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The effect of workplace lifestyle programmes on diet, physical activity, and weight-related outcomes for working women: A systematic review using the TIDieR checklist

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Summary

Physical activity and healthy diets are essential for the prevention of obesity and chronic disease that disparately impact women compared with men. Given the number of women engaged in the workforce, workplace interventions could improve lifestyle behaviours and health outcomes for women. This systematic review aimed to identify intervention characteristics of lifestyle programmes or organizational policy changes in the workplace associated with improved diet, physical activity, or weight-related outcomes for working women using the template for intervention description and replication (TIDieR) checklist. Seven databases were searched for controlled studies published up to March 2019 that included a workplace diet and/or physical activity intervention. From 5,318 identified records, 20 studies (23 articles and 26 intervention arms) were included. Data were extracted on diet, physical activity, weight-related outcomes, and TIDieR components. Findings indicated that group delivery may improve physical activity outcomes, and a high number of sessions may benefit weight-related outcomes for physical activity interventions. Mixed interventions that included tailoring and input from non-healthcare professionals may also enhance physical activity. In contrast, the role of mixed interventions in improving diet and weight-related outcomes was less clear. Overall, workplace health programmes were effective at improving lifestyle behaviours for working women.

KEYWORDS

health promotion programmes, lifestyle, women's health, workplace

1 | INTRODUCTION

The prevalence of obesity is an urgent public health issue, with a disproportionate impact on women's health.[1–3] Compared with women with a body mass index (BMI) of 18.0 to 24.9 kg/m^2, women with higher relative weight are more likely to experience adverse female-specific health conditions throughout their lives, including polycystic ovary syndrome (PCOS),[4] pregnancy-related complications such as

Abbreviations: ACM, Association for Computing Machinery; BMI, body mass index; CG, control group; GLTEQ, Godin Leisure-Time Exercise Questionnaire; HCP, healthcare professional; IG, intervention group; MET, metabolic equivalent of task; MVPA, moderate to vigorous physical activity; PA, physical activity; PCOS, polycystic ovary syndrome; PICOS, participants, intervention or exposure, comparator, outcome and study type; PRISMA, preferred reporting items for systematic reviews and meta-analyses; PROSPERO, International Prospective Register of Systematic Reviews; RCT, randomized controlled trial; RDA, recommended daily allowance; RoB, risk of bias; ROBINS-I, risk of bias in non-randomized studies of interventions; SE, standard error; TIDieR, template for intervention description and replication; UN, United Nations; WC, waist circumference.

pre-eclampsia, stillbirth, or foetal malformations,[5] impaired fertility,[6] decreased insulin sensitivity following menopause,[7] and gynaecological cancers.[4] Further, overweight and obesity are also important risk factors for a number of other chronic conditions such as cardiovascular disease, diabetes, and dementia,[8] which impact women differently to men[1–3]; for example, women have higher rates of myocardial ischemia and related mortality compared with men of similar age.[3] Rates of overweight and obesity are continuing to rise in high-income countries, and approximately two thirds of women now have an above "normal" BMI or a waist circumference (WC) indicative of increased chronic disease risk.[9,10] Targeted strategies to address obesity are needed to reduce rising economic costs and burdens of care, improve health outcomes, and to overcome the specific gender- and sex-based barriers to healthy lifestyle behaviours experienced by women.

The United Nations (UN) has identified unhealthy diets and a lack of physical activity (PA) as crucial targets in addressing the growing burden of disease.[11] In addition, the UN and a specialized agency, the World Health Organization, have identified workplaces as key settings for improving employee wellbeing,[11,12] thus highlighting the importance of the physical and social working environment on health behaviours. Rising sedentary occupational roles and increasing periods of time engaged in career advancement are important barriers to health and impair opportunities for women to be physically active.[13] Approximately 82% of working-age women in Australia do not meet current physical and strength-based activity guidelines,[14] and this pattern is also reflected in the United States.[15] Dietary intake is also significantly impacted by unhealthy food landscapes within the workplace.[16] In addition, established gender norms mean that women typically spend more time on unpaid work[17] and less time on leisure activities than men, and this difference is compounded for women with children.[18] Furthermore, women may also experience cycles of excessive weight gain during successive pregnancies and/or weight retention during the postpartum period.[5] Many workplaces are also heavily gender-segregated by industry and occupation, for example, nursing and teaching for women and construction and mining for men, and may benefit from a gender- or sex-specific health promotion intervention. Given that just under half of workforce participants are women[19,20] and approximately 70% of these women are of reproductive age,[21] the competing time demands of the workplace presents both unique challenges and opportunities for working women to engage in healthy lifestyle behaviours.[22]

Although workplaces are potentially important settings for women's health, scant research has assessed the effectiveness of workplace interventions in improving women's diet and PA behaviours. A meta-analysis examining the impact of workplace PA interventions and their effect on PA behaviours and cardiometabolic health of working women found that PA interventions resulted in significant weight loss and BMI decrease of −0.83 kg and −0.35 kg/m^2, respectively[17]; however, the analyses included sex-aggregated and uncontrolled study data, thus precluding rigorous analysis.[17] Other reviews, focused on mixed-sex populations, have found moderate quality of evidence that workplace health promotion interventions significantly improve outcomes for fitness and mixed results for work-related variables such as absenteeism and job stress.[23] Few systematic reviews have explored the effect of workplace diet-only interventions and, of those identified, high heterogeneity of results and study design makes it difficult to confidently evaluate the evidence.[24] To our knowledge, no reviews have examined the impact of workplace mixed lifestyle (i.e., diet and PA combined) or diet-only interventions for working women. As a result, the determinants of success specific to working women are not yet clear, thus leaving researchers unable to make evidence-based recommendations on PA and diet interventions targeted to women in workplaces.

Insight into the determinants of intervention success is key to understanding whether findings can be generalized across various workplace settings and populations,[25] or if a more tailored approach to individual and organizational needs is required to facilitate future implementation and translation. This insight is particularly important for workplaces because they are complex settings built around employee and employer needs and are also bound by social relationships, environmental elements, and hierarchical structures.[26] While workplace interventions typically adopt a generalized and ungendered approach to improve the lifestyle behaviours of men and women, this method may be ill-equipped to counter the barriers unique to working women, such as sex discrimination or pregnancy in the workplace. Understanding which aspects of intervention content and context are associated with intervention effectiveness for women may provide valuable evidence for the design and implementation of successful workplace diet and PA interventions. Rongen et al observed that although research frequently examines whether a programme is capable of inducing desired behaviour changes, few examine how intervention components influence these changes.[25] Tools such as the template for intervention description and replication (TIDieR) checklist provide a means to accomplish this.[27]

The TIDieR checklist is used to describe replicable aspects of interventions including items such as underpinning theories, who delivers the intervention, how and where the intervention is delivered, whether individual adaptations are used, and how well the intervention is adhered to.[27] However, workplace intervention characteristics that are associated with improved diet, PA behaviours, or weight management for working women have yet to be evaluated. Further, recognition of sex and gender-based differences as important determinants of health outcomes for women is essential, given the current gap in our knowledge.[28] Hence, the aim of this study was to conduct a systematic review to identify the intervention characteristics of lifestyle programmes or organizational policy changes in the workplace associated with improved diet, PA, or weight-related outcomes for working women using the TIDieR checklist.

2 | METHODS

This systematic review was registered on the International Prospective Register of Systematic Reviews (PROSPERO; CRD42019129163) and was conducted in accordance with the preferred reporting items for systematic reviews and meta-analyses (PRISMA) statement.[29]

2.1 | Search strategy

The following databases were searched for all relevant articles using title/abstract and Medical Subject Headings (or equivalent): PubMed, MEDLINE, PsycINFO, CINAHL, Scopus, Association for Computing Machinery (ACM) Digital Library, and Business Source Premier. The search strategy was conducted in consultation with a research librarian and included terms relating to or describing the following four concepts: work AND health promotion AND intervention AND lifestyle (Box 1). The full search strategy for MEDLINE is shown in Table S1. The search was conducted in March 2019. Only studies written in English from the last 10 years (2009-March 2019) were included.

Box 1. Search terms and concepts

Concept 1: Work

Workplace*
Employment

Concept 2: Health Promotion

Promotion
Program*
Initiative
Educat*
Behavio* Change
Behavio* Modification
Health Communication
Health Planning
Preventative
Preventive

Concept 3: Intervention

Efficacy
Effectiveness
Randomi*
Trial
Intervention

Concept 4: Lifestyle

Lifestyle
Diet
Physical Activit*
Obesity
Exercise
Overweight
Weight Loss
Physical Fitness

2.2 | Eligibility criteria

Eligibility criteria were defined according to the participants, intervention or exposure, comparator, outcome and study type (PICOS) framework outlined in Table S2. Included studies sought to examine lifestyle programmes delivered to working women in a workplace environment to improve diet, PA, or weight-related outcomes. Interventions facilitated by the workplace but conducted outside of the workplace or by external agencies were also eligible. Interventions targeting working men and women were eligible, provided they reported outcomes separately by gender.

Studies not facilitated by the workplace or conducted outside of the workplace and not as a part of one's employment were excluded. Studies that did not report outcomes related to diet, PA behaviours, or weight-related measurements were excluded. Protocol articles, review articles, unpublished or grey literature, conference abstracts, and studies that only reported on qualitative outcomes were also excluded.

2.3 | Study selection process

After removal of duplicates, titles/abstracts were screened in duplicate by two reviewers (from SM, ELC, CB, and BH) using Covidence software.[30] Conflicts were resolved by discussion with reference to the title and abstract; a third reviewer was consulted where necessary. Eligibility of full text articles was determined by two reviewers (from SM, EC, and SP) reading each paper in full, with consultation with a third reviewer (BH) where required. Reasons for exclusion at the full text stage are presented in Table S3. Forward and backward citation searching of all included articles was conducted.

2.4 | Data extraction and management

The Cochrane risk of bias (RoB) 2.0 tool was used to assess the RoB in randomized trials, and the RoB in non-randomized studies of interventions (ROBINS-I) assessment tool was used for studies without randomization (e.g., cohort). The RoB assessment was independently evaluated by one reviewer (SM or TLC), with a 10% subset of studies evaluated by both SM and TLC to establish reliability. Discrepancies were resolved via discussion, with reference to a third author (BH) where necessary.

General study characteristics (author, year, country of study, study name, aim, study design, sample size, and attrition), participant characteristics (BMI, weight, fat mass, fat percent, WC, age, PA, and diet), and outcomes (diet and/or PA behaviours and/or weight-related outcomes) were extracted from the included studies. The TIDieR checklist was used to extract information relevant to intervention replicability. The TIDieR checklist is used to describe theory (why), materials and procedures used (what), the intervention provider (who), the mechanism of delivery (how), the location (where), intervention schedule and intensity (when and how much), whether individual adaptations were used (tailoring), and the intervention adherence (how well).[27] Healthcare professionals (HCPs) were defined according to the ISCO-08 definition that includes medical doctors, nurses, allied health professionals, health associate professionals, and care workers.[31] Adherence to the intervention was categorized into low (<30%) and medium/high (≥30%) based on a review by Hawley-Hague et al.[32] Parameters for intervention duration (short ≤3 months, medium 3–12 months, long ≥12 months), attrition (low <13%, medium 13–26%, high >26%), and number of sessions (low 1–5 sessions, medium 6–13 sessions, high >13 sessions) were defined according to a review utilizing the TIDieR checklist by Lim et al.[33] Data extraction was conducted by one reviewer (SM or ELC), with a 10% subset of studies extracted by both SM and ELC to establish reliability.[34] Discrepancies were resolved by consensus and assisted by a third reviewer (BH) if necessary. Study authors were contacted for additional information relating to TIDieR components, sex-disaggregated outcomes and characteristics, and attrition rates.

Findings were synthesized narratively across the studies for overall intervention effectiveness. "Effectiveness" studies were defined according to demonstration of external validity, (i.e., conducted in real-world settings), reflection on the source population (i.e., working women with minimal exclusion criteria), and consideration of individual and systems factors (i.e., the work environment and employee behaviours).[35] Studies were evaluated according to the TIDieR checklist and then grouped by intervention focus into PA interventions and mixed (a mixture of diet-based and PA-based) interventions.[36] No diet-only studies were identified during the grouping process. Intervention outcomes were determined to have an effect if they achieved statistical significance ($P < 0.05$) compared with either the control or with baseline at any stage of the intervention, that is, during the intervention, immediately post-intervention, or at follow-up.

3 | RESULTS

3.1 | Study selection

The initial search returned 5,315 records (Figure 1). Of these, 23 articles (20 studies with 26 intervention arms) met the eligibility criteria. One study allowed participants the option of completing a PA intervention in either the home or the workplace[37]; this was included as it met our eligibility criteria of interventions that were facilitated by the workplace, even if conducted in an external setting. Three studies reported physical fitness using VO_{2max} or VO_{2peak}. These were included as the change (if present) in physical fitness is representative of altered PA behaviours.

3.2 | Characteristics of included studies

Ten studies used a randomized controlled trial (RCT) design[37–49] and 10 studies used a non-randomized study design (Table 1).[50–59] Nine studies were conducted in the United States[37,40,42,43,47,52,53,55,56,58] and two in Brazil.[44,45] Studies were also conducted in Iran,[50] Tunisia,[54] Norway,[38,39] Ireland,[51] Sweden,[41] Japan,[59] Germany,[57] Singapore,[46] and the Netherlands.[48,49] Sample sizes ranged from 18[51] to 771.[54] All male participants had dropped out of one intervention group by week 12 in a 40-week RCT with two intervention groups.[38,39] Two studies included only participants with a BMI above 25 kg/m^2 at baseline,[40,58] and 17 studies reported using convenience sampling during recruitment.[37–40,42,43,45–58]

Eight studies delivered PA interventions (n = 12 intervention arms),[37–39,44,45,47,50–52] and 12 studies delivered mixed interventions (n = 14 intervention arms),[40–43,46,48,49,53–59] that is, a combination of PA and diet interventions. One study incorporated an oral health component in their intervention.[59] Ten studies included both men and women,[38,39,41–43,48,49,51,54,55,57–59] and 10 studies included women only.[37,40,44–47,50,52,53,56] Six studies incorporated systems approaches, for example, participatory approach to programme design, management involvement and support, or environmental audits.[41,48,49,53,55–57] None of these studies reported the implementation of any clear organizational policy changes.[41,48,49,53,55–57] One study measuring weight outcomes provided online training programmes to participants to limit inaccurate self-report data.[58] An additional four studies used self-reported measurements alone[46,54,55,57] and two studies used both objective and self-report measurements (Table S4).[37,50] PA was measured via 15 different outcome variables (e.g., mean steps/day and VO_{2max}), weight outcomes were measured via seven different variables (e.g., weight loss and BMI), and diet outcomes were measured according to six different variables (e.g., dietary fat/salt intake and fruit and vegetable consumption) (see Table S4).

Intervention duration and follow-up periods varied considerably. Ten PA interventions reported post-intervention PA outcomes,[37–39,45,47,50,52] but only three PA interventions reported

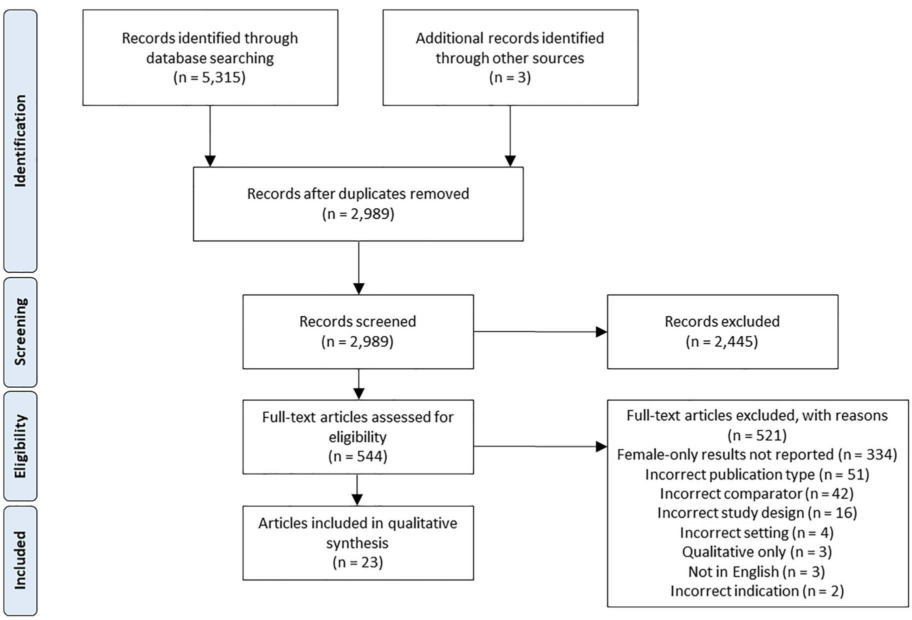

FIGURE 1 Study selection flowchart[29]

TABLE 1 Characteristics of included studies

First author (abbreviation), year, and workplace setting	Study design, duration, sample size, and target behaviours/behaviour change strategy	Baseline participant characteristics: Age (SD)	Weight-related measure (SD)	Activity/fitness and diet-related measure (SD)	Findings
Physical activity interventions					
Baghianimoghaddam (Bag)[50] 2016 Iran, university setting	Controlled before and after study. 16 weeks. 120 (*IG* = 60; *CG* = 60). Exercise.	*IG*: 36.5 (6.7) *CG*: 37.2 (7.3)	-	<u>PA</u> *IG*: 4,715 (1,715) steps per day. *CG*: 3,806 (716) steps per day.	*After 16-week intervention*: <u>PA</u> *IG* had a significant effect on mean steps per day (8,279 (SD 2,759) steps) compared with baseline, $P = 0.001$, while the *CG* had no effect (4,118 (SD 1,136) steps), $P = 0.15$. *IG* had an effect for PA during leisure time compared to *CG* (1086 MET mins/week vs. 369.0 MET mins/week, $P < 0.001$) and compared with baseline (1,086 MET mins/week vs. 325.2 MET mins/week, $P < 0.001$). No significant effect observed for PA at work ($P = 0.41$), during domestic duties ($P = 0.25$), or during transport ($P = 0.30$) between the *IG* or *CG* or compared with baseline.
Barene (Bar)[38,39] 2014 Norway, hospital setting	Cluster RCT. 40 weeks. *At 12-week assessment*: *Soccer* = 28. *Zumba* = 30. *CG* = 31. *After 40-week intervention*: *Soccer* = 22. *Zumba* = 25. *CG* = 23. Exercise.	*Soccer* = 44.1 (8.7) *Zumba* = 45.9 (9.6) *CG* = 47.4 (9.5)	*Soccer Group*: 69.2 kg (9.2) weight; 22.4 kg (6.4) total fat mass. *Zumba Group*: 71.2 kg (8.2) weight; 23.7 kg (5.5) total fat mass. *CG*: 71.4 kg (11.5) weight; 24.4 kg (7.5) total fat mass.	<u>PA</u> *Soccer Group*: 32.8 mL/kg/min (5.5) VO_{2max}. *Zumba Group*: 31.8 mL/kg/min (6.7) VO_{2max}. *CG*: 33.1 mL/kg/min (6.7) VO_{2max}.	*At 12-week assessment*: <u>Weight</u> *Soccer Group* had an effect for weight loss (−0.8 kg, $P = 0.02$) and total fat mass reduction (−1.0 kg, $P < 0.00$) compared with *CG*. *Zumba Group* had an effect for total fat mass (−0.6 kg, $P = 0.05$) but weight had no effect (−0.6 kg, $P = 0.09$) compared with *CG*. <u>PA</u> *Soccer Group* had an effect for fitness (+1.5 mL/kg/min relative VO_{2peak}, $P = 0.02$) compared with *CG*. *Zumba Group* had an effect for fitness (+1.5 mL/kg/min relative VO_{2peak}, $P = 0.03$) compared with *CG*. *After 40-week intervention*: <u>Weight</u> *Soccer Group* no effect for weight reduction (−1.1 kg, $P = 0.08$) or BMI (−0.3 kg/m^2, $P = 0.17$) but did have an effect for total fat mass (−1.2 kg, $P = 0.004$ compared with *CG*.

(Continues)

TABLE 1 (Continued)

First author (abbreviation), year, and workplace setting	Study design, duration, sample size, and target behaviours/behaviour change strategy	Baseline participant characteristics: Age (SD)	Weight-related measure (SD)	Activity/fitness and diet-related measure (SD)	Findings
					Zumba Group had an effect for weight reduction (−2.1 kg, $P = 0.001$), BMI (−0.7 kg/m^2, $P = 0.01$) and total fat mass (−1.3 kg, $P = 0.003$) compared with *CG*. PA *Soccer Group* had no effect for fitness (+1.1 mL/kg/min VO_{2max}, $P = 0.08$) compared with *CG*. *Zumba Group* had an effect for fitness (+2.2 mL/kg/min VO_{2max}, $P = 0.001$) compared with *CG*.
Mailey (Mai)[37] 2014 USA, specific workplaces NR	RCT with factorial design. 6 months. *At 1-month assessment*: 119; *IG* = 38, *IG+* = 42, *CG* = 39. *After 6-month intervention*: 109; *IG* = 34, *IG+* = 40, *CG* = 35. Exercise, goal-setting, and self-monitoring.	*IG*: 38.33 (7.13) *IG+*: 37.15 (6.72) *CG*: 36.35 (6.06)	-	PA *IG*: 19.01 (17.1) GLTEQ; 22.45 (13.3) MVPA; 217,591 (74,418) total counts accelerometer. *CG*: 16.92 (19.3) GLTEQ; 20.87 (13.6) MVPA; 222,057 (64,031) total counts accelerometer. Selection Criteria: Women not currently meeting PA recommendations (150 min+ of moderate PA weekly).	*After 1-month assessment*: PA *IG* had a large effect size for self-reported activity (35.51 (18.5) GLTEQ, *d* = 0.93), while the *CG* reported a moderate effect (24.44 (16.2) GLTEQ, *d* = 0.42). Objective measurements had a moderate effect size for activity in the *IG* (29.58 (20.3) MVPA, *d* = 0.42) and 254,682 (94,041) total counts (accelerometer), *d* = 0.44) and no effect on the *CG* (21.08 (14.9) MVPA, *d* = 0.01); 232,553 (75,914) total counts, *d* = 0.15). *After 6-month intervention*: PA *IG* had a large effect size for self-reported activity (33.75 (22.5) GLTEQ, *d* = 0.74) compared with a moderate effect in the *CG* (25.31 (18.3) GLTEQ, *d* = 0.45). No effect was observed on objectively measured PA for both the *IG* (21.28 (13.2) MVPA, *d* = −0.09 and 223,190 (71,858) total counts (accelerometer), *d* = 0.08) and the *CG* (19.42 (11.7) MVPA, *d* = −0.11) and 217,239 (57,253) total counts, *d* = −0.08).
Mair[51] 2014 Ireland, specific workplaces NR	Quasi-experimental wait-list cross-over study. 4 weeks. *After 4-week intervention*: 18. Exercise.	-	66.2 kg (9.8) weight; 25 kg/m^2 (3.19) BMI; 37.9% (5.37) body fat; 41.6 kg (4.69) fat-free mass.	PA Selection Criteria: Sedentary, not taking part in planned exercise 2+ times per week.	*After 4-week intervention*: Weight *IG* had no significant effect for weight-related measurements compared with baseline (66.6 kg (9.9) weight; 25.1 (3.24) kg/m^2 BMI; 37.8% (4.91) body fat; 39.1 kg (9.88) fat-free mass).

TABLE 1 (Continued)

First author (abbreviation), year, and workplace setting	Study design, duration, sample size, and target behaviours/behaviour change strategy	Baseline participant characteristics: Age (SD)	Baseline participant characteristics: Weight-related measure (SD)	Baseline participant characteristics: Activity/fitness and diet-related measure (SD)	Findings
Osiecki (Osi)[44] 2013 Brazil, university setting	RCT. 12 weeks. *At post-test*: 50 (*IG* = 24 and *CG* = 26). Exercise.	*IG*: 42.5 (11.35) *CG*: 48.77 (9.27) *CG*: 69.51 kg (20.13) weight; 26.76 kg/m^2 (6.9) BMI; 91.84 cm (12.91) WC; 35.27% (8.25) body fat.	*IG*: 67.22 kg (14.14) weight; 25.13 kg/m^2 (4.81) BMI; 86.97 cm (3.9) WC; 29.73% (9.42) body fat.	-	*After 12-week intervention*: Weight *IG* (67.52 kg (13.39) weight, P = 0.445 and 25.11 kg/m^2 (4.65) BMI, P = 0.936) and *CG* (72.93 kg (15.26) weight, P = 0.226; 28.08 kg/m^2 (4.38) BMI, P = 0.198) both had no effect for weight or BMI compared with baseline. *IG* had no effect for body fat percentage (28.51% (9.41), P = 0.433), however *CG* significantly increased their body fat percentage (36.5% (8.8), P = 0.014) compared with baseline. *IG* had an effect for WC (85.04 cm (2.38), P = 0.009), while *CG* had no effect (89.93 cm (13.78), P = 0.148) compared with baseline.
Ribeiro (Rib)[45] 2014 Brazil, university hospital setting	4-group RCT. 3 months. *After intervention*: *CG* = 45 (ITT = 47). *Pedometer/Individual* = 47 (ITT = 53). *Pedometer/Group* = 33 (ITT = 48). *Aerobic Training* = 26 (ITT = 47). Counselling, goal setting, self-monitoring, relapse prevention, self-efficacy (all pedometer/group), and exercise (all IGs).	All groups: 45 (3)	*CG*: 74.7 kg (17.3) weight; 96.4 cm (13.5) WC; 53% BMI ≥30 kg/m^2. *Pedometer/individual*: 76.5 kg (17.3) weight; 95 cm (12.3) WC; 27% BMI ≥30 kg/m^2. *Pedometer/group*: 73.8 kg (12.5) weight; 94.5 cm (11.7) WC; 23% BMI ≥30 kg/m^2. *Aerobic training*: 75.6 kg (12.8) weight; 95.2 cm (9.8) WC; 24% BMI ≥30 kg/m^2.	PA *CG*: 10,282 (1,338) daily steps. *Pedometer/individual*: 10,389 (909) daily steps. *Pedometer/group*: 10,083 (905) daily steps. *Aerobic training*: 9,733 (646) daily steps.	*After 3-month intervention*: PA *Pedometer/Individual* and *Pedometer/Group* had an effect for total steps/day (512 and 1,475 respectively compared with the *CG* (−597 steps/day), P < 0.05. *Pedometer/Group* had an effect for the number of moderate steps/day (845 steps/day) compared with the *CG* (−118 steps/day) and *Pedometer/Individual* (+137 steps/day), P < 0.05. *Aerobic Training* had no effect for PA (+234 total steps/day and +234 moderate steps/day) compared with the *CG*. Weight *Aerobic Training* had an effect for weight loss (−0.7 kg) and a reduction in WC (−0.95 cm), P < 0.05 compared with *CG*, while no effect was observed in the other intervention groups. *At 3-month follow-up*: PA No effect was observed within the groups. Weight *Aerobic Training* had an effect for weight loss (−0.74 kg), P < 0.05 compared with CG.

(Continues)

TABLE 1 (Continued)

First author (abbreviation), year, and workplace setting	Study design, duration, sample size, and target behaviours/behaviour change strategy	Baseline participant characteristics: Age (SD)	Weight-related measure (SD)	Activity/fitness and diet-related measure (SD)	Findings
					Pedometer/Group and *Aerobic Training* both reduced WC (−0.41 cm and −0.92 cm, respectively); however this was, not significant. *CG* and *Pedometer/Individual* both had no effect for WC (+0.54 cm and +0.05 cm, respectively).
Tucker (Tuc)[52] 2011 USA, hospital setting	Quasi-experimental controlled before and after study. 10 weeks. *End of intervention*: 55 (*IG* = 27 and *CG* = 28). Exercise.	*IG*: 34 (6.85) *CG*: 36 (6.94)	*IG*: 26.8 kg/m^2 (range: 19.9–42.9) BMI; 28.4 kg (range: 14.1–57.3) fat mass; 39.1% (range: 25.2–55.0) fat mass percent. *CG*: 28.0 kg/m^2 (range: 19–41.8) BMI; 29.4 kg (range: 10.1–67.4) fat mass; 38.2% (range: 20.1–56.6) fat mass percent.	PA *IG*: 12,461 (range: 9,015-18,207) daily steps. *CG*: 12,840 (range: 8,445-26,633) daily steps.	*After the 10-week intervention*: PA *IG* had no effect for daily steps (+1,424 (2,985) daily steps; 13,886 (range: 8,459-23,952) daily steps) compared with the *CG* (+1,358 (3,089) daily steps, *P* = 0.95; 14,198 (range: 8,791-26,807) daily steps). Weight *IG* had an effect over time for fat mass (27.8 kg (14.2–55.7)), fat mass percentage (38.4% (24.7–52.5)) compared with *CG* (fat mass: 29.3 kg (10.9–68.3), *P* < 0.028 and fat mass percentage: 38.1% (20.8–55.4), *P* < 0.035). There was no effect observed between *IG* BMI (26.8 kg/m^2 (20.0–42.3)) and *CG* BMI (28.1 kg/m^2 (range: 19.0 to 43)), *P* = 0.48.
Urda (Urd)[47] 2016 USA, university setting	RCT. 1 week. *End of intervention*: 44 (*IG* = 22 and *CG* = 22). Interrupted sitting.	*Both*: 48 (10)	*Both*: 30.5 kg/m^2 (8.2) BMI.	PA *CG*: 6.02 (0.66) hours average sit time per workday at baseline; 37 (11) sit-to-stand transitions every workday. *IG*: 5.54 (1.47) hours average sit time per workday; 41 (12.5) sit-to-stand transitions every workday.	*During 1-week intervention*: PA *CG* had no effect in hours sit time per work day (6.05 hours (.074)) or number of sit-to-stand transitions every workday (39 transitions (12)) compared with the *IG* (5.42 (1.19) average hours sit time per workday and 41 (12.7) sit-to-stand transitions every workday), *P* > 0.05. Compared with the *CG*, the *IG* had less average sit time (hours/workday) during the intervention, *P* = .012.

TABLE 1 (Continued)

First author (abbreviation), year, and workplace setting	Study design, duration, sample size, and target behaviours/behaviour change strategy	Baseline participant characteristics			Findings
		Age (SD)	Weight-related measure (SD)	Activity/fitness and diet-related measure (SD)	
Mixed interventions					
Ard[53] 2010 USA, agency facility setting	Pilot study Cross-over design. 22 weeks. *After 22-week control period*: 31. *After 22-week intervention*: 27. Incentives, education, and "basic principles of behaviour modification."	47.5 (11.8)	97.9 kg (2.5) weight; 36.4 kg/m^2 (0.9) BMI; 111 cm (2.2) WC.	-	*After 22-week control period*: Weight CG slightly increased their weight (98.5 kg (2.8)), BMI (36.7 kg/m2 (1.1)) and WC (111.5 cm (2.4)) during the control period. *After 22-week intervention*: Weight IG had an effect for weight (94.8 kg (3.0)), $P < 0.001$ and WC (107.8 cm (3.1)), $P = 0.006$ compared with CG. There was no effect on BMI (35.4 kg/m^2 (1.2)).
Bhiri (Bhi)[54] 2015 Tunisia, specific setting NR	Controlled before and after study. 3 years. *After 3-year intervention*: 771 (*IG* = 379 and *CG* = 392). Study contained 2 independent sample groups. Exercise and education.	-	-	Diet *IG*: 140 (45.3%) consume 5 servings of fruit and vegetables daily. *CG*: 139 (41.7%) consume 5 servings of fruit and vegetables daily. PA *IG*: 57 (18.1%) meet recommended PA levels. *CG*: 94 (28%) meet recommended PA levels.	*After 3-year intervention*: Diet The *CG* consumed significantly more daily servings of 5 fruit and vegetables (218 (58%)), $P < 0.001$, while there was no effect in the *IG* (183 (49.1%) consume 5 servings of fruit and vegetables daily), $P = 0.33$. PA *IG* (99 (26.3%)) and *CG* (142 (36.9%)) both had an effect for the number of participants meeting recommended PA levels, $P = 0.01$.
Carnie (Car)[40] 2013 USA, National Institutes of Health setting	RCT. 6 months. *At 3-month assessment*: 158 (*IG* = 79 and *CG* = 79). *After 6-month intervention*: 139 (*IG* = 69 and *CG* = 70). Education, weigh-in sessions, and goal setting.	*IG*: 47 (9) *CG*: 45 (12)	*IG*: 34 kg/m^2 (6.2) BMI; 91.3 kg (18.7) weight; 39.9 kg (11.9) fat mass; 104.4 cm (14.9) abdominal circumference. *CG*: 33.8 kg/m^2 (6.6) BMI; 90.6 kg (18.3) weight; 40.6 kg (12.5) fat mass; 105.7 cm	PA *IG*: 23.3 mL/kg/min (5.0) VO_{2peak} *CG*: 23.4 mL/kg/min (5.5) VO_{2peak}	*At 3-month assessment*: Weight *IG* had an effect for weight (−2.2 kg (2.8)) compared with *CG*, $P > 0.001$ The *CG* also lost some weight (−1.0 kg (3.0)), although this was not significant. *After 6-month intervention*: Weight *IG* had no effect for weight loss (−2.7 kg (3.9), $P = 0.784$), reduced fat mass (−2.2 kg (3.1),

(Continues)

TABLE 1 (Continued)

First author (abbreviation), year, and workplace setting	Study design, duration, sample size, and target behaviours/behaviour change strategy	Baseline participant characteristics: Age (SD)	Baseline participant characteristics: Weight-related measure (SD)	Baseline participant characteristics: Activity/fitness and diet-related measure (SD)	Findings
			(14.5) abdominal circumference.		P = 0.148) or reduced abdominal circumference (−3.4 cm (5.2), P = 0.266), compared with *CG* (−2.0 kg (3.9) weight; −1.7 kg (3.7) fat mass; −2.7 cm (5.4) abdominal circumference). PA Physical fitness had no effect between the *IG* (+1.7 mL/kg/min (3.1) VO_{2peak}) and the *CG* (+1.5 mL/kg/min (3.1) VO_{2peak}), P = 0.522.
Ferraro (Ferr)[55] 2013 USA, correctional facility setting	Controlled before and after study. 12 weeks. Education, incentives, and weigh-in sessions.	-	*IG*: 93.45 cm (3.12) WC + standard error (SE); 1 = number of women with normal WC. *CG*: 95.40 cm (7.59) WC + SE.	-	*At 20-week follow-up*: Weight *IG* had no effect for reduction in WC (89.33 cm (4.22) WC + SE) compared with *CG* 95.96 cm (5.94) WC + SE) 4 women had a normal WC (<80 cm) at follow-up.
Flannery (Fla)[56] 2012 USA, long-term care facility settings	Quasi-experimental pilot with control. 3 months. 28 (*IG* = 18 and *CG* = 10). Exercise, education, peer support, incentives, self-efficacy, goal setting, and goal monitoring.	*IG*: 43.31 (13.07) *CG*: 39.35 (13.06)	*IG*: 20 (87%) with overweight or obesity. 32.61 kg/m^2 (7.13) BMI. *CG*: 13 (92.9%) with overweight or obesity. 32.16 kg/m^2 (7.38) BMI.	PA *IG*: 17 (81%) ≤7,499 daily steps; 6,307.82 (3,591.37) average steps. *CG*: 11 (78.6%) ≤7,499 daily steps; 4,730.23 (2,323.52) average steps.	*After 3-month intervention*: PA *IG* had no effect for average steps 6,981.51 (2,779.51), nor was there any effect for *CG* (6,077.51 (3,987.61) average steps). *IG* had an effect for aerobic minutes/day (9.59 mins (12.77)) compared with *CG* (6.00 mins (16.49) aerobic mins/day), P = 0.05. Diet No effect was reported for dietary fat and salt intake. Weight No effect for BMI was observed between *IG* (32.85 kg/m^2 (7.56)) and *CG* (32.48 kg/m^2 (7.81)). *At 3-month follow-up:* PA No effect for PA was reported for the *IG* (8,008.43 (3,801.75) average steps) or *CG* (5,731.04 (3,535.20) average steps), P = 0.900. Weight No effect for BMI was observed between *IG* (32.51 kg/m^2 (7.59)) and *CG* (33.27 kg/m^2 (8.40)).

TABLE 1 (Continued)

First author (abbreviation), year, and workplace setting	Study design, duration, sample size, and target behaviours/behaviour change strategy	Baseline participant characteristics: Age (SD)	Weight-related measure (SD)	Activity/fitness and diet-related measure (SD)	Findings
Karlqvist (Kar)[41] 2013 Sweden; home care, schools, cleaning, and administrative settings	RCT. 1 year. *After 1-year intervention*: *Supervisor Group* = 53. *Supervisor + Champions Group* = 54. *Champions Group* = 56. *Control* = 42. Education and peer support.	-	-	PA *Supervisor Group*: 32.0 mL/kg/min VO_{2max}. *Supervisor + Champions Group*: 30.4 mL/kg/min VO_{2max}. *Champions Group*: 27.7 mL/kg/min VO_{2max}. *Control*: 30.5 mL/kg/min VO_{2max}.	*After 1-year intervention*: PA The *Supervisor Group* (34.9 mL/kg/min VO_{2max}, $P < 0.000$), the *Champions Group* (29.9 mL/kg/min VO_{2max}, $P = 0.002$) and the *CG* (32.6 mL/kg/min VO_{2max}, $P = 0.049$) all had a significant effect for fitness compared with baseline, while the *Supervisor + Champions Group* did not have an effect for fitness (31.3 mL/kg/min VO_{2max}, $P = 0.171$).
Mache (Mac)[57] 2015 Germany, logistics company setting	Quasi-experimental pilot with control. 12 months. *After 12-month intervention*: 427 (*IG* = 218 and *CG* = 209). Exercise, education, counselling, motivational interviewing, goal setting, self-efficacy, and problem solving.	-	-	-	*After 12-month intervention*: Weight *IG* had no effect for weight reduction (−0.4 kg (0.3)) compared with baseline, $P > 0.05$. Diet *IG* had an effect for intake of fast food and sweets, $P = 0.02$. Fruit, vegetable and soft drink consumption had no effect for *IG*, $P > 0.05$.
McHugh (McH)[58] 2012 USA, health care company setting	Controlled before and after study. 2 years. *At second risk assessment*: 83 (*IG* = 31 and *CG* = 52). Education, health assessment, goal setting and feedback.	-	*IG*: 187.36 lbs weight; 31.64 kg/m^2 BMI *CG*: 181.19 lbs weight; 30.49 kg/m^2 BMI.	-	*2 years after first risk assessment*: Weight *IG* had no effect for weight (187.53 lbs) or BMI (31.66 kg/m^2) compared with baseline and *CG* (180.92 lbs weight; 30.07 kg/m^2 BMI). *IG* had slight weight gain (+0.171 lbs (14.06)), while the *CG* had slight weight loss (−0.269 lbs).
Mitchell/Kemmick (Mit)[42,43] 2015 USA, berry grower worksite settings	RCT. 12–14 weeks. Exercise, education, peer support, and goal setting.	*IG* and *CG*: 33.2 (7.8)	*Both groups*: 66.2 kg (0.8) weight; 28.0 kg/m^2 (0.3) BMI; 87.5 cm (0.7) WC.	-	*After 12 to 14-week intervention*: Weight *IG* had an effect for all anthropometric measures (except glucose); −0.7 kg weight ($P = 0.001$); −0.3 kg/m^2 BMI ($P = 0.002$); −0.9 cm WC (P values not reported), while the *CG* had no effect for WC (+0.1 cm).

(Continues)

TABLE 1 (Continued)

First author (abbreviation), year, and workplace setting	Study design, duration, sample size, and target behaviours/behaviour change strategy	Baseline participant characteristics: Age (SD)	Weight-related measure (SD)	Activity/fitness and diet-related measure (SD)	Findings
Nishinoue (Nish)[59] 2011 Japan, manufacturing company and affiliate companies setting	Controlled before and after study. 2.5 days (plus 2 booster sessions one month and one-year post intervention). 138 (*IG* = 58 and *CG* = 80). Education, peer support, goal setting, "cognitive restructuring," and self-monitoring.	35	*IG*: 52 kg (1.1) weight; 20.3 kg/m^2 (0.4) BMI. *CG*: 52 kg (1.0) weight; 20.5 kg/m^2 (0.3) BMI.	-	*At 5-year follow-up:* Weight Both *IG* (+1.5 kg (0.4)) and *CG* (+0.9 kg (0.4)) had no effect for weight, *P* = 0.28. Both *IG* (+0.7 kg/m^2 (0.2)) and *CG* (+0.5 kg/m^2 (0.1)) had no effect for BMI, *P* = 0.26.
Tan[46] 2016 Singapore; government office, tertiary education, property developer, publishing company, insurance services, and internet services settings	Cluster RCT. 6 months and 4 weeks. *After 4 weeks*: 516 (IG = 252 and CG = 264). *After 6 months and 4 weeks:* 479 (IG = 234 and CG = 245). Exercise, education, peer support, skill building, goal setting, and overcoming barriers.	*IG*: 37 (6.73) *CG*: 37 (7.41)	-	Diet *IG*: 454.8 mg (178.04) daily calcium intake; 5.47% meeting RDA *CG*: 462.1 mg (202.2) daily calcium intake; 6.72% meeting RDA. PA *IG*: 59.2 min (94.4) load-bearing MVPA/week. *CG*: 54.5 min (78.7) load-bearing MVPA/week. Participants worked in a sedentary job (>50% time sitting).	*At 4-week assessment*: Diet *IG* had an effect for daily calcium intake compared with baseline (+343.2 mg (CI = 337.4 to 349.0)), *P* < 0.0005 and an effect for percentage of participants meeting RDA for calcium compared with *CG* (+47% (CI = 39.6 to 54.4)), *P* < 0.0005. PA *IG* had an effect for load-bearing MVPA/week compared with baseline (+55.6 min (CI = 54.5 to 56.6)), *P* < 0.0005 and an effect for load-bearing MVPA by 63.6 min more than the *CG*. *After 6-month and 4-week intervention*: Diet *IG* had an effect for daily calcium intake compared with baseline (+290.5 mg (CI = 285.3 to 295.7%)), *P* < 0.0005 and an effect for the percentage of participants meeting RDA for calcium compared with *CG* (+37.8% (CI = 28.5 to 47.0%)), *P* < 0.0005. PA *IG* had an effect for load-bearing MVPA/week compared with baseline +50.9 min (CI = 49.3 to 52.6), *P* < 0.0005 and an effect for load-bearing MVPA by 51.2 min more than the *CG*.

TABLE 1 (Continued)

First author (abbreviation), year, and workplace setting	Study design, duration, sample size, and target behaviours/behaviour change strategy	Baseline participant characteristics: Age (SD)	Weight-related measure (SD)	Activity/fitness and diet-related measure (SD)	Findings
Verweij (Ver)[48,49] 2013 The Netherlands, sedentary workplace setting	RCT. 6 months. Education, health assessment, and environment scan of risk factors to prevent weight gain.	-	-	Participants had unhealthy levels of daily PA or dietary behaviour and/or had overweight (WC >80 cm)	*After 6-month intervention:* Weight IG had no effect for WC (−0.8 cm, 95% CI −2.6 to 1.1 cm) compared with the CG. *At 18-month follow-up:* Weight IG slightly increased WC by 0.4 cm, (95% CI, −1.4 to 2.0), while no effect was reported compared with the CG.

Abbreviations: BMI, body mass index; CG, control group; GLTEQ, Godin leisure time exercise questionnaire; IG, intervention group; MET, metabolic equivalent of task; MVPA, moderate/vigorous physical activity (accelerometer); PA, physical activity; RCT, randomized controlled trial; RDA, recommended dietary allowance; SD, standard deviation; SE, standard error; WC, waist circumference; –, not reported.

follow-up PA outcomes (each at 3-month follow up).[45] Eight PA interventions reported post-intervention weight-related outcomes,[38,39,44,45,51,52] but only three PA interventions reported 3-month follow-up weight-related outcomes.[45] Seven mixed interventions reported post-intervention PA outcomes,[40,41,46,54,56] and one mixed intervention reported PA outcomes at 3-month follow-up.[56] Seven mixed interventions reported post-intervention weight-related outcomes,[40,42,43,48,49,53,56–58] and four mixed interventions reported weight-related outcomes at follow-up (3 months to 5 years).[48,49,55,56,59] [48,49,55,56,59] Four mixed interventions reported post-intervention diet outcomes,[46,54,56,57] but no diet outcomes were reported at follow-up.

3.3 | Risk of bias

Ten studies were assessed for RoB using ROBINS-I,[50–59] and 10 studies using RoB 2.0.[37–49] Tables S5 and S6 describe the RoB for each domain of the included studies according to ROB 2.0 and ROBINS-I, respectively. Observed agreements between reviewers was 95.65% for ROB 2.0 and 93.94% for ROBINS-I. Overall, randomized studies had a lower RoB than non-randomized studies (Figures 2 and 3). Eight studies (80%) rated using ROBINS-I had a serious or critical RoB,[50,52–58] and six studies (60%) rated using RoB 2.0 had a high RoB.[40–45,48,49] More than a quarter of randomized studies reported a high RoB in selection of the reported result.[42,43,45,48,49] Deviations from intended interventions in non-randomized studies were poorly reported with five (50%) of studies not reporting sufficient information to assess bias.[50,53–56] Six (60%) non-randomized studies had a serious or critical RoB due to measurement of outcomes,[50,53–57] mostly due to the use of subjective measurements (i.e., self-reported data).[50,54,55,57] Four (50%) PA interventions with an effect for relevant outcomes had a high, serious, or critical RoB,[44,45,50,52] and seven (80%) of mixed interventions with an effect for relevant outcomes had a high, serious, or critical RoB.[40–43,53,54,56,57] Four (83%) PA interventions with an effect on relevant outcomes were randomized studies,[37–39,44,45] but only four (40%) mixed interventions demonstrating an effect were randomized studies.[40–43,46]

3.4 | Intervention characteristics according to the TIDieR checklist

Table 2 summarizes “why,” “who,” “how,” “when and how much,” “tailoring,” and “how well” for the included studies. Characteristics relevant to “what' are summarized briefly below and in Table 1 but are not assessed in detail against intervention outcomes because these pertain to behaviour change strategies within the interventions; a detailed examination of behaviour change strategies (e.g., by mapping against a reliable taxonomy[61]) is beyond the scope of this review. Characteristics relevant to “where” (i.e., workplace setting) are also included in Table 1 and are not included in Table 2 because variation was minimal across studies. Table S7 presents the full data extraction of the TIDieR components of included studies.

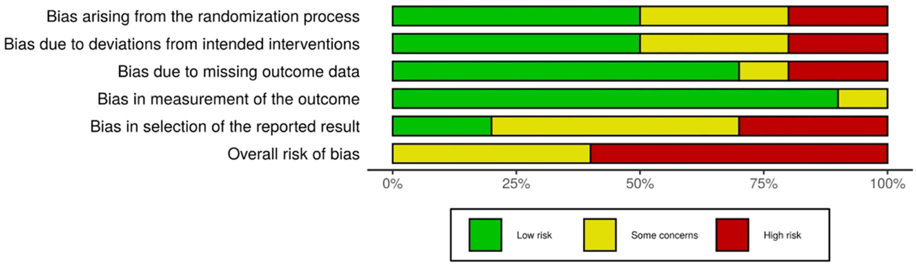

FIGURE 2 Risk of bias assessment summary of randomized studies using risk of bias (RoB) 2.0[60]

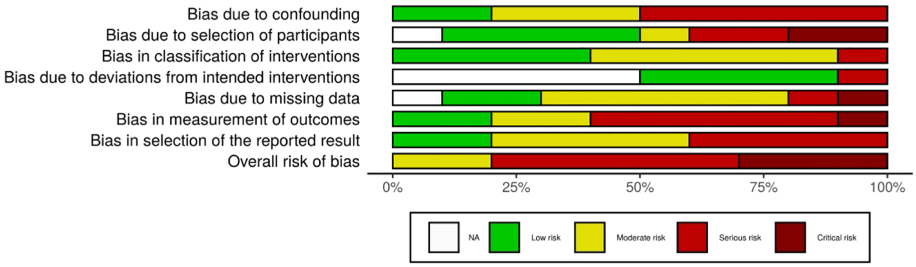

FIGURE 3 Risk of bias assessment summary of non-randomized studies using risk of bias in non-randomized studies of interventions (ROBINS-I)[60]

3.4.1 | Theory (why)

Eight interventions incorporated theory, including the social ecological model, self-efficacy theory, transtheoretical model of health behaviour change, social cognitive theory (or social learning theory), health belief model, and self-determination theory.[37,40,46,52,56–58] A further seven interventions seemed to incorporate theoretical concepts, for example, Karlqvist and Gard describe the need to address determinants of health to improve work conditions and health outcomes[41]; however, named theories were not explicitly reported with regard to intervention design and/or delivery.[41–43,48,49,53,55]

3.4.2 | Materials and procedures (what)

All interventions reported basic intervention procedures or target behaviours including behaviour change strategies such as setting and adhering to short- and long-term goals, discussions around expectations and self-efficacy, problem solving to address barriers, cognitive restructuring, self-monitoring, relapse prevention, and skill-building activities (*n* = 13)[37,40,42,43,45,46,48,49,52,53,56,57,59]; exercises (*n* = 16)[37–39,43–46,50–52,54,56,57]; education (*n* = 14)[40–43,46,48,49,53–59]; health assessments (*n* = 2)[48,49,58]; peer support (*n* = 7)[41–43,46,56,59]; incentives (*n* = 3)[53,55,56]; and weigh-in sessions (*n* = 2).[40,55]

3.4.3 | Intervention provider (who)

Eleven interventions were provided by HCPs (*n* = 5 by dietitians,[40,53–55,59] *n* = 4 by occupational health staff,[48,54,56,59] *n* = 2 by psychologists,[54,59] *n* = 2 by sports physician[46] or physiotherapist,[54] and *n* = 1 by dental hygienist[59]). Interventions were also facilitated by non-HCPs such as researchers or study investigators (*n* = 6),[37,42,43,46,47,51] exercise professionals or trainers (*n* = 6),[37–39,45,57] health promoters (*n* = 1),[42,43] or peers (*n* = 6).[41,50,55,56]

3.4.4 | Mechanism of delivery (how)

Seventeen interventions incorporated technology (phone; website; pedometer; treadmill; email; exercise materials, such as DVDs and Nintendo Wii™, heart rate monitor, and accelerometer) into their delivery.[37–40,45–52,55,56,58] One PA intervention did not report the inclusion of technology (main or secondary, Table 2) in its design.[44] Three interventions did not include an in-person delivery component.[47,52,58]

3.4.5 | Location (where)

All interventions were conducted at, or facilitated by, workplaces; however, eight interventions did not explicitly specify where the interventions were performed.[41,44,48,49,51,54,59]

3.4.6 | Intervention schedule and intensity (when and how much)

Nine interventions were conducted outside work hours,[37–40,42,43,45] four interventions took place during worktime and leisure time,[50,52,53,58] four interventions were conducted during paid worktime,[46,47,55,56] and one intervention reported that participants

TABLE 2 Summary of interventions and outcomes according to the TIDieR checklist

Study	Ix	Outcome			Why?	Who?		How?				When and How Much?						Tailoring	How Well?					Total
												Duration			Number of Sessions				Attrition			Adherence		
		Weight	PA	Diet	Theory	HCP	Non-HCP	Indiv	Group	Tech	In-person	Short: ≤3 mths	Med: >3 mths	Long: ≥12 mths	Low: 1-5	Med: 6-13	High: >13		Low: 0-12.99%	Med: 13-26%	High: >26 %	Low: <30%	Med/High: 30.1-100%	
Physical Activity Interventions																								
Bag[51]			✓		○		●	●	●	●	●		●			-		○		●			○	5
Bar[38,39]	Soccer	X ✓	X ✓		○		●		●	◔	●		●				●	○			●	●		7
Bar[38,39]	Zumba	✓	✓		○		●		●	◔	●		●				●	○		●			●	7
Mai[37]	IG		✓		●		●	●	●	◔	●	●			●			●			●		●	9
Mai[37]	IG+		X ✓		●		●	●	●	◔	●		●			●		●		●			●	9
Mair[56]		X			○		●	●		●	●	●				●		●		○			○	6
Osi[44]		X ✓			○	○			●		●	●					●	○		○			○	4
Rib[45]	Indiv	X	X ✓		○	●		●		●	●	●			●			○	●				●	7
Rib[45]	Group	X	X ✓		○	●			●	●	●	●				●		◍			●		●	7
Rib[45]	Aero	X ✓	X		○		●	○		●	●	●					●	○			●		●	6
Tuc[59]		X ✓	X		●	●		●		●		●			●			◍	●				○	7
Urd[47]			X		○		●	●		●		●				-		○		●			●	6
Mixed Interventions																								
Ard[50]		X ✓			◍	●			●		●		●				●	●	●				●	8
Bhi[52]			X ✓	X	○	●		◍	◍		●			●		○		○		○			○	3
Car[40]		X ✓	X		●	●		●	●	●	●		●				●	●			●		●	9
Fer[53]		X			◍	●	●	●		◔	●	●				-		●		○			○	5
Fla[54]		X	X ✓	X	●	●	●	●	●	●	●	●					●	●		●			●	9
Kar[41]	Super		✓		◍		●		●		●			●		-		●		○			○	5
Kar[41]	Champ		✓		◍		●		●		●			●		-		●		○			○	5
Kar[41]	Mixed		X		◍		●		●		●			●		-		●		○			○	5
Mac[55]		X		X ✓	●		●	●	●		●			●			●	●			●		○	8
McH[57]		X			●	-		●		●				●		-		●		○			○	5
Mit[42,43]		✓			◍		●		●		●	●				●		●		○			○	6
Nis[58]		X			○	●		●	●		●	●			●*			●	●				●	8
Tan[46]			✓	✓	●	●	●	●	●	◔	●		●			-		●		●			○	7
Ver[48,49]		X			◍	●		●		◔	●		●		●			●		○			○	6
Total		✓ 8 X 15	✓ 12 X 11	✓ 2 X 2	8	11	15	15	17	◔ 7 ● 10	23	12	8	6	5	4	8	16	4	6	6	1	11	

Abbreviations: Aero, aerobic training; Champ, champion group; HCP, healthcare professional; IG, intervention group; Indiv, individual; Ix, intervention; Med, medium; Mths, months; PA, physical activity; Super, supervisor group; Tech, technology; TIDieR, template for intervention description and replication; X, no effect; –, not applicable; *, two full days and one night; ●, reported; ○, not reported; ◍, unclear; ◔, adjunct to main intervention; ✓, effect.

took part during paid worktime but also reported participation outside of work hours or during lunch.[57] Twenty interventions were of a short-to-medium duration and ranged from 2.5 days[59] to 40 weeks.[38,39] The 2.5-day intervention also included two booster sessions at 1 month and at 1 year post-intervention.[59] Six interventions lasted 12 months or more,[41,54,57,58] with the longest lasting 2 years.[58]

3.4.7 | Individual adaptations (tailoring)

Sixteen interventions incorporated tailoring via personalized meal plans or recipes (*n* = 2),[40,56] individual targets or goals (*n* = 13),[40–43,46,48,49,52,55–59] and personalized plans or reports (*n* = 9).[41,48,49,51,56–59]

3.4.8 | Adherence and attrition (how well)

Sixteen interventions reported attrition, and only four of these (25%) reported low (<13%) levels of attrition; three of these lasted less than 3 months and had a low number of sessions (<5).[45,52,59] Conversely, four of the six interventions with high attrition also had a high number of sessions (>13).[38,39,45,56,57] Only 12 (46%) interventions reported adherence (Table 2), and this ranged from 30%[38,39] to 100%.[59]

3.5 | Intervention effectiveness according to TIDiER components

Table 2 summarizes TIDieR components and intervention effectiveness according to weight, PA, and diet outcomes. Table S4 shows the reported outcomes according to measurement variables; 17 PA, 17 weight, and four diet individual outcomes were reported.

3.5.1 | PA interventions

Eight studies (12 intervention arms) delivered PA interventions.[37–39,44,45,47,50–52] The PA interventions reported PA (*n* = 10, 83%)[37–39,45,47,50,52] and/or weight (*n* = 8, 67%)[38,39,44,45,51,52] outcomes.

Effect on PA outcomes

Of the 10 PA interventions reporting PA outcomes, at least one PA effect was observed during the intervention and/or immediately post-intervention for seven interventions (70%)[37–39,45,50] and no effect on any PA outcomes was observed for three (30%) interventions immediately post-intervention.[45,47,52] Two of the successful studies evaluated PA outcomes at 3-month follow-up, albeit the intervention effect was not sustained. The majority of PA interventions that reported improved PA outcomes included a group format (*n* = 6, 86%),[37–39,45,50] an in-person mode of delivery (*n* = 7, 100%),[37–39,45,50] lasted a short to medium duration (*n* = 7, 100%),[37–39,45,50] delivery by non-HCPs (*n* = 4, 57%, e.g., exercise professionals[37–39]), and had medium to high levels of adherence (*n* = 5, 71% from 42.9% to 94.4%).[37,45,50]

PA interventions that reported no effect on any PA outcomes included technology as their main intervention component (*n* = 3, 100%,[45,47,52] e.g., treadmill or Nintendo Wii™) lasted less than or equal to 3 months (*n* = 3, 100%),[45,47,52] used an individual mode of delivery (*n* = 2, 67%),[47,52] and did not incorporate tailoring (*n* = 2, 67%)[45,47] or named theory (*n* = 2, 67%).[45,47]

Effect on weight outcomes

Of the eight PA interventions reporting weight outcomes, at least one weight-related effect was observed during the intervention and/or immediately post-intervention for five (63%) interventions[38,39,44,45,52] and no effect on any weight-related outcomes was reported for three (38%) interventions immediately post-intervention.[45,51] One intervention reported a sustained weight-related effect at 3-month follow-up.[45] PA interventions that resulted in improved weight outcomes included an in-person mode of delivery (*n* = 4, 80%),[38,39,44,45] a high number of sessions (*n* = 4, 80%),[38,39,44,45] and lasted a short to medium duration (*n* = 5, 100%).[38,39,44,45,52]

PA interventions that reported no effect on any weight outcome did not incorporate a named theory (*n* = 3, 100%),[45,51] included technology as a main intervention component (*n* = 3, 100%, e.g., pedometer),[45,51] had an individual mode of delivery (*n* = 2, 67%),[45,51] lasted less than or equal to 3 months (*n* = 3, 100%),[45,51] included a low to medium number of sessions (*n* = 3, 100%),[45,51] and had a medium to high adherence (*n* = 2, 67%).[45]

3.5.4 | Mixed interventions

Twelve studies (14 intervention arms) delivered mixed interventions.[40–43,46,48,49,53–59] The mixed interventions reported PA (*n* = 7, 50%),[40,41,46,54,56] weight (*n* = 9, 64%),[40,42,43,48,49,53,55–59] and/or diet (*n* = 4)[46,54,56,57] outcomes. The mixed interventions that reported effects for diet,[46,57] weight,[40,42,43,53] or PA outcomes[41,46,54,56] during the intervention and/or immediately post-intervention did not report any follow-up outcomes.

Effect on PA outcomes

Of the seven mixed interventions reporting PA outcomes, at least one PA effect was observed for five (71%) interventions[41,46,54,56] and no effect on any PA outcomes was reported for two (29%) interventions.[40,41] Mixed interventions that resulted in improved PA outcomes were delivered by non-HCPs or a combination of non-HCPs and HCPs (*n* = 4, 80%),[41,46,56] included a group or combined individual and group format (*n* = 4, 80%),[41,46,56] used an in-person mode of delivery (*n* = 5, 100%),[41,46,54,56] lasted a medium to long duration (*n* = 4, 80%),[41,46,54] and incorporated tailoring (*n* = 4, 80%).[41,46,56]

Mixed interventions that reported no effect on any PA outcomes lasted a medium to long duration (*n* = 2, 100%)[40,41] and were delivered in-person (*n* = 2, 100%).[40,41]

Effect on weight outcomes

Of the nine mixed interventions reporting weight outcomes, at least one weight-related effect was observed for three (33%) interventions[40,42,43,53] and no effect on any weight-related outcomes was reported for six (67%) interventions.[48,49,55–59] Mixed interventions that resulted in improved weight-related outcomes included a group and in-person delivery (n = 3, 100%),[40,42,43,53] lasted a short to medium duration (n = 3, 100%),[40,42,43,53] were delivered by HCPs (n = 2, 67%),[40,53] had a medium to high number of sessions (n = 3, 100%),[40,42,43,53] incorporated tailoring (n = 2, 67%),[40,53] and had a medium to high adherence (n = 2, 67%).[40,53]

Mixed interventions that reported no effect on any weight-related outcomes were delivered by HCPs or a combination of HCPs and non-HCPs (n = 4, 67%),[48,49,55,56,59] included tailoring (n = 6, 100%)[48,49,55–59] and an individual delivery component (n = 6, 100%),[48,49,55–59] and lasted a short-medium duration (n = 4, 67%).[48,49,55,56,59]

Effect on diet outcomes

Of the four mixed interventions reporting diet outcomes, at least one diet-related effect was observed for two (50%) interventions[46,57] and no effect on any diet outcomes was reported for two (50%) interventions.[54,56] Mixed interventions that resulted in effects for diet outcomes were delivered by non-HCPs and/or HCPs (n = 2, 100%),[46,57] had a combined individual and group mode of delivery (n = 2, 100%),[46,57] incorporated tailoring (n = 2, 100%),[46,57] and were delivered in-person (n = 2, 100%).[46,57]

Mixed interventions that reported no effect on any diet outcomes were delivered by HCPs (n = 2, 100%)[54,56] and used an in-person delivery format (n = 2, 100%).[54,56]

4 | DISCUSSION

4.1 | Overall findings

This is the first systematic review to identify lifestyle intervention characteristics associated with effectiveness on PA, diet, or weight outcomes for working women using the TIDieR checklist. Our findings suggest that workplace PA interventions may be useful in improving PA and weight-related outcomes for women. Additionally, our review highlights a number of specific components aligned with intervention effectiveness. We found evidence that PA interventions demonstrating improved PA outcomes included group delivery mode and PA interventions demonstrating improved weight-related outcomes included a high number of sessions. PA interventions with no effect for PA or weight-related outcomes tended to have an individual mode of delivery. Workplace mixed interventions that incorporated tailoring and were of a medium to long duration may be useful in improving PA outcomes for women, whereas the impact on weight-related and diet outcomes was less clear. These findings suggest that adequate social support and intervention dosage are key characteristics of workplace interventions for working women.

Our findings are consistent with previous literature that has identified the workplace as an important setting to improve employee PA behaviours and weight-related outcomes using PA interventions.[17,23] A meta-analysis of the effect of workplace PA interventions (>38,000 working men and women) found significant effects for PA behaviour (d = 0.21), fitness (d = 0.57), and anthropometric measures including BMI and weight (d = 0.08).[23] Adoption of regular PA reduces inflammatory markers, such as C-reactive protein, and has a beneficial effect on insulin sensitivity, body composition, blood pressure, high-density lipoprotein cholesterol, and mental health.[62] Furthermore, proximal determinants of health, including exercise and weight maintenance, may directly influence future health outcomes, such as chronic disease progression.[63]

We found PA interventions using a group delivery format were more likely to have an effect on PA outcomes, compared with those using an individual mode of delivery.[64] This "group enhancement" effect was also highlighted by Cleland et al in their meta-analysis of PA interventions targeting socio-economically disadvantaged women.[65] The authors found that group delivery produced a clinically significant standardized mean difference of 0.38 greater PA intervention effectiveness than individual modes of delivery.[65] Group dynamics can facilitate both interpersonal relationships between participants and establish group cohesion through shared challenges and experiences.[66] Additionally, these relationships can make participants more amenable to change and may support improved wellbeing, given enough time by interventionists.[66] Further, peer motivation could enhance PA outcomes by making use of the inherent social relationships within a working environment.[64] Social support is an important resource for maintaining or initiating behaviour changes and improving self-efficacy,[67] both of which are required to sustain the effects of PA interventions.

The finding that PA interventions with a high number of sessions had an effect on weight outcomes is novel for this population. Previous research on interventions for women peripheral to workplace settings have indicated weight loss is not enhanced by high-contact (i.e., a high number of sessions with instructors) lifestyle interventions[33] and that low-intensity (minimal contact and participant burden) lifestyle programmes can alleviate weight gain.[68] Nevertheless, a review focused on workplace health promotion activities for women and men also found that studies with high contact were far more effective, perhaps indicating that intervention benefit is context specific.[25] The authors further noted that future studies must assess whether these effects are conditional to the intervention strategy, such as the inclusion of exercise.[25] It is possible that intervention dose may be more important for PA interventions due to the high level of motivation needed to sustain PA behaviours over time.

We also observed that mixed interventions of short to medium duration had an effect on PA outcomes. However, this result may not necessarily equate with long-term effectiveness given the general absence of follow-up reporting. Hutchinson et al found evidence to suggest that improved PA behaviours could be maintained over time in their meta-analysis; however, their findings were limited due to the small number of studies reporting sustained effects.[63] We did not find evidence to support the use of mixed interventions to improve diet or weight outcomes; however, the reasons behind this are unclear. A meta-analysis examining the effect of PA and diet interventions on weight-related outcomes found moderate quality evidence to suggest that the interventions significantly reduced body weight (−1.19 kg), BMI, and body fat percentage.[69] On the other hand, better quality studies demonstrated smaller effects compared with poorer quality studies, and the authors did not include studies with participants over 25 kg/m^2,[69] which may impact the ability to transfer these findings into real-world settings. As recently highlighted, formation of a clear evidence base for behavioural interventions is often hindered by erratic implementation and reporting of outcomes.[70] Thus, it is recommended that future research incorporates consistent follow-up reporting in order to assess the long-term sustainability of lifestyle behaviour interventions and inform implementation of effective strategies.

Tailoring was present in almost all mixed interventions demonstrating an effect for PA, weight, or diet outcomes, although it was also present in all the mixed interventions with no effect for any outcomes. Mixed interventions were more likely to incorporate tailoring compared with PA interventions; however, mixed interventions were also less likely to demonstrate an effect for PA and weight outcomes compared with PA-only interventions. This seems to suggest that the ideal blueprint for adapting to the local context has not yet been established. Equally, individualized tailoring derived from a generic intervention "template" may be insufficient to address the barriers to behaviour change specific to working women. Implementation experts must adapt to the needs of individual workplaces and work alongside employees to surmount the barriers to intervention adoption. Additionally, mixed interventions delivered by non-HCPs or a combination of non-HCPs and HCPs were more effective that those delivered by HCPs alone. This pattern was less evident in PA interventions. This finding could imply that the training and expertise required to administer a mixed lifestyle intervention is enhanced in interventions delivered by non-HCPs or that these interventions were able to capitalize on the interpersonal relationships provided by peer interventionists.[23]

4.2 | Strengths and limitations

There are several strengths to this review. First, the inclusion of both randomized and non-randomized controlled studies allowed interventions to be evaluated within a pragmatic working environment. Second, we assessed the effect of mixed interventions and PA interventions separately, therefore allowing us to make specific recommendations to facilitate intervention delivery. Third, the use of the TIDieR checklist enabled us to detail some of the key delivery characteristics necessary to replicate successful healthy lifestyle interventions for working women. There are some review-level limitations to this study. For instance, use of the TIDieR checklist highlighted poor adherence to CONSORT guidelines for reporting exact intervention details in some studies[61] and attempts to contact several of the authors of the included studies for more information went unanswered. Consequently, much of the knowledge around adherence and attrition (i.e. how well) was unable to be determined. A solution could be to formalize the adoption of the TIDieR checklist by intervention providers[33] and journals could make this a requirement for publication of lifestyle interventions. Additionally, many studies identified during the screening process did not sex-disaggregate their outcome data, deeming them ineligible for inclusion. Calls have recently been renewed to conduct sex and/or gender-specific data collection and analysis to better understand the associated biological and sociocultural factors pertinent to health research.[28] Although interventions provided to both men and women did not differ in their approach, further analysis of the interventions provided to women only would be unlikely to yield clear results due to the presence of individual tailoring (in some instances) and the absence of a male demographic for comparison. A further limitation, that has been highlighted previously[17,23] is the incorporation of multiple outcome variables into our assessment. This has made comparison between studies more difficult due to the significant heterogeneity in our results (negating the possibility of a meta-analysis); however, this method allowed this review to capture beneficial outcomes not typically identified in previous studies, for example, aerobic exercise minutes/day or percentage body fat.[17] Inclusion and reporting of core outcome sets in lifestyle interventions may help combat this limitation.

There were also several limitations identified at the individual study level. First, most of the included studies had a high RoB. Given the inherent biases associated with conducting interventions within real-world settings, some of these issues are potentially unavoidable. However, a high RoB was also observed in non-randomized studies for the measurement of outcomes, mainly due to the use of self-reported data. Most of the studies reporting an intervention effect were RCTs, whereas less than half of those reporting an effect were non-RCTs. This might suggest that there were issues regarding internal validity in the non-RCTs. Second, many of the nuances associated with running a work-based intervention were inadequately reported, for example, how long the employees had been working for their employer and whether management supported the programme. These factors could affect group cohesion or help address barriers to participation and must be considered within a work environment. Finally, some of the studies reported effects in the short-term and either did not report follow-up outcomes or did not maintain the effect. Given that maintenance outcomes are integral to evidence translation, it is essential to determine the interventions that can sustain long-term behaviour modifications.

4.3 | Implications

Our findings may help guide future intervention strategies for working women and their employers. Group delivery of PA interventions can make use of already established employee relationships, improve outcomes, and may be more cost-effective than interventions targeted to the individual.[66] PA interventions incorporating a high number of sessions should enable strategies to support weight loss; however, care should be taken to adapt this finding according to the local context based on previous literature.[33] Future research could explore whether an optimal group size or number of sessions exists to facilitate desired health outcomes. Higher effects for diet and PA compared with weight may belie the clinical significance of long-term weight gain prevention and positive interpersonal relationships within workplaces. Furthermore, our findings indicated that non-HCP support (including peers) can make an important contribution to the success of mixed lifestyle interventions and may contribute to more holistic and complementary means of health behaviour change. Although our findings may provide guidance for workplaces seeking to implement interventions targeted to meet the specific needs of working women,[71] a similar in-depth analysis for men is outside the scope of this review. A thorough investigation into whether these same findings are applicable to men is required to add to current research.[72,73] Future research should also assess the barriers and facilitators of healthy lifestyle behaviours specific to working women in order to identify optimal strategies for intervention and the effect of lifestyle interventions on workplace productivity.

5 | CONCLUSION

This systematic review identified the intervention characteristics associated with the effectiveness of workplace lifestyle interventions for working women using the TIDieR checklist, filling an important gap in the literature. The findings suggest that the effectiveness of PA interventions may be supported by group delivery and a high number of sessions to improve PA and weight outcomes, respectively. Mixed interventions that include tailoring and non-healthcare provider input may be beneficial for PA but the effect on diet and weight-related outcomes is less clear. A lack of follow-up data, high RoB, heterogeneity of study design, and multiple outcome variables introduce complexity to the results. Nevertheless, this review has demonstrated that workplaces are an important platform to encourage healthy lifestyle behaviours in working women. Future research should attempt to determine the characteristics for optimal intervention implementation, such as further investigation of the ways in which workplace intervention strategies can be adapted to the local context rather than opting for a generic approach.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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