Guideline-based digital exercise interventions for body weight and fat reduction and physical activity promotion in adults with overweight and obesity: A systematic review

Mohamad Motevalli, Clemens Drenowatz, Derrick Tanous, Gerhard Ruedl, Werner Kirschner, Markus Schauer, Thomas Rosemann, Katharina Wirnitzer

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Abstract

Background: Digital exercise interventions are increasingly popular in addressing the obesity epidemic. However, there remains uncertainty on the efficacy regarding the reduction of body weight (BW) and body fat, which may, at least partly, be due to variations in study designs and inconsistent adherence to international physical activity (PA) guidelines.

Objective: This systematic review aimed to evaluate the effectiveness of digital exercise interventions based on PA guidelines in reducing BW and fat in overweight/obese adults, as well as their impact on PA-related factors.

Methods: This review was prospectively registered in PROSPERO (CRD42024620020) and conducted following PRISMA guidelines. A series of comprehensive searches was performed in October 2024 across PubMed, Cochrane Library, Web of Science, and OVID Medline. Eligible studies included adults (?18 years) with objectively confirmed overweight or obesity who utilized digital interventions aligned with international PA guidelines. Risk of bias was evaluated using the Cochrane RoB 2 tool for randomized controlled trials and the ROBINS-I tool for non-randomized studies.

Results: Out of 4,948 studies identified through the Boolean search strategy, 188 were retrieved for full-text screening, and 30 studies met the predefined eligibility criteria. Intervention durations ranged from eight weeks to 24 months (average: 6.6 months). Fourteen studies used structured exercise programs, while other studies incorporated flexible PA/exercise routines based on international guidelines. Digital exercise intervention programs resulted in significant reductions in BW (22/25 studies, range: -1.3 to -8.4 kg), body mass index (19/23 studies, range: -0.4 to -3.4 kg/m2), waist circumference (15/16 studies, range: -2.1 to -9.2 cm), body fat percentage (9/9 studies, range: -0.3% to -4.1%), and fat mass (7/7 studies, range: -0.4 to -6.5 kg). Results for waist-to-hip ratio and PA outcomes were inconsistent. Compared to passive controls, results revealed a clear pattern of digital exercise interventions significantly reducing weight- and fat-related outcomes, while results were inconsistent when measured against active or usual care controls. No clear trend was observed between the duration or type of interventions and improvements in the outcome variables.

Conclusions: Guideline-based digital PA/exercise interventions show potential in reducing excess body weight and body fat in adults with overweight or obesity, although there remains uncertainty regarding their superiority over traditional methods. Substantial variations in study designs also contribute to challenges in drawing definitive conclusions on specific characteristics of effective digital exercise tools. Clinical Trial: PROSPERO (CRD42024620020)

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Review

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Abstract

Background: Digital exercise interventions are increasingly popular in addressing the obesity epidemic. However, there remains uncertainty on the efficacy regarding the reduction of body weight (BW) and body fat, which may, at least partly, be due to variations in study designs and inconsistent adherence to international physical activity (PA) guidelines.
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Trial Registration: PROSPERO (CRD42024620020).

Keywords: technology; mHealth; eHealth; uHealth; smartphone; weight loss; body composition; adulthood; training; fitness

Introduction

Overweight and obesity are among the most pressing public health challenges of the 21st century, posing significant health risks and economic burdens worldwide [1]. According to the World Health Organization (WHO), the prevalence of adult obesity has more than doubled since 1990 [2]. By 2022, 43% of adults aged 18 and over were classified as overweight, and 16% were living with obesity, making it a major risk factor for several chronic diseases, including cardiovascular disease, type 2 diabetes, musculoskeletal disorders, and cancer [2]. Data shows that being overweight or obese is associated with approximately 2.8 million deaths each year [3]. This highlights the urgent need for effective interventions to manage body weight (BW) and improve body composition in adults with excess body fat.

Physical activity (PA) is recognized as a critical component of obesity prevention and management strategies [4]. The WHO guidelines recommend that adults engage in at least 150–300 minutes of moderate-intensity aerobic activity or 75–150 minutes of vigorous-intensity activity per week [5]. It has been well documented that adherence to these recommendations is associated with significant improvements in body composition [6], emphasizing the critical role of PA in mitigating obesity-related health issues. Despite its proven benefits, adults often struggle to maintain sufficient levels of PA due to barriers such as time constraints, lack of access to fitness facilities, and motivation, highlighting the need for innovative solutions that make PA/exercise more accessible and sustainable [7].

Today's digital world represents a transformative change in how we live, work, and interact [8], characterized by the integration of digital technologies into almost every aspect of human life. One of the most significant outcomes of this technological revolution is the expansion of mobile applications (apps), which have become integral tools in daily life. An app is defined as software designed for specific tasks, which can be downloaded and installed on mobile phones or other digital devices [9]. In recent years, the advancement of digitalization has led to the emergence of digital health interventions as promising tools for supporting BW management and promoting healthy lifestyles [10]. Among these, PA and fitness apps have gained considerable attention by leveraging technological advancements to offer and deliver exercise plans, while also monitoring PA and fitness progress [11].

Over the past two decades, several studies have examined the effectiveness of health and fitness apps in BW management and other health outcomes [12-22]; however, the results have been inconsistent, with some studies reporting significant benefits while others finding minimal or no effect on target outcomes. This variability in results may be attributed to differences in study design, population characteristics, app features, and intervention characteristics. More importantly, existing studies on digital PA/exercise interventions often lack a standardized implementation of key exercise characteristics (such as type, frequency, duration, and intensity) based on international PA guidelines. This inconsistency makes it difficult to compare interventions and assess their adequacy, thereby potentially influencing the outcomes. Therefore, a comprehensive review of digital PA interventions that are based on PA guidelines, such as those from the WHO or an equivalent framework, is needed to ensure more consistent and reliable outcomes.

The primary objective of this systematic review is to evaluate the effectiveness of digital exercise interventions that were based on international PA recommendations on body composition, as well as PA/fitness outcomes, in adults with overweight and obesity. Additionally, while this review aims to identify gaps in the literature, its overarching goals are to provide insights that inform clinical practice and public health initiatives, and to guide the design of future digital interventions, thereby contributing to the effective management of overweight and obesity on a broader scale.

Methods

Study Protocol

The present systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [23]. The PRISMA checklist was used to guide the reporting across all stages of the review, encompassing the formulation of the research question, establishment of eligibility criteria, development of the search strategy, study selection, data extraction, and synthesis of results. The review protocol was registered prospectively in the International Prospective Register of Systematic Reviews (PROSPERO) under the registration number CRD42024620020.

Eligibility Criteria

The eligibility criteria encompassed multiple dimensions guided by the PICOS framework [24], along with additional considerations. The population of interest comprised adults aged 18 years and older with overweight or obesity. Overweight/obesity were defined using established thresholds: a body mass index (BMI) ≥ 25.0 [25] or ≥ 23.0 for Asia-Pacific adult populations [26], body fat percentage (BF%) ≥ 25% for males and ≥ 36% for females [27], or a waist-to-hip ratio (WHR) ≥ 0.90 for males and ≥ 0.80 for females [28]. Baseline measures of BW status had to be objectively assessed; studies relying on self-reported anthropometric data were excluded. To ensure the feasibility of participation in PA/exercise interventions, studies were required to include participants without severe health conditions or physical limitations that could hinder PA/exercise engagement. Studies involving trained participants who had been regularly engaged in PA, exercise, or sports within the three months prior to the intervention were also excluded. Furthermore, studies were excluded if they included participants who were pregnant or within one year postpartum, as these conditions can significantly influence body composition.

Regarding the intervention criteria, the review targeted interventional studies assessing the effectiveness of digital PA/exercise programs designed in alignment with WHO guidelines on PA, i.e., a minimum of 150 minutes of moderate-intensity PA or 75 minutes of vigorous-intensity PA per week [5], or a comparable framework. “PA” refers to any bodily movement produced by skeletal muscles that requires energy expenditure, while “exercise” is a subset of PA that is planned, structured, and repetitive, with the specific objective of achieving or maintaining health and fitness [29, 30]. Eligible studies implemented PA/exercise interventions with a minimum duration of eight weeks. In controlled trials, the control group (whether consisting of non-exercise participants or those who did not engage in digital PA/exercise interventions) was considered the comparator. For single-arm interventional studies, comparisons were made against baseline values of the same participants assessed prior to the intervention.

The primary outcomes of interest included anthropometric and body composition measures: BW, BMI, BF%, fat mass (FM), waist circumference (WC), and WHR. All outcomes had to be objectively measured; studies relying on self-reported data were excluded to minimize bias and ensure reliability. Any study that reported at least one of these outcomes was eligible for inclusion. The secondary outcomes included PA-related or physical fitness variables, regardless of the assessment method. Finally, eligible studies were restricted to publications in English or German, and no limitations were applied regarding the publication period, context, setting, or geographic location.

Information Sources and Search Strategy

A comprehensive search strategy was used to identify relevant studies for inclusion in this systematic review, conducted from October 1 to October 10, 2024. The databases searched included PubMed, Cochrane Library, Web of Science, and OVID Medline. The search strategy used a combination of keywords and MeSH terms with the Boolean operators “AND” and “OR”, as detailed in Table A1 of the supplementary materials. In addition to the database searches, the reference lists of the included studies and relevant review articles were manually reviewed to identify any additional publications that may not have been captured in the database search.

Study Selection and Data Extraction

The study selection process was conducted using Covidence, a specialized tool for systematic screening and data extraction. Two independent reviewers (MM and DT) screened the titles and abstracts of all retrieved articles based on the predefined eligibility criteria. Any discrepancies between the two reviewers were resolved through discussion. Articles deemed potentially relevant during the abstract screening phase underwent full-text review and the same reviewers thoroughly assessed the full text of each article, while reasons for exclusion were documented. A third reviewer (CD) was consulted for the final decision, if consensus could not be reached. Studies that met all eligibility criteria during the full-text screening process advanced to the data extraction phase, where the same reviewers extracted the data. The extracted data encompassed several domains, including study characteristics, study design, intervention details, sample size, population, app or digital tool specifics, PA/exercise protocols, comparators, anthropometric/body composition outcomes, and PA/fitness outcomes. When the data were unclear, incomplete, or missing, the reviewers contacted the authors of the studies to request clarifications or additional information. When multiple papers reported the same study with identical population, outcomes and data, the earliest publication was included to avoid data duplication. Any exclusions were carefully considered and documented to ensure transparency in the selection process.

Risk of Bias Assessment

The risk of bias in the included studies was assessed using standardized tools to ensure a thorough evaluation of methodological quality. For randomized controlled trials (RCTs), the Cochrane Risk of Bias 2 (RoB 2) tool was employed [31]. This tool evaluates bias across five key domains: randomization process, deviations from intended interventions, missing outcome data, measurement of the outcome, and selection of the reported result. Each domain is assessed for potential sources of bias that could impact the validity of the trial's findings. The Risk of Bias in Non-randomized Studies of Interventions (ROBINS-I) tool was used for non-randomized and single-arm studies [32]. This tool evaluates seven domains: confounding, selection of participants, classification of interventions, deviations from intended interventions, missing data, outcome measurement, and selection of the reported result. Using both tools enabled a comprehensive assessment of the methodological rigor and potential biases in each study, ensuring a reliable interpretation of the evidence.

Data Synthesis

A qualitative synthesis of the data was conducted, focusing on the various outcomes reported across studies. Due to the substantial heterogeneity among the included studies, including differences in interventions, populations, comparators, and study designs, a meta-analysis was not feasible. The extracted data were systematically grouped and analyzed by outcome categories and variables (study design, population, study group, app/digital tool, intervention, primary outcomes, and PA outcomes), enabling a detailed exploration of trends and patterns in the evidence. The synthesis aimed to identify consistent trends across studies while also highlighting areas of agreement, inconsistencies, or discrepancies in the findings. This approach provided a deeper understanding of the broader implications of the data and helped identify areas where further research is needed to resolve conflicting results or clarify uncertainties.

Results

Selection Process

A total of 4,948 studies were initially identified through databases and reference sources. After removing duplicates, 3,375 studies were screened by title and abstract, of which 188 were retrieved for full-text review. Ultimately, 30 studies met the predefined eligibility criteria and were included in the systematic review. Figure 1 presents the PRISMA flowchart outlining the study selection process.

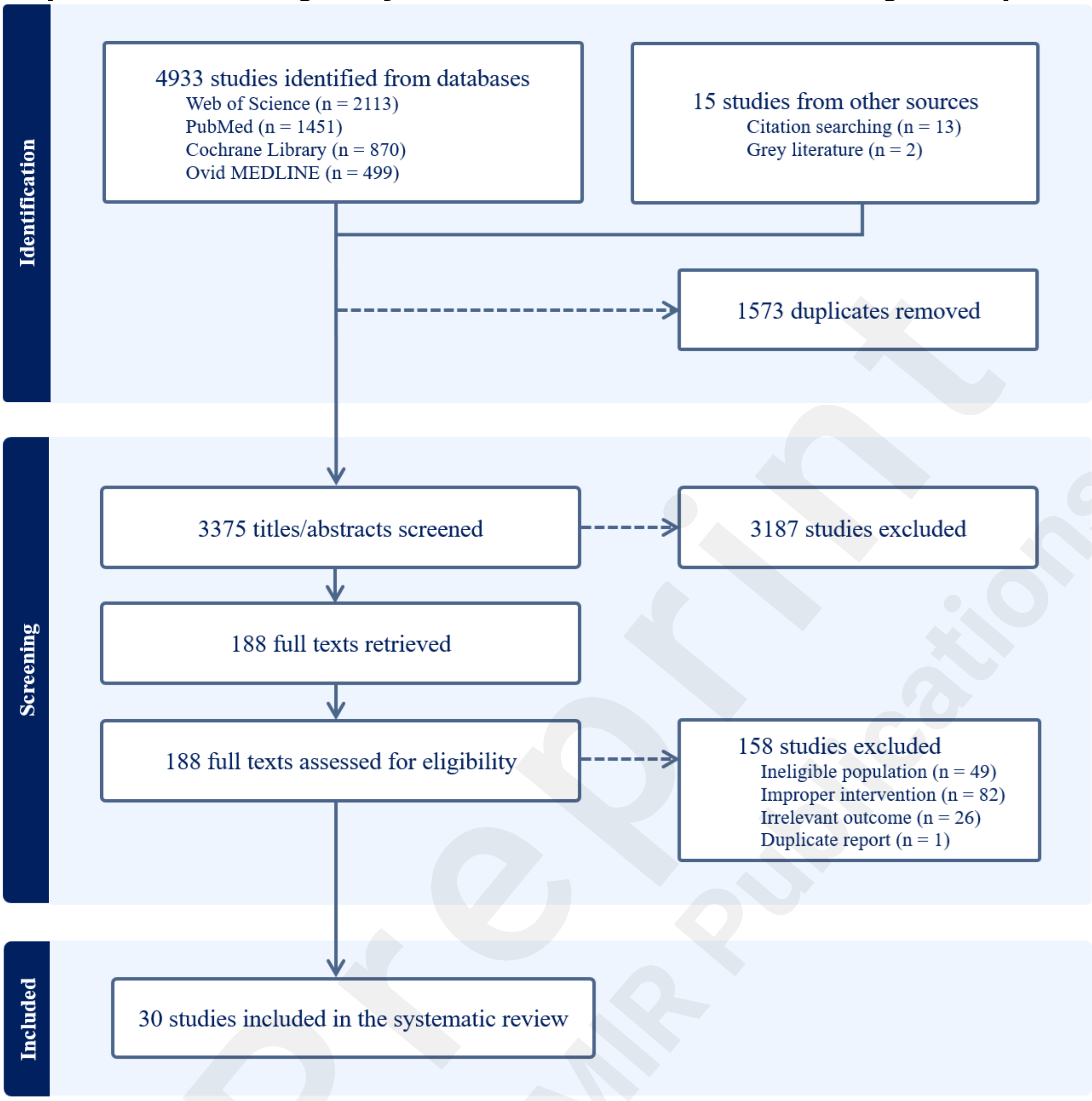

Figure 1. PRISMA flowchart showing the study identification, screening, and inclusion process.

Included Studies

The final sample of included studies consisted of 26 randomized controlled trials (RCTs) and four non-randomized studies. Out of the 30 included studies, eleven studies were conducted in the USA, three in Australia, three in Korea, two in the UK, two in Germany, two in Spain, and one each in Sweden, France, Canada, Belgium, Singapore, China, and Hong Kong. The sample sizes varied from 16 to 750 participants, with an average of 132 participants. Six studies exclusively included female participants, while none of the included studies focused solely on males. Table 1 provides a summary of the characteristics of the studies included in the review.

Table 1. Summary of the characteristics and outcomes of studies included in the systematic review. Studies are ordered by intervention duration.

Study	Design and Population	Study Groups	Intervention	Primary Outcomes and Findings	PA Outcomes and Findings
24 months					
Jakicic et al. [33] 2016 USA	2-arm RCT Sample size: 470 Median age: 30.9 71.1% females Median BMI: 31.2	1. Enhanced intervention (n = 237) 2. Standard intervention (n = 233)	*Digital tool: FIT Core; BodyMedia* 24-month intervention where all participants initially increased PA, followed a low-calorie diet, and attended group counseling. At 6 months, telephone counseling, text message prompts, and website access were introduced. The standard group used a website for self-monitoring, while the enhanced group used a wearable device with a web interface. Moderate-to-vigorous PA progressed from 100 to 300 min/week over 4-week intervals.	Significant decreases in BW BMI, BF%, and FM in both groups; no significant between-group differences for BMI, BF%, and FM, while post-intervention BW was significantly lower in the standard group.	Significant improvements in LPA and MVPA in both groups; no significant between-group differences
Svetkey et al. [34] 2015 USA	3-arm RCT Sample size: 365 Mean age: 29.4 69.6% females Mean BMI: 35.2	1. mHealth (n = 123) 2. Personal coaching (n = 120) 3. Control (n = 122)	*Digital tool: Investigator-designed app* 24-month intervention delivered via a smartphone app based on social cognitive theory and transtheoretical model, incorporating goal setting, behavioral self-management, and motivational enhancement, with a PA target of achieving ≥180 min/week of moderate PA.	Significant differences in BW between the study groups, with greater reductions in the personal coaching group at 6 and 12 months, but not at 24 months.	-
12 months					
Héroux et al. [35] 2017 Canada	Single-arm intervention trial Sample size: 28 Mean age: 49.6 100% females Mean BMI: 32.2	1. Intervention (n = 28)	*Digital tool: The online Precision Nutrition Coaching Program* 12-month online program focused on daily exercise, dietary habits, and health behavior lessons, with coaching delivered via computer, tablet, and mobile device. The exercise program included detailed daily workouts (aerobic interval training, weight training, or walking) with progressive intensity over time.	Significant decreases in BW, WC, and FM (but not in BMI).	-
Lynch et al. [36] 2017 USA	Single-arm intervention trial Sample size: 46 Mean age: 39 65.2% females Mean BMI: 31.8	1. Intervention (n = 46)	*Digital tool: Lean Eating by Precision Nutrition Coaching* 12-month weight loss intervention with daily components of exercise, nutrition, behavioral modification strategies, and health lessons via an online platform, along with online coaching. The PA component included at least 150 min of exercise/week, with a minimum of two strength training sessions/week.	Significant decreases in BW, BMI, and BF% (but not in WHR).	-
Watson et al. [37] 2015 UK	2-arm RCT Sample size: 65 Mean age: 52.2 55.4%	1. Web-based (n = 32) 2. Usual self-care (n = 33)	*Digital tool: Imperative Health* 12-month web-based weight loss intervention incorporating PA and dietary components, along with goal setting and tailored feedback and support provided by physiologists via telephone and email. The	Significant decreases in BW in the intervention group, with significant between-group differences at 3 and 6	Significant between-group differences in daily PA at 3 months, but not at 6 and 12

	females Mean BMI: 32.6		PA program included a weekly schedule for planning activities at light to vigorous intensity levels.	months, but not at 12 months. Significant between-group differences in BMI and WC at 3 and 6 (but not at 12) months.	months.
Six months					
Alcántara-Aragón et al. [38] 2018 Spain	2-arm RCT Sample size: 183 Mean age: 44.5 83.6% females Mean BMI: 34.75	1. Telematic intervention (n = 91) 2. Non-Telematic intervention (n = 92)	*Digital tool: PREDIRCAM2 web platform* Six-month tailored exercise and dietary plans based on international PA guidelines and the Mediterranean diet. The telematic group received online support and virtual contact, while the non-telematic group followed traditional methods.	Significant decreases in BW, WC, and WHR in the telematic intervention group; no significant between-group differences.	-
Allen et al. [39] 2013 USA	4-arm RCT Sample size: 68 Mean age: 44.9 77.9% females Mean BMI: 34.3	1. Intensive counseling (n = 18) 2. Smartphone only (n = 17) 3. Intensive counseling + smartphone (n = 16) 4. Less intensive counseling + smartphone (n = 17)	*Digital tool: Lose It!* Six-month intervention (PA and diet) using an eclectic approach combining social cognitive theory, behavioral self-management, and motivational interviewing techniques to achieve 5% BW loss and a minimum of 150 minutes of moderate-intensity PA per week. Intensive groups attended frequent in-person sessions, while less intensive and smartphone-based groups had fewer sessions.	Significant decreases in BW, BMI, and WC in all groups; no significant between-group differences.	No significant between-group difference in MVPA.
Apiñaniz et al. [40] 2019 Spain	2-arm RCT Sample size: 110 Mean age: 38.5 71.8% females Mean BMI: 32.7	1. Health advice + app (n = 54) 2. Health advice (n = 56)	*Digital tool: AKTIDIET®* Six-month intervention consisting of health advice (PA and dietary) based on international guidelines for both groups. In the intervention group, this advice was reinforced through an app consisting of aerobic and muscle training programs and food intake tracking.	Significant decreases in BW in both groups; no significant between-group differences.	-
Batsis et al. [41] 2021 USA	Single-arm intervention trial Sample size: 53 Mean age: 72.9 69.8% females Mean BMI: 36.5	1. Intervention (n = 53)	*Digital tool: Video conferencing* Six-month weight management program combining synchronous video-conferenced exercise and nutrition sessions, remote Fitbit monitoring, and periodic face-to-face interactions. Participants attended 75-minute, twice-weekly group exercise sessions led by a trained physical therapist.	Significant decreases in BW, BMI, and WC; no change in WHR.	Significant improvements in 30-s sit-to-stand and 6-min walk test; no changes in gait speed or grip strength.
Block et al. [42] 2015 USA	2-arm RCT Sample size: 339 Mean age: 55.0	1. Alive-PD intervention (n = 163) 2. Usual care control	*Digital tool: Alive-PD* Six-month program with weekly goal setting (PA and dietary) delivered via web, email, interactive voice response calls, and a supportive mobile app. The PA target	Significant decreases in BW, BMI, and WC in both groups, with significantly greater reductions in the	-

	31.3% females Mean BMI: 31.2	(n = 176)	included 150–300 minutes of aerobic activity and resistance training weekly, based on baseline levels and progress.	intervention group.	
Duncan et al. [18] 2020 Australia	3-arm RCT Sample size: 116 Mean age: 44.5 70.7% females Mean BMI: 31.7	1. Enhanced (n = 39) 2. Traditional (n = 41) 3. Waiting-list control (n = 36)	*Digital tool: Balanced app* Six-month multi-component (PA and dietary) mHealth intervention delivered via a smartphone app, providing educational materials, goal setting, self-monitoring, and feedback; the enhanced group received additional sleep-related support. PA action planning focused on MVPA, resistance training, and step count increases.	No significant between-group difference in BW, while post-intervention WC was significantly lower in the Traditional group.	No significant between-group differences in MVPA and LPA.
Hartman et al. [43] 2016 USA	2-arm RCT Sample size: 55 Mean age: 59.5 100% females Mean BMI: 31.9	1. Technology-based (n = 36) 2. Usual care (n = 18)	*Digital tool: Fitbit and a website* Six-month weight loss intervention focused on developing and practicing self-monitoring and self-regulatory skills, with a goal of losing 10% of BW by engaging in at least 150 minutes/week of moderate-to-vigorous PA and restricting calorie intake.	Significant decreases in BW in the intervention group, with a significant between-group difference (no BW change in the usual care group).	Significant improvement in daily MVPA in the intervention group, with no significant between-group differences.
Haufe et al. [44] 2019 Germany	2-arm RCT Sample size: 314 Mean age: 48.1 14% females Mean BMI: 33.3	1. Telemonitoring exercise (n = 160) 2. Waiting-list control (n = 154)	*Digital tool: Custom-designed smartphone app* Six-month telemonitoring-supported lifestyle intervention focused on regular exercise, including individual exercise recommendations provided during face-to-face meetings and via a smartphone application, aiming for at least 150 minutes of PA per week.	Significant decrease in WC in the intervention group, with a significant between-group difference (less but significant decrease in WC in the control group).	Significant increase in exercise capacity in both groups, with a significantly greater increase in the intervention group.
Hutchess-on et al. [20] 2018 Australia	2-arm RCT Sample size: 57 Mean age: 27.1 100% females Mean BMI: 29.4	1. Intervention (n = 29) 2. Control (n = 28)	*Digital tool: Be Positive Be Healthe* Six-month weight loss program delivered via e-health technologies (website, app, email, text messages, and social media), incorporating goal setting and grounded in social cognitive theory and control theory, aligned with international PA and dietary guidelines.	Significant decreases in BW, BMI, FM, and BF% in the intervention group, with no significant between-group differences except for FM. Significant decreases in WC in both groups.	No significant changes in MVPA, MPA, and VPA in any study group.
Lim et al. [45] 2022 Singapore	2-arm RCT Sample size: 148 Mean age: 53.1 39.9% females Mean BMI: 29.8	1. Intervention (n = 72) 2. Control (n = 76)	*Digital tool: nBuddy Diabetes app* Six-month in-app dietitian coaching incorporating behavioral strategies (goal setting, stimulus control, problem solving, self-monitoring, cognitive restructuring, motivational interviewing), with a PA goal of 150 min/week of moderate-intensity physical exercise.	Significant decreases in BW and BMI in both groups, with significantly greater reductions in the intervention group.	Significant improvement in general PA in the intervention group; no significant between-group difference.
Rogers et al. [46] 2016 USA	3-arm RCT Sample size: 39 Mean age: 39.9	1. Standard (n = 14) 2. Technology (n = 12) 3. Enhanced	*Digital tool: BodyMedia Fit and LINK* Six-month mHealth intervention program incorporating PA and dietary components, alongside self-monitoring and feedback. The PA component involved unsupervised,	Significant decreases in BW, BMI, WC, BF %, and FM in all groups; no significant between-group	-

	79.5% females Mean BMI: 39.5	technology (n = 13)	home-based exercise at moderate intensity, with a gradual increase in session duration.	differences.	
			12-16 weeks		
Hurst et al. [47] 2021 USA	Single-arm intervention trial Sample size: 30 Mean age: 38.1 43% females Median BMI: 32.7	1. Intervention (n = 30)	*Digital tool: Telehealth coaching* 16-week telehealth intervention delivered in primary care clinics, using wearable devices, automated text messaging, and trained health coaching (including real-time feedback) to support exercise and nutrition goals, including achieving at least 150 minutes of PA per week.	Significant decreases in BW, and BMI.	Significant improvement in MVPA.
Stephens et al. [48] 2017 USA	2-arm RCT Sample size: 62 Median age: 20.0 71% females Median BMI: 28.5	1. Smartphone + health coach (n = 31) 2. Control (n = 31)	*Digital tool: Lose it!* Three-month intervention using a behaviorally-based smartphone app (primarily grounded in self-efficacy theory) for weight loss, combined with counseling sessions and text messages from a health coach, with goals of losing 1–2 pounds per week and engaging in at least 150 minutes of moderate-intensity PA weekly.	Significant decreases in BW, BMI, and WC in the intervention group (but not in the control group), with significant between-group differences.	Significant improvement in PA score in the intervention group, with no significant between-group difference.
Wong et al. [49] 2021 Hong Kong	2-arm RCT Sample size: 77 Mean age: 58.9 55.8% females Mean BMI: 27.02	1. App (n = 38) 2. Booklet (n = 39)	*Digital tool: MetS app* Three-month lifestyle intervention delivered via a mobile app to support participants' individual exercise routines through goal setting, logging exercise type and duration, and self-monitoring. The PA goal was at least 30 minutes per day, 5 days per week.	Significant decreases in BW and BMI (but not in WC or WHR) in the app group, with significant between-group differences for BW and BMI (no change in the booklet group).	Significant improvements in exercise score and exercise self-efficacy in the app group, with significant between-group differences.
Zhang et al. [50] 2023 China	3-arm RCT Sample size: 750 Mean age: 70.1 53.9% females Mean BMI: 27.7	1. Remote PA and diet (n = 250) 2. Remote PA (n = 250) 3. Control (n = 250)	*Digital tool: mHealth app* Three-month remote weight management intervention focused on PA (with or without dietary components) including health assessments and guidance from exercise instructors and nutritional professionals. The PA program included 20 minutes of resistance or aerobic exercise or walking 6000 steps daily.	Significant decreases in BW, BMI, WC, and WHR in the remote PA & diet group, with significant between-group differences at day 90, but not at day 45.	No significant changes in total PA and PA levels in any study group.
Anderson et al. [51] 2018 UK	2-arm RCT Sample size: 78 Mean age: 47.1 88% females Mean BMI: 32.7	1. Intervention (n = 39) 2. Control – lifestyle booklet (n = 39)	*Digital tool: LivingWELL* 12-week intervention consisting of one face-to-face session, four phone consultations, and web-based support to achieve 5% BW reduction. It included a personalized diet and exercise plan with behavioral techniques like motivational interviewing and action planning.	Decreases in BW, BMI, and WC in the intervention group, but not in the control group.	Increases in daily MPA and daily steps (but not daily VPA) in the intervention group.
Bughin et al. [52] 2021	2-arm RCT Sample size: 50	1. Telerehabilitation program	*Digital tool: Telemouv app* 12-week multicomponent intervention (PA, diet, and education) available on	Significant decreases in BF% and FM in both groups, with no	No significant within- or between-group

France	Mean age: 52.2 54% females Mean BMI: 36.5	(n = 25) 2. Usual care (n = 25)	smartphones and a website. The PA program included endurance exercises (targeting 150 minutes of PA per week), muscle strengthening (with gradual increases in volume), and balance exercises.	significant changes in BW, BMI, or WHR. No significant between-group differences for any outcomes.	change/difference in the 6-minute walk test.
Hebden et al. [53] 2014 Australia	2-arm RCT Sample size: 51 Mean age: 22.8 81% females Mean BMI: 27.3	1. mHealth intervention (n = 26) 2. Control (n = 25)	*Digital tool: ePASS* 12-week mHealth program targeting key lifestyle behaviors associated with weight gain, delivered via smartphone applications, internet forums, text messages, and emails. The PA program included 30 minutes of moderate-intensity PA per day for general health and 60 minutes per day for weight management.	Significant decreases in BW and BMI in both groups; no significant between-group differences.	Significant increase in daily LPA (but not MVPA) in the intervention group.
Hong et al. [54] 2022 Korea	2-arm RCT Sample size: 31 Mean age: 79.9 100% females Mean BF%: 41.6	1. Intervention (n = 12) 2. Control (n = 17)	*Digital tool: Smartphone telepresence platform* 12-week smartphone mirroring-based telepresence exercise program conducted at home with three sessions per week, primarily focused on resistance training (with gradual intensity increases), all based on international guidelines; while the control group performed the same program in person.	Significant decreases in BF% in both groups and in BW in the control group; no significant between-group differences.	Significant left-hand grip strength improvement in the intervention group and right-hand in the controls; no significant between-group differences.
Hurkman-s et al. [16] 2018 Belgium	4-arm RCT Sample size: 81 Mean age: 45.0 71.6% females Mean BMI: 32.0	1. Face-to-face (n = 28) 2. App (n = 30) 3. Combi (n = 22) 4. Control (n = 22)	*Digital tool: Mobile Weight Loss App* 12-week weight loss programs employing face-to-face, mobile, and combined approaches, offering exercise and dietary guidance aligned with standard guidelines, along with personalized exercise plans provided by a coach.	Significant decreases in BMI in the face-to-face, app, and combi groups; no significant difference between the three interventions.	Significant improvements in MVPA; no significant between-group differences.
Johnson et al. [55] 2019 USA	3-arm RCT Sample size: 30 Mean age: 43.2 Mean BMI: 36.1	1. Video conferencing (n = 10) 2. In-person (n = 10) 3. Control (n = 10)	*Digital tool: Withings app and Healow app* 12-week telemedicine-based health coaching, including exercise routines, goal setting, and PA progression, with feedback provided by a registered dietitian and exercise physiologist. PA program followed international guidelines recommending at least 150 minutes of PA per week (30 min of moderate-to-vigorous PA, 5 days per week).	Significant differences in BW reduction between the study groups, with greater reduction in the videoconferencing group; no significant between-group differences in BMI. Decrease in BW and BMI in all groups.	Improvement in daily steps in all groups, with a significantly greater improvement in the video-conferencing group.
Pressler et al. [56] 2010 Germany	2-arm RCT Sample size: 105 Median age: 48 11.8% females Mean BMI: 29.0	1. Structured web-based exercise (n = 66) 2. Non-structured web-based exercise (n = 39)	*Digital tool: Interactive internet platform* 12-week intervention with structured or non-structured internet-delivered exercise programs performed individually, alongside education sessions. The exercise program included three moderate endurance sessions and one strength training session per week.	Significant decreases in WC in both groups and in BMI and BF% in the control group; no significant between-group differences in any of these outcomes.	No significant changes in daily step counts in any study group.

8-10 weeks					
Ballin et al. [57] 2020 Sweden	2-arm RCT Sample size: 77 Mean age: 71.0 50% females Mean BMI: 29.2	1. Web-based exercise (n = 38) 2. Supervised exercise (n = 39)	*Digital tool: Healthy Ageing Initiative* 10-week intervention consisting of a web-based progressive interval training program (10 weekly videos, 3 sessions/week), while the supervised exercise group participated in in-person sessions.	Significant decreases in BF% and FM in both groups, and in BMI only in the supervised exercise group; no significant between-group differences, except for FM (with a greater reduction in the supervised exercise group).	-
Hyun et al. [58] 2021 Korea	2-arm RCT Sample size: 16 Mean age: 38.4 100% females Mean BMI: 25.6	1. Moderate intensity training (n = 8) 2. High intensity training (n = 8)	*Digital tool: Real-time video web program* 8-week real-time video web program based on international PA/exercise guidelines, including bidirectional communication along with instructor feedback. Training sessions lasted 30 minutes (for moderate intensity group) or 50 minutes (for high intensity group), held three times weekly, with exercise intensity increasing biweekly for the high intensity group.	Significant decreases in BW, WC, FM, BMI, and BF% in both groups, with significant between-group differences for BMI, WC, and FM (greater reductions in the high-intensity group), but not for BW or BF%.	Significant left-hand grip strength improvement in the high intensity group and right-hand in both groups; significant between-group differences.
Seo et al. [59] 2023 Korea	3-arm RCT Sample size: 75 Mean age: 48.3 100% females Mean BMI: 25.5	1. Virtual reality exercise (n = 25) 2. Indoor bicycle exercise (n = 25) 3. Control (n = 25)	*Digital tool: VRFit app* 8-week virtual reality exercise program using an IoT sensor attached to an indoor bicycle, connected to a smartphone, and paired with a head-mounted display for immersive virtual reality exercise. Exercise sessions were conducted 3–5 times weekly, following international guidelines.	Significant decreases in BMI in the virtual reality group, with significant between-group differences (no BMI change in the two other groups).	Significant improvement in exercise fun in the virtual reality group, along with significant between-group differences.

RCT: Randomized Controlled Trial; BW: Body Weight; BMI: Body Mass Index; WC: Waist Circumference; WHR: Waist-to-Hip Ratio; BF%: Body Fat Percentage; FM: Fat Mass; PA: Physical Activity; MVPA: Moderate-to-Vigorous Physical Activity; LPA: Light Physical Activity; MPA: Moderate Physical Activity; VPA: Vigorous Physical Activity.

Data Synthesis

The duration of the interventions ranged from eight weeks to 24 months, with an average of 6.6 months. Although all studies included interventions involving PA/exercise through action planning, coaching, or goal setting, there were significant variations in the PA-related methods and techniques employed, as well as in the inclusion of other lifestyle components alongside PA. A total of 14 studies [18, 35-38, 41, 44, 50, 52-54, 56, 57, 59] used digital interventions that delivered structured exercise programs, while other studies included flexible PA/exercise routines based on international guidelines. Regarding the type of physical exercise, all studies incorporated aerobic or moderate-to-vigorous PA as a core component, while 13 studies additionally included resistance or strength training [18, 35, 36, 40-42, 44, 50, 52-54, 56, 57]. All but three studies [44, 56, 59] incorporated multiple lifestyle components, including diet, sleep, and stress management, with diet being the most commonly used component alongside PA. Dietary guidance was provided in the form of dietary plans, goal setting based on dietary guidelines, nutritional advice, dietary coaching, and/or behavior change strategies related to eating habits.

Various digital tools, including mobile apps, websites, wearable devices, telecommunication platforms (e.g., videoconferencing), virtual reality, or a combination of two or more in most studies, were used in the interventions. These tools supported features such as program delivery, coaching, feedback provision, goal setting, tracking, and progress monitoring. They were implemented in various ways, including automated or manual feedback, self-guided or professionally guided programs, real-time or asynchronous coaching, gamification elements, integration with other health platforms, and different levels of interactivity. This resulted in a diverse range of intervention designs, delivery modes, and user engagement levels.

While four studies used a single-arm design [35, 36, 41, 47], the control groups in the other studies exhibited considerable variability, including active control(s) (such as alternative digital or non-digital interventions or usual care) [33, 34, 37-40, 42, 43, 45, 46, 49, 51-58], passive control (such as no intervention or waitlist group) [20, 44, 48], or a combination of both [16, 18, 50, 59], reflecting a diversity in methodological designs and approaches. All single-arm design studies demonstrated a significant reduction in outcome variables. Similarly, interventional studies comparing digital interventions to passive controls showed favorable effects. However, in studies comparing experimental groups to non-digital active controls, the results were inconsistent, with some reporting greater reductions in outcome variables following digital interventions [37, 42, 43, 45, 49, 51, 59], while others found no significant difference [16, 18, 38-40, 46, 50], and one even reported less reduction following digital interventions [34]. Common non-digital interventions included educational booklets, self-care advice, and in-person exercise programs.

Among the studies included in this review, 25 studies evaluated BW as an outcome variable. Overall, 22 studies (with an average intervention duration of 6.2 months, ranging from eight weeks to 24 months) reported significant BW reduction (range: -1.3 to -8.4 kg) following digital intervention programs [18, 20, 33, 35-43, 45-51, 53, 55, 58], while three studies found no significant change in BW following a 12-week multi-component telerehabilitation program [52], a 12-week smartphone mirroring-based telepresence exercise program [54], or a 24 months of mHealth intervention [34]. A total of 10 studies (with an average intervention duration of 9.0 months, ranging from three to 24 months) found significant differences in post-intervention BW between their study groups [33, 34, 37, 42, 43, 45, 48-50, 55], most of which used active control groups, while one study using passive controls [48] and another using a combination of both [50]. However, 10 studies (with an average intervention duration of 4.7 months, ranging from eight weeks to six months) reported no significant between-group differences in BW [18, 20, 38-40, 46, 52-54, 58], most of which used active control groups, while one study using passive controls [20] and another using a combination of both [18]. No clear pattern was observed in BW outcomes when comparing experimental groups to non-digital active controls, with some studies reporting greater BW reduction following digital interventions [37, 42, 43, 45, 49], while others found no significant difference [18, 38-40, 46] or reported less BW reduction following digital interventions [34].

In this review, 23 studies examined BMI as an outcome measure. In total, 19 studies (with an average intervention duration of 5.7 months, ranging from eight weeks to 24 months) observed a significant reduction in BMI (range: -0.4 to -3.4 kg/m^2) following digital intervention programs [16, 20, 33, 36, 37, 39, 41, 42, 45-51, 53, 55, 58, 59], while four studies (with an average intervention duration of 5.1 months, ranging from 10 weeks to 12 months) reported no significant BMI change following digital interventions [35, 52, 56, 57]. A total of eight studies (with an average intervention duration of 4.6 months, ranging from eight weeks to 12 months) reported significant differences in post-intervention BMI between study groups [37, 42, 45, 48-50, 58, 59], most of which used active control groups, while one study used passive controls [55) and two others employed a combination of both [50, 59]. However, nine studies (with an average intervention duration of 6.3 months, ranging from 10 weeks to 24 months) found no significant between-group differences in BMI changes [16, 20, 33, 39, 46, 52, 55-57] most of which used active control groups, with one study using passive controls [20) and another using a combination of both [16]. No clear trend was observed in BMI outcomes when comparing experimental groups to non-digital active controls, with some studies reporting greater BMI reduction following digital interventions [37, 42, 45, 49, 59], while others found no significant difference [16, 39, 46].

A sum of 16 studies examined WC as an outcome measure. Overall, 15 studies (with an average intervention duration of 6.0 months, ranging from eight weeks to 12 months) found a significant reduction in WC (range: -2.1 to -9.2 cm) following digital intervention programs [18, 20, 35, 37-39, 41, 42, 44, 46, 48, 50, 51, 56, 58], while one study showed no significant change following a three-month multi-component lifestyle intervention delivered via a mobile app [49]. Eight studies (with an average intervention duration of 5.1 months, ranging from eight weeks to 12 months) reported significant between-group differences in post-intervention WC [18, 37, 42, 44, 48-50, 58]; however, five studies (with an average intervention duration of 5.4 months, ranging from 12 weeks to six months) indicated no significant between-group differences [20, 38, 39, 46, 56]. There was also no clear trend in WC outcomes when comparing experimental groups to non-digital active controls, with three studies reporting greater WC reduction following digital interventions [37, 42, 49], while three others found no significant difference [38, 39, 46]. WHR was assessed in six studies, with two studies (conducting six-month and three-month interventions) reporting a significant reduction in WHR (-0.02 and -0.01, respectively) [38, 50], while the other four studies (with an average intervention duration of 6.0 months, ranging from 12 weeks to 12 months) found no change in WHR following digital intervention programs [36, 41, 49, 52].

In the present review, FM was examined as an outcome measure in seven studies (with an average intervention duration of 7.9 months, ranging from eight weeks to 24 months) , all of which found a significant reduction (range: -0.4 to -6.5 kg) following digital intervention programs [20, 33, 35, 46, 52, 57, 58]. Among them, three studies (with an average intervention duration of 3.5 months, ranging from eight weeks to six months) reported significant between-group differences after the intervention [20, 57, 58], while three others (with an average intervention duration of 11.0 months, ranging from 12 weeks to 24 months) found no significant difference in FM between their study groups [33, 46, 52]. In terms of BF%, nine studies measured this outcome (with an average intervention duration of 6.8 months, ranging from eight weeks to 24 months), all of which found a significant reduction (range: -0.3% to -4.1%) from pre- to post-tests in digital intervention groups [20, 33, 36, 46, 52, 54, 56-58]; however, the majority (eight studies) reported no significant between-group differences in BF% changes, and one study followed a single-arm design [36]. No clear trend was observed in FM and BF% outcomes when comparing digital-based experimental groups to non-digital active controls.

Regarding PA, eight studies provided information on changes in MVPA following digital interventions, with four reporting significant improvements with an average intervention duration of 9.2 months (range: 3-24 months) [16, 33, 43, 47] and the other four observing no change in MVPA with an average intervention duration of 5.2 months [18, 20, 39, 53]. A similar trend of inconsistent results was observed across other PA-related variables, including general PA [37, 45, 48- 50], light PA [18, 33, 53], moderate PA [20, 51], vigorous PA [20, 51], daily steps [51, 55, 56], grip strength [41, 54, 58], and the six-minute walk test [41, 52]. Additionally, five other variables, including exercise capacity [44], exercise fun [59], exercise self-efficacy [49], sit-to-stand test [41], and gait speed [41], were each assessed in just one study. Inconsistent trends in post-intervention changes were observed in these variables, with some showing significant improvements [44, 49, 59], while others displayed no significant changes [50], and some revealed mixed results within individual studies [41, 54].

Risk of Bias

Figure 2 summarizes the risk of bias assessment for the included studies, with Panel A presenting the overall assessment for randomized controlled trials (RCTs) and Panel B for non-randomized studies. Among RCTs, four were classified as having a “low risk of bias,” indicating a strong methodological design with minimal threats to validity. Seventeen studies were rated as having “some concerns,” suggesting potential sources of bias that could affect the reliability of their findings. Additionally, five studies were deemed to have a “high risk of bias,” highlighting significant methodological limitations that may compromise the robustness of their results. Among non RCTs, two were found to have a “moderate risk of bias,” implying methodological shortcomings that could impact their conclusions. The remaining two studies were rated as having “some concerns,” indicating the presence of potential biases that warrant caution when interpreting their findings. Excluding studies with a high or serious risk of bias did not substantially alter the overall pattern of results. Similarly, findings from the four low-risk-of-bias studies [42, 44, 45, 52] aligned with the general trends, and the seven studies with high or serious risk of bias showed the same pattern [16, 35-37, 40, 55, 58].

A

	D1	D2	D3	D4	D5	Overall
Alcántara-Aragón et al., 2018	+	?	?	+	+	?
Allen et al., 2013	+	?	?	+	+	?
Anderson et al., 2018	+	?	?	+	+	?
Apiñaniz et al., 2019	+	?	?	?	+	x
Ballin et al., 2020	+	?	+	+	+	?
Block et al., 2015	+	+	+	+	+	+
Bughin et al., 2021	+	+	+	+	+	+
Duncan et al., 2020	+	?	+	+	?	?
Hartman et al., 2016	+	?	+	+	?	?
Haufe et al., 2019	+	+	+	+	+	+
Hebden et al., 2014	+	?	+	+	?	?
Hong et al., 2022	+	?	?	+	+	?
Hurkmans et al., 2018	?	?	+	+	x	x
Hutchesson et al., 2018	+	+	?	+	+	?
Hyun et al., 2021	+	?	?	+	?	x
Jakicic et al., 2016	+	?	?	+	+	?
Johnson et al., 2019	?	?	+	?	?	x
Lim et al., 2022	+	+	+	+	+	+
Pressler et al., 2010	+	?	?	+	+	?
Rogers et al., 2016	+	?	?	+	+	?
Seo et al., 2023	+	?	+	?	+	?
Stephens et al., 2017	+	?	+	+	?	?
Svetkey et al., 2015	+	?	+	+	+	?
Watson et al., 2015	?	?	x	+	+	x
Wong et al., 2021	+	?	+	+	?	?
Zhang et al., 2023	+	?	?	+	+	?

+ Low risk of bias
? Some concerns
x High risk of bias

D1 (domain 1): Bias arising from the randomization process
D2 (domain 2): Bias due to deviations from intended interventions
D3 (domain 3): Bias due to missing outcome data
D4 (domain 4): Bias in measurement of the outcome
D5 (domain 5): Bias in selection of the reported result

B

	D1	D2	D3	D4	D5	D6	D7	Overall
Batsis et al., 2021	?	?	+	+	?	?	+	?
Héroux et al., 2017	?	?	+	-	!	+	+	!
Hurst et al., 2021	?	?	+	+	?	+	?	?
Lynch et al., 2017	-	?	?	+	?	?	+	!

+ Low risk of bias
? Moderate risk of bias
! Serious risk of bias
x Critical risk of bias
- No information

D1 (domain 1): Bias due to confounding
D2 (domain 2): Bias in selection of participants into the study
D3 (domain 3): Bias in classification of interventions
D4 (domain 4): Bias due to deviations from intended interventions
D5 (domain 5): Bias due to missing data
D6 (domain 6): Bias in measurement of the outcome
D7 (domain 7): Bias in selection of the reported result

Figure 2. Summary of risk of bias assessment using the Cochrane RoB 2 for RCTs (A) and the Cochrane ROBINS-I for non-randomized studies (B) [31, 32].

Discussion

This systematic review assessed the effectiveness of guideline-based digital exercise interventions in improving body composition in adults with overweight and obesity, aiming to identify gaps in the literature and recommend strategies for developing and implementing future digital health interventions. Additionally, alterations in PA were considered as secondary outcome. The main findings were: (1) digital exercise intervention programs led to significant reductions in BW (22/25 studies, range: -1.3 to -8.4 kg), BMI (19/23 studies, range: -0.4 to -3.4 kg/m²), WC (15/16 studies, range: -2.1 to -9.2 cm), BF% (9/9 studies, range: -0.3% to -4.1%), and FM (7/7 studies, range: -0.4 to -6.5 kg); (2) inconsistent results were observed for WHR and PA outcomes; (3) no clear trend was identified between intervention duration or type and improvements in outcome variables; (4) all digital exercise interventions were beneficial compared to passive or no-intervention controls but showed mixed effects on body composition when compared to active controls; and (5) substantial variations were observed in intervention designs, comparators, confounders, and participant characteristics.

Consistent with the present review, evidence from other review studies suggests that mobile health (mHealth) and digital tools can be effective for BW reduction [60-64]. Results from a systematic review indicate that electronic health (eHealth) interventions are generally more effective than no care or usual care interventions [65], which is in contrast with the findings of the present review in relation to usual care interventions, where no clear pattern emerged in BW reduction between digital intervention groups and usual care controls. Research suggests that the impact of digital interventions on BW reduction may be influenced by factors such as intervention duration and design. In particular, the effectiveness of mHealth interventions for BW reduction tends to increase with longer intervention durations [62, 66]. Further, it has been documented that digital interventions incorporating personalized feedback and human interaction are more effective than fully automated programs [65, 67]. In this regard, evidence suggests that successful digital interventions often include components such as self-monitoring, social support, goal setting, and prolonged engagement, all of which are crucial for enhancing user engagement and promoting sustained behavior change [68, 69].

In line with the results of this review, evidence from comparable review studies suggests that mHealth/digital interventions can be effective in reducing BMI [60-62, 70, 71], with their impact largely influenced by factors such as the type of intervention, its integration with other health services, and user engagement levels [65, 72, 73]. In the present review, no clear pattern was found between the type and duration of interventions and BMI reductions. However, a review found that longer intervention duration enhanced the effectiveness of mHealth/digital interventions in reducing BMI [62]. Cultural and regional factors may also indirectly influence the effectiveness of mHealth interventions in BW outcomes; nevertheless, a study evaluating a digital weight loss intervention across multiple countries found similar BW outcomes even though levels of participants' engagement varied [74]. These factors may contribute to the high degree of heterogeneity among studies on this topic, as their inclusion adds complexity to the interventions. However, it is important to note that the methodological quality of studies on digital interventions for BW and BMI reduction varies significantly, which can affect the reliability of their findings and the associated review studies [65, 75], though excluding studies with low methodological quality did not substantially alter the overall pattern of results in the present study.

WC and WHR are two important obesity-related measurements used to assess fat distribution. A meta-analysis reported a statistically significant reduction in WC in adults with overweight/obesity following mHealth interventions [60]. Similarly, another review study found a consistent reduction in WC following web- and mobile-based interventions [71]. These findings align with the results of the present review, which examines the effectiveness of guideline-based digital exercise interventions on WC. Results from another systematic review show that mHealth and eHealth interventions, especially those with personalized feedback, have been associated with reductions in central obesity measures [76]. While there is a lack of similar review studies in the literature assessing the impact of digital interventions on WHR, the present review identified two studies reporting a reduction in WHR, while four others found no change following digital intervention programs. This insignificant trend, which has not been observed in BW, BMI, or WC, may be attributed to the fact that WHR appears to be an inaccurate measure of obesity in obese individuals, as both waist and hip circumferences reflect fat accumulation in these individuals [77], and fat loss occurs throughout the body, not in specific regions.

Consistent with the present review, there are review studies reporting that mHealth/digital interventions can lead to significant reductions in BF% [62, 71]. Inconsistently, results from a meta-analysis show an insignificant change in BF% following mHealth interventions in overweight/obese adults, while FM reduction was significant [60]. The discrepancy in BF%, but not in FM, compared to the present review findings may be due to the primary focus of the present review on the PA component, specifically guideline-based PA, as exercise contributes to increased lean mass, thereby having a greater impact on BF%. Research shows that interventions using telehealth and text messaging have also demonstrated positive effects on body fat reduction by providing continuous support and motivation, which can enhance adherence to the lifestyle changes necessary for fat reduction [78]. The use of multiple electronic modalities, such as combining mHealth with other digital tools, tends to yield more significant results in fat reduction compared to single-modality interventions, offering a more comprehensive and engaging intervention experience [79]. Although mHealth/digital interventions demonstrate potential for fat reduction, evidence indicates that the long-term sustainability of these interventions remains uncertain, and their effectiveness may differ based on factors such as socioeconomic status and ethnicity, which could contribute to disparities in health outcomes [80]. Overall, based on the available literature and the present findings, effective digital PA interventions for improving body composition typically incorporate human interaction and sustained engagement, with personalized feedback, social support, and goal setting further enhancing their efficacy.

There is limited evidence showing apps to be more effective for PA outcomes than face-to-face interventions [60, 81, 82]; however, digital tools may offer benefits in terms of cost-effectiveness and the ability to reach a larger and more geographically dispersed population [10, 11]. Insufficient and inconsistent results were found for PA outcomes in the present review. However, reports from review studies indicate an increase in general PA [83], daily step counts [64], and weekly MVPA [64) following mHealth interventions. Another review study examining the effects of mHealth interventions on older adults reported an increase in weekly MVPA [84]. A recent umbrella review of mHealth and eHealth interventions reported a significant increase in daily step counts among adult populations [85]. However, two systematic reviews found no significant change in general PA [81] or MVPA [60] following mHealth interventions. These discrepancies, which have also been observed in the present review, may be explained by variations in intervention design and duration, target populations, and the methods used to measure PA outcomes. A review study highlighted that combining digital media with face-to-face support showed the greatest potential for increasing PA compared to digital-only interventions [82]. This highlights the need for more rigorous research to confirm the long-term benefits of digital interventions in improving PA; however, the methodological quality of the included studies in the present review did not alter the results related to PA outcomes.

This systematic review presents a comprehensive evaluation of guideline-based digital exercise interventions across multiple anthropometric/body composition outcomes as well as PA-related variables. The inclusion of a variety of intervention formats allows for a broad understanding of the effectiveness of mHealth/digital approaches. Additionally, the review follows a rigorous methodology, ensuring high-quality data analysis and synthesis, thereby contributing to the growing body of evidence-based literature on digital health interventions for improving body composition and promoting PA. While the heterogeneity in intervention designs and duration has made direct comparisons challenging, variations in participant characteristics (such as baseline BMI, PA levels, sex distributions, age, socioeconomic status, and comorbidities) may have influenced individual study results, and consequently, the findings of this systematic review. Moreover, the variability in comparator groups, ranging from passive controls (such as waitlist or no intervention) to active controls (including alternative digital interventions, educational booklets, self-care advice, and in-person exercise programs), may have influenced the review validity. Furthermore, variation in potential confounders, such as dietary habits and other lifestyle factors, along with differences in adherence rates and self-reporting accuracy, may have further contributed to inconsistencies in the reported effects of the interventions. The quality of evidence supporting mHealth interventions should also be considered, as it may vary widely, though this was not observed in the present study. Some systematic reviews and meta-analyses have rated the methodological quality of studies as low to moderate, with only a few achieving high-quality ratings, primarily due to differences in study design, sample size, and outcome measures [87, 88].

Overall, this review provides insights for individuals, trainers, coaches, healthcare providers, health organizations, app developers, and policymakers by identifying the potential benefits of apps/digital tools focusing on PA for BW management, thereby contributing to the broader effort to manage overweight and obesity effectively. In addition, the findings highlight areas for future research to optimize the design and implementation of fitness apps for better health outcomes. Future research should focus on the role of personalized and adaptive digital programs, as well as their integration with other lifestyle interventions. By understanding the essential characteristics that enhance the effectiveness of digital health interventions, stakeholders can make informed decisions about integrating them into weight management programs and public health strategies. Meanwhile, clinicians and healthcare providers can leverage digital technologies to improve accessibility, enhance patient engagement, optimize treatment adherence, and support long-term success in weight management programs.

Conclusions

This systematic review of 30 studies on guideline-based digital exercise interventions reveals the potential of digital interventions for reducing BW, BMI, BF%, FM, and WC in adults with overweight/obesity; however, contradictory results were observed for WHR and PA-related outcomes. Although longer-duration interventions showed a trend toward greater BW reduction, no clear pattern emerged between the type or duration of interventions and improvements in body composition. Digital exercise interventions generally showed favorable effects when compared to passive controls or no controls; however, their effectiveness in improving body composition was inconsistent when compared to active controls (such as alternative digital or non-digital interventions or usual care). Key characteristics that are often identified as critical for successful digital PA interventions include personalized content, regular user engagement, and integration with other health strategies, such as dietary management and social support. While this review highlights the potential benefits of guideline-based digital exercise interventions for weight management, it also provides valuable insights to inform decisions about integrating them into health programs and public health strategies. Overall, digital health interventions can reach a larger population at a lower cost and have been shown to be effective for weight loss; however, evidence of their superiority over traditional methods is limited and inconsistent, suggesting that digital interventions may serve as a complementary approach rather than a definitive replacement for traditional methods. As technology continues to evolve, future interventions have the potential to examine and offer more tailored, engaging, and effective solutions for weight management.

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Author Contributions

Mohamad Motevalli: Conceptualization, Investigation, Formal analysis, Funding acquisition, Methodology, Writing - Original Draft, Writing - Review & Editing. Clemens Drenowatz: Conceptualization, Supervision, Investigation (third reviewer), Formal analysis, Methodology, Writing - Review & Editing. Derrick R. Tanous: Investigation (second reviewer), Formal analysis, Methodology, Writing - Review & Editing. Gerhard Ruedl: Investigation, Writing - Review & Editing. Werner Kirschner: Investigation, Writing - Review & Editing. Markus Schauer: Writing - Review & Editing. Thomas Rosemann: General support, Writing - Review & Editing. Katharina C. Wirnitzer: Conceptualization, Supervision, Investigation, Funding acquisition, Methodology, Writing - Review & Editing. All authors critically reviewed and agreed to the final version of the article to submit for publication.

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Conflicts of Interest

The authors declare no conflicts of interest.

Abbreviations

BF%: body fat percentage
BMI: body mass index
BW: body weight
eHealth: electronic health
FM: fat mass
LPA: light physical activity
MeSH: Medical Subject Headings
mHealth: mobile health
MPA: moderate physical activity
MVPA: moderate-to-vigorous physical activity

PA: physical activity
PICOS: population, intervention, comparison, outcome, and study design
PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PROSPERO: International Prospective Register of Systematic Reviews
RCTs: randomized controlled trials
RoB 2: Risk of Bias 2 Tool
ROBINS-I: Risk Of Bias In Non-randomized Studies - of Interventions
VPA: vigorous physical activity
WC: waist circumference
WHO: World Health Organization
WHR: waist-to-hip ratio

Multimedia Appendix 1

Table of keywords used in database search with Boolean operators: AND (between categories) & OR (between keywords within each category)

Multimedia Appendix 2

PRISMA 2020 checklist

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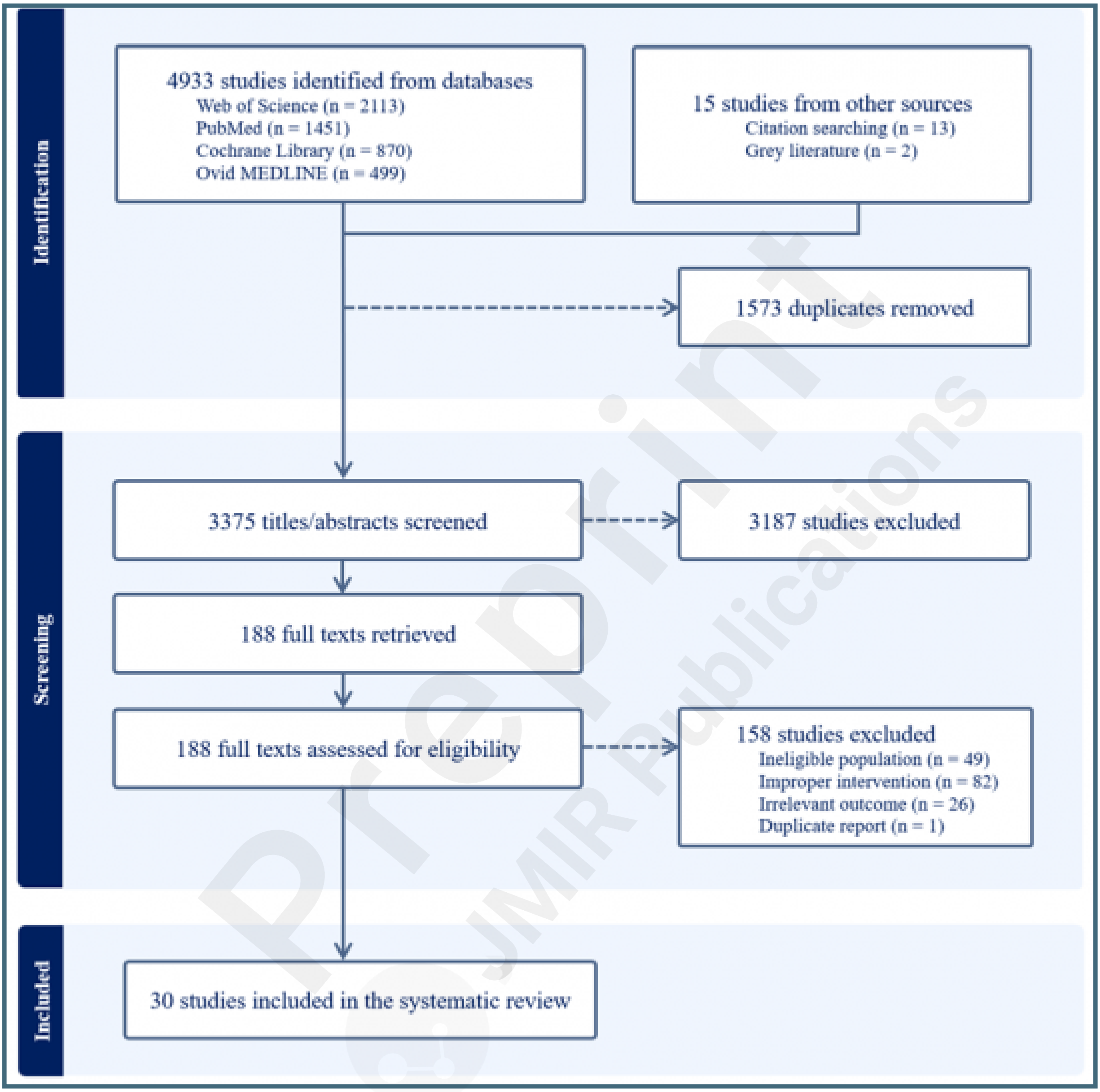
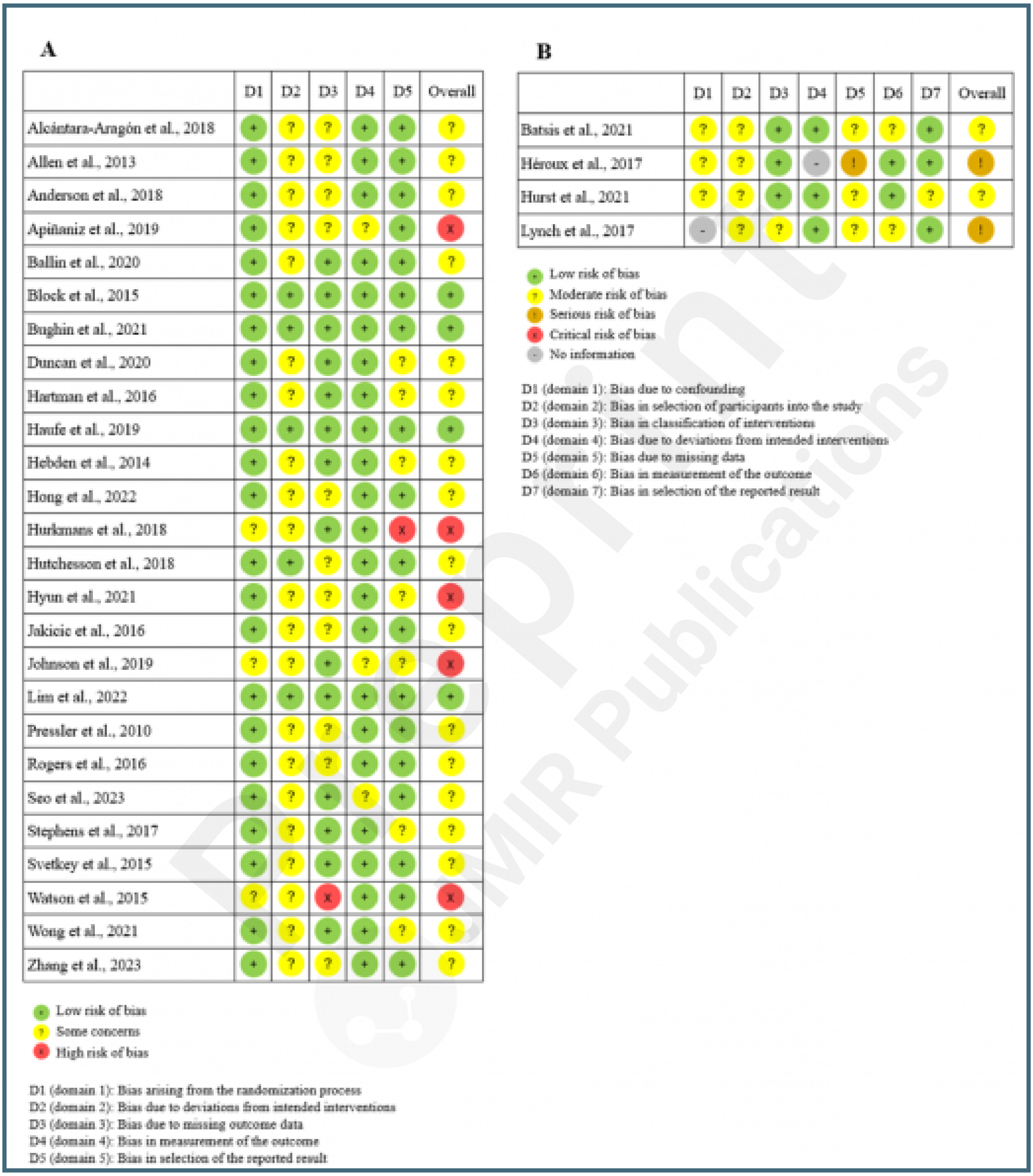
Supplementary Files

Figures

PRISMA flowchart showing the study identification, screening, and inclusion process.



Summary of risk of bias assessment using the Cochrane RoB 2 for RCTs (A) and the Cochrane ROBINS-I for non-randomized studies (B).



A

	D1	D2	D3	D4	D5	Overall
Alcántara-Aragón et al., 2018	+	?	?	+	+	?
Allen et al., 2013	+	?	?	+	+	?
Anderson et al., 2018	+	?	?	+	+	?
Apiñaniz et al., 2019	+	?	?	?	+	x
Ballin et al., 2020	+	?	+	+	+	?
Block et al., 2015	+	+	+	+	+	+
Bughin et al., 2021	+	+	+	+	+	+
Duncan et al., 2020	+	?	+	+	?	?
Hartman et al., 2016	+	?	+	+	?	?
Haufe et al., 2019	+	+	+	+	+	+
Hebden et al., 2014	+	?	+	+	?	?
Hong et al., 2022	+	?	?	+	+	?
Hurkmans et al., 2018	?	?	+	+	x	x
Hutchesson et al., 2018	+	+	?	+	+	?
Hyun et al., 2021	+	?	?	+	?	x
Jakicic et al., 2016	+	?	?	+	+	?
Johnson et al., 2019	?	?	+	?	?	x
Lim et al., 2022	+	+	+	+	+	+
Pressler et al., 2010	+	?	?	+	+	?
Rogers et al., 2016	+	?	?	+	+	?
Seo et al., 2023	+	?	+	?	+	?
Stephens et al., 2017	+	?	+	+	?	?
Svetkey et al., 2015	+	?	+	+	+	?
Watson et al., 2015	?	?	x	+	+	x
Wong et al., 2021	+	?	+	+	?	?
Zhang et al., 2023	+	?	?	+	+	?

+ Low risk of bias
? Some concerns
x High risk of bias

D1 (domain 1): Bias arising from the randomization process
D2 (domain 2): Bias due to deviations from intended interventions
D3 (domain 3): Bias due to missing outcome data
D4 (domain 4): Bias in measurement of the outcome
D5 (domain 5): Bias in selection of the reported result

B

	D1	D2	D3	D4	D5	D6	D7	Overall
Batsis et al., 2021	?	?	+	+	?	?	+	?
Héroux et al., 2017	?	?	+	-	!	+	+	!
Hurst et al., 2021	?	?	+	+	?	+	?	?
Lynch et al., 2017	-	?	?	+	?	?	+	!

+ Low risk of bias
? Moderate risk of bias
! Serious risk of bias
x Critical risk of bias
- No information

D1 (domain 1): Bias due to confounding
D2 (domain 2): Bias in selection of participants into the study
D3 (domain 3): Bias in classification of interventions
D4 (domain 4): Bias due to deviations from intended interventions
D5 (domain 5): Bias due to missing data
D6 (domain 6): Bias in measurement of the outcome
D7 (domain 7): Bias in selection of the reported result

Multimedia Appendixes

Keywords used in database search with Boolean operators: AND (between categories) & OR (between keywords within each category).
URL: http://asset.jmir.pub/assets/e7808c50233d814994223a8f74f9bed4.docx

Prisma checklist.
URL: http://asset.jmir.pub/assets/791a79994c956109327e32855cbd568f.docx