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The Effectiveness of Multiple Interventions in Promoting Healthy Lifestyle Behaviors among Adults at Risk for Disease: A Systematic Review of Randomized Controlled Trials

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Abstract

Lifestyle choices play a critical role in maintaining health and preventing chronic diseases. This systematic literature review, guided by the PICOS framework, aimed to evaluate the effectiveness of educational, behavioral, digital, and community-based interventions in promoting healthy behaviors and reducing obesity among adults (≥18 years). A comprehensive search was conducted in PubMed, Scopus, Web of Science, and Google Scholar to identify eligible randomized controlled trials (RCTs) and cluster-RCTs using predefined keywords. Of 2004 records retrieved, 25 studies met the eligibility criteria after independent dual screening, with intervention durations ranging from six weeks to eighteen months.The findings indicate that theory-based interventions grounded in models such as the Social Cognitive Theory, the Health Belief Model, and the Theory of Planned Behavior enhanced self-efficacy, improved health beliefs, and supported dietary and physical activity changes, with moderate effects on weight and metabolic markers. Multicomponent lifestyle programsthat integrated education, behavioural counselling, social support, and digital reminders demonstrated greater effectiveness than single-component approaches, producing clinically meaningful reductions in weight, BMI, and waist circumference over 10–12 weeks. Digital and app-based interventions achieved moderate weight loss with partial maintenance up to one year, while long-term lifestyle programs (≥12 months) yielded sustained improvements in visceral adiposity and postpartum weight retention. In contrast, very short programs (≤6 weeks) primarily improved psychosocial outcomes and dietary behaviours, with limited impact on anthropometric measures. Heterogeneity in study design,

reliance on self-reported data, and underrepresentation of low- and middle-income populations observed across the included studies affect the generalizability of the findings. Therefore, longer-term and more rigorous trials are warranted to strengthen the evidence base and inform future public health policies.
Keywords: Behavioural Interventions, Health Promotion, Lifestyle-Based Interventions, Motivational Strategies, Obesity Prevention, Sustainable Behaviour Change

Introduction

A healthy lifestyle encompasses behavioural patterns and habits that maintain, restore, and improve health (Fjeldsoe et al., 2011). It is closely associated with physical, mental, and social well-being through balanced nutrition and regular physical activity, both of which improve health outcomes and reduce the risk of chronic disease (Andreevna, 2021).

Unhealthy lifestyle behaviors are among the leading determinants of non-communicable diseases (NCDs), including cardiovascular diseases, cancer, chronic respiratory illnesses, diabetes, and obesity, which collectively account for more than 60% of global mortality (WHO, 2020; WHO, 2022). While genetic predisposition and environmental exposures play a role in the onset of these conditions, modifiable lifestyle factors remain central to disease prevention at the individual level (Kolb & Martin, 2017; Yu et al., 2016). Evidence consistently shows that dietary choices and other modifiable behaviors can reduce the risks of hypertension, hypercholesterolemia, obesity, and chronic inflammation, thereby lowering the burden of cardiometabolic diseases (Patiñini et al., 2021; Stanner et al., 2019).

Despite increasing awareness of healthy practices, the global rise in obesity and related health problems highlights the urgent need for practical, evidence-based interventions (Swaby et al., 2023). Adopting healthy eating patterns, engaging in regular physical activity, and ensuring adequate sleep have been shown to prevent or delay the onset of chronic conditions (Izath et al., 2023; Knutson, 2022). However, maintaining these behaviors over time remains challenging, particularly among adults with overweight and obesity.

Recent studies have demonstrated the effectiveness of various intervention strategies, including mobile health (mHealth) applications (Covolo et al., 2017; Schoeppe et al., 2016), structured educational programs, and motivational approaches (de Ridder et al., 2017; James et al., 2022). These findings underscore the importance of identifying and applying interventions that can produce sustainable changes in lifestyle behaviors and support weight management.

Accordingly, this systematic review aims to evaluate the effectiveness of educational, behavioral, dietary, digital, and motivational interventions in promoting healthy lifestyle behaviors and supporting weight loss among adults aged 18 years and older.

Search Strategy

A systematic search was carried out across four electronic databases PubMed, Web of Science, Scopus, and Google Scholar for studies published in English between January 2015 and June 2024. The search strategy was constructed using Boolean operators and adapted to each database. Keywords included *randomised controlled trial*, *intervention*, *health education*, *lifestyle*, *behavioural*, *mobile health*, *motivational*, and *risk factors for disease*. The

following example illustrates the PubMed search string:
("randomized controlled trial"[Publication Type] OR "randomised controlled trial"[Title/Abstract] OR RCT[Title/Abstract]) AND ("health education"[MeSH Terms] OR lifestyle[Title/Abstract] OR behavioural[Title/Abstract] OR "mobile health"[Title/Abstract] OR mHealth[Title/Abstract] OR motivational[Title/Abstract]) AND ("risk factors"[MeSH Terms] OR "disease prevention"[MeSH Terms]) with filters applied for adults (≥18 years), English language, and publication years 2015–2024. Equivalent strategies were used for Web of Science and Scopus, with syntax tailored to each database, while Google Scholar was searched using simplified terms and date limits. The search process followed the PRISMA 2020 framework, and the flow of studies through identification, screening, eligibility, and inclusion is presented in Figure 1.

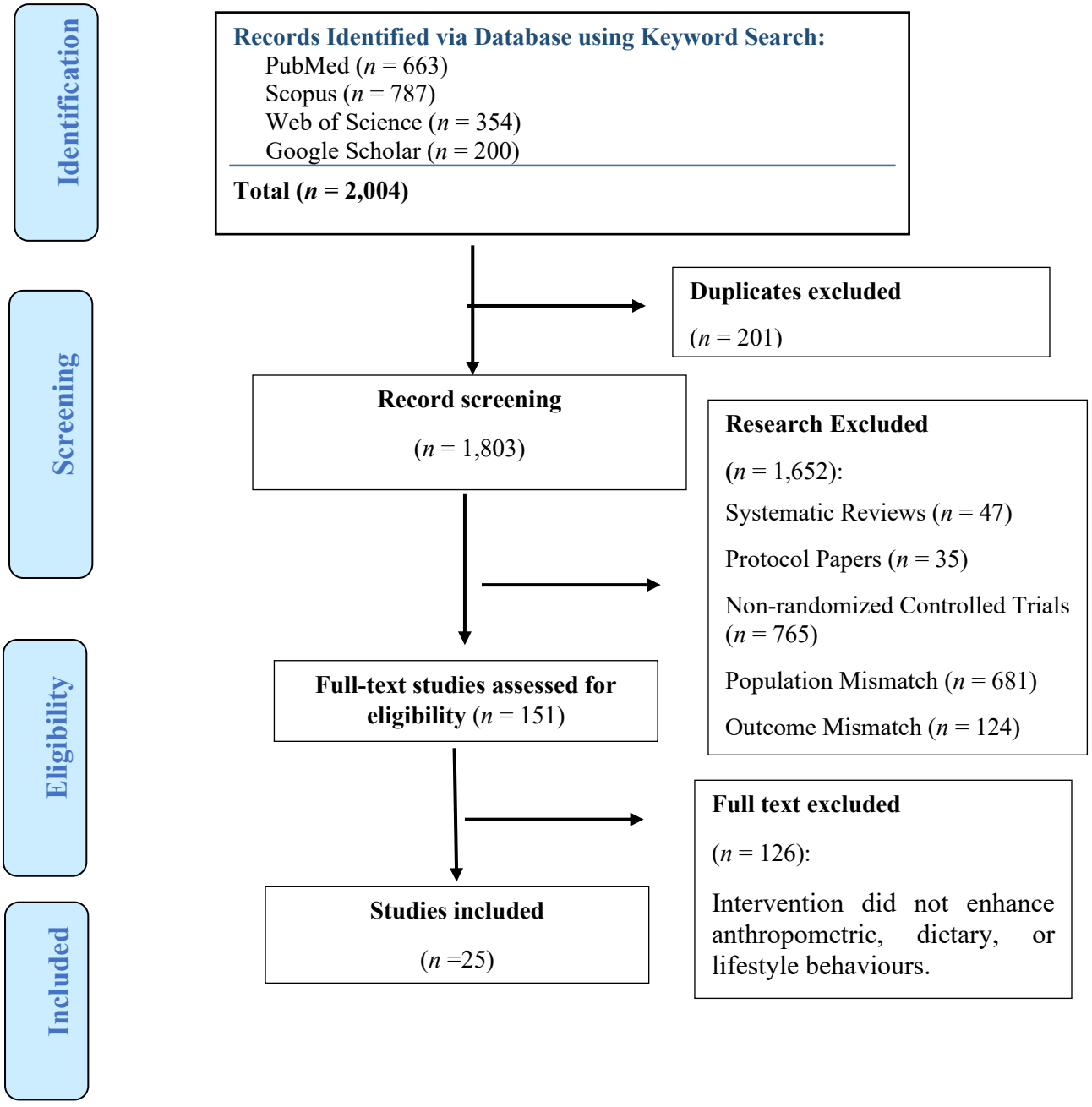

Figure 1: PRISMA flow diagram

Eligibility Criteria

Studies qualified for inclusion if they examined at-risk adults aged 18 and above, implementing educational, behavioural, lifestyle, mobile health, and motivational interventions. This study only included English-language randomised or cluster-randomised controlled trials (RCTs) published between 2015 and 2024 that reported at least one outcome related to self-efficacy, disease and weight management, dietary habits, physical activity, sedentary behaviour and quality of life. Studies were excluded if they involved paediatric populations, lacked an intervention, used non-randomised designs, failed to report predefined outcomes, or lacked original data.

Data Processing

Two reviewers independently extracted data using standardised forms, documenting study characteristics, participant demographics, intervention details, and results. They resolved discrepancies through discussion. The information extracted included study identification, country, setting, design, participants, assessment methods, intervention type, duration, follow-ups, key findings, and limitations.

Quality Assessment

This study evaluated study quality using the Effective Public Health Practice Project (EPHPP) tool, evaluating each article as weak, moderate, or strong regarding six domain ratings: selection bias, study design, confounding control, blinding, data collection, and participant retention. Those with no weak and at least two strong ratings were considered strong. Those with two strong ratings and one weak rating were considered moderate. Finally, those with two or more weak ratings were considered weak.

Data Synthesis

Given the wide scope of health-related behaviours examined across the included studies, substantial heterogeneity was observed in both the study objectives and the reported outcomes. To address this variation, a qualitative synthesis was undertaken to summarise the extracted data. This approach enabled a systematic review of theory-based educational interventions, behavioural and lifestyle-focused interventions, and digital health strategies, allowing for interpretation of their effectiveness, feasibility, usability, and application of behaviour change techniques. In addition, the synthesis emphasized study limitations and outlined directions for future research.

Results

Study Selection

The selection process is visualised in Figure 1. A comprehensive search across four major databases identified 2,004 articles, reduced to 1,803 after removing 201 duplicates via EndNote. Title and abstract screening retained only randomised or cluster-randomised controlled trials (RCTs) meeting inclusion criteria. This phase excluded 1,652 articles for the following reasons: systematic reviews (47) lacking original data, protocol papers (35) without intervention outcomes, non-randomised controlled trials (765), population mismatch (681), and outcome mismatch (124). Following rigorous filtering, 151 articles underwent full-text evaluation, leading to 126 articles being excluded for failing to demonstrate improvements in

anthropometric, dietary, or lifestyle behaviours. Ultimately, 25 studies met all inclusion criteria, aligned with the review's objectives and contributed to the evidence base.

Description of the Studies

The systematic review included twenty-five studies from different countries and world regions, reflecting diverse lifestyle behaviors and nutritional interventions. The studies were conducted in the United States of America (Barnett & Zeng, 2022; Gray et al., 2021; Liu et al., 2022; Hayes et al., 2021; Agboola et al., 2016), Europe(Martinez-Avila et al., 2020; Zelicha et al., 2022; Markkanen et al., 2024; Gemesi et al., 2023; Brame et al., 2022), Asia (Shao et al., 2018; Zheng et al., 2020; Hou et al., 2024; Cheung et al., 2022; Wong et al., 2020), Africa (Shuremu et al., 2023; Gebremichael & Belachew, 2023), and the Middle East (Daniali et al., 2017; Mohammadnia Motlagh et al., 2022; Faghih et al., 2024; Alghamdi, 2017; Alshahrani et al., 2021), in addition to Australia (Cleo et al., 2022; Cheung et al., 2022; Hou et al., 2024) (Table 1).

The most common design was the individual randomized controlled trial (RCT), applied in the majority of the studies (Daniali et al., 2017; Komaç & Duru, 2024; Shao et al., 2018; Faghih et al., 2024; Martinez-Avila et al., 2020; Zheng et al., 2020; Wong et al., 2020; Cleo et al., 2022; Hayes et al., 2021; Alshahrani et al., 2021; Agboola et al., 2016; Hou et al., 2024; Brame et al., 2022). A smaller proportion used cluster randomized controlled trials (Cluster RCTs) in community-based settings (Shuremu et al., 2023; Barnett & Zeng, 2022; Mohammadnia Motlagh et al., 2022; Gray et al., 2021; Gebremichael & Belachew, 2023), reflecting the interest in addressing both individual and communal health behaviors.

The settings were diverse: the majority of interventions were conducted in health centers (Daniali et al., 2017; Komaç & Duru, 2024; Mohammadnia Motlagh et al., 2022; Faghih et al., 2024; Alghamdi, 2017; Agboola et al., 2016; Hou et al., 2024; Wong et al., 2020), followed by community-based settings (Shuremu et al., 2023; Barnett & Zeng, 2022; Shao et al., 2018; Gray et al., 2021; Gebremichael & Belachew, 2023; Liu et al., 2022; Uemura et al., 2020), then universities (Martinez-Avila et al., 2020; Hayes et al., 2021; Alshahrani et al., 2021; Markkanen et al., 2024; Gemesi et al., 2023; Brame et al., 2022). Fewer studies were carried out in hospitals (Zheng et al., 2020; Cheung et al., 2022; Markkanen et al., 2024) and in workplace settings (Zelicha et al., 2022).

Table 1
Characteristics of the Included Studies

Author (Year)	Country	Setting	Study Design	Participants	Assessment Methods	Intervention Type	Duration	Follow-up	Key Findings	Limitations
(Shuremu et al., 2023)	Ethiopia	Urban and semi-urban communities	Cluster RCT	N=782 Individuals aged 60 years and above	Dietary diversity, Nutritional status, Anthropometric measurements, SCT components	Social Cognitive Theory-based nutrition education	6 months	Endline only 6 months	Improved healthy eating, dietary diversity, and nutritional status, along with the strengthening of Social Cognitive Theory constructs.	Limited to senior participants
(Daniali et al., 2017)	Iran	Primary health-care centers in Isfahan	RCT	146 hypertensive overweight/obese women 30–65 years	- Self-efficacy scale - Physical activity scale - DASH diet - Anthropometry (weight, height, BMI, BP) - Biochemical tests (lipids, sodium)	6 weekly participatory educational sessions (exercise, weight control, DASH diet, medication adherence, self-monitoring) + SMS reminders; group-based with psychologist, nutritionist, coach	6 weeks	6 months	- Significant improvement in self-efficacy, physical activity, healthy diet adherence - Reduction in systolic and diastolic BP in intervention group - Positive but non-significant effect on weight loss	- Reliance on self-reported behaviors (recall bias) - Limited to women attending public health centers in Isfahan - Short intervention period
(Barnett & Zeng, 2022))	USA	community sites across	Cluster RCT	292 older adults ≥60 years	- lifestyle behaviors - Healthy Behavior Index	Healthy Eating for Successful Living	6 weeks	6 months	Improvement in lifestyle behaviors and the	Self-reported behaviors

		5 states			(HBI) - Anthropometrics: BMI, waist-to-hip ratio (WHR) - Quality of life (EQ-5D-5L)	in Older Adults™ (HESL) program: 6 weekly			Healthy Behavior Index, reduction in waist-to-hip ratio, with no significant effect on BMI or physical activity	
(Komaç & Duru, 2024)	Türkey	Family Health Centre (FHC)	RCT	N=80, patients with essential hypertension, aged 30–59 years	Blood pressure, cardiovascular risk knowledge of risk factors, healthy lifestyle behaviors, medication adherence, anthropometric measures	Health Belief Model education with motivational interviews	6 months	6 months	Improved cardiovascular risk factors and behaviors	Small sample size; self-reported changes
(Mohammadnia Motlagh et al., 2022)	Iran	Health Service Center	Cluster RCT	N=71, pre-diabetic women, aged 30–60 years	- TPB-based questionnaire (knowledge, attitudes, subjective norms, perceived behavioral control, intention, behavior) - Physical activity questionnaire (GLTEQ) - Dietary behavior questionnaire - Fasting blood sugar (FBS) measurement	Educational intervention based on the Theory of Planned Behavior (3 sessions × 60–90 min; lectures, group discussions, booklets) + 3-month follow-ution	3 weeks educational sessions	3 months	Improved fasting blood sugar and behavioral control	Short follow-up; small sample size

(Shao et al., 2018)	China	Community health service center	RCT	N=193, asymptomatic hyperuricemia patients mean age ~60 years,	Health beliefs, physical activity,BMI, waist–hip ratio and serum uric acid	Health Belief Model-based education program: educational booklets + 6 weekly sessions (45–60 min) including lectures & group discussions on HU risks, low-purine diet, physical activity, benefits & barriers, strategies for adherence	6 weeks	Not specified	Improved HBM domains (susceptibility, severity, benefits, barriers, self-efficacy), physical activity, BMI, WHR, and SUA. No significant effect on blood pressure.	Small sample size; lack of long-term follow-up
(Cleo et al., 2019))	Australia	University and Institute of Health and Spor	RCT	75 adults, 18–75 yrs, BMI ≥25 (mean BMI 34.5, mean age 51 yrs)	Weight, BMI, WC ; diet (fruit/veg servings); exercise, wellbeing, depression, anxiety, habit strength, openness to change	Habit-based weight loss interventions TTT (Ten Top Tips): habit formation ; DSD (Do Something Different): habit disruption (daily/weekly novel tasks); WL: waitlist control	12 weeks	Post-intervention, 6 & 12 months (for TTT & DSD)	Significant weight loss maintenance	High attrition rates; limited generalizability
(Faghih et al., 2024	Iran	Health centers	RCT	N=73, middle-aged women,	- Physical Activity - Bandura's Exercise	Health Belief Model training	6 weeks	4 weeks	The intervention led to improve	Short follow-up period

				aged 30–59 years	Self-Efficacy Scale (ESE) and HBM constructs	with social support 6 weeks (120-min weekly sessions).			ments in perceived benefits, cues to action, self-efficacy, increased social support, higher physical activity levels, reduced perceived barriers, and a decrease in BMI	
(Gray et al., 2021)	USA	Three health systems Medical Center, Health Care System Community Health Centers	RCT	N=287, adults with type 2 diabetes, aged 30–70 years	Diabetes self-management, dietary habits, HbA1c	Community health worker-led education	7–10 months of CHW visits	12 months	Increased physical activity and dietary behaviors	No significant HbA1c changes
(Martinez-Avila et al., 2020)	Spain	University	RCT	N=139, young healthy adults, aged 18–25 years	Physical activity, eating behaviors	Exercise training program	6 months	Endline 6 months	sedentary behaviour inversely associated with binge and uncontrolled eating; PA (esp. MVPA) positively associated with binge, uncontrolled, and emotional eating. Only emotional eating	Self-reported behaviors unchanged by the program

									increased in vigorous-intensity group. No significant effects on binge or uncontrolled eating	
(Gebremichael & Belachew, 2023)	Ethiopia	Rural and urban clusters and communities	Cluster RCT	N=770 pregnant women, Mean Age = 27.3 years	- Dietary practices (DDS, ASF, meal frequency) - Nutritional status (MUAC)	Community-based behavior change communication	3 months	Endline at 36–37 weeks of pregnancy	Reduced undernutrition prevalence	Lack of blinding
(Zheng et al., 2020)	China	Hospital	RCT	N=173 patients with metabolic syndrome, Mean Age = 55.6 years	Framingham 10-year CVD risk score - Self-rated Abilities for Health Practices - Health Promoting Lifestyle Profile nutrition, exercise, stress	Nurse-led lifestyle intervention based on Health Promotion Model: • 1 face-to-face education (30–40 min) • 10-chapter educational booklet • 6 bi-weekly phone calls (20–30 min each	3 months	3 months	improved self-efficacy (nutrition, stress, exercise, health responsibility, total score). Improved health-promoting behaviours (nutrition, exercise, stress management, overall). No significant reduction in 10-year cardiovascular risk	Short duration; no long-term follow-up
(Liu et al., 2022)	USA	South Carolina (community & clinics)	RCT	N=219 pregnant women, Mean aged 18-44 years	Postpartum weight retention, dietary adherence	Pregnancy and postpartum lifestyle intervention	Pregnancy to 6 months postpartum	12 months postpartum	Reduced postpartum weight retention	Limited to specific racial groups

					PA assessment		From early pregnancy until 6 months postpartum (~12 months total)			
(Uemura et al., 2020)	Japan	A rural community	RCT	N=60 older adults with low health literacy, Mean Age = 74.0 years	Health literacy, lifestyle factors, physical function	Active learning program	24 weeks	Endline 24 weeks	Improved health literacy and physical function	Small sample size; no long-term follow-up
(Zelicha et al., 2022)	Israel	Research Center workplace	RCT	N=294, Mean Age=51 years	MRI (3-T) for visceral, deep, and superficial adipose tissue; anthropometrics (weight, WC); blood biomarkers; dietary intake via validated FFQ; urine & plasma polyphenols	Three arms: (1) Healthy Dietary Guidelines (HDG), (2) Mediterranean (MED) diet, (3) Green-MED diet (extra polyphenols: green tea, Wolffia globosa [Mankai], walnuts; reduced red/processed meat).	18 months	Assessed at baseline, 6 months, and 18 months	Significant visceral adipose tissue reduction	Self-reported dietary adherence bias
(Hayes et al., 2021)	USA	University	RCT	95 college students (18–25 years) with overweight/obesity (BMI ≥25)	Anthropometric measurements (weight, height, BMI); Diet History Questionnaire II (FFQ – energy intake, Healthy Eating Index [HEI]	(1) IMP: Implementation intentions for 6 goals (dietary + daily weighing). (2) IMP+: IMP + fluency training (weekly online MCQs) +	4 weeks	post-intervention only (no long-term follow-up	All groups achieved slight reductions in weight and caloric intake, and improvements in diet quality, with impleme	Short duration; no follow-up

					score); Ecological Momentary Assessment (EMA) via mobile application	text message reminders (16 msgs). (3) GOL: Goal intention control (dietary goals + weighing only)			ntation intentions associated with weight loss–supportive behaviors.	
(Alghamdi, 2017)	Saudi Arabia	Primary care obesity clinic	RCT	N=140, Mean Age=Not specified	Weight loss, lifestyle changes	Intensive lifestyle intervention	12 weeks	Endline only (12 weeks)	Significant weight reduction	Single-center study; no long-term follow-up
(Alshahrani et al., 2021)	Saudi Arabia	King Khalid University, Abha	RCT	N=110, Female college students aged 18–28	Physical activity measures	WhatsApp-based intervention: orientation session + 3–4 PA-promotional messages/week (CDC/WHO materials)	10 weeks	Endline only (10 weeks	Increased physical activity levels and improved metabolic equivalents	Limited generalizability due to small sample size
(Agboola et al., 2016)	USA	4 health centers in Boston	RCT	N=126, Patients with Type 2 Diabetes Mellitus	Step counts, HbA1c levels	TTM program: ≥2 daily SMS (feedback & motivation) + pedometer; CG: pedometer only	6 months	Endline (6 months	Increased step count and reduced HbA1c	High attrition rate
(Hou et al., 2024)	China	Community clinics	RCT	N=105, Older adults with Type 2 Diabetes mean age IG = 69.2, CG = 64.5	HbA1c, fasting glucose, BMI, weight, BP, lipids, PA, health beliefs	Diabetes education with text-message support	6 months	Endline (6 months	Improved physical activity and health beliefs reduction in BMI, but no significant effect on HbA1c compare	Small sample; low mHealth acceptance among older adults; limited follow-up; limited generalizability.

									d with the control group. The control group had greater reductions in blood pressure, total cholesterol, and LDL	
(Cheung et al., 2022)	Australia	Hospitals	RCT	177women diagnosed with gestational diabetes mellitus (GDM)	Self-reported online surveys (diet, PA, EPDS), FFQ (diet), AAQ (PA), BLISS (breastfeeding), OGTT verified, weight (self-reported)	Text messaging and activity monitoring	6 months	Endline (6 months postpartum	No significant improvement in weight, diet, or overall lifestyle outcomes; only higher step-count adherence in the intervention group, with COVID-19 restrictions limiting impact	COVID-19 impact;
(Markkanen et al., 2024)	Finland	University of Oulu & Oulu University Hospital	RCT	N = 200 volunteers, Mean Age = 46.5 years including both men and women	Anthropometrics (weight, BMI, WC, BP), blood tests (glucose, lipids, liver enzymes)	Mobile health behavior support system app	6-month active intervention + continued access until 12 months	12 months	App users achieved moderate weight loss (−2.5% at 6 months, maintained at −2.1% at 12 months) with a significant reduction in waist circumfe	The study was conducted in a single region with a limited sample, which restricts generalizability.

									rence but no improvement in metabolic markers.	
(Gemesi et al., 2023)	Germany	University	RCT	N = 168, Mean Age = 47.4 years	Anthropometrics (weight, BMI, body composition via Tanita BIA, height via SECA stadiometer), Quality of life (EQ-5D-5L, EQ-VAS), App usability (TAM3, SUS), App usage data	App-based multimodal weight loss program	12 weeks	12 weeks	The digital multimodal application led to a moderate and statistically significant weight loss over 12 weeks, with maintenance of the results after 24 weeks.	limited generalizability
(Brame et al., 2022)	Germany	Web-based intervention, at the University	RCT	N = 92, Mean Age = 50.0 years including both men and women	Anthropometrics , blood pressure, flow-mediated dilatation, blood biomarkers (HbA1c, lipids)	Web-based weight loss program	12 weeks	Post-intervention (12 weeks)	Improved weight, BMI, waist circumference, and systolic blood pressure compared to the control group, with no significant effect on HbA1c, lipids, or endothelial function.	Small sample size; self-reported adherence
(Wong et al., 2020)	Hong Kong	cardiac clinics	RCT	N = 438, Mean Age = 52.22 years	Physical Activity , Self-Efficacy for Exercise Scale (SEE-C), anthropo	Web-based educational support	6 months	6 months	Increased physical exercise; improved HDL-C no significant effect	Self-reported data bias

					metrics, BP, lipid profile				on other CVD risk markers or exercise self-efficacy	

Different assessment methods and intervention types were examined to determine their relationship with promoting healthy behaviours. Nine types of interventions were evaluated. The most prevalent outcomes targeted BMI, weight loss, and body composition (Barnett & Zeng, 2022; Cleo et al., 2022; Liu et al., 2022; Zelicha et al., 2022; Hayes et al., 2021; Markkanen et al., 2024; Gemesi et al., 2023; Brame et al., 2022). This was followed by technology-based interventions such as mobile applications, text messaging, and web-based programs (Alghamdi, 2017; Alshahrani et al., 2021; Agboola et al., 2016; Cheung et al., 2022; Gemesi et al., 2023). Physical activity and exercise measures were also frequently included (Komaç & Duru, 2024; Cleo et al., 2022; Martinez-Avila et al., 2020; Alshahrani et al., 2021; Cheung et al., 2022; Wong et al., 2020), as well as blood pressure and cardiovascular risk factors (Daniali et al., 2017; Komaç & Duru, 2024; Gray et al., 2021; Zheng et al., 2020; Wong et al., 2020).

Other interventions focused on self-care behaviours and health beliefs (Daniali et al., 2017; Shao et al., 2018; Faghih et al., 2024; Zheng et al., 2020; Hou et al., 2024), fasting blood sugar and metabolic markers (Mohammadnia Motlagh et al., 2022; Shao et al., 2018; Zheng et al., 2020; Hou et al., 2024), and diabetes management and HbA1c(Gray et al., 2021; Agboola et al., 2016; Hou et al., 2024). Moreover, some studies assessed dietary intake and nutrition outcomes (Shuremu et al., 2023; Gebremichael & Belachew, 2023), while others emphasized health literacy and lifestyle factors (Uemura et al., 2020).

Overall, the assessment methods predominantly measured physical and clinical indicators such as BMI, body weight, blood pressure, and metabolic outcomes, in addition to behavioural and psychosocial measures such as knowledge, self-efficacy, and lifestyle practices related to nutrition and physical activity..

The studies also examined several interventions designed to promote healthy behaviours. Most of the studies assessed the efficacy of education-based approaches in improving lifestyle outcomes. These included education about healthy beliefs (Komaç & Duru, 2024; Shao et al., 2018; Faghih et al., 2024; Zheng et al., 2020), theory-based learning programs (Daniali et al., 2017; Mohammadnia Motlagh et al., 2022; Uemura et al., 2020), and community-based interventions (Shuremu et al., 2023; Barnett & Zeng, 2022; Gray et al., 2021; Gebremichael & Belachew, 2023).

Other interventions focused on diet and nutrition, such as healthy eating programs and counselling (Shuremu et al., 2023; Barnett & Zeng, 2022; Martinez-Avila et al., 2020; Zelicha et al., 2022), including the high-polyphenol Mediterranean diet (Zelicha et al., 2022), which aimed to improve overall health and reduce obesity-related risks.

Five studies investigated physical activity and exercise training interventions (Komaç & Duru, 2024; Martinez-Avila et al., 2020; Alshahrani et al., 2021; Cheung et al., 2022; Wong

et al., 2020). With the rise of digital health, technology-based programs became common, with seven studies examining interventions such as mobile health applications and web-based platforms (Alghamdi, 2017; Markkanen et al., 2024; Gemesi et al., 2023; Brame et al., 2022), text messaging, and social media support (Alshahrani et al., 2021; Agboola et al., 2016; Hou et al., 2024; Cheung et al., 2022).

Other approaches emphasized behaviour change and motivational strategies (Komaç & Duru, 2024; Gebremichael & Belachew, 2023; Hayes et al., 2021), as well as diabetes and metabolic health management (Gray et al., 2021; Zheng et al., 2020; Agboola et al., 2016; Hou et al., 2024).The most common interventions were education, physical fitness and diet, counselling, and technology-based programs.

The duration and follow-up period of the interventions varied substantially across the included studies, reflecting both short- and longer-term horizons. Very short programs lasting four to six weeks were reported by Daniali et al. (2017), Hayes et al. (2021), Barnett & Zeng (2022), Shao et al. (2018), and Faghih et al. (2024). Interventions lasting around three months (approximately 12 weeks) were conducted by Cleo et al. (2022), Alghamdi (2017), Gemesi et al. (2023), Brame et al. (2022), Zheng et al. (2020), and Gebremichael & Belachew (2023). Six-month interventions were common and included studies such as Shuremu et al. (2023), Komaç & Duru (2024), Martinez-Avila et al. (2020), Uemura et al. (2020), Hou et al. (2024), Cheung et al. (2022), Wong et al. (2020), and Agboola et al. (2016). Extended interventions lasted 12 months in the studies of Gray et al. (2021), Liu et al. (2022), and Markkanen et al. (2024), while Zelicha et al. (2022) conducted an 18-month program.

The studies also examined diverse health outcomes, emphasizing the broad implications of lifestyle and dietary interventions. Healthy eating and nutritional outcomes were evaluated in studies such as Shuremu et al. (2023), Gray et al. (2021), Martinez-Avila et al. (2020), Gebremichael & Belachew (2023), and Zelicha et al. (2022). Physical activity was assessed in Daniali et al. (2017), Komaç & Duru (2024), Shao et al. (2018), Faghih et al. (2024), Zheng et al. (2020), Alshahrani et al. (2021), Hou et al. (2024), Cheung et al. (2022), and Wong et al. (2020). Weight-related outcomes were measured in Cleo et al. (2022), Liu et al. (2022), Zelicha et al. (2022), Hayes et al. (2021), Markkanen et al. (2024), Gemesi et al. (2023), and Brame et al. (2022). It is noteworthy that Barnett & Zeng (2022) found improvements in lifestyle behaviours and waist-to-hip ratio but no significant change in BMI, indicating a more complex effect. Blood pressure and cardiovascular risk markers were investigated by Daniali et al. (2017), Komaç & Duru (2024), Gray et al. (2021), Zheng et al. (2020), and Wong et al. (2020). Other important outcomes included self-efficacy and health beliefs (Daniali et al., 2017; Shao et al., 2018; Faghih et al., 2024; Zheng et al., 2020; Hou et al., 2024), diabetes management and HbA1c (Gray et al., 2021; Agboola et al., 2016; Hou et al., 2024), and engagement with technology-based interventions (Alghamdi, 2017; Alshahrani et al., 2021; Agboola et al., 2016; Cheung et al., 2022; Gemesi et al., 2023; Brame et al., 2022).

Overall, the synthesis of evidence revealed that participants benefited from both short- and long-term outcomes, though the effectiveness varied depending on the type of intervention, the study design, and the target population.

The methodological quality of the included studies was appraised using the Effective Public Health Practice Project (EPHPP) Quality Assessment Tool, which evaluates six domains: selection bias, study design, confounders, blinding, data collection methods, and participant withdrawals. The assessment was independently conducted by two reviewers during the data extraction stage (March–April 2024) to ensure rigour and transparency. Disagreements between reviewers were resolved through discussion, and when necessary, a third reviewer was consulted to achieve consensus. This process was conducted in accordance with the PRISMA 2020 guidelines, ensuring systematic and transparent quality appraisal.

As shown in Table 2, most of the studies were rated as moderate quality (Shuremu et al., 2023; Barnett & Zeng, 2022; Mohammadnia Motlagh et al., 2022; Gray et al., 2021; Zelicha et al., 2022; Markkanen et al., 2024; Brame et al., 2022). A smaller proportion were classified as strong with a low risk of bias (Daniali et al., 2017; Komaç & Duru, 2024; Shao et al., 2018; Faghih et al., 2024; Wong et al., 2020), while only one study was ranked as weak (Cheung et al., 2022), suggesting that the reliability of findings varied across the evidence base.

A recurring methodological limitation identified in several studies was the reliance on self-reported behavioural outcomes (Daniali et al., 2017; Komaç & Duru, 2024; Martinez-Avila et al., 2020; Zelicha et al., 2022; Brame et al., 2022; Wong et al., 2020), which introduced the possibility of self-reporting bias and reduced reliability. Furthermore, other studies (Barnett & Zeng, 2022; Gray et al., 2021; Martinez-Avila et al., 2020; Cheung et al., 2022) were marked by weaknesses in blinding, raising the risk of detection and performance bias.

To enhance methodological robustness, future research should reduce reliance on subjective reporting by incorporating objective health measures such as biomarkers and wearable health devices, adopt stronger blinding procedures, extend long-term follow-up assessments, and employ diverse data collection strategies to improve validity and reproducibility.

Table 2
Risk of Bias Assessment using the EPHPP

Study (year)	Selection Bias	Study Design	Confounders	Blinding	Data Collection Methods	Withdrawals and Drop-Outs	Global Rating
(Shuremu et al., 2023)	Strong	Strong	Moderate	Weak	Strong	Moderate	Moderate
(Daniali et al., 2017)	Moderate	Strong	Moderate	Moderate	Strong	Moderate	Strong
(Barnett & Zeng, 2022)	Moderate	Strong	Moderate	Weak	Strong	Moderate	Moderate
(Komaç & Duru, 2024)	Moderate	Strong	Moderate	Moderate	Strong	Strong	Strong
(Mohammadnia Motlagh et al., 2022)	Moderate	Strong	Moderate	Moderate	Strong	Weak	Moderate
(Shao et al., 2018)	Moderate	Strong	Moderate	Moderate	Strong	Strong	Strong
(Cleo et al., 2019)	Moderate	Strong	Strong	Strong	Strong	Moderate	Strong
(Faghih et al., 2024)	Strong	Strong	Strong	Weak	Strong	Moderate	Strong
(Gray et al., 2021)	Moderate	Strong	Moderate	Weak	Strong	Moderate	Moderate
(Martinez-Avila et al., 2020)	Moderate	Strong	Moderate	Weak	Strong	Moderate	Moderate
(Gebremichael & Belachew, 2023)	Moderate	Strong	Moderate	Weak	Strong	Moderate	Moderate
(Zheng et al., 2020)	Moderate	Strong	Moderate	Weak	Strong	Moderate	Moderate
(Liu et al., 2022)	Moderate	Strong	Moderate	Weak	Strong	Moderate	Moderate
(Uemura et al., 2020)	Moderate	Strong	Moderate	Weak	Strong	Moderate	Moderate
(Zelicha et al., 2022)	Moderate	Strong	Moderate	Weak	Strong	Moderate	Moderate
(Hayes et al., 2021)	Moderate	Strong	Moderate	Weak	Strong	Moderate	Moderate
(Alghamdi, 2017)	Moderate	Strong	Moderate	Weak	Strong	Moderate	Moderate
(Alshahrani et al., 2021)	Moderate	Strong	Moderate	Weak	Moderate	Moderate	Moderate
(Agboola et al., 2016)	Moderate	Strong	Moderate	Weak	Strong	Moderate	Moderate
(Hou et al., 2024)	Moderate	Strong	Moderate	Weak	Moderate	Moderate	Moderate

(Cheung et al., 2022)	Moderate	Strong	Moderate	Weak	Moderate	Weak	Weak
(Markkanen et al., 2024)	Moderate	Strong	Moderate	Weak	Moderate	Strong	Moderate
(Gemesi et al., 2023)	Moderate	Strong	Moderate	Weak	Strong	Moderate	Moderate
(Brame et al., 2022)	Moderate	Strong	Moderate	Weak	Strong	Moderate	Moderate
(Wong et al., 2020)	Strengths	Strong	Moderate	Weak	Moderate	Strong	Strong

Discussion

This review of 25 randomized and cluster-randomized controlled trials demonstrates that the effectiveness of obesity- and lifestyle-related interventions is shaped by three interrelated factors: theoretical foundation, program duration, and supportive mechanisms. Interventions grounded in behavioural theories such as the Social Cognitive Theory (SCT), the Health Belief Model (HBM), and the Theory of Planned Behavior (TPB) consistently achieved stronger outcomes compared with purely educational or short-term programs. For example, Shuremu et al. Researchers in Ethiopia reported significant improvements in dietary diversity and nutritional status through an SCT-based intervention supplemented by home visits and role-playing, while Mohammadnia Motlagh et al. in Iran showed reductions in fasting blood sugar following a TPB-based intervention. Similarly, Shao et al. in China confirmed that HBM-based education enhanced health beliefs, increased physical activity, and reduced BMI, WHR, and uric acid levels. These findings suggest that theory-driven frameworks, when combined with practical tools such as goal setting, social support, and self-monitoring, strengthen self-efficacy and facilitate sustainable behaviour change. Digital and mobile health strategies are also becoming powerful adjuncts, particularly for enhancing adherence. SMS, WhatsApp, and app-based interventions as demonstrated by Agboola, Alshahrani, and Markkanen led to improvements in daily step counts, physical activity levels, HbA1c, or moderate weight loss. However, their effect on deeper metabolic outcomes was generally modest, especially among older adults with lower digital literacy (Hou). Moreover, external challenges such as COVID-19 restrictions, as seen in Cheung's postpartum trial, further limited program effectiveness, highlighting the vulnerability of digital interventions to contextual barriers. The duration and intensity of the program is another determining factor. Short-term interventions (≤10 weeks) improved behavioural indicators such as self-efficacy, perceived benefits, and dietary habits, but these did not translate into significant changes in BMI, HbA1c, or lipid profiles. Importantly, evidence shows that short-term programs (10–12 weeks) achieved notable improvements in weight (Alghamdi, 2017; Brame, 2022) and physical activity (Alshahrani, 2021; Faghih, 2024) when combined with social support or motivational messaging, while digital interventions (Markkanen, 2024; Gemesi, 2022) produced moderate weight loss with partial maintenance over time. By contrast, longer-term interventions (≥12 months) demonstrated deeper and more sustainable outcomes: Zelicha et al.'s 18-month Green-Mediterranean program substantially reduced visceral fat, while Liu et al. showed that a pregnancy-to-postpartum intervention effectively reduced long-term postpartum weight retention. These findings highlight the importance of extended follow-up to capture lasting anthropometric and metabolic changes. Content depth and cultural adaptability also influenced the results. Barnett & Zeng's program improved dietary behaviours and WHR but not BMI due to a lack of structured physical activity, while Faghih's HBM-based training combined with social support (childcare, transport, family involvement, motivational

messages) enhanced physical activity and self-efficacy alongside slight reductions in BMI. In Ethiopia, Gebremichael & Lema demonstrated that culturally adapted, community-based interventions reduced maternal undernutrition through the involvement of community leaders and home visits. Similarly, Saudi-based interventions (Alghamdi, Alshahrani) proved effective in weight loss or PA improvements, underlining the importance of cultural tailoring. Nevertheless, several limitations recurred across studies: reliance on self-reported measures (as in Wong and many mHealth studies) introduced recall bias and obscured real differences; short duration constrained the ability to detect physiologic changes; and small, single-centre samples limited generalisability. Additionally, external factors, particularly the COVID-19 pandemic, have further reduced compliance and impact. Overall, the evidence suggests that the most effective interventions are theory-based, multi-component, culturally adapted, extended in duration, and supported by social or digital mechanisms. In contrast, short or narrowly focused interventions relying heavily on self-reports often yield modest or unsustained results

Heterogeneity and Limitations Discussion

Despite the valuable insights gained from the reviewed studies, several limitations must be acknowledged. A major challenge in synthesising the evidence was the heterogeneity in intervention design, participant demographics, and outcome measures, which limited the ability to conduct direct comparisons and draw robust conclusions.

The duration of interventions varied widely, ranging from very short programs of four weeks (Hayes et al., 2021) to long-term interventions extending up to 18 months (Zelicha et al., 2022; Alghamdi, 2017). Most studies had a median duration of around six months (e.g., Shuremu et al., 2023; Komaç & Duru, 2024; Shao et al., 2018; Faghih et al., 2024; Martinez-Avila et al., 2020; Gebremichael & Lema, 2023; Liu et al., 2022; Uemura et al., 2020; Agboola et al., 2016; Markkanen et al., 2024; Wong et al., 2020). Shorter interventions (≤3 months) represented more than one-third of the included studies, which may have limited the capacity to evaluate long-term behavioural and health outcomes.

The interventions themselves also differed considerably, reflecting a broad spectrum of strategies. These included self-care training (Barnett & Zeng, 2022; Shao et al., 2018; Faghih et al., 2024; Martinez-Avila et al., 2020; Zelicha et al., 2022; Alshahrani et al., 2021; Cheung et al., 2022; Wong et al., 2020), nutrition and dietary education (Shuremu et al., 2023; Barnett & Zeng, 2022; Mohammadnia Motlagh et al., 2022; Faghih et al., 2024; Martinez-Avila et al., 2020; Zheng et al., 2020; Liu et al., 2022; Zelicha et al., 2022), and digital or app-based support (Alshahrani et al., 2021; Markkanen et al., 2024; Gemesi et al., 2023; Brame et al., 2022). Other approaches included structured weight loss programs (Gray et al., 2021; Faghih et al., 2024; Zheng et al., 2020; Hayes et al., 2021; Alghamdi, 2017; Markkanen et al., 2024; Brame et al., 2022), community-based health programs (Shuremu et al., 2023; Barnett & Zeng, 2022; Gray et al., 2021; Gebremichael & Lema, 2023; Hou et al., 2024), interventions focusing on hypertension and cardiovascular risk management (Daniali et al., 2017; Komaç & Duru, 2024; Wong et al., 2020), and motivational interviewing (Shuremu et al., 2023; Komaç & Duru, 2024; Shao et al., 2018; Faghih et al., 2024; Zheng et al., 2020; Wong et al., 2020). This diversity in methodology complicated the synthesis of results and the ability to isolate which strategies were most effective.

Outcome measures were equally diverse. While some studies relied on anthropometric indicators such as BMI, waist circumference, or waist-to-hip ratio (Barnett & Zeng, 2022; Faghih et al., 2024; Zheng et al., 2020; Zelicha et al., 2022; Alghamdi, 2017; Markkanen et al., 2024; Gemesi et al., 2023; Brame et al., 2022), others focused on biochemical outcomes such as fasting blood sugar (Mohammadnia Motlagh et al., 2022), or cardiometabolic risk factors including lipids and blood pressure (Komaç & Duru, 2024; Zheng et al., 2020; Brame et al., 2022; Wong et al., 2020). Behavioural measures were also common, particularly physical activity (Daniali et al., 2017; Shao et al., 2018; Gray et al., 2021; Martinez-Avila et al., 2020; Gebremichael & Lema, 2023; Zheng et al., 2020; Alshahrani et al., 2021; Agboola et al., 2016; Hou et al., 2024; Cheung et al., 2022; Wong et al., 2020).

Another limitation relates to the reliance on self-reported data in approximately one-third of the studies (Daniali et al., 2017; Komaç & Duru, 2024; Martinez-Avila et al., 2020; Markkanen et al., 2024; Wong et al., 2020), which introduces potential bias and undermines the reliability of results. Studies with longer follow-up, such as Zelicha et al. (2022), tended to demonstrate more sustained improvements, while shorter interventions (e.g., Hayes et al., 2021) lacked the capacity to determine whether changes were maintained over time. Additionally, small sample sizes and context-specific populations (e.g., single-centre or older adult–focused studies) further restricted the generalisability of findings.

Overall, the heterogeneity across interventions, populations, and outcome measures created substantial challenges in drawing consistent conclusions. While the evidence highlights promising effects of various interventions, the diversity of study designs and reliance on self-report limit the strength, comparability, and generalisability of the findings.

Intervention Standardization Challenges

A recurring challenge identified in this review is the lack of intervention standardisation, which complicates comparisons across studies and limits the generalisability of findings. Considerable heterogeneity was evident in study protocols, delivery methods, and outcome assessments, highlighting the need for future research to adopt more uniform approaches. Standardised protocols and consistent outcome measures would enhance comparability, while extended follow-up periods are essential to determine the long-term efficacy of short-term interventions. Furthermore, the inclusion of more diverse samples is necessary to address the underrepresentation of certain demographic groups and improve the external validity of findings. Integrating digital innovations and personalised strategies, such as AI-driven health coaching and mobile health applications, may also enhance scalability while mitigating common barriers related to participant engagement and adherence. Together, these refinements are critical for strengthening the evidence base and ensuring that interventions achieve sustainable impacts across varied populations.

Conclusion

This systematic review shows that diverse interventions, including educational, behavioural, lifestyle-focused, mHealth-based, and motivational approaches, can promote healthy behaviours and support weight reduction among adults. Theory-driven and multifaceted strategies, such as those based on the Social Cognitive Theory, the Health Belief Model, and the Theory of Planned Behavior, appear more effective in sustaining long-term changes than single-component interventions.

However, many studies were of short duration ≤3 months, relied on self-reported outcomes, or involved small samples, which limited generalisability and the ability to assess long-term sustainability. Only a few longer studies demonstrated extended benefits.

Future strategies should therefore emphasise culturally sensitive, scalable, and theory-based interventions that integrate digital health tools, social support, and structured follow-up with objective measures. Such approaches can enhance accessibility, adherence, and sustainability in preventing obesity and improving public health.

References

Agboola, S., Jethwani, K., Lopez, L., Searl, M., O'Keefe, S., & Kvedar, J. (2016). Text to move: A randomised controlled trial of a text-messaging program to improve physical activity behaviours in patients with type 2 diabetes mellitus. *Journal of Medical Internet Research, 18*(11), e307. https://doi.org/10.2196/jmir.6439

Alghamdi, R. Q. (2017). A randomised controlled trial of a 12-week intensive lifestyle intervention program at a primary care obesity clinic for adults in western Saudi Arabia. *Saudi Medical Journal, 38*(8), 837–845. https://doi.org/10.15537/smj.2017.8.20553

Alshahrani, A., Siddiqui, A., Khalil, S., Farag, S., Alshahrani, N., Alsabaani, A., … & Alqarni, A. (2021). WhatsApp-based intervention for promoting physical activity among female college students, Saudi Arabia: A randomised controlled trial. *Eastern Mediterranean Health Journal, 27*(8), 782–789. https://doi.org/10.26719/emhj.21.012

Andreevna, A. N. (2021). Healthy lifestyle as a value. *Actual Problems of Pedagogy and Psychology, 2*(3), 5–14.

Barnett, J. B., & Zeng, W. (2022). Healthy Eating for Successful Living in Older Adults™ community education program—Evaluation of lifestyle behaviours: A randomised controlled trial. *Frontiers in Aging, 3*, 960986. https://doi.org/10.3389/fragi.2022.960986

Battineni, G., Sagaro, G. G., Chintalapudi, N., Amenta, F., Tomassoni, D., & Tayebati, S. K. (2021). Impact of obesity-induced inflammation on cardiovascular diseases (CVD). *International Journal of Molecular Sciences, 22*(9), 4798. https://doi.org/10.3390/ijms22094798

Brame, J., Centner, C., Berg, N., Bartlam, M., Gollhofer, A., & König, D. (2022). Effects of a 12-week web-based weight loss program for adults with overweight and obesity on COVIDAge and lifestyle-related cardiometabolic risk factors: A randomised controlled trial. *Frontiers in Public Health, 10*, 868255. https://doi.org/10.3389/fpubh.2022.868255

Cheung, N. W., Thiagalingam, A., Smith, B. J., Redfern, J., Barry, T., Mercorelli, L., & Chow, C. K. (2022). Text messages promoting healthy lifestyles linked with activity monitors stimulate increased physical activity among women after gestational diabetes. *Diabetes Research and Clinical Practice, 190*, 109991. https://doi.org/10.1016/j.diabres.2022.109991

Cleo, G., Glasziou, P., Beller, E., Isenring, E., & Thomas, R. (2019). Habit-based interventions for weight loss maintenance in adults with overweight and obesity: A randomised controlled trial. *International Journal of Obesity, 43*(2), 374–383. https://doi.org/10.1038/s41366-018-0067-4

Covolo, L., Ceretti, E., Moneda, M., Castaldi, S., & Gelatti, U. (2017). Does evidence support using mobile phone apps as a driver for promoting healthy lifestyles from a public health

perspective? A systematic review of randomized controlled trials. *Patient Education and Counseling, 100*(12), 2231–2243. https://doi.org/10.1016/j.pec.2017.07.032

Daniali, S. S., Eslami, A. A., Maracy, M. R., Shahabi, J., & Mostafavi-Darani, F. (2017). The impact of educational intervention on self-care behaviours in overweight hypertensive women: A randomised controlled trial. *ARYA Atherosclerosis, 13*(1), 20–28.

De Ridder, D., Kroese, F., Evers, C., Adriaanse, M., & Gillebaart, M. (2017). Healthy diet: Health impact, prevalence, correlates, and interventions. *Psychology & Health, 32*(8), 907–941. https://doi.org/10.1080/08870446.2017.1316849

Faghih, M., Kaveh, M. H., Nazari, M., Khademi, K., & Hasanzadeh, J. (2024). Effect of health belief model-based training and social support on the physical activity of overweight middle-aged women: A randomised controlled trial. *Frontiers in Public Health, 12*, 1250152. https://doi.org/10.3389/fpubh.2024.1250152

Fjeldsoe, B., Neuhaus, M., Winkler, E., & Eakin, E. (2011). Systematic review of maintenance of behaviour change following physical activity and dietary interventions. *Health Psychology, 30*(1), 99–109. https://doi.org/10.1037/a0021974

Gebremichael, M. A., & Belachew Lema, T. (2023). The effect of nutrition and health behaviour change communication through community-level actors on the nutritional status of pregnant women in the Ambo district, Ethiopia: A randomised controlled trial. *Food Science & Nutrition, 11*(11), 7172–7187. https://doi.org/10.1002/fsn3.3643

Gemesi, K., Winkler, S., Schederecker, F., Hauner, H., & Holzapfel, C. (2023). Weight loss effect of an app-based multimodal lifestyle intervention in adults with obesity—A randomised controlled trial. *Proceedings, 91*(1), 68. https://doi.org/10.3390/proceedings2023091068

Gray, K. E., Hoerster, K. D., Taylor, L., Krieger, J., & Nelson, K. M. (2021). Improvements in physical activity and some dietary behaviours in a community health worker-led diabetes self-management intervention for adults with low incomes: Results from a randomised controlled trial. *Translational Behavioral Medicine, 11*(12), 2144–2154. https://doi.org/10.1093/tbm/ibab113

Hayes, J. F., Balantekin, K. N., Graham, A. K., Strube, M. J., Bickel, W. K., & Wilfley, D. E. (2021). Implementation intentions for weight loss in college students with overweight and obesity: A proof-of-concept randomised controlled trial. *Translational Behavioral Medicine, 11*(2), 359–368. https://doi.org/10.1093/tbm/ibaa038

Hou, M., Qiu, W. N., Qi, H. L., Shao, H. X., Yu, J. M., & Bian, H. Y. (2024). Effects of a diabetes education program integrated with text-message support for lifestyle change among older individuals with type 2 diabetes in communities: A randomised controlled trial. *Public Health, 235*, 152–159. https://doi.org/10.1016/j.puhe.2024.06.032

Isath, A., Koziol, K. J., Martinez, M. W., Garber, C. E., Martinez, M. N., Emery, M. S., … & Lavie, C. J. (2023). Exercise and cardiovascular health: A state-of-the-art review. *Progress in Cardiovascular Diseases, 79*, 44–52. https://doi.org/10.1016/j.pcad.2023.04.008

James, A., Lawrence, B., & O'Connor, M. (2022). Healthy eating as a new way of life: A qualitative study of successful long-term diet change. *INQUIRY, 59*, 1–10. https://doi.org/10.1177/00469580221090397

Knutson, K. L. (2022). Associations between sleep, diet, and exercise: Implications for health and well-being. In *Foundations of Sleep Health* (pp. 123–131). Elsevier. https://doi.org/10.1016/b978-0-12-815501-1.00013-2

Kolb, H., & Martin, S. (2017). Environmental/lifestyle factors in the pathogenesis and prevention of type 2 diabetes. *BMC Medicine, 15*(1), 131. https://doi.org/10.1186/s12916-017-0901-x

Komaç, F., & Duru, P. (2024). The effect of education based on a health belief model and motivational interviews on cardiovascular disease risk factors and healthy lifestyle behaviour changes in patients with essential hypertension: A randomised controlled trial. *Patient Education and Counseling, 120*, 108126. https://doi.org/10.1016/j.pec.2023.108126

Liu, J., Wilcox, S., Hutto, B., Turner-McGrievy, G., & Wingard, E. (2022). Effects of a lifestyle intervention on postpartum weight retention among women with elevated weight. *Obesity, 30*(7), 1370–1379. https://doi.org/10.1002/oby.23449

Markkanen, J. O., Oikarinen, N., Savolainen, M. J., Merikallio, H., Nyman, V., Salminen, V., … & Laatikainen, T. (2024). Mobile health behaviour change support system as an independent treatment tool for obesity: A randomised controlled trial. *International Journal of Obesity, 48*(3), 376–383. https://doi.org/10.1038/s41366-023-01426-x

Martinez-Avila, W. D., Sanchez-Delgado, G., Acosta, F. M., Jurado-Fasoli, L., Oustric, P., Labayen, I., … & Ruiz, J. R. (2020). Eating behaviour, physical activity and exercise training: A randomised controlled trial in young, healthy adults. *Nutrients, 12*(12), 3685. https://pubmed.ncbi.nlm.nih.gov/33260423/

Mohammadnia Motlagh, K., Shamsi, M., Roozbahani, N., Karimi, M., & Moradzadeh, R. (2022). Effect of theory-based education on promoting a healthy lifestyle in pre-diabetic women: A randomised controlled trial. *BMC Women's Health, 22*(1), 29. https://doi.org/10.1186/s12905-022-01608-1

Schoeppe, S., Alley, S., Van Lippevelde, W., Bray, N. A., Williams, S. L., Duncan, M. J., … & Vandelanotte, C. (2016). Efficacy of interventions that use apps to improve diet, physical activity and sedentary behaviour: A systematic review. *International Journal of Behavioral Nutrition and Physical Activity, 13*(1), 26. https://doi.org/10.1186/s12966-016-0454-y

Shao, C., Wang, J., Liu, J., Tian, F., & Li, H. (2018). Effect of a health belief model-based education program on patients' belief, physical activity, and serum uric acid: A randomised controlled trial. *Patient Preference and Adherence, 12*, 1239–1245. https://doi.org/10.2147/ppa.s166523

Shuremu, M., Abate, K. H., & Belachew, T. (2023). Effect of nutrition education intervention to improve dietary diversity practice and nutritional status of the older people: A cluster randomised controlled trial. *Food Science & Nutrition, 11*(11), 7383–7395. https://doi.org/10.1002/fsn3.3667

Stanner, S., Coe, S., & Frayn, K. N. (Eds.). (2019). *Cardiovascular disease: Diet, nutrition and emerging risk factors.* John Wiley & Sons.

Swaby, A., Atallah, A., Varol, O., Cristea, A., & Quail, D. F. (2023). Lifestyle and host determinants of antitumor immunity and cancer health disparities. *Trends in Cancer, 9*(12), 1019–1040. https://doi.org/10.1016/j.trecan.2023.08.003

Uemura, K., Yamada, M., & Okamoto, H. (2021). The effectiveness of an active learning program in promoting a healthy lifestyle among older adults with low health literacy: A randomised controlled trial. *Gerontology, 67*(1), 25–35. https://doi.org/10.1159/000511357

World Health Organization. (2020). *Non-communicable diseases progress monitor*. World Health Organization. https://www.who.int/publications/i/item/ncd-progress-monitor-2020

World Health Organization. (2022). *Non-communicable diseases progress monitor 2022*. World Health Organization. https://www.who.int/publications-detail-redirect/9789240047761

Wong, E. M., Leung, D. Y., Chair, S. Y., & Sit, J. W. (2020). Effects of a web-based educational support intervention on total exercise and cardiovascular risk markers in adults with coronary heart disease. *Worldviews on Evidence-Based Nursing, 17*(4), 283–292. https://doi.org/10.1111/wvn.12456

Yu, E., Rimm, E., Qi, L., Rexrode, K., Albert, C. M., Sun, Q., Willett, W. C., Hu, F. B., & Manson, J. E. (2016). Diet, lifestyle, biomarkers, genetic factors, and risk of cardiovascular disease in the nurses' health studies. *American Journal of Public Health, 106*(9), 1616–1623. https://doi.org/10.2105/ajph.2016.303316

Zelicha, H., Kloting, N., Kaplan, A., Yaskolka Meir, A., Rinott, E., Tsaban, G., … & Shai, I. (2022). The effect of high-polyphenol Mediterranean diet on visceral adiposity: The DIRECT PLUS randomised controlled trial. *BMC Medicine, 20*(1), 327. https://doi.org/10.1186/s12916-022-02525-8