Review

Effectiveness of Digital Lifestyle Interventions on Depression, Anxiety, Stress, and Well-Being: Systematic Review and Meta-Analysis

Jacinta Brinsley[1], PhD; Edward J O'Connor[2], PhD; Ben Singh[1], PhD; Grace McKeon[3], PhD; Rachel Curtis[1], PhD; Ty Ferguson[1], PhD; Georgia Gosse[4], BPT; Iris Willems[5,6], MSc; Pieter-Jan Marent[5,7], MSc; Kimberley Szeto[1], BHSc; Joseph Firth[8,9], PhD; Carol Maher[1], PhD

[1]Alliance for Research in Exercise, Nutrition and Activity, University of South Australia, Adelaide, Australia

[2]Health & Biosecurity, Commonwealth Scientific and Industrial Research Organisation (CSIRO), Adelaide, Australia

[3]Discipline of Psychiatry and Mental Health, School of Clinical Medicine, Nutrition, Exercise and Social Equity (NExuS), University of New South Wales, Sydney, Australia

[4]IIMPACT in Health, University of South Australia, Adelaide, Australia

[5]Department of Movement and Sports Sciences, Research Centre for Aging Young, Ghent University, Ghent, Belgium

[6]Research Foundation Flanders, Brussels, Belgium

[7]Department of Movement Sciences, KU Leuven, Leuven, Belgium

[8]Division of Psychology and Mental Health, Manchester Academic Health Science Centre, The University of Manchester, Manchester, United Kingdom

[9]Manchester Academic Health Science Centre, Greater Manchester Mental Health NHS Foundation Trust, Manchester, United Kingdom

Corresponding Author:
Jacinta Brinsley, PhD
Alliance for Research in Exercise, Nutrition and Activity
University of South Australia
108 North Terrace
Adelaide, 5000
Australia
Phone: 61 8 8302 6558
Email: jacinta.brinsley@unisa.edu.au

Abstract

Background: There is a growing body of robust evidence to show that lifestyle behaviors influence mental health outcomes. Technology offers an accessible and cost-effective implementation method for interventions, yet the study of the effectiveness of interventions to date has been specific to the mode of delivery, population, or behavior.

Objective: The primary aim of this review was to comprehensively evaluate the effectiveness of digital lifestyle interventions for improving symptoms of depression, anxiety, stress, and well-being as coprimary outcomes in adults. The secondary aim was to explore the technological, methodological, intervention-specific, and population-specific characteristics that were associated with major changes in mental health outcomes.

Methods: A systematic search was conducted across the MEDLINE, CINAHL, Embase, Emcare, PsycINFO, and Scopus databases to identify studies published between January 2013 and January 2023. Randomized controlled trials of lifestyle interventions (physical activity, sleep, and diet) that were delivered digitally; reported changes in symptoms of depression, anxiety, stress, or well-being in adults (aged ≥18 years); and were published in English were included. Multiple authors independently extracted data, which was evaluated using the 2011 Levels of Evidence from the Oxford Centre for Evidence-Based Medicine. Inverse-variance random-effects meta-analyses were used for data analysis. The primary outcome was the change in symptoms of depression, anxiety, stress, and well-being as measured by validated self-report of clinician-administered outcomes from pre- to postintervention. Subgroup analyses were conducted to determine whether results differed based on the target lifestyle behavior, delivery method, digital features, design features, or population characteristics.

Results: Of the 14,356 studies identified, 61 (0.42%) were included. Digital lifestyle interventions had a significant small-to-medium effect on depression (standardized mean difference [SMD] −0.37; *P*<.001), a small effect on anxiety (SMD −0.29; *P*<.001) and stress (SMD −0.17; *P*=.04), and no effect on well-being (SMD 0.14; *P*=.15). Subgroup analyses generally

suggested that effects were similar regardless of the delivery method or features used, the duration and frequency of the intervention, the population, or the lifestyle behavior targeted.

Conclusions: Overall, these results indicate that delivering lifestyle interventions via a range of digital methods can have significant positive effects on depression ($P<.001$), anxiety ($P<.001$), and stress ($P=.04$) for a broad range of populations, while effects on well-being are inconclusive. Future research should explore how these interventions can be effectively implemented and embedded within health care with a concerted focus on addressing digital health equity.

Trial Registration: PROSPERO CRD42023428908; https://www.crd.york.ac.uk/PROSPERO/view/CRD42023428908

Introduction

Background

Mental disorders are among the leading causes of global disease burden [1] and a significant risk factor for premature mortality [2]. Recent estimates suggest that between 5% and 19% of global disability-adjusted life-years can be attributed to mental disorders [1,3], causing annual economic losses of approximately US $4.7 trillion [4]. These mental health difficulties cause enormous psychological impact, have widespread deleterious effects on health behaviors [5], and vastly increase the odds of experiencing physical health morbidities [6].

There is increasing recognition that poor lifestyle behaviors, such as diet, physical activity, and sleep, contribute to both poor physical and mental health. Concurrently, there is increasing evidence for the role of lifestyle interventions in preventing, managing, and treating mental illness [7-9]. Numerous clinical guidelines and health policy documents now call for lifestyle behaviors to be addressed alongside pharmacotherapies and psychotherapy, as part of mental health care [10].

Digital technology offers a promising avenue for revolutionizing mental health care delivery on a global scale. Digital interventions can also reduce the stigma associated with seeking help [11], while data-driven insights allow for personalized and efficient interventions tailored to individual needs.

In recent years, an increasing number of studies have demonstrated the effectiveness of digital interventions in delivering mental health treatments [12], including compelling outcomes for smartphone-delivered psychological interventions in reducing depression and anxiety symptoms [13,14]. Concurrently, research related to digital lifestyle interventions is increasing rapidly [15]. A growing body of evidence shows that these interventions can be effective for improving health behaviors such as physical activity [16], sleep quality [17], weight loss [18], and healthy diet [19]. However, there is little evidence specifically focused on the effect of digital lifestyle interventions on mental health and well-being outcomes in the general population. The few reviews in this area have focused on singular lifestyle behaviors such as physical activity [20], specific clinical populations [21], or a single delivery method [22] or have reported lifestyle behavior changes but not changes in mental health [19,23]. Moreover, only 1 review has

synthesized data from >10 randomized controlled trials (RCTs) [19]. This fragmented approach limits our ability to rigorously discern the effectiveness of the various intervention components and combinations on mental health across the general population.

Objectives

This systematic review and meta-analysis takes a broad approach, aiming to provide a thorough synthesis of the evidence on digitally delivered lifestyle interventions for depression, anxiety, stress, and well-being outcomes in adults. Recognizing that mental health is more than the absence of disorders and distress [24], we also evaluated the effectiveness of digital lifestyle interventions on psychological well-being (ie, well-being), as operationalized by van Agteren et al [25]. Here, well-being refers to positive aspects of mental health, including positive affect and life satisfaction (ie, subjective well-being), as well as meaning, purpose, and related concepts (ie, psychological well-being).

Given the breadth of the review, the secondary aim was to explore the technology-specific intervention features that are associated with greater mental health outcomes. We further considered the impact of various methodological (ie, study quality), intervention-specific (ie, type, delivery method, and delivery features), and population-specific (ie, general population, those with a mental illness, and those with a physical illness) characteristics. Finally, this review aimed to shed light on the overall quality of the evidence provided in the meta-analyses and discuss the implications of the evidence for future research and lifestyle intervention delivery.

Methods

This systematic review and meta-analysis adheres to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines [26] and is registered with PROSPERO (CRD42023428908). A completed PRISMA checklist for this study is available in Multimedia Appendix 1.

Search Strategy and Selection of Studies

The following electronic databases were searched from January 2013 to January 10, 2023: MEDLINE (Ovid), CINAHL (EBSCOhost), Embase (Ovid), Emcare (Ovid), PsycINFO (Ovid), and Scopus. Subject heading, keyword, and Medical Subject Headings term searches relating to technology,

XSL•FO

RenderX

modifiable lifestyle behaviors (ie, physical activity, diet, and sleep), mental health, and study design were used. Full search queries are detailed in Multimedia Appendix 2. Additional searches were conducted using Google Scholar and by scanning the reference lists of included papers and review articles to identify any additional studies. Studies were exported to Covidence (Veritas Health Innovation Ltd), and duplicates were removed. Studies were screened in duplicate with conflicts resolved between the 2 reviewers or a third independent reviewer.

Inclusion and Exclusion Criteria

To be included in this systematic review and meta-analysis, studies needed to meet the following criteria: (1) involve adults (aged ≥18 years) of any health status and (2) include a digitally delivered lifestyle intervention targeting physical activity, diet, sleep, or any combination thereof. We defined digital lifestyle interventions as interventions delivered via digital technologies (such as apps, websites, and wearable devices) that were self-guided and did not require real-time clinician delivery (eg, behavior change and education) and aimed to improve lifestyle behaviors [27]. Considering the nature of the research, we included interventions that were supplemented with contact for follow-up or adherence and technology support (eg, orientation session or phone call to create a user profile or a peer-driven social forum moderated by a clinician). Lifestyle interventions were eligible if at least 50% of the intervention was focused on physical activity, diet, and sleep. Physical activity was considered in the broadest sense, including overall physical activity levels, structured exercise interventions, and studies examining reducing physical inactivity (ie, sedentary time). Diet was considered as any intervention targeting food intake (ie, amount or type). Studies focusing on supplementation or specific nutrient treatments were excluded. Sleep interventions were considered as anything targeting sleep; therefore, psychological therapies targeting sleep (eg, cognitive behavioral therapy for insomnia) were eligible for inclusion; (3) studies that had an adequate control condition of no treatment, treatment as usual, waitlist control, or attention (ie, sham) control were included, while control groups that received an alternative intervention comprising behavior change techniques or an in-person version of the digital intervention were excluded, as they would limit our ability to evaluate the effectiveness of the intervention; (4) studies that reported changes in symptoms of depression, anxiety, psychological stress, or well-being using validated tools were included, and due to the broad and varied definitions of well-being [28], we considered well-being measures listed as per the review by van Agteren et al [25]. Studies that focused on momentary affective states were considered outside the scope of this review and were excluded; (5) RCTs were included. No restriction was placed on the setting or context of the included studies.

Data Synthesis and Analysis

In total, 2 reviewers independently extracted data using a predefined data extraction sheet, cross-checked the data, assessed study quality, and resolved disagreements by discussion or referral to a third reviewer (JB or CM). The authors of the included studies were contacted to provide additional data for inclusion in the meta-analysis if required.

Intervention effect sizes (ie, differences between intervention and control groups) for outcome data were calculated across all studies and standardized to Hedges g [29] along with the SE. Studies were grouped by outcomes (ie, depression, anxiety, stress, and well-being) for analyses. Random-effects meta-analyses were conducted due to expected heterogeneity. All analyses used an inverse variance method with restricted maximum-likelihood estimator for τ^2 and Hartung-Knapp adjustment for the random effects model. Standardized mean differences (SMDs) were used as the effect measure for meta-analyses to allow comparison of data from different scales. If means and SDs were not reported in a study, authors were contacted twice before means and SDs were calculated based on available data using recommended formulas (eg, using sample size, median, and range) [30]. Meta-analyses were conducted only when at least 5 studies were included. Effect sizes were categorized as small (0.2), medium (0.5), or large (≥0.8) [31], with a significance level set at .05 [32]. Cochrane Q test was used to assess statistical heterogeneity, and the I^2 statistic was used to quantify the proportion of the overall outcome effect attributed to heterogeneity. The following cutoff values for the I^2 statistic were used: 0%-29%=no heterogeneity, 30%-49%=moderate heterogeneity, 50%-74%=substantial heterogeneity, and 75%-100%=considerable heterogeneity [33]. Publication bias was assessed with visual inspection of funnel plots and tested using the Begg-Mazumdar [34] and Egger regression method [35], with a P value <.05 suggesting the presence of bias. Where significant bias was detected, a Duval and Tweedie [36] trim-and-fill analysis was applied. Heterogeneity was explored with subgroup and sensitivity analyses. Sensitivity analyses were conducted by removing outliers, studies with samples <100, studies of poor to fair quality, and those with attrition >25% to investigate changes in effect for each outcome. All analyses were conducted in R software (version 4.2.0, "Mountain Hydrangea"; R Foundation for Statistical Computing).

Quality Assessment

The risk of bias of each study was assessed using the Physiotherapy Evidence Database Scale (PEDro) [37]. The PEDro scale comprises 10 questions, each answered as yes or no. A study was deemed to be high quality with a score of 6 to 10, fair quality with a score of 4 to 5, and low quality with a score <4.

The overall level of evidence was graded using the Oxford Centre for Evidence-Based Medicine 2011 Levels of Evidence [38] as follows: grade A—consistent level 1 studies (ie, individual RCTs with narrow CIs), grade B—consistent level 2 (ie, individual cohort studies or low-quality RCTs) or level 3 studies (ie, individual case-control studies) or extrapolations from level 1 studies, grade C—level 4 studies or extrapolations from level 2 or 3 studies, or grade D—level 5 (ie, expert opinion without explicit critical appraisal) evidence or inconsistent or inconclusive studies of any level.

Subgroup Analyses

The central aim of this review was to examine the effect of various methodological, intervention-specific, and population-specific factors on the effectiveness of digital lifestyle interventions for mental health outcomes [39]. Intervention-specific factors included the lifestyle behavior; the intervention targeted (ie, physical activity alone, diet alone, sleep alone, herein referred to as the respective singular behavior, or any combination of these behaviors, which is referred to herein as multibehavioral); delivery method (ie, web based, app, email or text, and wearable device); features of delivery format (ie, use of a chatbot or gamification); frequency and duration of the intervention; whether the intervention was co-designed, individualized, or publicly available; and whether it contained a theoretical underpinning. The frequency of intervention delivery was split into three categories: (1) intended daily use; (2) 1 to 4 times per week; and (3) "other," which included fortnightly, monthly, varied, once-off, and self-paced engagement. Methodological factors were control group types and study quality. Study quality was based on the risk of bias, where studies were categorized into poor, fair, good, or excellent as per the PEDro scoring. Control groups were divided into no treatment, including waitlist; treatment as usual; or attention control. To determine which populations might benefit most from digital lifestyle interventions, we conducted subgroup analyses for each outcome for apparently healthy adults; those with a physical health condition; those diagnosed with a mental health condition; and, due to the number of sleep-specific studies, people who met the criteria for insomnia.

Deviation From the Registered Protocol

We originally planned to include interventions targeting alcohol, smoking, and substance use as behaviors, considering their association with poor mental health outcomes. However, due to the unfeasible volume of search results and their distinct focus on addiction, these lifestyle behaviors were excluded from this review.

Results

Included Studies

Searching of databases yielded 14,357 results. Following the removal of duplicates, 9727 potentially eligible studies remained for which abstracts were screened. At full-text stage, 230 studies were reviewed, and 169 were removed because they failed to meet the inclusion criteria (Multimedia Appendix 3). The remaining 61 studies were included in the review, and 59 studies were included in the quantitative synthesis (Figure 1).

Figure 1. PRISMA flowchart of study selection.
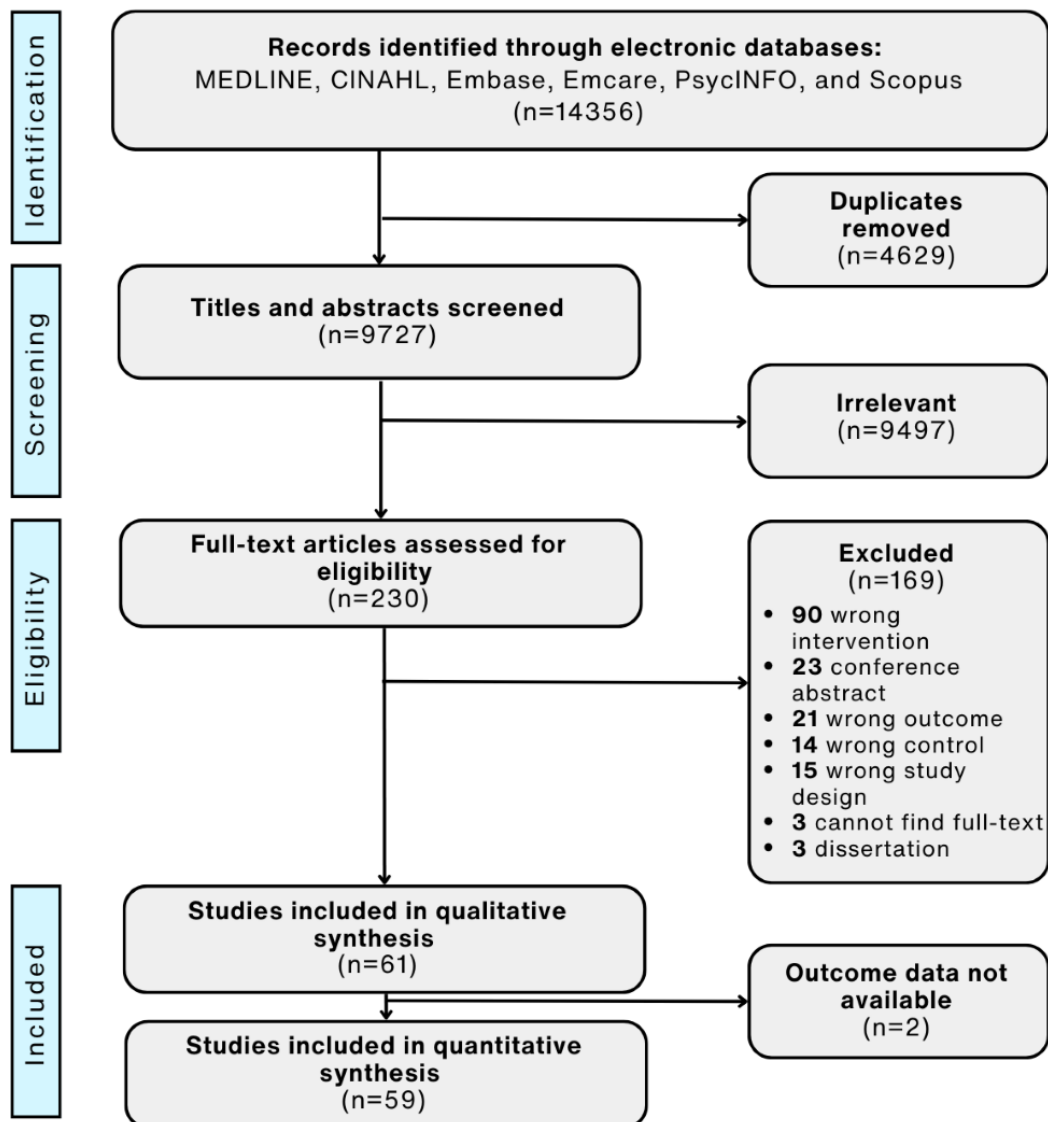
Study Characteristics

In total, 22,483 participants across 61 studies were included in the review. Sample sizes ranged between 20 and 3755 participants, and the mean age ranged between 19 and 68 years. Interventions lasted between 2 and 52 weeks. Studies originated from Europe, America, Canada, Australia, New Zealand, the United Kingdom, Iran, and Asia. Full details of each study are outlined in Table 1.

Table 1. Descriptive characteristics of the included studies.

Study	Country	Sample population; N; female (%)	Intervention						Mental health outcome	Publicly available	Risk of bias, PEDro[a] score
			Study aim	Behaviors targeted	Delivery format	Comparator	Duration (wk)	Included BCTs[b]			
Abbott et al [40], 2021	United States	Individuals experiencing major depressive disorder; 71; 86%	Efficacy for depressive symptoms	PA[c], diet, and sleep	Web based	Waitlist	6	No	PHQ-9[d] (secondary)	No	6
Abedi et al [41], 2015	Iran	Postmenopausal women; 106; 100%	Effectiveness for depression, anxiety, and insomnia	PA	Wearable	No treatment	12	Yes	BDI[e] (primary)	No	6
Bade et al [42], 2021	United States	Individuals with advanced-stage lung cancer; 40; 75%	Feasibility, effectiveness for PA, QoL[f], depression	PA	Wearable, app, and SMS text messages	Treatment as usual	12	Yes	PHQ-9 (secondary)	No	7
Bailey et al [43], 2020	United Kingdom	Individuals with diabetes; 20; 50%	Feasibility	PA and sleep	App	Treatment as usual	8	Yes	WEMWBS[g] (secondary)	No	7
Bennion et al [44], 2020	United States	Low-income postpartum women; 370; 100%	Effectiveness for weight loss	PA and diet	Web based and SMS text messages	Treatment as usual	52	Yes	EPDS[h] (secondary)	No	7
Bossen et al [45], 2013	Netherlands	Individuals with hip and knee OA[i]; 199; 65%	Effectiveness for PA	PA	Web based and emails	Waitlist	9	Yes	HADS[j] (secondary)	Yes; Join2Move	7
Brindal et al [46], 2019	Australia	Individuals who had 5% weight loss in past 2 years; 88; 75%	Effectiveness for weight, food, exercise, mood, and stress	PA and diet	App	Attention control	12	Yes	DASS[k]-21 and SLS[l]-5 (primary)	Yes: MotiMate	7
Carli et al [47], 2022	Italy and Portugal	Individuals with somatic disorders; 425; 44%	Effectiveness for depressive symptoms	PA, diet, and sleep	App and sensorized shirt	Treatment as usual	12	Yes	BDI-II (primary)	Yes; NEVERMIND	8
Chee et al [48], 2016	United States	Asian American women with depressive symptoms; 33; 100%	Preliminary efficacy for depressive symptoms	PA	Web based	No treatment	12	Yes	CES-D[m] (primary)	No	5
Cheng et al [49], 2019	United States	Individuals experiencing insomnia; 1358; 38%	Efficacy for depression	Sleep	Web based and emails	Attention control	12	Yes	CES-D (primary)	Yes; Sleepio	9

Study	Country	Sample population; N; female (%)	Intervention						Mental health outcome	Publicly available	Risk of bias, PEDro[a] score
			Study aim	Behaviors targeted	Delivery format	Comparator	Duration (wk)	Included BCTs[b]			
Christensen et al [50], 2016	Australia	Individuals experiencing insomnia and depressive symptoms; 1149; 74%	Effectiveness for depressive symptoms	Sleep	App and emails	Attention control	6	Yes	PHQ-9 (primary)	Yes; Sleepio	9
Conner et al [51], 2017	New Zealand	Young adults; 115; 67%	Effectiveness for fruit or vegetable consumption	Diet	SMS text messages	No treatment	2	No	CES-D and HADS (primary)	No	7
Devi et al [52], 2014	United Kingdom	Individuals with stable angina; 95; 26%	Effectiveness for cardiac rehabilitation	PA and diet	Website	Treatment as usual	6	Yes	HADS (secondary)	Yes; ActivateYourHeart	8
Duan et al [53], 2017	China	University students; 493; 71%	Effectiveness for PA and fruit or vegetable consumption	PA and diet	Website	No intervention	8	Yes	CES-D (secondary)	No	4
Duan et al [54], 2018	China	Individuals with coronary heart disease; 114; 57%	Efficacy for PA and fruit or vegetable consumption	PA and diet	Website	Treatment as usual	8	Yes	CES-D (secondary)	No	5
Eberts et al [55], 2015	Germany	Teachers with insomnia symptoms; 128; 74%	Efficacy for work-related stress and sleep	Sleep	Website	Waitlist	8	Yes	CES-D (secondary)	No	7
Eckert et al [56], 2022	United States	Individuals with allogenic bone marrow transplant; 72; 55%	Feasibility	PA	Website	Attention control	12	No	PROMIS[n] (exploratory)	Yes; Udaya	7
Edney et al [57], 2020	Australia	Community; 284; 74%	Effectiveness for PA	PA	App	Waitlist	12	Yes	DASS-21 (secondary)	No	6
Espie et al [58], 2019	United Kingdom	Individuals experiencing insomnia; 1712; 78%	Effectiveness for health and well-being	Sleep	App	Treatment as usual	12	Yes	WEMWBS (primary), PHQ-9, and GAD-7[o] (secondary)	Yes; Sleepio	8
Falk et al [59], 2022	United States	Sedentary employees; 47; 74%	Associations with well-being, stress, mood, and fatigue	PA	Website	Waitlist	12	Yes	PSS[p] (exploratory)	No	7

Study	Country	Sample population; N; female (%)	Intervention						Mental health outcome	Publicly available	Risk of bias, PE-Dro[a] score
			Study aim	Behaviors targeted	Delivery format	Comparator	Duration (wk)	Included BCTs[b]			
Felder et al [60], 2020	United States	Pregnant women; 208; 100%	Efficacy for insomnia	Sleep	App	Treatment as usual	10	Yes	EPDS and GAD-7 (secondary)	Yes; Sleepio	7
Freeman et al [61], 2017	United Kingdom	University students with insomnia; 3755; 71%	Effectiveness for insomnia, paranoia, and hallucinations	Sleep	App	Treatment as usual	10	Yes	PHQ-9, GAD-7, and WEMWBS (secondary)	Yes; Sleepio	10
Glozier et al [62], 2019	Australia	Older men experiencing depression; 87; 0%	Effectiveness for depression and insomnia	Sleep	App	Attention control	12	Yes	CES-D (primary)	Yes; SHUTi	9
Golsteijn et al [63], 2018	Netherlands	Patients with cancer; 478; 13%	Efficacy for PA	PA	Web based and wearable	Treatment as usual	12	Yes	HADS (secondary)	No	7
Hershner and O'Brien [64], 2018	United States	College students; 551; 57%	Effectiveness for sleep behavior	Sleep	Web based	No intervention	8	No	PHQ-9 (secondary)	No	4
Hilmarsdottir et al [65], 2020	Iceland	Individuals with type 2 diabetes; 37; 51%	Effectiveness for metabolic health	PA and diet	App	Not reported	52	Yes	HADS and PAID[q] (exploratory)	Yes; Sidekick-Health	7
Horsch et al [66], 2017	Netherlands	Individuals experiencing insomnia; 151; 63%	Efficacy for insomnia	Sleep	App	Waitlist	7	Yes	HADS (secondary)	Yes; Sleepcare	8
Houchen-Wolloff et al [67], 2018	United Kingdom	Individuals with coronary heart disease; 60; 10%	Feasibility of web-based cardiac rehab	PA	Website	Treatment as usual	8	Yes	HADS (exploratory)	Yes; ActivateYourHeart	8
Huberty et al [68], 2019	United States	Individuals with myolo-proliferative neoplasm; 62; 94%	Feasibility and preliminary effectiveness for QoL	PA	Website	Waitlist	12	No	PROMIS (exploratory)	No	8
Ifejika et al [69], 2020	United States	Individuals who experienced stroke; 36; 44%	Feasibility and preliminary effectiveness for monitoring diet	Diet	App	Attention control	26	Yes	PHQ-9 (secondary)	Yes; Lose it!	6
Joutsenniemi et al [70], 2014[r]	Finland	General population; 3274; 83%	Effectiveness of PA versus positive psychology on happiness	PA	Email	Attention control	16	No	BDI (secondary)	No	7

XSL•FO
RenderX

Study	Country	Sample population; N; female (%)	Intervention						Mental health outcome	Publicly available	Risk of bias, PEDro[a] score
			Study aim	Behaviors targeted	Delivery format	Comparator	Duration (wk)	Included BCTs[b]			
Katz et al [71], 2018	United States	Individuals with rheumatoid arthritis; 96; 88%	Effectiveness for PA and fatigue	PA	Wearable	Treatment as usual	21	Yes	PHQ-8 (secondary)	No	7
Kuhn et al [72], 2022	United States	Veterans; 50; 42%	Feasibility, acceptability, and preliminary efficacy for insomnia	Sleep	App	Waitlist	6	Yes	PHQ-8 and GAD-7 (secondary)	Yes; insomnia coach	9
Lambert et al [73], 2018	United Kingdom	Individuals who experienced depression; 62; 84%	Feasibility and acceptability in community setting	PA	Web based	Treatment as usual	8	Yes	PHQ-8 and GAD-7 (secondary)	No	6
Lambert et al [74], 2022	Canada	Individuals with prostate cancer; 49; 0%	Feasibility, acceptability, and clinical significance for anxiety and QoL	PA	Web based	Waitlist	10	Yes	HADS (secondary)	No	7
Lopez et al [75], 2019	France	Individuals experiencing insomnia; 46; 74%	Efficacy for insomnia	Sleep	Web based	Treatment as usual	12	Yes	BDI (secondary)	No	7
Lorenz et al [76], 2019	Switzerland	Individuals experiencing insomnia; 56; 69%	Efficacy for insomnia	Sleep	Web based	Waitlist	6	Yes	BDI and APSQ[s] (secondary)	Yes; Mementor somnium	9
McGrath et al [77], 2017	United Kingdom	Individuals with elevated blood pressure; 134; 61%	Efficacy for reducing blood pressure	Sleep	Web based and text or email	Treatment as usual	8	Yes	BDI and BAI[t] (secondary)	Yes; Sleepio	9
Mensorio [78], 2019	Spain	Individuals with obesity and hypertension; 106; 80%	Efficacy for promoting lifestyle changes	PA and diet	Web based	Treatment as usual	12	Yes	DASS-21 (secondary)	No	7
Mueller et al [79], 2022	United Kingdom	Individuals who are overweight or obese; 388; 78%	Effectiveness for body-weight, eating behavior, PA, and well-being	PA and diet	Web based and email	Treatment as usual	12	Yes	PHQ-9 and GAD-7 (secondary)	No	8
Murawski et al [80], 2019	Australia	Individuals who are inactive and experience poor sleep; 160; 80%	Efficacy for sleep and PA	PA and sleep	App, wearable, and email or text	Waitlist	12	Yes	DASS-21 (secondary)	Yes; balanced	6

Study	Country	Sample population; N; female (%)	Intervention						Mental health outcome	Publicly available	Risk of bias, PEDro[a] score
			Study aim	Behaviors targeted	Delivery format	Comparator	Duration (wk)	Included BCTs[b]			
Nystrom et al [81], 2017	Sweden	Individuals experiencing depression; 312; 76%	Evaluate or compare PA and behavior activation	PA	App and text or email	Waitlist	12	Yes	PHQ-9 and GAD-7 (secondary)	No	7
Philippot et al [82], 2022	Belgium	Higher education students; 30; 92%	Feasibility for psychological symptoms	PA	Web based	No intervention	4	No	DASS-21 (secondary)	No	7
Przybylko et al [83], 2021	Australia	General population; 508; 70%	Effectiveness for mental health and well-being	PA and diet	Web based	Waitlist	10	Yes	DASS-21 (primary)	Yes; The Lift Project	6
Puig-Ribera et al [84], 2017	Spain	Office workers; 264; 65%	Effectiveness for presenteeism, well-being, and performance	PA	Web based and wearable	Attention control	19	Yes	WEMWBS (secondary)	No	6
Puterman et al [85], 2022	Canada	Inactive general population; 334; 87%	Effectiveness for depressive symptoms	PA	App	Waitlist	6	No	CES-D (primary)	No	6
Ritterband et al [86], 2012	United States	Patients with cancer experiencing insomnia; 28; 86%	Effectiveness for insomnia	Sleep	Web based and email	Waitlist	9	No	HADS (secondary)	Yes; SHUT-i	8
Savard et al [87], 2014[r]	Canada	Individuals with breast cancer; 242; 100%	Efficacy of video-based cognitive behavioral therapy in breast cancer	Sleep	DVD	No intervention	6	Yes	HADS (secondary)	No	10
Serrat et al [88], 2022	Spain	Individuals with fibromyalgia; 330; 97%	Effectiveness for fibromyalgia	PA	Web based	Treatment as usual	12	No	HADS (secondary)	No	7
Shaffer et al [89], 2022	United States	Older adults; 311; 69%	Effectiveness for depression and anxiety	Sleep	Web based and email	Attention control	10	Yes	HADS (primary)	Yes; SHUT-i	3
Spanhel et al [90], 2022	Germany	Refugees; 66; 27%	Feasibility for insomnia and sleep	Sleep	Web based	Waitlist	4	Yes	PHQ-9 (secondary)	No	8
Stiglbauer et al [91], 2019	Austria	University students; 105; 63%	Efficacy of self-tracking device on health	PA	App and wearable	Waitlist	2	Yes	PERMA[u]-Profiler (secondary)	No	5

| Study | Country | Sample population; N; female (%) | Intervention | | | | | | Mental health outcome | Publicly available | Risk of bias, PEDro[a] score |
			Study aim	Behaviors targeted	Delivery format	Comparator	Duration (wk)	Included BCTs[b]			
Teychenne et al [92], 2021	Australia	Postpartum women; 62; 100%	Feasibility and acceptability for health behaviors	PA	Web based	No intervention	12	Yes	EPDS and GAD-7 (secondary)	No	7
Vandelanotte et al [93], 2022	Australia	General population; 501; 72%	Efficacy on depression, anxiety, stress, and QoL	PA	Web based	Treatment as usual	12	Yes	DASS-21 (primary)	No	6
Wan et al [94], 2017	United States	Individuals with coronary obstructive pulmonary disease; 118; 2%	Effectiveness for increasing step count	PA	Web based and wearable	Attention control	12	Yes	BDI (secondary)	No	8
Wang et al [95], 2022	China	Individuals with PCOS[v]; 122; 100%	Effectiveness for PCOS	PA and diet	App	Treatment as usual	52	Yes	SDS[w] and SAS[x] (secondary)	No	7
Wang F and Boros S [96], 2020	Hungary	Young adults; 54; 53%	Effectiveness for sleep quality, stress, and life satisfaction	PA	Wearable	No intervention	4	Yes	PSS-4 and SWLS[y] (secondary)	No	5
Wong et al [97], 2021	China	Individuals with depressive symptoms; 79; 85%	Efficacy for depressive symptoms	PA, diet, and sleep	App	Waitlist	8	Yes	PHQ-9 and GAD-7 (primary)	No	7
Young et al [98], 2021	Australia	Individuals who are overweight or obese; 125; 0%	Effectiveness for weight loss and depression	PA, diet, and sleep	Web based and wearable	No intervention	12	Yes	PHQ-9 (primary) and GAD-7 (secondary)	Yes; SHED-IT	7
Xuto et al [99], 2022	Thailand	Pregnant women; 66; 100%	Effectiveness for health behaviors and anxiety	PA and diet	SMS text messages	Treatment as usual	28	No	STAI[z] (secondary)	No	8

Study	Country	Sample population; N; female (%)	Intervention						Mental health outcome	Publicly available	Risk of bias, PE-Dro[a] score
			Study aim	Behaviors targeted	Delivery format	Comparator	Duration (wk)	Included BCTs[b]			
Yudi et al [100], 2017	Australia	Individuals with acute coronary syndrome; 2016; 16%	Efficacy for exercise capacity and cardiac risk factor	PA	App	Treatment as usual	8	Yes	CDS[aa] and HADS-A (secondary)	No	8

[a]PEDro: Physiotherapy Evidence Database Scale.

[b]BCT: behavior change technique.

[c]PA: physical activity.

[d]PHQ-9: 9-item Patient Health Questionnaire.

[e]BDI: Beck Depression Inventory.

[f]QoL: Quality of life.

[g]WEMWBS: Warwick-Edinburgh Mental Well-Being Scale.

[h]EPDS: Edinburgh postnatal depression scale.

[i]OA: osteoarthritis.

[j]HADS: Hospital Anxiety and Depression Scale.

[k]DASS: Depression Anxiety and Stress Scale.

[l]SLS: selective laser sintering.

[m]CES-D: Centre for Epidemiological Studies Depression.

[n]PROMIS: Patient-Reported Outcomes Measurement Information System.

[o]GAD-7: Generalized Anxiety Disorder-7.

[p]PSS: Perceived Stress Scale.

[q]PAID: problem areas in diabetes.

[r]Not included in quantitative analyses.

[s]APSQ: Perceived Stress Scale.

[t]BAI: bay-annulated indigo.

[u]PERMA: Positive Emotions, Engagement, Relationships, Meaning, Accomplishment.

[v]PCOS: Polycystic Ovarian Syndrome.

[w]SDS: Self-Rating Depression Scale.

[x]SAS: Self-Rating Anxiety Scale.

[y]SWLS: Satisfaction with Life Scale.

[z]STAI: State Trait Anxiety Inventory.

[aa]CDS: Cardiac Depression Scale.

A total of 55 studies assessed depressive symptoms [40-42,44-58,60-83,85-90,92-95,97,98,100], 35 assessed anxiety symptoms [45,46,50-52,57,58,60,61,63,65-68,72-74, 76-83,86,88,89,92,93,95,97-100], 11 assessed stress [44,46,57,59,65,78,80,82,83,93,96], and 6 assessed well-being [43,46,61,84,91,96]. Overall, 24 studies included apparently healthy adults [44,46,48,50,51,53,55,57,59,64,70, 76,80,82-85,89-93,99]; 23 included adults with a physical health condition [43,45,47,52,54,56,63,65,67-69,71,74,77-79,86, 88,94,95,98,100]; 6 included adults with a mental health condition, all of which were depressive disorders [40,41,62,73,81,97]; and a further 8 included adults with insomnia [49,58,60,61,66,72,75,87]. Interventions were digitally delivered via the web (38/61, 62%) [40,44,45,48-50,52-56,58-64,67,68,73-79,82-84,86,88-90,92-94,98], app (17/61, 28%) [42,43,46,47,57,60,65,66,69,72,80,81, 85,91,95,97,100], email, or SMS text messages (15/61, 25%) [44,46,51,58,61,63,70,77,79-81,86,89,99,100], and 16% (10/61) of the interventions included a wearable activity tracker [41,42,57,63,71,80,91,94,96,98]. A total of 15 interventions used >1 delivery method [42,44,57,58,61,63,77,79-81,86,89,91,94,98]. Of the 61 interventions, 26 (43%) targeted physical activity [41,42,45,48,56,57,59,63,67,68,70,71,73,74,81,82,84,85, 88,91-94,96,100], 17 (29%) targeted sleep [49,50,55,58,60-62,64,66,72,75-77,86,87,89,90], 2 (3%) targeted diet [51,69], and 16 (27%) targeted multiple lifestyle behaviors [42,44,57,58,61,63,79-81,86,89,91,94,98]. Of the 17 studies targeting multiple behaviors, 4 (24%) targeted physical activity, diet, and sleep [40,47,97,98]; 11 (65%) targeted physical activity and diet [44,46,52-54,65,78,79,83,95,99]; and 2 (12%) targeted physical activity and sleep [43,80].

Mental health (ie, depression, anxiety, stress, and well-being) outcomes were measured as a primary outcome in 14 studies [41,46-51,62,83,85,89,93,97,98]. The risk of bias of the included studies is detailed in Multimedia Appendix 4.

Meta-Analyses

For 2 of the included studies, the outcome data of interest was not presented in the manuscript and was unavailable after contacting the corresponding author [70,87].

Publication Bias

Visual inspection of funnel plots (Multimedia Appendix 5) suggests that there was no publication bias for depression (Kendall τ=−0.093, P=.33; Egger regression=0.19, P=.85), anxiety (Kendall τ=−0.106, P=.38; Egger regression=0.90, P=.37), or stress (Kendall τ=−0.055, P=.88; Egger regression=−0.11, P=.92).

Heterogeneity

There was significant heterogeneity across study data for depression (Q=166; P<.001; I^2=69%) and anxiety (Q=55; P=.01; I^2=39%). Stress and well-being data had moderate, nonsignificant heterogeneity (Q=17; P=.07; I^2=42% and Q=8; P=.15; I^2=39%, respectively).

Overall Effects of Digital Lifestyle Interventions on Symptoms of Depression

Pooled effects from 53 studies (ie, 12,385 participants) showed a small-to-medium significant effect of digital lifestyle interventions for reducing depressive symptoms in comparison to all control conditions (SMD=−0.37; 95% CI −0.46 to −0.27; P<.001; Figure 2).

Figure 2. Meta-analysis of the effects of digital lifestyle interventions on symptoms of depression [40-42,44-58,60-69,71-83,85,86,88-90,92-95,97,98,100]. SMD: standardized mean difference.
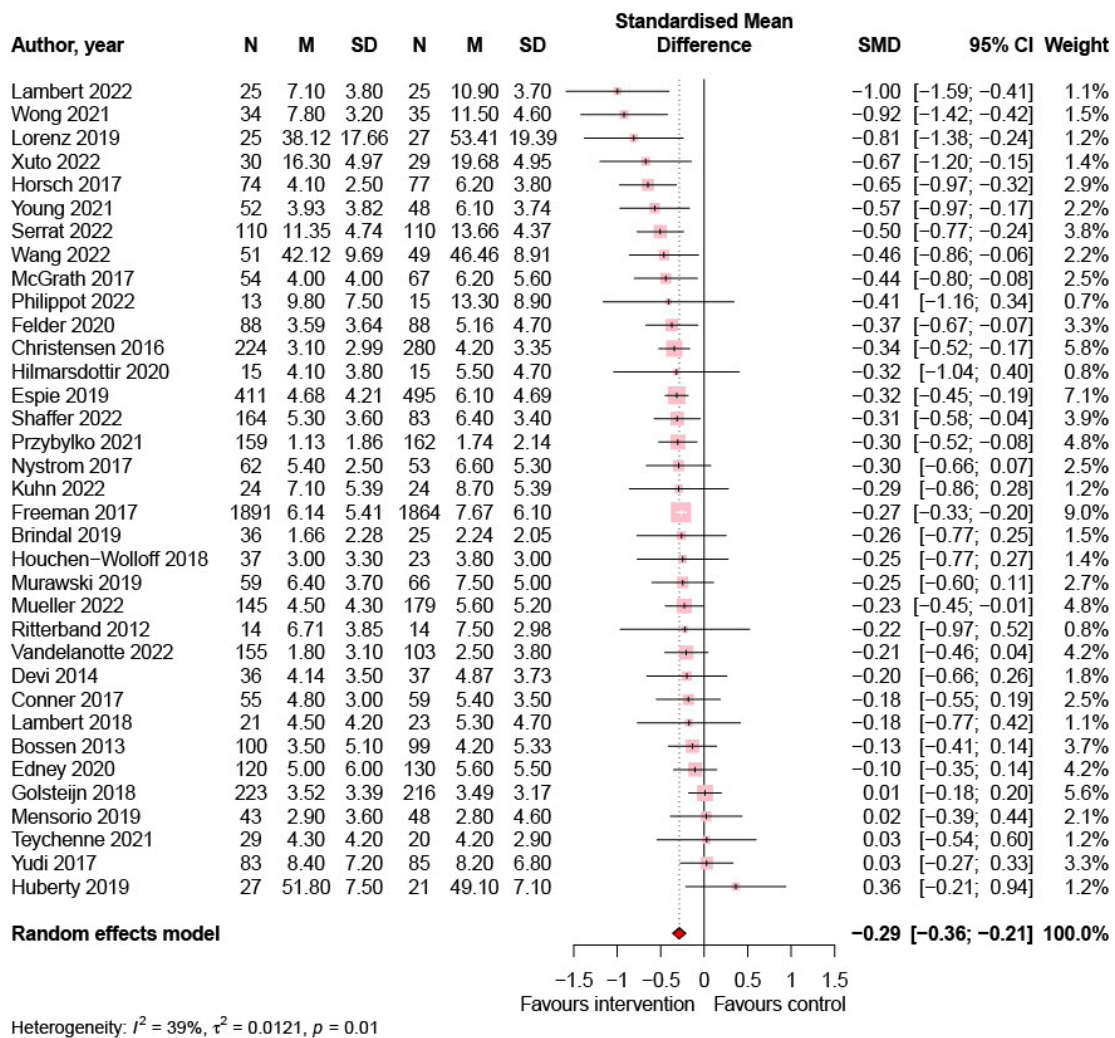
Author, year	N	M	SD	N	M	SD	Standardised Mean Difference	SMD	95% CI	Weight
Bade 2021	20	2.70	0.70	19	3.90	0.80		−1.57	[−2.29; −0.84]	1.0%
Wang 2022	51	40.57	5.41	49	49.24	7.14		−1.36	[−1.80; −0.93]	1.8%
Abedi 2015	48	13.70	5.00	49	19.60	4.79		−1.20	[−1.63; −0.76]	1.8%
Abbott 2021	26	5.00	6.11	28	13.50	9.26		−1.06	[−1.63; −0.49]	1.4%
Young 2021	52	6.47	6.13	48	12.21	6.03		−0.94	[−1.35; −0.52]	1.9%
Lambert 2022	25	8.70	4.80	25	12.90	4.20		−0.92	[−1.50; −0.33]	1.3%
Ifejika 2020	15	3.00	2.22	12	6.00	4.81		−0.81	[−1.60; −0.01]	0.9%
Philippot 2022	13	7.20	6.60	15	13.20	8.50		−0.76	[−1.53; 0.01]	1.0%
Wong 2021	34	8.80	3.80	35	11.60	4.70		−0.65	[−1.13; −0.16]	1.6%
Shaffer 2022	164	3.50	3.20	83	5.60	3.60		−0.63	[−0.90; −0.36]	2.4%
Serrat 2022	110	10.15	4.93	110	13.12	4.53		−0.63	[−0.90; −0.35]	2.4%
Lopez 2019	18	5.00	2.96	20	8.00	5.93		−0.62	[−1.27; 0.04]	1.2%
Przybylko 2021	159	1.49	2.45	162	3.17	3.17		−0.59	[−0.81; −0.37]	2.5%
Ebert 2015	49	13.17	6.85	51	19.22	13.17		−0.57	[−0.97; −0.17]	1.9%
Houchen−Wolloff 2018	37	1.50	1.40	23	2.50	2.20		−0.56	[−1.10; −0.03]	1.5%
Ritterband 2012	14	3.21	2.42	14	5.14	4.02		−0.56	[−1.32; 0.19]	1.0%
Horsch 2017	45	11.00	5.60	62	15.50	9.50		−0.55	[−0.94; −0.16]	1.9%
Christensen 2016	224	3.80	2.99	280	5.50	3.35		−0.53	[−0.71; −0.35]	2.7%
Cheng 2019	358	6.80	5.38	300	9.10	4.79		−0.45	[−0.60; −0.29]	2.7%
Espie 2019	411	6.20	4.40	495	8.20	4.90		−0.43	[−0.56; −0.29]	2.8%
Lorenz 2019	25	5.48	5.56	27	8.00	6.09		−0.42	[−0.98; 0.13]	1.4%
Nystrom 2017	62	7.10	3.80	53	9.30	6.50		−0.42	[−0.79; −0.05]	2.0%
Carli 2022	213	6.88	7.42	212	10.21	8.62		−0.41	[−0.61; −0.22]	2.6%
Mensorio 2019	43	1.73	2.60	48	3.00	3.50		−0.41	[−0.82; 0.01]	1.8%
Felder 2020	88	5.36	4.20	88	7.25	5.05		−0.41	[−0.70; −0.11]	2.3%
Spanhel 2022	28	8.60	6.40	29	10.90	6.50		−0.37	[−0.89; 0.16]	1.5%
Puterman 2022	251	7.17	5.71	83	9.25	5.58		−0.37	[−0.62; −0.12]	2.4%
Freeman 2017	1891	8.00	6.54	1864	10.34	6.79		−0.35	[−0.42; −0.29]	2.9%
Teychenne 2021	31	6.00	4.30	25	7.40	3.60		−0.34	[−0.88; 0.19]	1.5%
Kuhn 2022	24	8.60	4.90	24	10.00	4.90		−0.28	[−0.85; 0.29]	1.4%
Murawski 2019	59	10.60	7.60	66	12.60	8.00		−0.25	[−0.61; 0.10]	2.1%
Lambert 2018	21	3.70	4.40	23	4.80	4.30		−0.25	[−0.84; 0.35]	1.3%
Hilmarsdottir 2020	15	3.30	3.00	15	4.20	4.60		−0.23	[−0.94; 0.49]	1.1%
Duan 2018	44	1.00	0.47	39	1.12	0.60		−0.22	[−0.65; 0.21]	1.8%
McGrath 2017	54	6.50	5.80	67	7.90	6.70		−0.22	[−0.58; 0.14]	2.0%
Hershner 2018	161	4.60	4.98	197	5.60	4.94		−0.20	[−0.41; 0.01]	2.6%
Glozier 2019	41	18.50	12.00	38	20.90	11.80		−0.20	[−0.64; 0.24]	1.8%
Brindal 2019	36	2.22	2.88	25	2.77	2.55		−0.20	[−0.71; 0.31]	1.5%
Mueller 2022	145	6.10	5.10	179	7.00	5.40		−0.17	[−0.39; 0.05]	2.5%
Edney 2020	120	6.50	7.00	130	7.70	7.60		−0.16	[−0.41; 0.09]	2.4%
Bennion 2020	174	5.50	4.22	196	6.12	4.20		−0.15	[−0.35; 0.06]	2.6%
Bossen 2013	100	2.60	5.61	99	3.20	5.58		−0.11	[−0.38; 0.17]	2.3%
Eckert 2022	18	47.20	11.47	25	48.50	13.65		−0.10	[−0.71; 0.51]	1.3%
Golsteijn 2018	223	3.09	3.34	216	3.31	3.08		−0.07	[−0.26; 0.12]	2.7%
Duan 2017	88	1.99	0.59	54	2.02	0.57		−0.06	[−0.40; 0.28]	2.1%
Devi 2014	36	2.00	1.48	37	2.00	3.15		0.00	[−0.46; 0.46]	1.7%
Huberty 2019	27	47.30	7.90	21	47.20	6.70		0.01	[−0.56; 0.58]	1.4%
Wan 2017	57	8.60	7.96	52	8.50	6.80		0.01	[−0.36; 0.39]	2.0%
Conner 2017	55	13.10	8.40	59	12.80	10.10		0.03	[−0.34; 0.40]	2.0%
Yudi 2017	83	68.50	25.10	85	65.20	25.40		0.13	[−0.17; 0.43]	2.2%
Vandelanotte 2022	155	3.50	5.60	104	2.80	4.40		0.14	[−0.11; 0.38]	2.4%
Chee 2016	13	19.27	10.77	14	15.46	8.74		0.38	[−0.38; 1.14]	1.0%
Katz 2018	31	7.30	4.30	26	5.70	2.80		0.43	[−0.10; 0.95]	1.5%
Random effects model								−0.37	[−0.46; −0.27]	100.0%

−2   −1   0   1   2
Favours intervention   Favours control

Heterogeneity: $I^2 = 69\%$, $\tau^2 = 0.0732$, $p < 0.01$

Overall Effects of Digital Lifestyle Interventions on Symptoms of Anxiety

Figure 3 displays the pooled effect size from 35 studies (9383/22,483, 41.73%), showing a small-to-medium positive effect of digital lifestyle interventions compared to all control conditions on symptoms of anxiety (SMD=−0.29; 95% CI −0.36 to −0.21; *P*<.001).

Figure 3. Meta-analysis of the effects of digital lifestyle interventions on symptoms of anxiety [45,46,50-52,57,58,60,61,63,65-68,72,73,75-83,86,88,89,92,93,95,97-100]. SMD: standardized mean difference.

Author, year	N	M	SD	N	M	SD	SMD	95% CI	Weight
Lambert 2022	25	7.10	3.80	25	10.90	3.70	−1.00	[−1.59; −0.41]	1.1%
Wong 2021	34	7.80	3.20	35	11.50	4.60	−0.92	[−1.42; −0.42]	1.5%
Lorenz 2019	25	38.12	17.66	27	53.41	19.39	−0.81	[−1.38; −0.24]	1.2%
Xuto 2022	30	16.30	4.97	29	19.68	4.95	−0.67	[−1.20; −0.15]	1.4%
Horsch 2017	74	4.10	2.50	77	6.20	3.80	−0.65	[−0.97; −0.32]	2.9%
Young 2021	52	3.93	3.82	48	6.10	3.74	−0.57	[−0.97; −0.17]	2.2%
Serrat 2022	110	11.35	4.74	110	13.66	4.37	−0.50	[−0.77; −0.24]	3.8%
Wang 2022	51	42.12	9.69	49	46.46	8.91	−0.46	[−0.86; −0.06]	2.2%
McGrath 2017	54	4.00	4.00	67	6.20	5.60	−0.44	[−0.80; −0.08]	2.5%
Philippot 2022	13	9.80	7.50	15	13.30	8.90	−0.41	[−1.16; 0.34]	0.7%
Felder 2020	88	3.59	3.64	88	5.16	4.70	−0.37	[−0.67; −0.07]	3.3%
Christensen 2016	224	3.10	2.99	280	4.20	3.35	−0.34	[−0.52; −0.17]	5.8%
Hilmarsdottir 2020	15	4.10	3.80	15	5.50	4.70	−0.32	[−1.04; 0.40]	0.8%
Espie 2019	411	4.68	4.21	495	6.10	4.69	−0.32	[−0.45; −0.19]	7.1%
Shaffer 2022	164	5.30	3.60	83	6.40	3.40	−0.31	[−0.58; −0.04]	3.9%
Przybylko 2021	159	1.13	1.86	162	1.74	2.14	−0.30	[−0.52; −0.08]	4.8%
Nystrom 2017	62	5.40	2.50	53	6.60	5.30	−0.30	[−0.66; 0.07]	2.5%
Kuhn 2022	24	7.10	5.39	24	8.70	5.39	−0.29	[−0.86; 0.28]	1.2%
Freeman 2017	1891	6.14	5.41	1864	7.67	6.10	−0.27	[−0.33; −0.20]	9.0%
Brindal 2019	36	1.66	2.28	25	2.24	2.05	−0.26	[−0.77; 0.25]	1.5%
Houchen−Wolloff 2018	37	3.00	3.30	23	3.80	3.00	−0.25	[−0.77; 0.27]	1.4%
Murawski 2019	59	6.40	3.70	66	7.50	5.00	−0.25	[−0.60; 0.11]	2.7%
Mueller 2022	145	4.50	4.30	179	5.60	5.20	−0.23	[−0.45; −0.01]	4.8%
Ritterband 2012	14	6.71	3.85	14	7.50	2.98	−0.22	[−0.97; 0.52]	0.8%
Vandelanotte 2022	155	1.80	3.10	103	2.50	3.80	−0.21	[−0.46; 0.04]	4.2%
Devi 2014	36	4.14	3.50	37	4.87	3.73	−0.20	[−0.66; 0.26]	1.8%
Conner 2017	55	4.80	3.00	59	5.40	3.50	−0.18	[−0.55; 0.19]	2.5%
Lambert 2018	21	4.50	4.20	23	5.30	4.70	−0.18	[−0.77; 0.42]	1.1%
Bossen 2013	100	3.50	5.10	99	4.20	5.33	−0.13	[−0.41; 0.14]	3.7%
Edney 2020	120	5.00	6.00	130	5.60	5.50	−0.10	[−0.35; 0.14]	4.2%
Golsteijn 2018	223	3.52	3.39	216	3.49	3.17	0.01	[−0.18; 0.20]	5.6%
Mensorio 2019	43	2.90	3.60	48	2.80	4.60	0.02	[−0.39; 0.44]	2.1%
Teychenne 2021	29	4.30	4.20	20	4.20	2.90	0.03	[−0.54; 0.60]	1.2%
Yudi 2017	83	8.40	7.20	85	8.20	6.80	0.03	[−0.27; 0.33]	3.3%
Huberty 2019	27	51.80	7.50	21	49.10	7.10	0.36	[−0.21; 0.94]	1.2%
Random effects model							**−0.29**	**[−0.36; −0.21]**	**100.0%**

Heterogeneity: $I^2 = 39\%$, $\tau^2 = 0.0121$, $p = 0.01$

Overall Effects of Digital Lifestyle Interventions on Stress

Pooled effects from 11 studies (n=1608) showed a small positive effect of digital lifestyle interventions compared to all control conditions on stress (SMD=−0.17; 95% CI −0.33 to −0.01; P=.04; Figure 4).

Figure 4. Meta-analysis of the effects of digital lifestyle interventions on stress [44,46,57,59,65,78,80,82,83,93,96]. SMD: standardized mean difference.
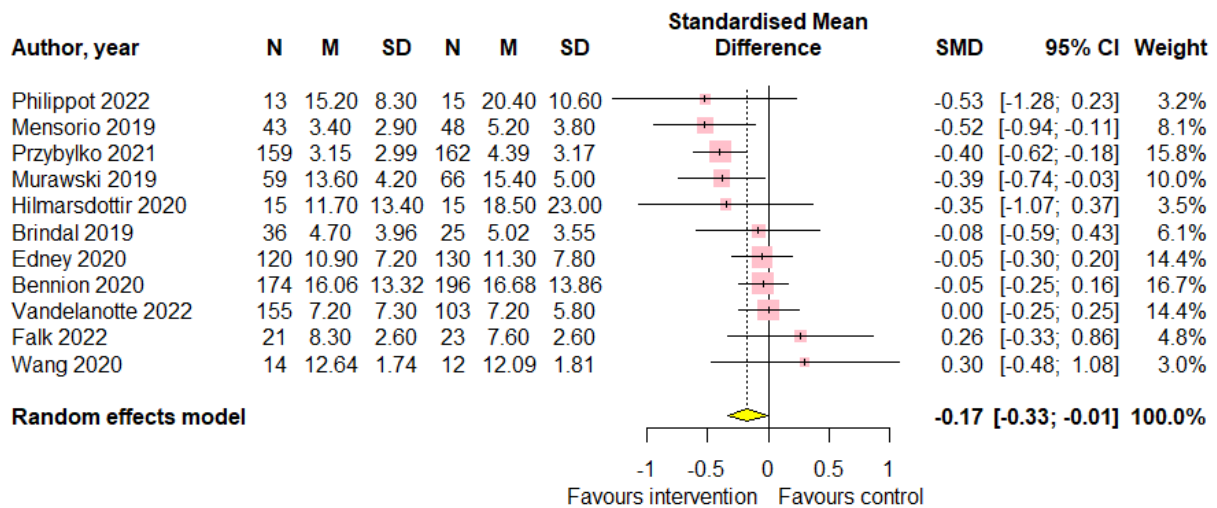
Overall Effects of Digital Lifestyle Interventions on Well-Being

Pooled effects from 6 studies (4204/22,483, 18.7%) suggest no significant effect of digital lifestyle interventions compared to all control conditions on well-being (SMD=0.14; 95% CI −0.07 to 0.37; P=.15; Figure 5), although the data show a nonsignificant (P=.15) trend in the direction that favors digital lifestyle interventions.

Figure 5. Meta-analysis of the effects of digital lifestyle interventions on well-being [43,46,61,84,91,96]. SMD: standardized mean difference.
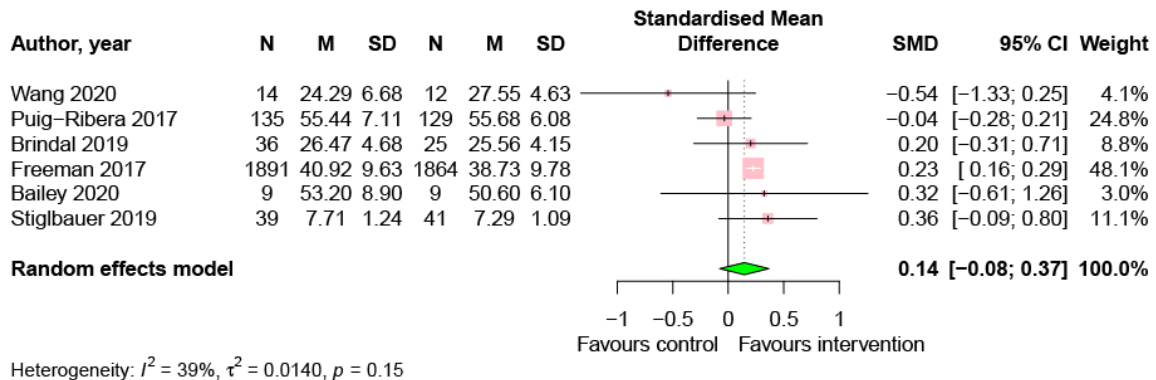
Subgroup Analyses

Overview

To understand which aspects of digital lifestyle interventions contribute to their effectiveness in improving mental health and well-being, and for whom they are most beneficial, we conducted a series of comparative subgroup analyses. These analyses were based on technology-specific features, methodological approaches, intervention characteristics, and population characteristics. Due to the limited number of studies for stress and well-being, these analyses were conducted for depressive and anxiety outcomes only. The results are outlined in Tables 2 and 3.

Table 2. Subgroup analyses of depression outcomes.

	Number of studies, k	Intervention, n	Control, n	Meta-analysis		Heterogeneity		Subgroup test, P value
				Standardized mean difference (95% CI)	P value	Q	I^2 (%)	
Overall	53	6285	6100	−0.37 (−0.4641 to −0.2673)	<.0001	166.32	68.7	—[a]
Population characteristics								
General population	17	1792	1586	−0.30 (−0.4252 to −0.1753)	<.001	43.41	63.1	.46
Mental diagnosis	7	288	288	−0.51 (−0.9005 to −0.1131)	.02	21.72	67.8	—
Physical diagnosis	21	1370	1373	−0.36 (−0.5828 to −0.1455)	<.001	87.88	77.2	—
Insomnia	7	2835	2853	−0.39 (−0.4428 to −0.3350)	<.001	3.40	3.4	—
Intervention characteristics								
Behavior								
Diet	2	70	71	−0.31 (−5.5627 to 4.9394)	.59	3.55	71.8	.75
Physical activity	20	1445	1197	−0.29 (−0.5138 to −0.0708)	.01	79.58	76.1	—
Sleep	16	3595	3639	−0.41 (−0.4662 to −0.3437)	<.001	14.58	0	—
Multiple behavior	15	1175	1193	−0.43 (−0.6452 to −0.2173)	<.001	52.71	73.4	—
Frequency								
Daily	17	1336	1368	−0.32 (−0.5658 to −0.0695)	.02	69.12	76.9	.40
1-4 times per wk	26	1880	1598	−0.34 (−0.4473 to −0.2368)	<.001	53.52	53.3	—
Other[b]	10	3069	3134	−0.52 (−0.8015 to −0.2339)	<.001	42.91	79	—
Duration								
≤6 wk	9	682	582	−0.38 (−0.6239 to −0.1410)	.006	16.47	51.4	.95
7-16 wk	37	5244	5172	−0.35 (−0.4639 to −0.2454)	<.001	113.61	68.3	—
≥4 mo	7	359	346	−0.40 (−0.9378 to 0.1295)	.11	34.87	82.8	—
Individualized								
No	16	1003	1054	−0.40 (−0.6365 to −0.1716)	<.001	64.61	76.8	.64
Yes	37	5282	5046	−0.35 (−0.4538 to −0.2400)	<.001	101.5	64.5	—
Theoretical underpinning								
No	31	4715	4603	−0.39 (−0.4850 to −0.2945)	<.001	60.33	50.3	.69
Yes	22	1570	1497	−0.35 (−0.5497 to −0.1444)	<.001	69.35	78.2	—
Co-designed								

	Number of studies, k	Intervention, n	Control, n	Meta-analysis		Heterogeneity		Subgroup test, P value
				Standardized mean difference (95% CI)	P value	Q	I^2 (%)	
No	47	5927	5707	−0.38 (−0.4864 to −0.2714)	<.001	154.81	70.3	.09
Yes	6	358	393	−0.20 (−0.4351 to 0.0271)	0.07	7.47	33.1	—
Publicly available								
No	32	2330	2147	−0.35 (−0.5054 to −0.1878)	<.001	123.4	74.9	.42
Yes	21	3955	3953	−0.42 (−0.4961 to −0.3381)	<.001	29.88	33.1	—
Delivery method								
Wearable								
No	45	5675	5494	−0.36 (−0.4473 to −0.2698)	<.001	110.04	60	.74
Yes	8	610	606	−0.44 (−0.9897 to 0.1122)	.10	53.74	87	—
App								
No	38	5169	5142	−0.33 (−0.4450 to −0.2248)	<.001	117.66	68.6	.31
Yes	15	1116	958	−0.46 (−0.6866 to −0.2263)	<.001	47.98	70.8	—
Web based								
No	17	1162	1004	−0.44 (−0.6971 to −0.1767)	<.001	75.3	78.8	.46
Yes	36	5123	5096	−0.34 (−0.4329 to −0.2451)	<.001	90.78	61.4	—
Text or email								
No	40	2930	2704	−0.39 (−0.5114 to −0.2767)	<.001	118.39	67.1	.31
Yes	13	3355	3396	−0.29 (−0.4770 to −0.0945)	<.001	44.25	72.9	—
Multiple methods								
No	39	2839	2618	−0.37 (−0.4907 to−0.2499)	<.001	119.97	68.3	.82
Yes	14	3446	3482	−0.35 (−0.5333 to −0.1598)	<.001	45.17	71.2	—
Delivery features								
Video								
No	36	2494	2537	−0.41 (−0.5435 to −0.2760)	<.001	112.77	69	.24
Yes	17	3791	3563	−0.30 (−0.4402 to −0.1596)	<.001	53.10	69.9	—
Chatbot								
No	47	5134	4848	−0.35 (−0.4665 to −0.2397)	<.001	156.18	70.5	.08
Yes	6	1151	1252	−0.46 (−0.5112 to −0.4055)	<.001	1.22	0	—
Gamification or interaction								

	Number of studies, k	Intervention, n	Control, n	Meta-analysis		Heterogeneity		Subgroup test, P value
				Standardized mean difference (95% CI)	P value	Q	I^2 (%)	
No	40	3193	3031	−0.36 (−0.4785 to −0.2362)	<.001	129.65	69.9	.69
Yes	13	3092	3069	−0.40 (−0.5797 to −0.2176)	<.001	34.28	65	—
Notifications								
No	32	4102	3898	−0.33 (−0.4756 to −0.1915)	<.001	109.38	71.7	.45
Yes	21	2183	2202	−0.41 (−0.5399 to −0.2705)	<.001	54.74	63.5	—
Social features								
No	37	5149	4961	−0.36 (−0.4726 to −0.2525)	<.001	105.75	66	.96
Yes	16	1136	1139	−0.37 (−0.5950 to −0.1426)	<.001	60.26	75.1	—
Methodological characteristics								
Control group								
Waitlist control or none	36	4135	3988	−0.44 (−0.5629 to −0.3111)	<.001	101.68	65.6	.11
Treatment as usual	11	1626	1522	−0.22 (−0.4330 to −0.0081)	.04	47.08	78.8	—
Attention	6	524	590	−0.27 (−0.5498 to 0.0089)	.06	13.32	62.5	—
Outcome measure								
Primary	13	1751	1444	−0.39 (−0.6066 to −0.1666)	.002	50.31	76.1	.64
Secondary	36	4437	4572	−0.37 (−0.4934 to −0.2438)	<.001	108.51	67.7	—
Exploratory	4	97	84	−0.23 (−0.6696 to 0.1958)	0.18	2.40	0	—
Study quality								
Poor to fair	5	470	387	−0.23 (−0.6161 to 0.1573)	.17	11.44	65.0	.53
Good	41	3198	3113	−0.39 (−0.5169 to −0.2660)	<.001	146.70	72.7	—
Excellent	7	2617	2600	−0.39 (−0.4768 to −0.3020)	<.001	5.79	0	—
Publication year								
2014 or earlier	3	150	150	−0.12 (−0.5666 to 0.3230)	.36	1.59	0	.01
2015-2017	12	2669	2690	−0.29 (−0.5450 to −0.0515)	.02	73.81	77.0	—
2018-2020	20	1947	2005	−0.27 (−0.3636 to −0.1753)	<.001	45.06	75.6	—
2021or later	18	1519	1255	−0.57 (−0.7795 to −0.3635)	<.001	30.47	37.7	—

[a]Not applicable.

[b]Other frequency includes fortnightly, monthly, once-off, and self-paced.

Table 3. Subgroup analyses of anxiety outcomes.

	Number of studies, k	Intervention, n	Control, n	Meta-analysis		Heterogeneity		Subgroup test, P value
				Standardized mean difference (95% CI)	P value	Q	I^2 (%)	
Overall	35	4689	4694	−0.29 (−0.3620 to −0.2116)	<.001	55.42	38.7	__[a]
Population								
General population	11	905	916	−0.28 (−0.3829 to −0.1731)	<.001	9.84	0	.94
Mental diagnosis	4	160	159	−0.33 (−0.9751 to 0.3087)	.19	8.52	64.8	—
Physical diagnosis	14	972	988	−0.26 (−0.4282 to −0.0940)	<.001	29.52	56.0	—
Insomnia	6	2652	2631	−0.30 (−0.3947 to −0.2113)	<.001	5.60	10.7	—
Intervention characteristics								
Behavior								
Diet	1	55	59	−0.18 (−0.5505 to 0.1858)	.33	0	0	.47
Physical activity	14	1035	952	−0.20 (−0.3696 to −0.0388)	.01	27.28	52.4	—
Sleep	10	2969	3019	−0.33 (−0.4024 to −0.2486)	<.001	9.68	7.0	—
Multi	10	630	664	−0.31 (−0.4536 to −0.1672)	<.001	11.41	21.1	—
Frequency								
Daily	8	631	695	−0.26 (−0.4352 to −0.0776)	.01	11.44	38.8	.65
Weekly	19	1236	1204	−0.35 (−0.4289 to −0.2175)	<.001	25.36	29.0	—
Other[b]	8	2822	2795	−0.25 (−0.4396 to −0.0653)	.02	16.81	58.3	—
Duration								
≤6 wk	6	377	442	−0.34 (−0.4925 to −0.1771)	.003	3.76	0	.31
7-16 wk	24	4143	4111	−0.27 (−0.3705 to −0.1700)	<.001	47.57	51.7	—
≥4 mo	5	169	141	−0.41 (−0.6219 to −0.1924)	.006	1.78	0	—
Individualized								
No	11	726	742	−0.28 (−0.5126 to −0.0560)	.02	26.41	62.1	.99
Yes	24	3963	3952	−0.28 (−0.3544 to −0.2140)	<.001	29.01	20.7	—
Theoretical underpinning								
No	21	3594	3657	−0.29 (−0.3499 to −0.2390)	<.001	23.45	14.7	.73
Yes	14	1095	1037	−0.26 (−0.4315 to −0.1010)	.004	29.12	55.4	—
Co-designed								

	Number of studies, k	Intervention, n	Control, n	Meta-analysis		Heterogeneity		Subgroup test, P value
				Standardized mean difference (95% CI)	P value	Q	I^2 (%)	
No	31	4383	4354	−0.29 (−0.3689 to −0.2100)	<.001	48.41	38.0	.93
Yes	4	306	340	−0.31 (−0.8339 to 0.2240)	0.16	6.91	56.6	—
Publicly available								
No	19	1350	1313	−0.25 (−0.3946 to −0.1114)	.001	39.57	54.5	0.51
Yes	16	3339	3381	−0.31 (−0.3519 to −0.2486)	<.001	12.86	0	—
Delivery methods								
Wearable								
No	31	4235	4234	−0.29 (−0.3450 to −0.2374)	<.001	42.14	28.8	.36
Yes	4	454	460	−0.18 (−0.5553 to 0.1952)	0.22	7.18	58.2	—
App								
No	24	4043	4047	−0.27 (−0.3562 to −0.1905)	<.001	36.93	37.7	.52
Yes	11	646	647	−0.33 (−0.5017 to −0.1572)	.002	18.19	45.0	—
Web based								
No	12	643	647	−0.33 (−0.5043 to −0.1623)	.001	20.29	45.8	.49
Yes	23	4046	4047	−0.27 (−0.3548 to −0.1922)	<.001	34.91	37.0	—
Text or email								
No	23	1498	1484	−0.33 (−0.4464 to −0.2169)	<.001	36.98	40.5	.17
Yes	12	3191	3210	−0.24 (−0.3309 to −0.1421)	<.001	15.81	30.4	—
Multiple methods used								
No	24	1494	1479	−0.32 (−0.4375 to −0.2033)	<.001	39.94	42.4	.29
Yes	11	3195	3215	−0.25 (−0.3375 to −0.1562)	<.001	13.68	26.9	—
Delivery features								
Video								
No	25	1810	1840	−0.30 (−0.3823 to −0.2206)	<.001	28.87	16.9	.63
Yes	10	2879	2854	−0.25 (−0.4528 to −0.0569)	.02	25.61	64.9	—
Chatbot								
No	30	3867	3727	−0.25 (−0.3373 to −0.1717)	<.001	44.6	35.0	.10
Yes	5	822	967	−0.37 (−0.5304 to −0.2107)	.003	5.78	30.7	—
Gamification or interaction								

	Number of studies, k	Intervention, n	Control, n	Meta-analysis		Heterogeneity		Subgroup test, P value
				Standardized mean difference (95% CI)	P value	Q	I^2 (%)	
No	23	1610	1639	−0.27 (−0.3771 to −0.1705)	<.001	36.56	39.8	.91
Yes	12	3079	3055	−0.28 (−0.3546 to −0.2070)	<.001	18.64	41.0	—
Notifications								
No	19	3072	3034	−0.23 (−0.3652 to −0.1042)	.001	37.21	51.6	.15
Yes	16	1617	1660	−0.34 (−0.4087 to −0.2658)	<.001	13.33	0	—
Social features								
No	25	3957	3943	−0.29 (−0.4038 to −0.1912)	<.001	48.83	50.8	.70
Yes	10	732	751	−0.27 (−0.3727 to −0.1698)	<.001	6.59	0	—
Methodological characteristics								
Control group								
Waitlist control or none	25	3221	3223	−0.31 (−0.4068 to −0.2061)	<.001	37.88	36.6	.46
Treatment as usual	8	1208	1166	−0.24 (−0.4126 to −0.0741)	.01	16.01	56.3	—
Attention	2	260	305	−0.34 (−0.6574 to −0.0126)	.05	0.09	0	—
Outcome measure								
Primary	7	827	747	−0.32 (−0.4533 to −0.1792)	.001	7.09	15.3	.50
Secondary	25	3783	3888	−0.29 (−0.3877 to −0.1973)	<.001	42.9	44.1	—
Exploratory	3	79	59	−0.05 (−0.9823 to 0.8771)	.83	3.06	34.6	—
Study quality								
Poor	1	164	83	−0.31 (−0.5757 to −0.0448)	.02	0	0	.87
Good	29	2307	2349	−0.27 (−0.3684 to −0.1805)	<.001	50.24	44.3	—
Excellent	5	2218	2262	−0.31 (−0.4406 to −0.1751)	.003	4.79	16.5	—
Publication year								
2014 or earlier	3	150	150	−0.16 (−0.2635 to −0.0525)	.02	0.09	0	.003
2015-2017	7	2443	2485	−0.30 (−0.4578 to −0.1345)	.004	10.55	43.1	—
2018-2020	12	1105	1177	−0.19 (−0.3372 to −0.0500)	.01	19.17	42.6	—
2021 or later	13	991	882	−0.39 (−0.5282 to −0.2492)	<.001	18.21	34.1	—

[a]Not applicable.

[b]Other frequency includes fortnightly, monthly, once-off, and self-paced.

Delivery Method and Features

The effectiveness of interventions for improving depression and anxiety did not significantly differ based on the digital delivery method used or their technological features (eg, video, gamification, notifications, interactive design, and social features). There was a nonsignificant trend for interventions using chatbots to be slightly more effective for reducing depressive symptoms than interventions not using chatbots (P=.08).

Intervention Characteristics

Interventions had similar effects on depression and anxiety, regardless of whether this was achieved through physical activity, sleep, diet, or multiple lifestyle behaviors. Diet-only interventions demonstrated nonsignificant effects on depression and anxiety, likely due to the paucity of studies.

Intervention effectiveness did not differ based on the frequency or duration of the intervention; however, long-term interventions (≥4 months) demonstrated a nonsignificant effect on depressive symptoms. Intervention effectiveness did not differ based on the intervention being personalized, based on a theoretical framework, whether they had been co-designed with consumers, or whether they were publicly available.

Methodological Characteristics

The effectiveness of interventions did not differ when comparing waitlist or no treatment controls, treatment-as-usual controls, and attention or sham controls. Similarly, effectiveness did not differ based on study quality.

Considering we included studies that did not specifically target mental health, but captured it as an outcome, we compared interventions with depression or anxiety as a primary outcome to those capturing these as secondary outcomes or exploratory outcomes. Intervention effectiveness did not differ based on whether the outcome was primary or secondary; however, the few studies that captured depression and anxiety as exploratory outcomes demonstrated nonsignificant intervention effects.

Population Characteristics

Digital lifestyle interventions demonstrated comparable effectiveness for improving depression and anxiety across all populations: apparently healthy adults, people with a mental disorder, people with a physical health condition, and people with insomnia. For depressive symptoms, the largest effect was seen in people with a mental disorder, whereas for anxiety symptoms, a nonsignificant effect was observed for those with a mental disorder.

Publication Year

The effectiveness of interventions on depression and anxiety differed significantly based on the year of publication, with more recently published interventions demonstrating the greatest effects.

Mixed-effects metaregression analysis showed no significant effect of intervention duration, study quality, or publication year on the effect of digital lifestyle interventions for depression, anxiety, stress, or well-being outcomes. A detailed overview of the metaregression analyses is provided in Multimedia Appendix 6.

Sensitivity Analyses

Sensitivity analyses for all meta-analyses are detailed in Multimedia Appendix 7. For depression, when small studies were omitted from the analysis, the effect size shrunk but remained significant (SMD=−0.28; 95% CI −0.38 to −0.19; P<.001). For anxiety, the effect size was slightly larger when studies with >25% attrition were removed (SMD=−0.31; 95% CI −0.43 to −0.18; P<.001). For stress, omitting small studies or studies with >25% attrition no longer demonstrated a significant effect (P=.13 and P=.22, respectively). The overall effect on well-being remained nonsignificant when fair to poor quality studies, small studies, and studies with >25% attrition were removed (all P values >.10).

Level of Evidence

Overall, the level of evidence for digital lifestyle interventions for improving symptoms of depression, anxiety, and stress is grade A: consistent level 1 studies. The grade of recommendation for digital lifestyle interventions for improving symptoms of well-being was grade D: level 5 evidence.

Discussion

Principal Findings

This systematic review aimed to comprehensively examine the effectiveness of digital lifestyle interventions for improving symptoms of depression, anxiety, stress, and well-being in adults. We identified 61 RCTs involving 22,483 participants. The findings suggest that digital lifestyle interventions had small-to-medium favorable effects on depression, anxiety, and stress symptoms across a broad range of populations and via a broad range of digital delivery methods. These effects are similar in magnitude to those observed for established mental health treatments, such as antidepressant medication [101] and psychotherapy [102]. No significant effect was observed for well-being, although in comparison to mental ill health, fewer studies (n=6) of lower average quality measured well-being outcomes. These studies operationalized well-being broadly using either global measures that span various affective and functional dimensions [43,61,84,91] or scales of overall life satisfaction [46,96]. These are broad constructs that tend to be relatively stable [103]. As a result, the available evidence offers limited precision for elucidating the effects of digital lifestyle interventions on specific well-being domains. Two-thirds of the included studies (41/61, 67%) were published within the last 5 years, reflecting the increased interest in using digital technology for health behavior change for mental health, with greater reductions in depressive and anxiety symptoms observed for more recently published interventions. This likely reflects the volume of studies published recently but may also be driven by improved quality of digital interventions as technology, particularly artificial intelligence, is better used within health promotion [104].

To better understand what factors drive the effects of digital lifestyle interventions on depressive and anxiety symptoms, we conducted a range of comparative subgroup analyses on specific

features relating to the intervention, methodology, technology, and population. These analyses found that interventions demonstrated comparable effectiveness for reducing symptoms of depression and anxiety in apparently healthy adults or adults with a mental disorder, a physical health condition, or insomnia. Equivalent effectiveness was found regardless of the lifestyle behaviors targeted, method of digital delivery (eg, app and website), technological features (ie, chatbot and gamification), intervention duration, or intended frequency of engagement. Overall, our subgroup analyses indicated that there are no specific features that drive the effectiveness of digital lifestyle interventions for improving symptoms of depression or anxiety, except for publication year.

Although differences among population groups were not significant, it appears that digital lifestyle interventions are effective for improving depressive symptoms in people with a depressive disorder but are potentially less effective at improving symptoms of anxiety in people with a depressive disorder. Interestingly, depressive disorders were the only diagnosed mental disorder in the included studies, highlighting a clear gap. Therefore, the effectiveness of these interventions as a self-management approach for other mental disorders is unclear and should be explored in future studies.

We also observed that interventions using chatbots trended toward being more effective than those without chatbots, though these results were not statistically significant. These findings have been supported with recent research,. Emerging evidence suggests chatbots can help improve lifestyle behaviors [105], although it appears their effectiveness for delivering psychological interventions (ie, therapy) is less conclusive [106]. Co-designed interventions showed a trend for being less effective. This is likely due to the small number of studies included in the subgroup analysis and the high variation of co-design approaches used in the design of health interventions, which are often poorly described and rarely evaluated [107].

A key challenge of digital health interventions is maintaining user engagement over time [13]. It is possible that the lack of significant intervention effects at 4 months was due to drop off in engagement. Alternatively, it is possible that symptoms may recur in some individuals even if they remain engaged with the intervention, reflecting the recurring nature of mental health symptoms. Digital lifestyle interventions may offer an appropriate short-term strategy to engage people in mental health–promoting behaviors and initiate positive shifts in mental health, whereas more sustainable mental health benefits may require other mental health treatment approaches. These findings reinforce the existing literature that the clinical implications of lifestyle interventions, even when delivered digitally, are compelling as a self-management tool for targeting both the risk and protective factors for mental health and should be given consideration as part of standard mental health care. This review did not directly compare digital to face-to-face delivery of these interventions; therefore, the impact that delivery method has on effectiveness should be examined directly in future research. Given the role of patient-practitioner rapport and other psychosocial benefits of in-person care, it is pivotal to understand how digital interventions may best fit and integrate within the broader health care setting, including alongside gold standard treatments, to optimize patient outcomes.

In line with previous research [108], we found interventions targeting multiple or single behaviors to have comparable effectiveness. Interventions that aim to change multiple health behaviors concurrently seem logical, given the cooccurrence of and bidirectional relationship between unhealthy lifestyle behaviors and poor mental health. In particular, some health behaviors may have synergistic impacts (eg, people who improve their sleep may have more energy for physical activity and, in turn, people who are more physically active may sleep better); therefore, future research should explore how behavior change techniques can be implemented most effectively to address multiple behaviors and aim to identify moderators of effective interventions and whether delivering lifestyle behavior change within or alongside traditional psychological interventions has synergistic effects on outcomes or improves adherence.

This review also focused on adults, although adolescence is a period when mental health issues commonly present and offers an opportune time for preventive intervention. Digital interventions would seem to be appealing and accessible for this population, given their familiarity with technology. A recent review by Raeside et al [109] included 11 interventions and found small nonsignificant effects for digital lifestyle interventions on mental health outcomes in adolescents. Considering the shared protective and risk factors for mental health and chronic diseases, future research efforts should focus on if and how digital tools can be best harnessed to address the interplay between lifestyle behaviors, mental ill health, and well-being and engage young people in the design and development of interventions through participatory research methods, such as co-design.

Strengths and Limitations

This is the largest review to evaluate the effects of digital interventions targeting lifestyle behaviors on depression, anxiety, stress, and well-being in adults. We adhered to rigorous methodological approaches for the conduct and reporting of systematic reviews and meta-analyses and conducted comprehensive database searches. In total, 87% (53/61) of the included RCTs received good or excellent quality ratings, increasing confidence in the findings of this review. Given the very large number of studies included in the meta-analyses, the dataset was sufficient to support numerous subgroup analyses, facilitating closer interrogation of the factors influencing intervention effectiveness. Our review included digital lifestyle interventions that have been evaluated using an RCT design and published in a peer-reviewed academic journal. Many commercial digital products claim to support lifestyle changes and mental health but often lack rigorous scientific assessment. The conclusions from this study should not be generalized to such unevaluated products.

Most of the study's limitations arose from the limitations of the included studies. First, only 2 studies reported on diet-only interventions, and few studies measured stress and well-being, resulting in uncertain and underpowered results for these meta-analyses and precluding subgroup analyses with stress

and well-being as outcomes. Second, all but 2 studies [41,99] were conducted in high-income countries, limiting the generalizability of our results. Third, it is important to acknowledge that our subgroup analyses, such as the comparison between single- and multibehavioral interventions, were conducted using available data from studies not specifically designed to test these differences. Consequently, these findings should be interpreted cautiously and should not be used as definitive evidence for or against any particular intervention approach. Finally, we acknowledge significant heterogeneity as a limitation, and we conducted numerous subgroup and sensitivity analyses to mitigate its impact and assess the robustness of our findings, which remained consistent with the main analyses.

Future Directions

This review highlights some key areas for future research. First, there were limited studies focused on addressing diet as a stand-alone intervention; however, a nonsignificant effect in the direction of lifestyle interventions for reducing depressive symptoms highlights that further research is needed to better determine if, and how, effective these interventions may be in addressing mental health symptoms. Second, digital interventions may be less effective over longer periods, emphasizing a need to address longer-term strategies or the potential to integrate other mental health treatment approaches, which may demonstrate greater effects over time. Research also needs to address how best to integrate these evidence-based interventions into service delivery to support health care capacity. Third, for a more complete understanding of how digital lifestyle interventions influence mental health, future research should ensure that positive aspects of mental well-being are measured alongside symptoms of mental ill health. A growing body of literature suggests that these are distinct continua, with both overlapping and unique antecedents, that should be measured in tandem [110]. Finally, as the field continues to mature and research elucidates optimal intervention designs, other factors that are imperative to consider are the influence of both health literacy and digital literacy as well as the impact of health status and socioeconomic status [111]. Furthermore, future research should consider the digital determinants of health and the direct and indirect impacts on health equity when designing health promotion interventions [112].

Conclusions

Overall, the small-to-medium effects indicate that digital lifestyle interventions may provide an effective short-term self-management strategy for mental health support by encouraging positive shifts in lifestyle behaviors. All digital delivery platforms and features demonstrated comparable effectiveness for depression and anxiety outcomes. The effectiveness on well-being is inconclusive, with few studies capturing this positive dimension of mental health. Digitally delivered lifestyle interventions support self-management and target both risk and protective factors for mental health and should be given consideration as part of mental health care and support. This is especially relevant in situations where access to in-person treatment is limited, such as due to long waitlists, financial or geographical barriers, or stigma associated with traditional treatment options.

Future research should explore how best to implement these findings and integrate such interventions with existing health care services, with concerted efforts to improve health equity by considering the digital determinants of health and impacts of digital and health literacy in the design and implementation of these interventions.

Data Availability

The datasets generated or analyzed during this study are available from the corresponding author on reasonable request.

Authors' Contributions

JB and CM were responsible for conceptualization. JB completed database searching. JB, EO, BS, GM, RC, TF, GG, IW, PJM, and KS completed article screening, data extraction, and critical appraisal. JB was responsible for data curation and analysis. JB, CM, and JF contributed to data interpretation. JB, EO, BS, GM, TF, GG, IW, PJM, and KS wrote the original draft. CM and JF provided advice. All authors contributed to reviewing and editing the final manuscript and approved the final version of the manuscript.

Conflicts of Interest

None declared.

Multimedia Appendix 1

PRISMA checklist.

XSL•FO

RenderX

[[PDF File (Adobe PDF File), 66 KB-Multimedia Appendix 1]]

Multimedia Appendix 2

Search strategy.
[[DOCX File , 16 KB-Multimedia Appendix 2]]

Multimedia Appendix 3

Reasons for exclusion at full-text screening.
[[DOCX File , 91 KB-Multimedia Appendix 3]]

Multimedia Appendix 4

Physiotherapy Evidence Database Scale risk of bias for included studies.
[[DOCX File , 65 KB-Multimedia Appendix 4]]

Multimedia Appendix 5

Funnel plots for meta-analyses.
[[DOCX File , 142 KB-Multimedia Appendix 5]]

Multimedia Appendix 6

Meta-regression analyses for all outcomes.
[[DOCX File , 15 KB-Multimedia Appendix 6]]

Multimedia Appendix 7

Sensitivity analyses for all meta-analyses.
[[DOCX File , 15 KB-Multimedia Appendix 7]]

References

1. GBD 2019 Mental Disorders Collaborators. Global, regional, and national burden of 12 mental disorders in 204 countries and territories, 1990-2019: a systematic analysis for the Global Burden of Disease Study 2019. Lancet Psychiatry. Feb 2022;9(2):137-150. [FREE Full text] [doi: 10.1016/S2215-0366(21)00395-3] [Medline: 35026139]
2. O'Connor RC, Worthman CM, Abanga M, Athanassopoulou N, Boyce N, Chan LF, et al. Gone too soon: priorities for action to prevent premature mortality associated with mental illness and mental distress. Lancet Psychiatry. Jun 2023;10(6):452-464. [FREE Full text] [doi: 10.1016/s2215-0366(23)00058-5]
3. Vigo D, Thornicroft G, Atun R. Estimating the true global burden of mental illness. Lancet Psychiatry. Feb 2016;3(2):171-178. [doi: 10.1016/S2215-0366(15)00505-2] [Medline: 26851330]
4. Arias D, Saxena S, Verguet S. Quantifying the global burden of mental disorders and their economic value. EClinicalMedicine. Dec 2022;54:101675. [FREE Full text] [doi: 10.1016/j.eclinm.2022.101675] [Medline: 36193171]
5. Hoang D, Kristoffersen I, Li IW. All in the mind? Estimating the effect of mental health on health behaviours. Soc Sci Med. Mar 2019;225:69-84. [doi: 10.1016/j.socscimed.2019.02.017] [Medline: 30818089]
6. Stubbs B, Vancampfort D, Veronese N, Kahl KG, Mitchell AJ, Lin P, et al. Depression and physical health multimorbidity: primary data and country-wide meta-analysis of population data from 190 593 people across 43 low- and middle-income countries. Psychol Med. Apr 04, 2017;47(12):2107-2117. [doi: 10.1017/s0033291717000551]
7. Firth J, Marx W, Dash S, Carney R, Teasdale SB, Solmi M, et al. The effects of dietary improvement on symptoms of depression and anxiety: a meta-analysis of randomized controlled trials. Psychosom Med. Apr 2019;81(3):265-280. [FREE Full text] [doi: 10.1097/PSY.0000000000000673] [Medline: 30720698]
8. Singh B, Olds T, Curtis R, Dumuid D, Virgara R, Watson A, et al. Effectiveness of physical activity interventions for improving depression, anxiety and distress: an overview of systematic reviews. Br J Sports Med. Sep 2023;57(18):1203-1209. [doi: 10.1136/bjsports-2022-106195] [Medline: 36796860]
9. Alvaro PK, Roberts RM, Harris JK. A systematic review assessing bidirectionality between sleep disturbances, anxiety, and depression. Sleep. Jul 01, 2013;36(7):1059-1068. [FREE Full text] [doi: 10.5665/sleep.2810] [Medline: 23814343]
10. Malhi GS, Bassett D, Boyce P, Bryant R, Fitzgerald PB, Fritz K, et al. Royal Australian and New Zealand College of Psychiatrists clinical practice guidelines for mood disorders. Aust N Z J Psychiatry. Dec 2015;49(12):1087-1206. [doi: 10.1177/0004867415617657] [Medline: 26643054]

XSL•FO
RenderX

11. Borghouts J, Eikey E, Mark G, De Leon C, Schueller SM, Schneider M, et al. Barriers to and facilitators of user engagement with digital mental health interventions: systematic review. J Med Internet Res. Mar 24, 2021;23(3):e24387. [FREE Full text] [doi: 10.2196/24387] [Medline: 33759801]

12. Philippe TJ, Sikder N, Jackson A, Koblanski ME, Liow E, Pilarinos A, et al. Digital health interventions for delivery of mental health care: systematic and comprehensive meta-review. JMIR Ment Health. May 12, 2022;9(5):e35159. [FREE Full text] [doi: 10.2196/35159] [Medline: 35551058]

13. Firth J, Torous J, Nicholas J, Carney R, Pratap A, Rosenbaum S, et al. The efficacy of smartphone-based mental health interventions for depressive symptoms: a meta-analysis of randomized controlled trials. World Psychiatry. Oct 2017;16(3):287-298. [FREE Full text] [doi: 10.1002/wps.20472] [Medline: 28941113]

14. Firth J, Torous J, Nicholas J, Carney R, Rosenbaum S, Sarris J. Can smartphone mental health interventions reduce symptoms of anxiety? A meta-analysis of randomized controlled trials. J Affect Disord. Aug 15, 2017;218:15-22. [FREE Full text] [doi: 10.1016/j.jad.2017.04.046] [Medline: 28456072]

15. Müller AM, Maher CA, Vandelanotte C, Hingle M, Middelweerd A, Lopez ML, et al. Physical activity, sedentary behavior, and diet-related eHealth and mHealth research: bibliometric analysis. J Med Internet Res. Apr 18, 2018;20(4):e122. [FREE Full text] [doi: 10.2196/jmir.8954] [Medline: 29669703]

16. Jahangiry L, Farhangi MA, Shab-Bidar S, Rezaei F, Pashaei T. Web-based physical activity interventions: a systematic review and meta-analysis of randomized controlled trials. Public Health. Nov 2017;152:36-46. [doi: 10.1016/j.puhe.2017.06.005] [Medline: 28734170]

17. Shin JC, Kim J, Grigsby-Toussaint D. Mobile phone interventions for sleep disorders and sleep quality: systematic review. JMIR Mhealth Uhealth. Sep 07, 2017;5(9):e131. [FREE Full text] [doi: 10.2196/mhealth.7244] [Medline: 28882808]

18. Beleigoli AM, Andrade AQ, Cançado AG, Paulo MN, Diniz MD, Ribeiro AL. Web-based digital health interventions for weight loss and lifestyle habit changes in overweight and obese adults: systematic review and meta-analysis. J Med Internet Res. Jan 08, 2019;21(1):e298. [FREE Full text] [doi: 10.2196/jmir.9609] [Medline: 30622090]

19. Duan Y, Shang B, Liang W, Du G, Yang M, Rhodes RE. Effects of eHealth-based multiple health behavior change interventions on physical activity, healthy diet, and weight in people with noncommunicable diseases: systematic review and meta-analysis. J Med Internet Res. Feb 22, 2021;23(2):e23786. [FREE Full text] [doi: 10.2196/23786] [Medline: 33616534]

20. Carneiro L, Rosenbaum S, Ward PB, Clemente FM, Ramirez-Campillo R, Monteiro-Júnior RS, et al. Web-based exercise interventions for patients with depressive and anxiety disorders: a systematic review of randomized controlled trials. Braz J Psychiatry. 2022;44(3):331-341. [FREE Full text] [doi: 10.1590/1516-4446-2021-2026] [Medline: 34852034]

21. Sawyer C, McKeon G, Hassan L, Onyweaka H, Martinez Agulleiro L, Guinart D, et al. Digital health behaviour change interventions in severe mental illness: a systematic review. Psychol Med. Sep 28, 2023;53(15):6965-7005. [doi: 10.1017/s0033291723002064]

22. Young CL, Trapani K, Dawson S, O'Neil A, Kay-Lambkin F, Berk M, et al. Efficacy of online lifestyle interventions targeting lifestyle behaviour change in depressed populations: a systematic review. Aust N Z J Psychiatry. Sep 27, 2018;52(9):834-846. [doi: 10.1177/0004867418788659] [Medline: 30052063]

23. McKeon G, Papadopoulos E, Firth J, Joshi R, Teasdale S, Newby J, et al. Social media interventions targeting exercise and diet behaviours in people with noncommunicable diseases (NCDs): a systematic review. Internet Interv. Mar 2022;27:100497. [FREE Full text] [doi: 10.1016/j.invent.2022.100497] [Medline: 35198409]

24. Keyes CL. Mental illness and/or mental health? Investigating axioms of the complete state model of health. J Consult Clin Psychol. Jun 2005;73(3):539-548. [FREE Full text] [doi: 10.1037/0022-006X.73.3.539] [Medline: 15982151]

25. van Agteren J, Iasiello M, Lo L, Bartholomaeus J, Kopsaftis Z, Carey M, et al. A systematic review and meta-analysis of psychological interventions to improve mental wellbeing. Nat Hum Behav. May 19, 2021;5(5):631-652. [doi: 10.1038/s41562-021-01093-w] [Medline: 33875837]

26. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. Int J Surg. Apr 2021;88:105906. [FREE Full text] [doi: 10.1016/j.ijsu.2021.105906] [Medline: 33789826]

27. Michie S, Yardley L, West R, Patrick K, Greaves F. Developing and evaluating digital interventions to promote behavior change in health and health care: recommendations resulting from an international workshop. J Med Internet Res. Jun 29, 2017;19(6):e232. [FREE Full text] [doi: 10.2196/jmir.7126] [Medline: 28663162]

28. Dodge R, Daly A, Huyton J, Sanders L. The challenge of defining wellbeing. Int J Wellbeing. Aug 28, 2012;2(3):222-235. [FREE Full text] [doi: 10.5502/ijw.v2i3.4]

29. Lakens D. Calculating and reporting effect sizes to facilitate cumulative science: a practical primer for t-tests and ANOVAs. Front Psychol. Nov 26, 2013;4:863. [FREE Full text] [doi: 10.3389/fpsyg.2013.00863] [Medline: 24324449]

30. Hozo SP, Djulbegovic B, Hozo I. Estimating the mean and variance from the median, range, and the size of a sample. BMC Med Res Methodol. Apr 20, 2005;5:13. [FREE Full text] [doi: 10.1186/1471-2288-5-13] [Medline: 15840177]

31. Sullivan GM, Feinn R. Using effect size-or why the P value is not enough. J Grad Med Educ. Sep 2012;4(3):279-282. [FREE Full text] [doi: 10.4300/JGME-D-12-00156.1] [Medline: 23997866]

32. Jakobsen JC, Wetterslev J, Winkel P, Lange T, Gluud C. Thresholds for statistical and clinical significance in systematic reviews with meta-analytic methods. BMC Med Res Methodol. Nov 21, 2014;14:120. [FREE Full text] [doi: 10.1186/1471-2288-14-120] [Medline: 25416419]

33. Higgins J, Thomas J, Chandler J, Cumpston M, Li T, Page M, et al. Cochrane Handbook for Systematic Reviews of Interventions Version 6.4, 2023. London, UK. Cochrane Collaboration; 2023.

34. Begg CB, Mazumdar M. Operating characteristics of a rank correlation test for publication bias. Biometrics. Dec 1994;50(4):1088-1101. [Medline: 7786990]

35. Egger M, Smith GD, Schneider M, Minder C. Bias in meta-analysis detected by a simple, graphical test. BMJ. Sep 13, 1997;315(7109):629-634. [doi: 10.1136/bmj.315.7109.629]

36. Duval S, Tweedie R. Trim and fill: a simple funnel-plot-based method of testing and adjusting for publication bias in meta-analysis. Biometrics. Jun 24, 2000;56(2):455-463. [doi: 10.1111/j.0006-341x.2000.00455.x] [Medline: 10877304]

37. Maher CG, Sherrington C, Herbert RD, Moseley AM, Elkins M. Reliability of the PEDro scale for rating quality of randomized controlled trials. Phys Ther. Aug 2003;83(8):713-721. [Medline: 12882612]

38. The Oxford levels of evidence 2. Oxford Centre for Evidence-Based Medicine. 2011. URL: https://www.cebm.ox.ac.uk/resources/levels-of-evidence/ocebm-levels-of-evidence [accessed 2025-02-06]

39. Tanniou J, van der Tweel I, Teerenstra S, Roes KC. Subgroup analyses in confirmatory clinical trials: time to be specific about their purposes. BMC Med Res Methodol. Feb 18, 2016;16(1):20. [FREE Full text] [doi: 10.1186/s12874-016-0122-6] [Medline: 26891992]

40. Abbott RD, Sherwin K, Klopf H, Mattingly HJ, Brogan K. Efficacy of a multimodal online lifestyle intervention for depressive symptoms and quality of life in individuals with a history of major depressive disorder. Cureus. Jul 08, 2020;12(7):e9061. [FREE Full text] [doi: 10.7759/cureus.9061] [Medline: 32656047]

41. Abedi P, Nikkhah P, Najar S. Effect of pedometer-based walking on depression, anxiety and insomnia among postmenopausal women. Climacteric. Sep 23, 2015;18(6):841-845. [doi: 10.3109/13697137.2015.1065246] [Medline: 26100101]

42. Bade BC, Gan G, Li F, Lu L, Tanoue L, Silvestri GA, et al. "Randomized trial of physical activity on quality of life and lung cancer biomarkers in patients with advanced stage lung cancer: a pilot study". BMC Cancer. Apr 01, 2021;21(1):352. [FREE Full text] [doi: 10.1186/s12885-021-08084-0] [Medline: 33794808]

43. Bailey DP, Mugridge LH, Dong F, Zhang X, Chater AM. Randomised controlled feasibility study of the MyHealthAvatar-diabetes smartphone app for reducing prolonged sitting time in type 2 diabetes mellitus. Int J Environ Res Public Health. Jun 19, 2020;17(12):4414. [FREE Full text] [doi: 10.3390/ijerph17124414] [Medline: 32575482]

44. Bennion KA, Tate D, Muñoz-Christian K, Phelan S. Impact of an internet-based lifestyle intervention on behavioral and psychosocial factors during postpartum weight loss. Obesity (Silver Spring). Oct 04, 2020;28(10):1860-1867. [FREE Full text] [doi: 10.1002/oby.22921] [Medline: 32888250]

45. Bossen D, Veenhof C, Van Beek KE, Spreeuwenberg PM, Dekker J, De Bakker DH. Effectiveness of a web-based physical activity intervention in patients with knee and/or hip osteoarthritis: randomized controlled trial. J Med Internet Res. Nov 22, 2013;15(11):e257. [FREE Full text] [doi: 10.2196/jmir.2662] [Medline: 24269911]

46. Brindal E, Hendrie GA, Freyne J, Noakes M. A mobile phone app designed to support weight loss maintenance and well-being (MotiMate): randomized controlled trial. JMIR Mhealth Uhealth. Sep 04, 2019;7(9):e12882. [FREE Full text] [doi: 10.2196/12882] [Medline: 31486407]

47. Carli V, Petros NG, Hadlaczky G, Vitcheva T, Berchialla P, Bianchi S, et al. The NEVERMIND e-health system in the treatment of depressive symptoms among patients with severe somatic conditions: a multicentre, pragmatic randomised controlled trial. EClinicalMedicine. Jun 2022;48:101423. [FREE Full text] [doi: 10.1016/j.eclinm.2022.101423] [Medline: 35706482]

48. Chee W, Kim S, Ji X, Park S, Chee E, Tsai HM, et al. The effect of a culturally tailored web-based physical activity promotion program on Asian American midlife women's depressive symptoms. Asian Pac Isl Nurs J. Dec 28, 2016;1(4):162-173. [doi: 10.9741/23736658.1044]

49. Cheng P, Kalmbach DA, Tallent G, Joseph CL, Espie CA, Drake CL. Depression prevention via digital cognitive behavioral therapy for insomnia: a randomized controlled trial. Sleep. Oct 09, 2019;42(10):zsz150. [FREE Full text] [doi: 10.1093/sleep/zsz150] [Medline: 31535688]

50. Christensen H, Batterham PJ, Gosling JA, Ritterband LM, Griffiths KM, Thorndike FP, et al. Effectiveness of an online insomnia program (SHUTi) for prevention of depressive episodes (the GoodNight Study): a randomised controlled trial. Lancet Psychiatry. Apr 2016;3(4):333-341. [doi: 10.1016/S2215-0366(15)00536-2] [Medline: 26827250]

51. Conner TS, Brookie KL, Carr AC, Mainvil LA, Vissers MC. Let them eat fruit! The effect of fruit and vegetable consumption on psychological well-being in young adults: a randomized controlled trial. PLoS One. 2017;12(2):e0171206. [FREE Full text] [doi: 10.1371/journal.pone.0171206] [Medline: 28158239]

52. Devi R, Powell J, Singh S. A web-based program improves physical activity outcomes in a primary care angina population: randomized controlled trial. J Med Internet Res. Sep 12, 2014;16(9):e186. [FREE Full text] [doi: 10.2196/jmir.3340] [Medline: 25217464]

XSL•FO
RenderX

53. Duan YP, Wienert J, Hu C, Si GY, Lippke S. Web-based intervention for physical activity and fruit and vegetable intake among Chinese university students: a randomized controlled trial. J Med Internet Res. Apr 10, 2017;19(4):e106. [FREE Full text] [doi: 10.2196/jmir.7152] [Medline: 28396306]

54. Duan YP, Liang W, Guo L, Wienert J, Si GY, Lippke S. Evaluation of a web-based intervention for multiple health behavior changes in patients with coronary heart disease in home-based rehabilitation: pilot randomized controlled trial. J Med Internet Res. Nov 19, 2018;20(11):e12052. [FREE Full text] [doi: 10.2196/12052] [Medline: 30455167]

55. Ebert DD, Berking M, Thiart H, Riper H, Laferton JA, Cuijpers P, et al. Restoring depleted resources: efficacy and mechanisms of change of an internet-based unguided recovery training for better sleep and psychological detachment from work. Health Psychol. Dec 2015;34S:1240-1251. [doi: 10.1037/hea0000277] [Medline: 26651465]

56. Eckert R, Huberty J, Kurka J, Laird B, Mesa R, Palmer J. A randomized pilot study of online hatha yoga for physical and psychological symptoms among survivors of allogenic bone marrow transplant. Int J Yoga Therap. Jan 01, 2022;32(2022):Article 12. [doi: 10.17761/2022-D-21-00047] [Medline: 36305845]

57. Edney SM, Olds TS, Ryan JC, Vandelanotte C, Plotnikoff RC, Curtis RG, et al. A social networking and gamified app to increase physical activity: cluster RCT. Am J Prev Med. Feb 2020;58(2):e51-e62. [doi: 10.1016/j.amepre.2019.09.009] [Medline: 31959326]

58. Espie CA, Emsley R, Kyle SD, Gordon C, Drake CL, Siriwardena AN, et al. Effect of digital cognitive behavioral therapy for insomnia on health, psychological well-being, and sleep-related quality of life: a randomized clinical trial. JAMA Psychiatry. Jan 01, 2019;76(1):21-30. [FREE Full text] [doi: 10.1001/jamapsychiatry.2018.2745] [Medline: 30264137]

59. Falk GE, Mailey EL, Okut H, Rosenkranz SK, Rosenkranz RR, Montney JL, et al. Effects of sedentary behavior interventions on mental well-being and work performance while working from home during the COVID-19 pandemic: a pilot randomized controlled trial. Int J Environ Res Public Health. May 24, 2022;19(11):6401. [FREE Full text] [doi: 10.3390/ijerph19116401] [Medline: 35681986]

60. Felder JN, Epel ES, Neuhaus J, Krystal AD, Prather AA. Efficacy of digital cognitive behavioral therapy for the treatment of insomnia symptoms among pregnant women: a randomized clinical trial. JAMA Psychiatry. May 01, 2020;77(5):484-492. [FREE Full text] [doi: 10.1001/jamapsychiatry.2019.4491] [Medline: 31968068]

61. Freeman D, Sheaves B, Goodwin GM, Yu LM, Nickless A, Harrison PJ, et al. The effects of improving sleep on mental health (OASIS): a randomised controlled trial with mediation analysis. Lancet Psychiatry. Oct 2017;4(10):749-758. [FREE Full text] [doi: 10.1016/S2215-0366(17)30328-0] [Medline: 28888927]

62. Glozier N, Christensen H, Griffiths KM, Hickie IB, Naismith SL, Biddle D, et al. Adjunctive internet-delivered cognitive behavioural therapy for insomnia in men with depression: a randomised controlled trial. Aust N Z J Psychiatry. Apr 07, 2019;53(4):350-360. [doi: 10.1177/0004867418797432] [Medline: 30191722]

63. Golsteijn RH, Bolman C, Volders E, Peels DA, de Vries H, Lechner L. Short-term efficacy of a computer-tailored physical activity intervention for prostate and colorectal cancer patients and survivors: a randomized controlled trial. Int J Behav Nutr Phys Act. Oct 30, 2018;15(1):106. [FREE Full text] [doi: 10.1186/s12966-018-0734-9] [Medline: 30376857]

64. Hershner S, O'Brien LM. The impact of a randomized sleep education intervention for college students. J Clin Sleep Med. Mar 15, 2018;14(3):337-347. [FREE Full text] [doi: 10.5664/jcsm.6974] [Medline: 29510791]

65. Hilmarsdóttir E, Sigurðardóttir ÁK, Arnardóttir RH. A digital lifestyle program in outpatient treatment of type 2 diabetes: a randomized controlled study. J Diabetes Sci Technol. Sep 17, 2021;15(5):1134-1141. [FREE Full text] [doi: 10.1177/1932296820942286] [Medline: 32680441]

66. Horsch CH, Lancee J, Griffioen-Both F, Spruit S, Fitrianie S, Neerincx MA, et al. Mobile phone-delivered cognitive behavioral therapy for insomnia: a randomized waitlist controlled trial. J Med Internet Res. Apr 11, 2017;19(4):e70. [FREE Full text] [doi: 10.2196/jmir.6524] [Medline: 28400355]

67. Houchen-Wolloff L, Gardiner N, Devi R, Robertson N, Jolly K, Marshall T, et al. Web-based cardiac REhabilitatioN alternative for those declining or dropping out of conventional rehabilitation: results of the WREN feasibility randomised controlled trial. Open Heart. 2018;5(2):e000860. [FREE Full text] [doi: 10.1136/openhrt-2018-000860] [Medline: 30364405]

68. Huberty J, Eckert R, Dueck A, Kosiorek H, Larkey L, Gowin K, et al. Online yoga in myeloproliferative neoplasm patients: results of a randomized pilot trial to inform future research. BMC Complement Altern Med. Jun 07, 2019;19(1):121. [FREE Full text] [doi: 10.1186/s12906-019-2530-8] [Medline: 31174535]

69. Ifejika NL, Bhadane M, Cai CC, Noser EA, Grotta JC, Savitz SI. Use of a smartphone-based mobile app for weight management in obese minority stroke survivors: pilot randomized controlled trial with open blinded end point. JMIR Mhealth Uhealth. Apr 22, 2020;8(4):e17816. [FREE Full text] [doi: 10.2196/17816] [Medline: 32319963]

70. Joutsenniemi K, Kaattari C, Härkänen T, Pankakoski M, Langinvainio H, Lönnqvist J, et al. E-mail-based exercises in happiness, physical activity and readings: a randomized trial on 3274 Finns. Afr J Psychiatry. 2014;17(5):1-13. [FREE Full text] [doi: 10.4172/psychiatry.1000140]

71. Katz P, Margaretten M, Gregorich S, Trupin L. Physical activity to reduce fatigue in rheumatoid arthritis: a randomized controlled trial. Arthritis Care Res (Hoboken). Jan 2018;70(1):1-10. [doi: 10.1002/acr.23230] [Medline: 28378441]

72. Kuhn E, Miller KE, Puran D, Wielgosz J, YorkWilliams SL, Owen JE, et al. A pilot randomized controlled trial of the insomnia coach mobile app to assess its feasibility, acceptability, and potential efficacy. Behav Ther. May 2022;53(3):440-457. [doi: 10.1016/j.beth.2021.11.003] [Medline: 35473648]

73.   Lambert JD, Greaves CJ, Farrand P, Price L, Haase AM, Taylor AH. Web-based intervention using behavioral activation and physical activity for adults with depression (The eMotion Study): pilot randomized controlled trial. J Med Internet Res. Jul 16, 2018;20(7):e10112. [FREE Full text] [doi: 10.2196/10112] [Medline: 30012547]

74.   Lambert SD, Duncan LR, Culos-Reed SN, Hallward L, Higano CS, Loban E, et al. Feasibility, acceptability, and clinical significance of a dyadic, web-based, psychosocial and physical activity self-management program (TEMPO) tailored to the needs of men with prostate cancer and their caregivers: a multi-center randomized pilot trial. Curr Oncol. Feb 01, 2022;29(2):785-804. [FREE Full text] [doi: 10.3390/curroncol29020067] [Medline: 35200566]

75.   Lopez R, Evangelista E, Barateau L, Chenini S, Bosco A, Billiard M, et al. French language online cognitive behavioral therapy for insomnia disorder: a randomized controlled trial. Front Neurol. 2019;10:1273. [FREE Full text] [doi: 10.3389/fneur.2019.01273] [Medline: 31866929]

76.   Lorenz N, Heim E, Roetger A, Birrer E, Maercker A. Randomized controlled trial to test the efficacy of an unguided online intervention with automated feedback for the treatment of insomnia. Behav Cogn Psychother. May 2019;47(3):287-302. [FREE Full text] [doi: 10.1017/S1352465818000486] [Medline: 30185239]

77.   McGrath ER, Espie CA, Power A, Murphy AW, Newell J, Kelly C, et al. Sleep to lower elevated blood pressure: a randomized controlled trial (SLEPT). Am J Hypertens. Mar 01, 2017;30(3):319-327. [doi: 10.1093/ajh/hpw132] [Medline: 28391289]

78.   Mensorio MS, Cebolla-Martí A, Rodilla E, Palomar G, Lisón JF, Botella C, et al. Analysis of the efficacy of an internet-based self-administered intervention ("Living Better") to promote healthy habits in a population with obesity and hypertension: an exploratory randomized controlled trial. Int J Med Inform. Apr 2019;124:13-23. [doi: 10.1016/j.ijmedinf.2018.12.007] [Medline: 30784422]

79.   Mueller J, Richards R, Jones RA, Whittle F, Woolston J, Stubbings M, et al. Supporting weight management during COVID-19: a randomized controlled trial of a web-based, ACT-based, guided self-help intervention. Obes Facts. 2022;15(4):550-559. [FREE Full text] [doi: 10.1159/000524031] [Medline: 35417910]

80.   Murawski B, Plotnikoff RC, Rayward AT, Oldmeadow C, Vandelanotte C, Brown WJ, et al. Efficacy of an m-health physical activity and sleep health intervention for adults: a randomized waitlist-controlled trial. Am J Prev Med. Oct 2019;57(4):503-514. [doi: 10.1016/j.amepre.2019.05.009] [Medline: 31542128]

81.   Nyström MB, Stenling A, Sjöström E, Neely G, Lindner P, Hassmén P, et al. Behavioral activation versus physical activity via the internet: a randomized controlled trial. J Affect Disord. Jun 2017;215:85-93. [FREE Full text] [doi: 10.1016/j.jad.2017.03.018] [Medline: 28319696]

82.   Philippot A, Moulin P, Charon MH, Balestra C, Dubois V, de Timary P, et al. Feasibility of online high-intensity interval training (HIIT) on psychological symptoms in students in lockdown during the COVID-19 pandemic: a randomized controlled trial. Front Psychiatry. 2022;13:904283. [FREE Full text] [doi: 10.3389/fpsyt.2022.904283] [Medline: 35800026]

83.   Przybylko G, Morton D, Kent L, Morton J, Hinze J, Beamish P, et al. The effectiveness of an online interdisciplinary intervention for mental health promotion: a randomized controlled trial. BMC Psychol. May 11, 2021;9(1):77. [FREE Full text] [doi: 10.1186/s40359-021-00577-8] [Medline: 33975645]

84.   Puig-Ribera A, Bort-Roig J, Giné-Garriga M, González-Suárez AM, Martínez-Lemos I, Fortuño J, et al. Impact of a workplace 'sit less, move more' program on efficiency-related outcomes of office employees. BMC Public Health. May 16, 2017;17(1):455. [FREE Full text] [doi: 10.1186/s12889-017-4367-8] [Medline: 28511642]

85.   Puterman E, Hives B, Mazara N, Grishin N, Webster J, Hutton S, et al. COVID-19 Pandemic and Exercise (COPE) trial: a multigroup pragmatic randomised controlled trial examining effects of app-based at-home exercise programs on depressive symptoms. Br J Sports Med. May 2022;56(10):546-552. [FREE Full text] [doi: 10.1136/bjsports-2021-104379] [Medline: 34580067]

86.   Ritterband LM, Bailey ET, Thorndike FP, Lord HR, Farrell-Carnahan L, Baum LD. Initial evaluation of an internet intervention to improve the sleep of cancer survivors with insomnia. Psychooncology. Jul 2012;21(7):695-705. [FREE Full text] [doi: 10.1002/pon.1969] [Medline: 21538678]

87.   Savard J, Ivers H, Savard MH, Morin CM. Is a video-based cognitive behavioral therapy for insomnia as efficacious as a professionally administered treatment in breast cancer? Results of a randomized controlled trial. Sleep. Aug 01, 2014;37(8):1305-1314. [FREE Full text] [doi: 10.5665/sleep.3918] [Medline: 25083010]

88.   Serrat M, Albajes K, Navarrete J, Almirall M, Lluch Girbés E, Neblett R, et al. Effectiveness of two video-based multicomponent treatments for fibromyalgia: the added value of cognitive restructuring and mindfulness in a three-arm randomised controlled trial. Behav Res Ther. Nov 2022;158:104188. [FREE Full text] [doi: 10.1016/j.brat.2022.104188] [Medline: 36116229]

89.   Shaffer KM, Smith JG, Glazer JV, Camacho F, Chow PI, Mattos M, et al. Effects of an internet-delivered insomnia intervention for older adults: a secondary analysis on symptoms of depression and anxiety. J Behav Med. Oct 2022;45(5):728-738. [FREE Full text] [doi: 10.1007/s10865-022-00353-y] [Medline: 35932397]

90.   Spanhel K, Hovestadt E, Lehr D, Spiegelhalder K, Baumeister H, Bengel J, et al. Engaging refugees with a culturally adapted digital intervention to improve sleep: a randomized controlled pilot trial. Front Psychiatry. Feb 23, 2022;13:832196. [FREE Full text] [doi: 10.3389/fpsyt.2022.832196] [Medline: 35280163]

91.   Stiglbauer B, Weber S, Batinic B. Does your health really benefit from using a self-tracking device? Evidence from a longitudinal randomized control trial. Comput Hum Behav. May 2019;94:131-139. [doi: 10.1016/j.chb.2019.01.018]

92. Teychenne M, Abbott G, Stephens LD, Opie RS, Olander EK, Brennan L, et al. Mums on the move: a pilot randomised controlled trial of a home-based physical activity intervention for mothers at risk of postnatal depression. Midwifery. Feb 2021;93:102898. [doi: 10.1016/j.midw.2020.102898] [Medline: 33290891]

93. Vandelanotte C, Duncan MJ, Plotnikoff RC, Rebar A, Alley S, Schoeppe S, et al. Impact of a web-based personally tailored physical activity intervention on depression, anxiety, stress and quality of life: secondary outcomes from a randomized controlled trial. Ment Health Phys Act. Oct 2022;23:100477. [doi: 10.1016/j.mhpa.2022.100477]

94. Wan ES, Kantorowski A, Homsy D, Teylan M, Kadri R, Richardson CR, et al. Promoting physical activity in COPD: insights from a randomized trial of a web-based intervention and pedometer use. Respir Med. Sep 2017;130:102-110. [FREE Full text] [doi: 10.1016/j.rmed.2017.07.057] [Medline: 29206627]

95. Wang L, Liu Y, Tan H, Huang S. Transtheoretical model-based mobile health application for PCOS. Reprod Health. May 12, 2022;19(1):117. [FREE Full text] [doi: 10.1186/s12978-022-01422-w] [Medline: 35549736]

96. Wang F, Boros S. Effects of a pedometer-based walking intervention on young adults' sleep quality, stress and life satisfaction: randomized controlled trial. J Bodyw Mov Ther. Oct 2020;24(4):286-292. [FREE Full text] [doi: 10.1016/j.jbmt.2020.07.011] [Medline: 33218524]

97. Wong VW, Ho FY, Shi NK, Tong JT, Chung KF, Yeung WF, et al. Smartphone-delivered multicomponent lifestyle medicine intervention for depressive symptoms: a randomized controlled trial. J Consult Clin Psychol. Dec 2021;89(12):970-984. [doi: 10.1037/ccp0000695] [Medline: 35025538]

98. Young MD, Drew RJ, Kay-Lambkin F, Collins CE, Callister R, Kelly BJ, et al. Impact of a self-guided, eHealth program targeting weight loss and depression in men: a randomized trial. J Consult Clin Psychol. Aug 2021;89(8):682-694. [doi: 10.1037/ccp0000671] [Medline: 34472895]

99. Xuto P, Toyohiko K, Prasitwattanaseree P, Sriarporn P. Effect of receiving text messages on health care behavior and state anxiety of Thai pregnant women: a randomized controlled trial. Int J Community Based Nurs Midwifery. Jan 2022;10(1):18-29. [FREE Full text] [doi: 10.30476/IJCBNM.2021.89364.1604] [Medline: 35005038]

100. Yudi MB, Clark DJ, Tsang D, Jelinek M, Kalten K, Joshi SB, et al. SMARTphone-based, early cardiac REHABilitation in patients with acute coronary syndromes: a randomized controlled trial. Coron Artery Dis. Aug 01, 2021;32(5):432-440. [doi: 10.1097/MCA.0000000000000938] [Medline: 32868661]

101. Cipriani A, Furukawa TA, Salanti G, Chaimani A, Atkinson LZ, Ogawa Y, et al. Comparative efficacy and acceptability of 21 antidepressant drugs for the acute treatment of adults with major depressive disorder: a systematic review and network meta-analysis. Lancet. Apr 07, 2018;391(10128):1357-1366. [FREE Full text] [doi: 10.1016/S0140-6736(17)32802-7] [Medline: 29477251]

102. Linde K, Sigterman K, Kriston L, Rücker G, Jamil S, Meissner K, et al. Effectiveness of psychological treatments for depressive disorders in primary care: systematic review and meta-analysis. Ann Fam Med. Jan 12, 2015;13(1):56-68. [FREE Full text] [doi: 10.1370/afm.1719] [Medline: 25583894]

103. Hudson NW, Anusic I, Lucas RE, Donnellan MB. Comparing the reliability and validity of global self-report measures of subjective well-being with experiential day reconstruction measures. Assessment. Jan 2020;27(1):102-116. [FREE Full text] [doi: 10.1177/1073191117744660] [Medline: 29254354]

104. Ayenigbara IO. The evolving nature of artificial intelligence: role in public health and health promotion. J Public Health (Oxf). May 29, 2024;46(2):e322-e323. [doi: 10.1093/pubmed/fdad240] [Medline: 37973395]

105. Singh B, Olds T, Brinsley J, Dumuid D, Virgara R, Matricciani L, et al. Systematic review and meta-analysis of the effectiveness of chatbots on lifestyle behaviours. NPJ Digit Med. Jun 23, 2023;6(1):118. [FREE Full text] [doi: 10.1038/s41746-023-00856-1] [Medline: 37353578]

106. Abd-Alrazaq AA, Rababeh A, Alajlani M, Bewick BM, Househ M. Effectiveness and safety of using chatbots to improve mental health: systematic review and meta-analysis. J Med Internet Res. Jul 13, 2020;22(7):e16021. [FREE Full text] [doi: 10.2196/16021] [Medline: 32673216]

107. Slattery P, Saeri AK, Bragge P. Research co-design in health: a rapid overview of reviews. Health Res Policy Syst. Feb 11, 2020;18(1):17. [FREE Full text] [doi: 10.1186/s12961-020-0528-9] [Medline: 32046728]

108. Gómez-Gómez I, Bellón JÁ, Resurrección DM, Cuijpers P, Moreno-Peral P, Rigabert A, et al. Effectiveness of universal multiple-risk lifestyle interventions in reducing depressive symptoms: systematic review and meta-analysis. Prev Med. May 2020;134:106067. [FREE Full text] [doi: 10.1016/j.ypmed.2020.106067] [Medline: 32194097]

109. Raeside R, Jia S, Todd A, Hyun K, Singleton A, Gardner L, et al. Are digital health interventions that target lifestyle risk behaviors effective for improving mental health and wellbeing in adolescents? A systematic review with meta-analyses. Adolescent Res Rev. Aug 12, 2023;9(2):193-226. [doi: 10.1007/s40894-023-00224-w]

110. Iasiello M, van Agteren J, Ali K, Fassnacht DB. J Posit Psychol. Feb 26, 2023;19(2):337-341. [doi: 10.1080/17439760.2023.2179935]

111. Rodriguez JA, Clark CR, Bates DW. Digital health equity as a necessity in the 21st century Cures Act era. JAMA. Jun 16, 2020;323(23):2381-2382. [doi: 10.1001/jama.2020.7858] [Medline: 32463421]

112. Kickbusch I, Holly L. Addressing the digital determinants of health: health promotion must lead the charge. Health Promot Int. Jun 01, 2023;38(3):daad059. [doi: 10.1093/heapro/daad059] [Medline: 37264549]

Abbreviations

PEDro: Physiotherapy Evidence Database Scale
PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RCT: randomized controlled trial
SMD: standardized mean difference

XSL•FO
RenderX