiveness of physical activity promotion interventions in the worksite setting in Europe in order to identify those studies that had measured obesity-related outcomes and to evaluate how external validity of the findings had been assessed. **Methods:** We conducted a review of studies conducted in Europe, published up to December 2009. We assessed levels of evidence regarding effectiveness and analysed external validity using the RE-AIM framework. **Results:** Studies included (n = 33) were divided in 6 intervention categories. Moderate evidence of effectiveness was found for physical fitness outcomes with exercise training interventions and for physical activity outcomes with active commuting interventions. There was no or inconclusive evidence for obesity-related outcomes for all intervention categories. For external validity, elements receiving the least attention (<20%) were representativeness of participants, setting-level inclusion/exclusion criteria and representativeness, characteristics regarding intervention staff, implementation of intervention, costs, long-term effects and programme sustainability. **Conclusions:** Active commuting and exercise training appear as promising approaches to promote physical activity or fitness in the workplace. The effect of interventions on obesity-related outcomes remains to be further investigated. There is a need to better report elements of generalizability and dissemination for translation into practice of worksite physical activity interventions.

Introduction

The worksite is considered as an important setting to implement programmes and strategies both to promote physical activity and to prevent body weight gain and obesity [1, 2]. The worksite represents a relatively controlled environment, and a substantial proportion of the adult population can be reached through worksite interventions. For employers, the possibility of increasing productivity [3] while reducing health care costs through the reduction of sick leaves and accidents may represent a strong incentive for the implementation of worksite programmes designed to increase physical activity [4].

Among previous reviews that have assessed the published evidence regarding the effectiveness of physical activity promotion interventions in the worksite setting [1, 4–10], only three [8–10] have focused on obesity-related outcomes with inconclusive evidence of effectiveness. Although it may be of major interest for practical implementation, studies were not categorized by type of intervention in these reviews. In addition, to translate research findings into practice and policy,

KARGER
Fax +49 761 4 52 07 14
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Prof. Dr. Jean-Michel Oppert
Department of Nutrition, Pitié-Salpêtrière Hospital (AP-HP)
83, Boulevard de l'Hôpital, 75013 Paris, France
Tel. +33 1 42 1779-48, Fax -63
jean-michel.oppert@psl.aphp.fr

there is increasing interest in the assessment of external validity of available research data but these issues relative to external validity have received less attention [11]. The extent to which research has reported on elements of external validity in the field of worksite physical activity interventions has not been examined in detail. The RE-AIM framework [12, 13] is a tool that has been designed for such purpose. Using this framework, the public health impact of an intervention may be described as a function of five factors: Reach (the target population), Efficacy (impact on important outcomes), Adoption (by target settings or institutions), Implementation (consistency of delivery of intervention) and Maintenance (of intervention effects in individuals and settings over time).

The HOPE (acronym for Health-promotion through Obesity Prevention across Europe, see *www.hopeproject.eu*) European Commission-funded project (DG Research) aims at supporting and advancing the development and implementation of systematic, evidence-based European, national and regional policies effective for the prevention of obesity and its negative consequences on health and health inequalities, by providing information and inventories of obesogenic behaviours, such as physical inactivity, important environmental determinants of these behaviours and effective intervention approaches across Member States. Because the traditions of health promotion and disease prevention in the workplace appear quite different between continents [4], it appears of importance to identify the types of interventions that would be generalised in European settings.

The aim of our work in this part of the HOPE project was therefore to update the issue of effectiveness of physical activity promotion interventions in the worksite setting with a specific focus on interventions conducted in Europe. We included worksite interventions that had examined physical activity or physical fitness outcomes, and we identified among these studies those that had measured obesity-related outcomes. Using the RE-AIM framework, an additional aim was to evaluate if and how aspects of external validity of the findings had been assessed.

Material and Methods

Literature Search, Selection of Studies and Data Extraction

Studies published from January 1990 up to December 2009 were located by searches using PubMed, EMBASE, CINAHL, PsycINFO, SportDiscus, Web of Science and Cochrane. Thesaurus terms and free terms were used for each database. The initial search was centred on the following elements: worksite, physical activity, exercise, intervention, primary prevention, using combinations of terms depending on the database searched. This was completed by manual search of relevant references found in individual papers or existing reviews.

To be eligible for inclusion in the review, studies had to 1) be published in English between 1990 and December 2009, 2) study the effectiveness of interventions aimed at increasing physical activity of employees in a workplace, 3) be aimed at working adults in general (over 18 years), 4) be specifically carried out in a worksite setting (including commuting to work as part of active transport), 5) be performed in Europe (not restricted to EU member states but encompassing the whole of Europe Region as defined by WHO *(www.euro.who.int)*, 6) be a primary prevention study. To have a broad approach of the topic, we did not restrict our search to only randomised controlled trials (RCTs). The outcome measure had to be a difference in change in physical activity such as habitual physical activity level, and/or in physical fitness such as cardiorespiratory fitness, strength, and/or in obesity-related outcomes such as BMI, body weight, percentage body fat, waist circumference or waist-to-hip ratio. Data from studies that met the inclusion criteria were extracted by one reviewer (CR) into structured templates and checked by a second reviewer (JMO).

Assessment of Evidence of Effectiveness

We assessed methodological quality using a scale that was derived from previous published systematic literature reviews on effectiveness of physical activity interventions at the workplace [7] and in children and adolescents [14]. The 11 criteria we included for quality assessment were as follows: 1) randomisation (randomisation was performed and, if yes, the randomisation procedure was described), 2) comparability between intervention and control groups at baseline, 3) inclusion/exclusion criteria were indicated, 4) follow-up (a minimum of 6 months was set), 5) drop outs (number indicated, reasons for described), 6) validated measures used for physical activity outcomes, 7) compliance, 8) timing of measurements (similar between intervention and control groups), 9) blinding (whether intervention providers and participants were aware of the research question), 10) intention-to-treat analyses, 11) confounders taken into account in the analyses. Items were scores 'positive', 'negative', 'not applicable' or 'unclear'. Scores were then summed, and high quality was defined by a total of 6 for RCTs and a total or 5 or more for other study designs. All included studies were rated independently by two reviewers (CR, JMO). When opinions differed, consensus on ratings was reached through discussion.

For effectiveness, we followed the grading of evidence proposed by Van Sluijs et al. [14] based on sample size (under 250 subjects is considered small, over 250 is considered large), design (randomised or non-randomised controlled trial) and methodological quality as detailed above. Available results were judged consistent when two thirds of results of relevant studies were found significant and in the same direction [14]. On that basis, five levels of evidence are possible: strong, moderate, limited, inconclusive and no evidence. Given the heterogeneity of studies examined in terms of design, type of intervention, participants, measures and outcomes, a meta-analysis of pooled effects was not considered.

RE-AIM Framework

RE-AIM is a five-step framework designed to translate research into action [12]. RE-AIM criteria have been presented as key quality rating criteria for reporting on external validity [13], and the RE-AIM Framework has been used recently for this purpose in obesity prevention research (in children) [15]. We used the following criteria to assess the reviewed studies: 1) reach (e.g. participation rate and representativeness of individuals), 2) efficacy on selected outcomes (e.g., whether outcomes were compared to a standard goal, whether adverse effects were reported), 3) adoption (e.g., participation rate and representativeness of community or worksite settings), 4) implementation (e.g., levels of interventionist expertise and training, consistency of delivery, adaptation of an approach to local circumstances), 5) maintenance and sustainability (e.g., which components are institutionalized or modified over time).

All articles were coded by two reviewers (JMO, AV) who independently evaluated each study for whether it reported information on each external validity criteria. Discrepancies were resolved by discussion and clarification. Results are reported as the percentage of papers that reported on the respective external validity criteria.

Table 1. Overview on main characteristics and outcomes examined of included studies by type of intervention

Type of intervention	Reference	Design	n	Physical activity measure	Physical fitness, physical performance measure	Obesity-related measure
Exercise training	Brand 2006 [47]	RCTi	202	–	Strength ('Back Check by Dr Wolf') Body flexibility (Schober test, Ott-Test) Endurance (PWC-150 biker ergometer test)	–
	Brox 2005 [37]	RCTi	119	Leisure time physical activity questionnaire	Cardiorespiratory fitness (2 km walking test)	–
	Gamble 1993 [18]	RCTi	14	–	VO_2max (treadmill test) Explosive leg power (standing broad jump) Lower back and hamstring flexibility Abdominal strength (30 s sit-ups) Handgrip strength	Weight, % body fat (4 skinfold thicknesses)
	Gerdle 1995 [45]	RCTi	97	–	VO_2max (submaximal ergometer test) Strength and endurance tests of the shoulder flexors and the knee extensors (isokinetic dynamometer Cybex II)	Weight
	Gronningsaeter 1992 [38]	RCTi	79	–	VO_2max	–
	Hewitt 2008 [21]	RCTi	20	–	VO_2peak, submaximal oxygen consumption at 2 and 4 min	Weight, BMI
	Kennedy 2007 [22]	RCTi	52	–	VO_2max	Weight, BMI, % body fat
	Norris 1990 [26]	CBA	150	–	Endurance (timed 1.5 miles run)	–
	Pedersen 2009 [49]	RCTc	616	IPAQ	Maximal muscle strength (maximal voluntary isometric muscle strength for shoulder, elevation and abduction, handgrip, back extension and flexion). VO_2max (submaximal cycle ergometer test)	BMI, % body fat
	Perkio-Makela 1999 [29]	RCTi	126	Leisure time physical activity questionnaire	Muscle endurance of the legs (squatting) Muscle endurance of the trunk flexors (repetitive muscle tests) Muscle endurance of the trunk extensors (static muscle test) Back mobility (measurements of the side flexion of the back) Static balance (standing on 1 leg, eyes closed) Cardiorespiratory fitness (2-km walking test)	Weight
	Pohjonen 2001 [30]	CNRT	97	–	Dynamic muscle endurance of the trunk flexors (sit-ups, repetitions/30 s) Dynamic muscle endurance of the lower extremities (squatting, repetitions/30 s) Maximal isometric strength of body extension measured in a standing position (n) Flexibility (sit-and-reach test, cm) VO_2max (bicycle ergometer)	Weight, body fat (%)

Table 1 to be continued on next page.

Table 1. Continued

Type of intervention	Reference	Design	n	Physical activity measure	Physical fitness, physical performance measure	Obesity-related measure
	Sjogren 2005, 2006 31, 32]	RCTc, cross-over	90	Weekly diary, structured interview, physical activity at work (7-point scale and illustrations)	Upper extremity muscular strength (1 RM, flexion and extension)	–
	Skargren 1996 [46]	BA, cross-over	106	–	Cardiovascular capacity: VO_2max (submaximal exercise on bicycle) Maximal muscle strength (quadriceps on the right leg, Cybex II)	–
Counselling	Aittasalo 2004 [27]	RCT	155	IPAQ, 7-day diary, pedometer (Yamax DW 700),	–	–
	Osteras 2006 [39]	BA	131	IPAQ	VO_2max	BMI
	Prior 2005 [40]	BA	4198	Modified questionnaire from MONICA	–	BMI
	Spittaels 2007 [35]	RCTi	526	IPAQ, stages of change Accelerometer CSA (1 worksite/6)	–	BMI,% body fat
	Talvi 1999 [33]	BA	885	–	VO_2max	BMI
Stair use	Adams 2002 [16]	CBA	5293	Stair use (%)	–	–
	Auweele 2005 [36]	BA	131 (3146 choices)	Stair use (%)	–	–
	Eves 2006 [17]	BA	26806 choices	Stair use (%)	–	–
	Kerr 2001 [50]	BA	12288 choices	Stair use (%)	–	–
	Kwak 2007 [44]	BA	800+150 (6771 choices)	Stair use (%)	–	–
	Titze 2001 [41]	BA	338	Stair use (%)	–	–
Active commuting	de Geus 2008 [34]	RCTi	92	Cycling data: distance and time spent per trip (distance recorder), leisure time physical activity diary	Maximal physical performance (cycle ergometer)	–
	Hendriksen 2000 [43]	RCTi	122	–	Wmax, VO_2max (maximal exercise test, cycle ergometer)	Weight

Table 1 to be continued on next page.

Table 1. Continued

Type of intervention	Reference	Design	n	Physical activity measure	Physical fitness, physical performance measure	Obesity-related measure
	Mutrie 2002 [25]	RCTi	295	Stage of change for active commuting, 7-day recall	–	–
	Oja 1991 [28]	RCTi	71	Daily log of the distance, duration and subjective strain of walking and cycling during commuting, leisure time physical activity diary	VO_2max	Weight
Walking	Gilson 2007 [19]	RCTi	70	Total step/day	–	% body fat, waist circumference
	Gilson 2009 [20]	RCTi	179	Step counts and reported sitting times (logbook)	–	–
	Murphy 2006 [24]	RCTi	37	Pedometer (Yamax SW-200)	–	Body mass, % body fat, waist and hip circumferences
	Puig-Ribera 2008 [48]	RCTi	70	Pedometer (Yamax SW 200)	–	–
Multi-component	Titze 2001 [42]	CNRT	598	7-day physical activity questionnaire, stages of change	–	–

BA = Before and after; CBA = controlled before and after; CNRT = controlled non-randomised trial; RCTi = randomised controlled trial individual; RCTc = randomised controlled trial cluster.

Results

Types of Interventions and Designs

33 European studies met the inclusion criteria and were fully analysed. Studies originated from 10 European countries: UK [16–26] (n = 11 studies, 33%), Finland [27–33] (n = 6, 18%), Belgium [34–36], Norway [37–39] and Switzerland [40–42] (n = 3 each, 9%), the Netherlands [43, 44] and Sweden [45, 46] (n = 2 each, 6%), Germany [47], Spain [48] and Denmark [49] (n = 1 each, 3%). To better describe the types of interventions, six categories were used: 1) counselling (n = 5, 15%) [27, 33, 35, 39, 40]; 2) exercise training (n = 13, 39%) with 10 aerobic fitness and muscular training [18, 21, 26, 29, 30, 32, 37, 45–47, 49], one aerobic fitness training with stress management strategies [38] and one stair climbing training [22]; 3) active commuting (n = 4, 12%) with 2 cycling [34, 43] and 2 cycling and walking [25, 28]; 4) walking interventions (n = 4, 12%) [19, 20, 24, 48]; 5) stair use (n = 6, 18%) with signs and prompts-of-choice [16, 17, 36, 41, 44, 50]; and 6) multi-component intervention (associating a physical activity educational programme, commuting, walking and counselling interventions) (n = 1, 3%) [42]. Table 1 presents the design of the study, the number of participants involved and the outcomes examined, by type of intervention. 20 out of 33 studies (61%) were RCTs [18–22, 24–29, 32, 34, 35, 37, 38, 43, 45, 47–49] (2 used cluster-randomised designs [32, 49]), 2 (6%) were controlled non-randomised trials [30, 42], 2 (6%) were controlled before and after studies [16, 26] and 9 (27%) studies had a pre-post design [17, 33, 36, 39–41, 44, 46, 51]. 15 studies (45%) considered obesity-related outcomes [18, 19, 21, 22, 24, 28–30, 33, 35, 39, 40, 43, 45, 49], with only 1 study where this was a primary outcome [22]. 22 studies (67%) considered increased physical activity as outcome [16, 17, 19, 20, 24, 25, 27–29, 31, 32, 34–37, 39–42, 44, 48, 49, 51], and 18 studies (54%) considered physical fitness improvement as outcome [18, 21, 22, 26, 28–34, 37–39, 43, 45–47, 49].

Evidence of Effectiveness

Table 2 shows the main results regarding evidence of effectiveness on physical activity, physical fitness and obesity-related outcomes by type of intervention. For these outcomes, the evidence was graded as inconclusive for counselling, walking, stair use and multi-component interventions whatever the outcome considered. The evidence was graded as moderate for exercise training (physical fitness outcomes) and limited (physical fitness outcomes) to moderate (physical activity outcomes) for active commuting studies. There was either no evidence (active commuting) or inconclusive evidence (counselling, exercise training, walking) of effec-

tiveness for obesity-related outcomes. In total, 17 studies (52%) were considered of high methodological quality (16 of 17 were randomised controlled trials), and 9 among them were exercise training studies (8 of 13 were RCTs).

Reporting of External Validity Dimensions

Table 3 summarises the percentage of studies reporting various external validity dimensions using the coding framework. In general, all studies lacked full reporting on potential generalisability and dissemination elements. Elements receiving the least attention (<20%) were representativeness of participants, setting-level inclusion/exclusion criteria and representativeness, characteristics regarding intervention staff (participation rate, implementation and effect moderator), implementation of intervention content, costs, long-term effects and programme sustainability.

Reach

At the level of individual participants, almost all types of intervention studies reported on the target audience description, except for studies on stair use (67%). The individual inclusion/exclusion criteria and the participation rate were frequently reported (≥50%), but not for multi-component (individual criteria) and stair use (participation rate) interventions. The representativeness of participants was described in exercise training (31%) and counselling (20%) studies only.

Efficacy

All studies on walking (n = 4) and multi-component interventions (n = 1), 15% (n = 2/13) of exercise training and 40% (n = 2/5) of counselling interventions compared their physical activity and physical fitness outcomes to current recommendations for physical activity or to defined public health goals. An effect moderator by participant characteristics was reported in the majority of studies (n = 17/33 total number of studies, n = 3/13 for exercise training, n = 4/5 for counselling, n = 5/6 for stair use, n = 4/4 for active commuting and n = 1 for multi-component interventions). In contrast, an effect moderator by staff/setting was reported in 3 studies only (1 active commuting and 2 stair use interventions).

Adoption

At the setting level, the intended target setting description was mostly reported (60–100% depending on type of intervention), but not the setting inclusion/exclusion criteria, participation rate or representativeness. No information was provided on delivery staff.

Implementation

Except for the only multi-component intervention included in the review [42], studies on counseling and stair use were more likely to describe a consistent implementation of their pro-

Table 2. Evidence of effectiveness on physical activity, physical fitness, obesity-related outcomes by type of intervention

Type	N	Number of RCTs	Number of high-quality studies	Number of large-size high-quality studies	Outcomes					
					physical activity		physical fitness		obesity	
					significance	evidence	significance	evidence	significance	evidence
Counselling	5	2	2 (2 RCT)	1	+: 1 NS: 1	inconclusive	–	–	+: 1	inconclusive
Exercise training	13	10	9 (8 RCT)	1	+: 2 NS: 2	inconclusive	+: 8 NS: 1	*moderate*	+: 2 NS: 3	inconclusive
Active commuting	4	4	4	1	+: 2 NS: 0	*moderate*	+: 3 NS: 0	*limited*	+: 0 NS: 2	no evidence
Walking	4	4	2	0	+: 3 NS: 1	inconclusive	–	–	+: 1 NS: 1	inconclusive
Stair use	6	0	0	0	+: 0 NS: 0	inconclusive	–	–	–	–
Multi-component	1	0	0	0	+: 0	inconclusive	–	–	–	–
Total	33	20	17	3	–	–	–	–	–	–

RCT = Randomised controlled trial; NS = not significant; + = significant positive relationship found followed by number of corresponding studies.

Table 3. Percentage of studies reporting external validity dimensions (using RE-AIM framework)[a]

	n	% reporting
Reach		
Individual participants		
Target audience description	31	94
Individual inclusion/exclusion criteria	22	67
Participation rate	19	58
Representativeness of participants	5	15
Efficacy (on selected outcomes)		
Outcomes compared to standard goal	9	27
Adverse consequences	10	30
Effect moderator by participant characteristic(s)	17	52
Effect moderator by staff/setting	3	9
Adoption		
Setting level		
Target setting description	24	73
Setting inclusion/exclusion criteria	6	18
Participation rate	7	21
Representativeness of setting	1	3
Delivery staff		
Participation rate	0	0
Implementation		
Consistent implementation of program	10	30
Staff expertise or training	17	52
Implementation differed by staff	0	0
Program adaptation	7	21
Number of sessions or time needed to deliver intervention	33	100
Costs	0	0
Maintenance and sustainability		
Long-term effects (at least 12 months)	4	12
Program sustainability	1	3
Attrition rate	25	76
Differential attrition by condition tested	12	36
Drop-out representativeness	7	21

[a]Total number of included intervention studies was 33.

gramme (n = 3/5, 60% and n = 4/6, 67% respectively) compared to the others (active commuting, n = 1/4, 25%; exercise training, n = 1/13, 8%; walking, n = 0/4, 0%).

For studies on exercise training and counseling, staff expertise was specified (n = 10/13, 78% and n = 3/5, 60% respectively), but no data on quality of implementation by different types of staff was presented, whatever the type of intervention. Programme adaptation was reported in 3 out of 13 (23%) exercise training studies, in 2 out of 6 (33%) stair use studies, in 1 out of 4 (25%) walking studies and in the multicomponent study. All studies, whatever type of intervention, reported on the number of sessions or time needed to deliver intervention. No information was provided on costs in any study.

Maintenance and Sustainability

Only 4 studies, 2 exercise training and 2 counselling intervention studies, performed a follow-up evaluation 12 months after the end of the intervention. Only 1 study, which was an active commuting intervention, reported information related to the sustainability of the programme. Regarding attrition, 7 studies did not report clearly on this issue. However, 6 of these studies were stair use interventions where this information was not relevant. Differential attrition by condition tested and drop-out representativeness were only reported in active commuting (n = 4/4, 100% and n = 2/4, 50%, respectively) and multi-component (100% both) intervention studies.

Discussion

Our review identified 33 studies on the effectiveness of physical activity interventions at the workplace conducted in Europe. Settings, intervention characteristics and outcomes were very heterogeneous, and the analysis of evidence of effectiveness led to overall mixed results. Our findings suggest that, to date, whatever the type of worksite intervention considered, there is no evidence or only inconclusive evidence for an effect on obesity-related outcomes. We found only limited to moderate evidence for active commuting interventions on physical fitness and physical activity outcomes, whereas moderate evidence was observed for exercise training on physical fitness outcomes. Importantly, a majority of studies did not report the generalisability elements of key importance for future translation and dissemination of interventions.

Among the particularity of our review we can emphasise the large inclusion criteria, the categorisation by type of interventions and the focus on obesity-related outcomes. The grading of evidence for effectiveness that we used was mainly based on the number of studies available, sample size, methodological quality and the significance of results. Using this grading system, one important finding was the moderate evidence of effectiveness of exercise training interventions on physical fitness outcomes. This category comprised the greatest number of studies included in the review, included the greatest number of RCTs and had the greatest number of significant results, therefore strongly influencing the rating of the evidence. In addition, it should not come as a surprise that exercise training does improve physical fitness, whatever setting [52, 53]. In contrast, for this same type of intervention, there was only inconclusive evidence of effectiveness on obesity-related outcomes. It should however be noted that only half of the training studies had measured weight outcomes, and only half of the latter studies considered body fat as outcome. Indeed, training may be associated with increased fat-free mass and decreased fat mass, resulting in no change in body weight [54]. These findings illustrate first the lack of

data for obesity-related outcomes in included studies and also the need to include body composition data to better assess intervention-induced weight changes.

In sharp contrast to the series of training studies, studies on stair use only used a before and after design, and only one of these was a controlled trial [16]. Shifting lift to stair use looks as an intuitively appealing strategy to increase habitual physical activity at the worksite. However, the design of such studies, as well as the definition of appropriate outcomes, makes it difficult to obtain high rankings with the chosen grading system for evidence of effectiveness. This may explain, at least in part, the inconclusive evidence found here for physical activity outcomes and the few data available for fitness as well as for obesity-related outcomes. In addition, it has been shown that the estimated gross energy expended during ascending and descending were equivalent to an intensity of 9.6 and 4.9 metabolic equivalents (METs) respectively [55]. This is not negligible but, considering the habitual duration of stair climbing in a typical working day, it may well not be enough to substantially affect body weight on the long term. One can however speculate that it could act as a starter for a more physically active lifestyle [56]. Along the same lines, when turning to commuting studies, it has been shown, that active transportation could increase adherence to activity recommendations [57] which could be a first step in the prevention of body weight gain. In this review, no effect on obesity outcomes was found for commuting studies in spite of moderate to limited evidence on physical activity/fitness outcomes. Altogether, a combination of interventions would seem as a promising approach. Multi-component approaches appear to have a higher potential impact on obesity-related outcomes [58]. Only one study of this type could be included in our review [42], and more data would be needed to assess evidence.

In previous literature, 2 meta-analyses focused on weight-related outcomes [9, 10]. These reviews included international studies and were not limited to Europe. The most recent and comprehensive review is the one by Verweij et al. [10]. In this meta-analysis, 14 studies on physical activity only were included. Only 5 among these studies were European studies also included in our review. The authors concluded that there was low quality of evidence that workplace physical activity interventions significantly reduce body weight (5 studies, mean difference between treatment and control –1.08 kg (95% CI –1.79 to –0.36)) and BMI (2 studies, mean difference –0.50 kg/m^2 (95% CI –0.46 to –0.22)); for body fat percentage (2 studies), evidence was rated as of very low quality with a non-significant effect (mean difference –0.56% (95% CI –2.53 to 1.42)). Conn et al. [9] reported positive although modest and significantly heterogeneous effect sizes for anthropometric measures (BMI), requiring, according to the authors, cautious interpretation of findings. Findings from these previous reviews are difficult to compare to our results, given that we chose to analyse data according to type of intervention. In any case, it reinforces the need for more data on weight-related outcomes from interventions with a controlled design.

To our knowledge, this review is the first to apply the RE-AIM model in the context of physical activity interventions in the worksite setting. Success at translating behavioural programmes into public health practice means closer attention to the elements of a programme that can most easily be translated into practice [59]. The RE-AIM model provides a useful framework to determine programme strengths and weaknesses on this path from evidence to action.

Regarding reach and representativeness for individual participants, the participation rate was reported in the majority of studies. It was however not always clearly described and the denominator (eligible population) sometimes not indicated. Although almost all studies described their target audience, this description was not always detailed. Specifically, the term 'employee' was used but it is known that it may cover a wide variety of work tasks that may be more or less physically demanding [60]. At the setting level (adoption criteria), a majority of studies described the target setting, but the level of description varied widely and in general little information was provided on the company/institution studied. This is critical in attempts to transfer successful programmes according to socio-economic status, cultural background or type of resident location (urban/rural), to reach subgroups known at higher risk for weight gain and obesity [61].

Regarding implementation, at an individual level, most of the studies (52%) involved 'trained staff' although the expertise or specific competences of this staff was seldom described. The role of the exercise supervisor, as well as his/her training, is known to be important to maintain high participation into programmes [62, 63]. Some kind of programme adaptation was reported in 21% of studies only, limiting possibilities to implement the programs in different contexts. Concerning maintenance and sustainability, these issues cannot be overlooked when dealing with obesity prevention. To assess the impact of behaviour modifications on body weight would require long-term (>12 months) intervention and follow-up. Only 1 study reported a long follow-up (1–6 years) [40]. High level of attrition and high variability in participation rates, in particular in the long term as observed here, challenge whether programmes fulfil their aims. In this field, a better understanding of reasons for drop-outs and the development of means to retain subjects into the programmes are needed. In some studies, incentives were offered as pull measures, either in form of gifts or even financial rewards, leading e.g. to a 31% increased participation to a walking programme in adults [64]. Importantly, sustainability of the programme was not reported except in one study [36]. This appears as crucial for decision-makers to consider the possibility to integrate physical activity in their policy development.

Some limitations of our review may be considered. We focused the search on physical activity and physical fitness outcomes, and we did not take into account interventions to

reduce sedentary behaviour. Employees in many working sectors spend a substantial part of their time sitting [60]. A recent review emphasised the few data available and the current lack of evidence to show the effectiveness of workplace interventions for reducing sitting [65]. Another limitation may concern our focus on European studies only. It was our intention to identify types of interventions that could be generalised in European settings.

In conclusion, based on the evidence gathered in European adults, we would recommend providing exercise training programmes and facilitating active commuting (walking, cycling) in the worksite setting. These types of intervention were shown to increase components of physical fitness such as cardiorespiratory fitness, an important physiological risk marker. The potential importance of changing parts of the design of working places (e.g. stairs) to increase habitual physical activity level would need further assessment. There is currently too little evidence regarding the effect of worksite interventions on obesity-related outcomes to provide recommendations. However, body weight and body composition outcomes should more systematically be included in workplace health promotion intervention studies. Finally, for translation into practice of worksite physical activity interventions, we would strongly advocate that the elements of generalisability and dissemination are better reported in future studies.

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