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

Abstract

Physical activity and healthy diets are essential for the prevention of obesity and chronic disease that disparately impact women compared to 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 programs or organisational 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-health care 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 programs were effective at improving lifestyle behaviours for working women.

Abbreviations

BMI-Body Mass Index; PCOS-Polycystic Ovary Syndrome; WC-Waist Circumference; UN-United Nations; PA-Physical Activity; USA-United States of America; TIDieR-Template for Intervention Description and Replication; PROSPERO-International Prospective Register of Systematic Reviews; PRISMA-Preferred Reporting Items for Systematic Reviews and Meta-Analyses; ACM-Association for Computing Machinery; PICOS-Participants, Intervention or exposure, Comparator, Outcome and

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This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: [10.1111/obr.13027](https://doi.org/10.1111/obr.13027)

Study type; RoB-Risk of Bias; ROBINS-I-Risk Of Bias In Non-randomised Studies-of Interventions; HCP-Health Care Professional; RCT-Randomised Controlled Trial; IG-Intervention Group; CG-Control Group; MET-Metabolic Equivalent of Task; GLTEQ-Godin Leisure-Time Exercise Questionnaire; MVPA-Moderate to Vigorous Physical Activity; SE-Standard Error; RDA-Recommended Daily Allowance.

Introduction

Prevalence of obesity is an urgent public health issue, with a disproportionate impact on women's health.¹⁻³ Compared to women with a body mass index (BMI) of 18.0 to 24.9 kg/m², 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 pre-eclampsia, stillbirth, or fetal malformations⁵; impaired fertility⁶; decreased insulin sensitivity following menopause⁷; 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 men¹⁻³; for example women have higher rates of myocardial ischemia and related mortality compared to 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 specialised agency, the World Health Organisation, 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 guidelines¹⁴ and this pattern is also reflected in the United States (USA).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 work¹⁷ 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/m², respectively¹⁷; 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 generalised across various workplace settings and populations,²⁵ or if a more tailored approach to individual and organisational 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 generalised 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 and colleagues observed that although research frequently examines whether a program 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 programs or

organisational policy changes in the workplace associated with improved diet, PA or weight-related outcomes for working women using the TIDieR checklist.

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

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.

[Insert Box 1](#)

Eligibility criteria

Eligibility criteria were defined according to the PICOS (participants, intervention or exposure, comparator, outcome and study type) framework outlined in Table S2. Included studies sought to examine lifestyle programs 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.

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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.

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 Supplementary Table S3. Forward and backward citation searching of all included articles was conducted.

Data extraction and management

The Cochrane Risk of Bias (RoB) 2.0 Tool was used to assess the risk of bias in randomised trials and the Risk of Bias in Non-randomised Studies-of Interventions (ROBINS-I) assessment tool was used for studies without randomisation (e.g., cohort). The risk of bias 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, waist circumference 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 Health care 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 categorised into low (<30%) and medium/high (≥30%) based on a review by Hawley-Hague and colleagues.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 utilising 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 synthesised 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 to either the control or to baseline at any stage of the intervention, that is, during the intervention, immediately post-intervention, or at follow up.

Results

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 workplace³⁷; 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.

[Insert Figure 1](#)

Characteristics of included studies

Ten studies used a randomised controlled trial (RCT) design³⁷⁻⁴⁹ and 10 studies used a non-randomised study design (Table 1).⁵⁰⁻⁵⁹ Nine studies were conducted in the US^{37,40,42,43,47,50,53,54,57,59} and 2 in Brazil.^{44,45} Studies were also conducted in Iran,⁵¹ Tunisia,⁵² Norway,^{38,39} Ireland,⁵⁶ Sweden,⁴¹ Japan,⁵⁸ Germany,⁵⁵ Singapore⁴⁶ and The Netherlands.^{48,49} Sample sizes ranged from 18⁵⁶ to 771.⁵² 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/m² at baseline^{40,57} and 17 studies reported using convenience sampling during recruitment.^{37-40,42,43,45-57,59}

Eight studies delivered PA interventions (n = 12 intervention arms)^{37-39,44,45,47,51,56,59} and 12 studies delivered mixed interventions (n = 14 intervention arms),^{40-43,46,48-50,52-55,57,58} i.e., a combination of PA and diet interventions. One study incorporated an oral health component in their intervention.⁵⁸ Ten studies included both men and women^{38,39,41-43,48,49,52,53,55-58} and 10 studies included women only.^{37,40,44-47,50,51,54,59} Six studies incorporated systems approaches, for example participatory approach to program design, management involvement and support, or environmental audits.^{41,48-50,53-55} None of these studies reported the implementation of any clear organisational

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policy changes.^{41,48-50,53-55} One study measuring weight outcomes provided online training programs to participants to limit inaccurate self-report data.⁵⁷ An additional 4 studies used self-reported measurements alone^{46,52,53,55} and 2 studies used both objective and self-report measurements (Table S4).^{37,51} PA was measured via 15 different outcome variables (e.g., mean steps/day, VO_{2max}), weight outcomes were measured via seven different variables (e.g., weight loss, BMI), and diet outcomes were measured according to six different variables (e.g., dietary fat/salt intake, fruit and vegetable consumption) (see Table S4).

Intervention duration and follow-up periods varied considerably. Ten PA interventions reported post-intervention PA outcomes^{37-39,45,47,51,59} but only 3 PA interventions reported follow-up PA outcomes (each at 3-month follow up).⁴⁵ Eight PA interventions reported post-intervention weight-related outcomes^{38,39,44,45,56,59} but only 3 PA interventions reported 3-month follow-up weight-related outcomes.⁴⁵ Seven mixed interventions reported post-intervention PA outcomes^{40,41,46,52,54} and 1 mixed intervention reported PA outcomes at 3-month follow-up.⁵⁴ Seven mixed interventions reported post-intervention weight-related outcomes^{40,42,43,48-50,54,55,57} and 4 mixed interventions reported weight-related outcomes at follow up (3 months to 5 years).^{48,49,53,54,58} Four mixed interventions reported post-intervention diet outcomes,^{46,52,54,55} but no diet outcomes were reported at follow-up.

Risk of bias

Ten studies were assessed for risk of bias using ROBINS-I⁵⁰⁻⁵⁹ and 10 studies using RoB 2.0.³⁷⁻⁴⁹ Supplementary Tables S5 and S6 describe the risk of bias 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, randomised studies had a lower risk of bias than non-randomised studies (Figure 2 and Figure 3). Eight studies (80%) rated using ROBINS-I had a serious or critical risk of bias^{50-55,57,59} and six studies (60%) rated using RoB 2.0 had a high risk of bias.^{40-45,48,49} More than a quarter of randomised studies reported a high risk of bias in selection of

the reported result.^{42,43,45,48,49} Deviations from intended interventions in non-randomised studies were poorly reported with five (50%) of studies not reporting sufficient information to assess bias.⁵⁰⁻
⁵⁴ Six (60%) non-randomised studies had a serious or critical risk of bias due to measurement of outcomes,⁵⁰⁻⁵⁵ mostly due to the use of subjective measurements (i.e. self-reported data).^{51-53,55} Four (50%) PA interventions with an effect for relevant outcomes had a high, serious, or critical risk of bias^{44,45,51,59} and seven (80%) of mixed interventions with an effect for relevant outcomes had a high, serious, or critical risk of bias.^{40-43,50,52,54,55} Four (83%) PA interventions with an effect on relevant outcomes were randomised studies^{37-39,44,45} but only four (40%) mixed interventions demonstrating an effect were randomised studies.^{40-43,46}

[Insert Figure 2](#)

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Characteristics of included studies

Intervention characteristics according to the TIDieR checklist

Table 2 summarises ‘Why’, ‘Who’, ‘How’, ‘When and How Much’, ‘Tailoring’ and ‘How Well’ for the included studies. Characteristics relevant to ‘what’ are summarised 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 taxonomy⁶¹), 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. Supplementary Table S7 presents the full data extraction of the TIDieR components of included studies.

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.^{37,40,46,54,55,57,59} 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.^{41-43,48-50,53}

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)^{37,40,42,43,45,46,48-50,54,55,58,59}; exercises (n = 16)^{37-39,43-46,51,52,54-56,59}; education (n = 14)^{40-43,46,48-50,52-55,57,58}; health assessments (n = 2)^{48,49,57}; peer support (n = 7)^{41-43,46,54,58}; incentives (n = 3)^{50,53,54}; and weigh-in sessions (n = 2).^{40,53}

Intervention provider (Who). Eleven interventions were provided by HCPs (n = 5 by dietitians,^{40,50,52,53,58} n = 4 by occupational health staff,^{48,52,54,58} n = 2 by psychologists,^{52,58} n = 2 by

sports physician⁴⁶ or physiotherapist,⁵² and n = 1 by dental hygienist⁵⁸). Interventions were also facilitated by non-HCPs such as researchers or study investigators (n = 6),^{37,42,43,46,47,56} exercise professionals or trainers (n = 6),^{37-39,45,55} health promoters (n = 1),^{42,43} or peers (n = 6).^{41,51,53,54}

Mechanism of delivery (How). Seventeen interventions incorporated technology (phone; website; pedometer; treadmill; email; exercise materials, such as DVDs and *Nintendo Wii*TM; heart rate monitor and accelerometer) into their delivery.^{37-40,45-49,51,53,54,56,57,59} 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.^{47,57,59}

Location (Where). All interventions were conducted at, or facilitated by, workplaces, however, eight interventions did not explicitly specify where the interventions were performed.^{41,44,48,49,52,56,58}

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,^{50,51,57,59} four interventions were conducted during paid worktime^{46,47,53,54} and one intervention reported that participants took part during paid worktime, but also reported participation outside of work hours or during lunch.⁵⁵ Twenty interventions were of a short-to-medium duration, and ranged from 2.5 days⁵⁸ to 40 weeks.^{38,39} The 2.5-day intervention also included 2 booster sessions at 1 month and at 1 year post intervention.⁵⁸ Six interventions lasted 12 months or more,^{41,52,55,57} with the longest lasting 2 years.⁵⁷

Individual adaptations (Tailoring). Sixteen interventions incorporated tailoring via personalised meal plans or recipes (n = 2),^{40,54} individual targets or goals (n = 13),^{40-43,46,48,49,53-55,57-59} and personalised plans or reports (n = 9).^{41,48,49,54-58}

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 three months and had a low number of sessions (<5).^{45,58,59} Conversely, four of the six interventions with high

attrition also had a high number of sessions (>13).^{38,39,45,54,55} Only 12 (46%) interventions reported adherence (Table 2) and this ranged from 30%^{38,39} to 100%.⁵⁸

Insert Table 2

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Summary of interventions and outcomes according to the TIDieR checklist

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Intervention effectiveness according to TIDieR components

Table 2 summarises 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 4 diet individual outcomes were reported.

Physical activity interventions. Eight studies (12 intervention arms) delivered PA interventions.^{37-39,44,45,47,51,56,59} The PA interventions reported PA (n = 10, 83%)^{37-39,45,47,51,59} and/or weight (n = 8, 67%)^{38,39,44,45,56,59} 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%)^{37-39,45,51} and no effect on any PA outcomes was observed for three (30%) interventions immediately post-intervention.^{45,47,59} Two of the successful studies evaluated PA outcomes at 3-months 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%),^{37-39,45,51} an in-person mode of delivery (n = 7, 100%),^{37-39,45,51} lasted a short to medium duration (n = 7, 100%),^{37-39,45,51} delivery by non-HCPs (n = 4, 57% e.g. exercise professionals³⁷⁻³⁹) and had medium to high levels of adherence (n = 5, 71% from 42.9% to 94.4%).^{37,45,51}

PA interventions that reported no effect on any PA outcomes included technology as their main intervention component (n = 3, 100%,^{45,47,59} e.g., treadmill or Nintendo Wii™) lasted ≤3 months (n = 3, 100%),^{45,47,59} used an individual mode of delivery (n = 2, 67%)^{47,59} 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^{38,39,44,45,59} and no effect on any weight-related outcomes was reported for three (38%) interventions immediately post-intervention.^{45,56} One intervention reported a sustained weight-related effect at 3-months 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%).^{38,39,44,45,59}

PA interventions that reported no effect on any weight outcome did not incorporate a named theory (n = 3, 100%),^{45,56} included technology as a main intervention component (n = 3, 100% e.g. pedometer),^{45,56} had an individual mode of delivery (n = 2, 67%),^{45,56} lasted ≤3 months (n = 3, 100%),^{45,56} included a low to medium number of sessions (n = 3, 100%),^{45,56} and had a medium to high adherence (n = 2, 67%).⁴⁵

Mixed interventions. Twelve studies (14 intervention arms) delivered mixed interventions.^{40-43,46,48-50,52-55,57,58} The mixed interventions reported PA (n = 7, 50%),^{40,41,46,52,54} weight (n = 9, 64%),^{40,42,43,48-50,53-55,57,58} and/or diet (n = 4)^{46,52,54,55} outcomes. The mixed interventions that reported effects for diet,^{46,55} weight^{40,42,43,50} or PA outcomes^{41,46,52,54} during the intervention and/or immediately post-intervention did not report any follow-up outcomes.

Effect on physical activity outcomes. Of the seven mixed interventions reporting PA outcomes, at least one PA effect was observed for five (71%) interventions^{41,46,52,54} 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%),^{41,46,54} included a group or combined individual and group format (n = 4, 80%),^{41,46,54} used an in-person mode of delivery (n = 5, 100%),^{41,46,52,54} lasted a medium to long duration (n = 4, 80%),^{41,46,52} and incorporated tailoring (n = 4, 80%).^{41,46,54}

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^{40,42,43,50} and no effect on any weight-related outcomes was reported for six (67%) interventions.^{48,49,53-55,57,58} Mixed

interventions that resulted in improved weight-related outcomes included a group and in-person delivery (n = 3, 100%),^{40,42,43,50} lasted a short to medium duration (n = 3, 100%),^{40,42,43,50} were delivered by HCPs (n = 2, 67%),^{40,50} had a medium to high number of sessions (n = 3, 100%),^{40,42,43,50} incorporated tailoring (n = 2, 67%)^{40,50} and had a medium to high adherence (n = 2, 67%).^{40,50}

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%),^{48,49,53,54,58} included tailoring (n = 6, 100%)^{48,49,53-55,57,58} and an individual delivery component (n = 6, 100%),^{48,49,53-55,57,58} and lasted a short-medium duration (n = 4, 67%).^{48,49,53,54,58}

Effect on diet outcomes. Of the four mixed interventions reporting diet outcomes, at least one diet-related effect was observed for two (50%) interventions^{46,55} and no effect on any diet outcomes was reported for two (50%) interventions.^{52,54} Mixed interventions that resulted in effects for diet outcomes were delivered by non-HCPs and/or HCPs (n = 2, 100%),^{46,55} had a combined individual and group mode of delivery (n = 2, 100%),^{46,55} incorporated tailoring (n = 2, 100%),^{46,55} and were delivered in-person (n = 2, 100%).^{46,55}

Mixed interventions that reported no effect on any diet outcomes were delivered by HCPs (n = 2, 100%)^{52,54} and used an in-person delivery format (n = 2, 100%).^{52,54}

Discussion

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 to those using an individual mode of delivery.⁶⁴ This “group enhancement” effect was also highlighted by Cleland and colleagues in their meta-analysis of PA interventions targeting socio-economically disadvantaged women.⁶⁵ The authors found that group delivery produced a clinically significant standardised 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 interventions³³ and that low-intensity (minimal contact and participant burden) lifestyle programs 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 to poorer quality studies and the authors did not include studies with participants over 25 kg/m²,⁶⁹ 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 to PA-only interventions. This seems to suggest that the ideal blueprint for adapting to the local context has not yet been established. Equally, individualised 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 than 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 capitalise on the interpersonal relationships provided by peer interventionists.²³

Strengths and limitations

There are several strengths to this review. Firstly, the inclusion of both randomised and non-randomised controlled studies allowed interventions to be evaluated within a pragmatic working environment. Secondly, we assessed the effect of mixed interventions and PA interventions separately, therefore allowing us to make specific recommendations to facilitate intervention delivery. Thirdly, 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 studies⁶¹ 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 formalise the adoption of the TIDieR checklist by intervention providers³³ 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. Firstly, most of the included studies had a high risk of bias. Given the inherent biases associated with conducting interventions within real-world settings some of these issues are potentially unavoidable. However, a high risk of bias was also observed in non-randomised 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. Secondly, 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 program. 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.

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.

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-health care 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 risk of bias, 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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Table Legends

Table 1: SD = Standard Deviation; RCT = Randomised Controlled Trial; SE = Standard Error; IG = Intervention Group; CG = Control Group; PA = Physical Activity; BMI = Body Mass Index; GLTEQ = Godin Leisure Time Exercise Questionnaire; MVPA = moderate/vigorous physical activity (accelerometer); MET = Metabolic Equivalent of Task; RDA = recommended dietary allowance; - = Not Reported; WC = Waist Circumference

Table 2: ● = Reported; ○ = Not Reported; ◐ = Unclear; ◑ = Adjunct to Main Intervention; ✓ = Effect; ✗ = No Effect; - = Not Applicable; Ix = Intervention; PA = Physical Activity; HCP = Health Care Professional; Indiv = Individual; Tech = Technology; Mths = Months; Med = Medium; * = 2 full days and 1 night; TIDieR = Template for Intervention Description and Replication; IG = Intervention Group; Aero = Aerobic Training; Super = Supervisor Group; Champ = Champion Group

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Title:

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

Date:

2020-08-17

Citation:

Madden, S. K., Cordon, E. L., Bailey, C., Skouteris, H., Ahuja, K., Hills, A. P. & Hill, B. (2020). The effect of workplace lifestyle programmes on diet, physical activity, and weight-related outcomes for working women: A systematic review using the TIDieR checklist. OBESITY REVIEWS, 21 (10), <https://doi.org/10.1111/obr.13027>.

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