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A systematic review on the effectiveness of diet and exercise in the management of obesity

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ABSTRACT

Background and aims: Obesity is a worldwide epidemic and has quickly become a clinical and public health challenge. The primary concern is the effect of obesity on quality of life. This review assesses the effectiveness of interventions such as exercise and diet in the management of obesity.
Methods: Studies selected reported on the obese adult population (18 years and older), who had a lifestyle modification using diet, exercise, or both. We screened a total of 324 articles, 25 were found to be duplicated, 261 were excluded after screening for eligibility, and 27 full-text articles due to study design, incomplete data. 11 full-text articles were reviewed and included in our study.
Results: Participants placed on a dairy-based diet achieved a more significant reduction in body weight (−1.16 kg [-1.66, −0.66 kg], $p < 0.001$) and body fat mass (−1.49 kg [-2.06, −0.92 kg], $p < 0.001$). The ADF participants achieved body weight change of mean −0.9% ± 0.6% in the low-weight-loss group, and −9.9% ± 1.1% in the high-weight-loss group, whereas the caloric restricted (CR) participants achieved −1.3% ± 0.7% in the low-weight-loss, and −9.2% ± 1.2% in the high-weight-loss groups. A combination of intensive physical activity of about 175 min per week and a portion-controlled diet led to a more significant weight loss of 5%.
Conclusion: This systematic review identified that the most efficient regimen for obesity management in adults is the combination of strength plus endurance exercise for a minimum of 175 min per week and a customized hypocaloric diet based on patient-specific metabolic needs and overall health status.

1. Introduction

According to the World Health Organization, overweight and obesity refer to abnormal or excessive fat accumulation that presents a health risk to individuals [1]. Based on body mass index (BMI) classification, a BMI over 25 is considered overweight, and over 30 is obese [1]. The growing incidence and prevalence of obesity globally have become both a clinical and public health challenge. It is estimated that with the continuation of current trends, 20% of the world's adult population will be obese, and 38% will be overweight by 2030 [2]. In the United States, according to the National Center for Health Statistics (NCHS) data brief, the age-adjusted prevalence of obesity was 42.4% in adults from 2017 to 2018 [3]. The highest prevalence of 44.8% was found among middle-aged adults aged 40–59 [3]. Transition to a predominantly sedentary lifestyle is seen as a primary factor of the predominance of obesity in the middle-aged population.

With one-third of the world's population obese, obesity has become one of the leading risk factors for most chronic diseases [4]. The impact of obesity does not just affect the physical health of the population but also affects the mental health and socio-economic dynamics of the population; the health care cost of obesity in 2008 was $147 billion, approximating 9% of the national health care budget [4]. Obesity has been linked as a risk factor for diabetes,

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depression, anxiety, cardiovascular diseases, and cancer, which are some of the leading causes of preventable, premature deaths [5].

The essence of an effective and sustainable weight loss regimen to combat the growing prevalence of obesity cannot be overemphasized. Preventive efforts to reduce and control obesity have become a billion-dollar industry involving health care and non-healthcare experts. These efforts are centered on diet and exercise (physical activity) [6]. These diets involve caloric restriction, the Mediterranean diet, inclusive dairy diet, and changes in eating (alternate-day fasting) [7]. The exercise regimen involves either high or low-intensity physical activity, resistance training, aerobic exercise, and endurance training [8]. Through the years, different exercise routines and diet regimens have been formulated and researched. Substantial research proved that aside from surgical intervention, exercise and diet simultaneously or exclusively can lead to weight loss and maintenance in all ages and ethnicities. However, more importantly, is the type, duration of exercises, and diet required to effect an evident and sustainable change.

The study's primary aim was to assess the effectiveness of exercise and diet in managing obesity. The secondary aim was to determine the effectiveness of exclusive diet or exercise and the mutual effect of different exercises and diets in patients with obesity.

2. Methods

2.1. Search strategy

The systematic review was registered and developed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocol (PRISMA-P) guidelines through a participatory process and registered with the International Prospective Register of Systematic Reviews (registration ID: CRD42021255334). We searched PubMed and Embase using the following keywords: diet, exercise, obesity, and lifestyle intervention. We searched for articles written between May 1, 2016, through May 1, 2021, to reflect most recent lifestyle modifications associated with obesity. Our search criteria were based on studies that reported on the obese adult population (18 years and older), who had a lifestyle modification namely diet, exercise, or diet and exercise. There was no restriction regarding sex, race, geographic distribution, or ethnicity. Articles that focused on different diet and exercise programs were prioritized to give a more inclusive outcome. We also checked the reference list of eligible studies that met our inclusion criteria and screened abstracts using Abstrackr; a screening tool that helps to facilitate the collaborative screening of articles using their titles and abstracts.

2.2. Eligibility criteria

Inclusion criteria were studies describing adult patients with obesity and lifestyle interventions including, different diets, exercise, or both. We included studies performed in the last 5 years (2016–2021) to capture most recent research done to date on interventions available in the management of obesity.

Exclusion criteria were duplicate publications and studies that focused on non-obese patients, acutely ill obese patients, pediatrics obese patients, non-English articles, and articles published before 2016.

2.3. Types of studies

Eligible studies were those that were designed to assess intervention impact including study designs that were case-control study, case series, cohort study, and clinical trials. We included free full-text articles originally written in English language.

2.4. Study selection

Two authors (I.O., and T.O.) conducted the preliminary literature search, saved all articles to a file, and uploaded the articles using their PMID number on Abstrackr. Three authors (I.O., J.U., and T.O.) independently screened all abstracts. For research letters and books without abstracts, reviewers used the content of the text for initial screening. After the initial screening, Abstrackr generated a spreadsheet of the abstracts screened. The full text of studies with a consensus were carefully reviewed to assess final eligibility. The screening process is reported using a PRISMA flow chart (see Fig. 1). All conflicts at this stage were resolved by four authors (E.O., A.O., K.O., and J.A).

2.5. Data collection and quality assessment

Two authors (A.O., and J.U.) created a spreadsheet designed to extract information from the final eligible studies. The information included on the spreadsheet is study title, study location, authors, study design, study population, date of publication, follow-up duration, intervention, and outcome. Two authors (I.O, and T.O) used the specialized spreadsheet design to extract data from eligible studies. There were no disagreement/conflicts at this stage. Quality assessment was done using the Modified Newcastle-Ottawa scale.

3. Results

3.1. Literature search results

We reviewed a total of 324 articles from PubMed (283) and Embase (41). Of these 324 articles, 25 were found to be duplicated and therefore excluded. The remaining 299 articles were screened using their titles and abstracts. Of the 299 abstracts screened, 261 were excluded after screening for eligibility, and 27 full-text articles either had a wrong study design, incomplete data, or lacked a report of clinical outcomes. Eleven full-text articles were reviewed and included in our study. A PRISMA flow chart summarizing the number of studies assessed at each stage of our identification and screening process is represented in Fig. 1.

Our study included a total of 2191 adults within 18–79 years of age. Most trials were carried out in the United States of America (n = 6). Others were carried out in Australia (n = 2), China (n = 1), Spain (n = 1) and Poland (n = 1). The study designs include meta-analysis of randomized controlled trials (n = 1), randomized controlled trials (RCT) (n = 4), cluster-randomized trial (n = 1), clinical trials (n = 3), randomized parallel arm trial (n = 1), and exploratory analysis of randomized clinical trials (n = 1). See Table 1.

3.2. Interventions

3.2.1. Dietary intervention only

A study by Stonehouse et al. used dairy foods as the treatment intervention. The dairy intervention used includes daily servings of milk, mixed dairy foods including milk, yogurt, and cheese dairy supplement intakes ranging from 20 to 84 g/day and reduced energy intake by > 2092 kJ/day (>500 kcal/day) [9]. Kroeger et al. used alternate day fasting (ADF) and calorie restriction (CR); the ADF diet consisted of 25% energy needs on a fast day and 125% of energy needs on the feast day, while the CR diet consisted of 75% of energy needs daily for the first six months. For the next six months (months 6–12), the ADF diet consisted of 50% of energy needs on a

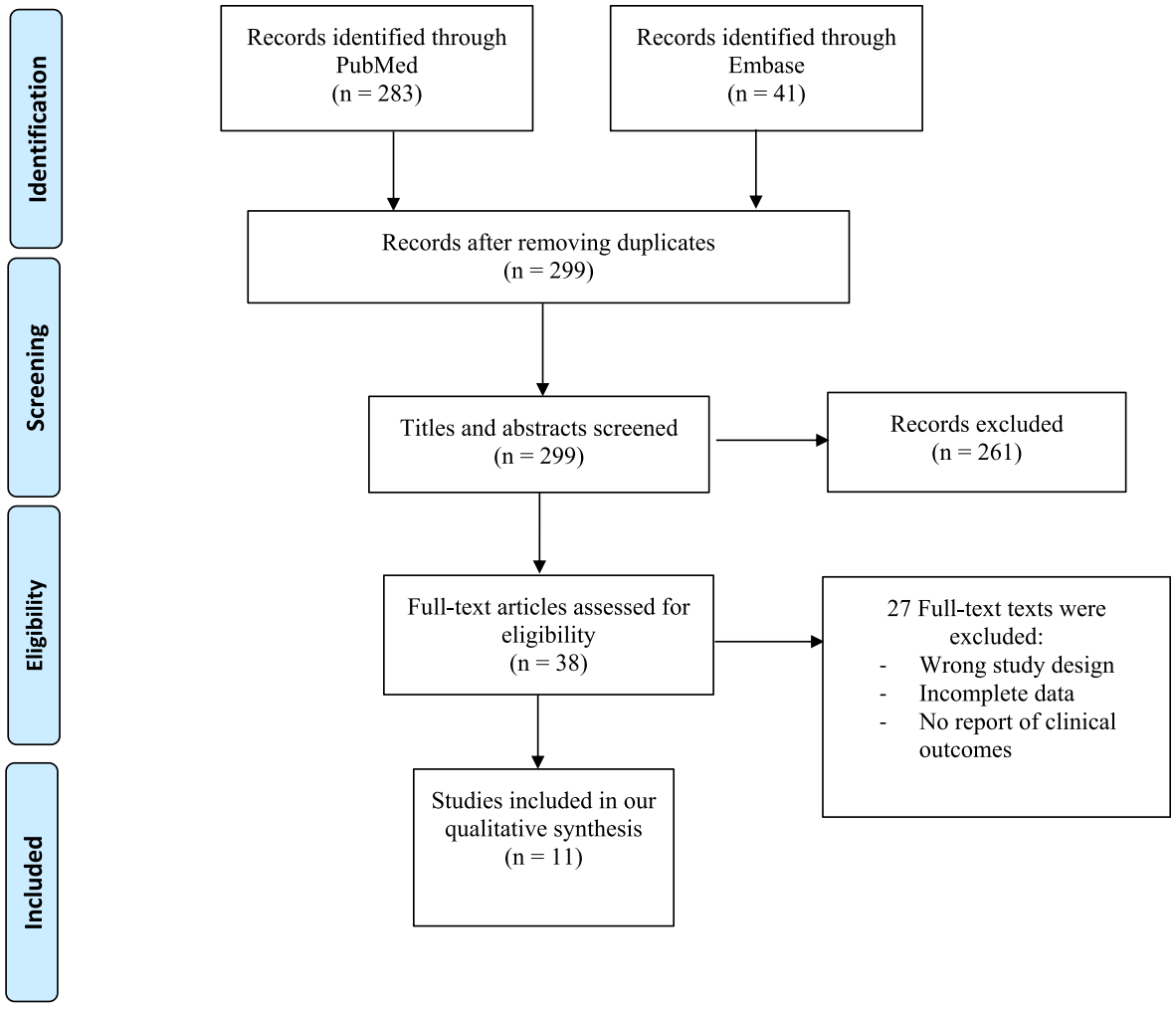

Fig. 1. PRISMA flowchart.

Table 1
Overview of included studies evaluating the effect of diet and exercise in management of obesity.

Authors	Study type	Study population	Study Country	Date of publication	Sample size	Intervention
Stonehouse et al. [9].	A Meta-Analysis of Randomized Controlled Trials	18–50 years	Australia	July 2016	27 studies	Dairy based diet
Tapsell et al. [10].	A single-blind, randomized controlled trial	25–54 years	Australia	July 2017	377	Interdisciplinary advice
Katzmarzyk et al. [11].	A Cluster-Randomized Trial	20–75 years	USA	September 2020	803	Portion-controlled foods and physical activity
Normandin et al. [12].	A Randomized Clinical Trial	65–79 years	USA	March 2017	126	Caloric restriction and resistance training
Jiang et al. [13].	A 6-month multicenter randomized clinical trial	18–50 years	China	February 2021	254	Program online and offline medical interventions with calories restriction and individualized exercise
Psota et al. [14].	Randomized, parallel-arm trial	21–50 years	USA	March 2020	101	Hypocaloric diet, nutrition education sessions, and supervised exercise
Kroeger et al. [7].	An exploratory analysis of a randomized controlled trial	18–67 years	USA	January 2018	34	Alternate day fasting and calorie restriction
Benito et al. [8].	A Parallel Randomized Clinical Trial	18–50 years	Spain	April 2020	119	Physical activity recommendations and balanced, individualized hypocaloric diet
Nicklas et al. [15].	A single-blind, randomized controlled trial	65–79 years	USA	June 2019	180	Aerobic training and calorie restriction
Bajerska et al. [16].	A two-arm parallel group randomized controlled trial	51–61 years	Poland	July 2018	144	Dietary intervention (Mediterranean and Central European)
Francois et al. [17].	A randomized controlled trial	34–58 years	USA	June 2018	26	Low-calorie diet and interval exercise training

fast day and 150% of energy needs on the feast day, while the CR diet consisted of 100% of energy needs daily [7].

Bajerska et al. used the Mediterranean diet (MED) and the Central European diet (CED). MED diet consisted of 37% energy (from total fat, 20% MUFAs, 9% (PUFAs), 8% (SFAs)), 18% protein, and 45% carbohydrates. Olive oil was on every meal, and 5–7 nuts were served daily, while the CED diet consisted of 27% energy from total fat, 10% MUFAs, 9% PUFAs, 8% SFAs, 18% protein, and 55% carbohydrate, with high levels of dietary fiber [16].

Jiang et al. used Companion-Intensive Multi-aspect Weight Management (CIMWM) and traditional multi-aspect weight management (TMWM). CIMWM group were provided with two Fit Nutrition Bars/day in the first three months plus monthly face-to-face guidance and daily online instructions, while the TMWM group had monthly face-to-face guidance by the same multi-aspect team and the exact meal replacements, but with daily self-monitoring instead of online instructions. The plan was 1200–1800 kcal/day: 40–55% from carbohydrates, 20–30% from fat, and 15–20% from protein (Table 2) [13].

3.2.2. Dietary and exercises intervention

Some other studies used a combination treatment intervention. These studies include Tapsell et al. who used usual care, which involved a nurse providing general advice and three interventions. These interventions included dietitian negotiated changes in specific food choices after assessment, advice to increase physical activity and reduce sedentary behavior by the exercise physiologist after assessment, and the psychologist developed a workbook for participants and trained health coaches to deliver related scripted calls for 15 min. They also included intervention + food supplements [10].

Katzmarzyk et al. used the intensive-lifestyle and usual-care intervention regimen. The intensive-lifestyle regimen included an increase in physical activity up to 175 min per week, portion-controlled foods (e.g., bananas, apples, soups, and frozen entrees), and prepackaged foods and meal-replacement shakes during the first month while the usual-care regimen included regular, usual care from primary care team throughout the 24 months and three newsletters per year on selected topics and a listing of health promotion events offered in their community [11]. Benito et al. used strength training (S), endurance training (E), and strength + endurance training (SE). The S group included shoulder presses, squats, barbell rows, lateral splits, bench presses, front splits, biceps curls, and French presses for triceps. Running, cycling, or elliptical exercises were included for the E group, while the SE group followed a combination of cycle ergometry, treadmill, or elliptical exercises intercalated with squats, rowing machine, bench presses, and front split exercises (15 lifts per set or 45″ SE endurance phase). The C subjects exercised for at least 200–300′ of moderate-intensity physical activity/week (30–60 min/day) [8]. Francois et al. used a low-calorie diet (LCD) and energy-matched LCD with interval exercise training (LCD + INT). LCD (1000–1200 kcal/day) consisted of a meal replacement shake for breakfast and lunch providing 160 kcal protein and carbohydrate, sensible dinner option that did not exceed 600 kcal (e.g., lean protein with vegetables or salad), two 100 kcal snack options. LCD + INT regimen consisted of 12 sessions of interval exercise with one rest day. Each exercise session was supervised and alternated 3 min cycling periods at 50% and 90% of heart rate peak (HR peak); ten repetitions of 50% and 90% were completed per 60 min session.

Table 2
Studies applying dietary changes only as interventions.

Study	Type of intervention	Groups	Outcomes
	Dietary intervention only		
Stonehouse et al. [9].	Daily servings of milk, mixed dairy foods including milk, yogurt, and cheese, dairy supplement intakes ranged from 20 to 84 g/day, reduced energy intake by > 2092 kJ/day (>500 kcal/day), protein were relatively standard (17–22% E) Six studies included resistance training (or aerobic or both) between 2 and 6 times/week. Exercise regimes were similar between dairy and control groups.	Dairy products vs. appropriate control diet lower in dairy products. Differences in the amount of dairy food: ~2 to 4 servings/day.	- A high dairy diet intervention resulted in greater body weight and fat mass loss than control interventions under hypocaloric conditions.
Kroeger et al. [7].	Months 0–6, ADF: consume 25% of energy needs on a fast day and 125% of energy needs on the feast day, CR: consume 75% of energy needs daily. Months 7–12, ADF: consume 50% of energy needs on a fast day and 150% of energy needs on the feast day, CR: consume 100% of energy needs daily	Alternate day fasting (ADF) vs calorie restriction (CR) group	- The ADF group had body weight change (month 12) of mean −0.9% ± 0.6% in the low-weight-loss group, and −9.9% ± 1.1% in the high-weight-loss group, whereas in the CR group, it was −1.3% ± 0.7% in the low-weight-loss group, and −9.2% ± 1.2% in the high-weight-loss group.
Bajerska et al. [16].	A caloric deficit of ~2.93 MJ/day in addition to MED (37% energy from total fat, 20% MUFAs, 9% (PUFAs), 8% (SFAs), 18% protein, and 45% carbohydrates, Olive oil was on every meal, and 5–7 nuts were served daily. CED: 27% energy from total fat, 10% MUFAs, 9% PUFAs, 8% SFAs, 18% protein, and 55% carbohydrate, with high levels of dietary fiber	Mediterranean diet (MED) vs Central European diet (CED)	- Postmenopausal women lost on average 7.6 kg weight (95% CI; −8.2, −7.0), 7.4 cm WC (−8.1, −6.8), 6.6 kg FM (−7.1, −6.1), and 0.26 kg VF (−0.28, −0.23), with no differences between diets. - Both MED and CED diets were equally efficient regardless of their macronutrient compositions.
Jiang et al. [13].	CIMWM group were given two Fit Nutrition Bars/day in the first three months + monthly face-to-face guidance and daily online instructions TMWM group had monthly face-to-face guidance by the same multi-aspect team and the exact meal replacements, but with daily self-monitoring instead of online instructions. The plan was 1200–1800 kcal/day: 40–55% from carbohydrates, 20–30% from fat, and 15–20% from protein.	Companion-Intensive Multi-aspect Weight Management (CIMWM) vs traditional multi-aspect weight management (TMWM)	CIMWM appeared to be superior to TMWM in improving clinically significant weight loss, BMI, total cholesterol (TC), BFM, and the skeletal muscle mass-to-visceral fat area ratio.

Abbreviations: ADF: alternate day fasting; CR: calorie restriction; MED: Mediterranean diet; MUFAs: monounsaturated fatty acids; PUFAs: polyunsaturated fatty acids; SFAs: saturated fatty acids; CED: central European diet; WC: waist circumference; FM: fat mass; VF: visceral fat; CIMWM: companion-intensive multi-aspect weight management; TMWM: traditional multi-aspect weight management; BMI: body mass index; BFM: body fat mass; TC: total cholesterol.

The duration progressed from 30 min on day 1–45 min on day 2 and 60 min after. After each exercise session, a mixed-meal shake (350 kcal, 13 g protein, 11 g fat, 50 g carbohydrate) was provided (Table 3) [17] (see Table 4).

4. Discussion

Our systematic review provides up-to-date evidence supporting incorporating exercise interventions combined with diet restrictions in the management of obese individuals. It is known that any modification in behavior among severely obese sedentary adults must cause an effective immediate means for altering both general status and body composition. All published papers reported a positive effect on both health status and body composition. Therefore, it is customary to find effect size across publications that indicate effective treatment despite the methodology utilized. The methodological and sociological bias towards said programs may be the inherent rationale for continued praise and high recommendation to obese patients and may promote the reoccurring cycles of repetitive diets and exercise programs for body morphology modifications and health status [18].

Although studies conducted by Benito et al. suggested that combining exercise and diet can lead to significant reductions in body fat and metabolic improvements [8], only a few studies

Table 3
Studies applying both dietary and physical activity changes as interventions.

Study	Type of intervention	Groups	Outcomes
	Dietary and exercises intervention		
Tapsell et al. [10].	The usual care group provided general advice with the help of a nurse. Intervention counseling session included dietitian negotiated changes in specific food choices after assessment, advice to increase physical activity and reduce sedentary behavior by the exercise physiologist after assessment and the psychologist developed a workbook for participants and trained health coaches to deliver related scripted calls (15 min)	Usual care (C general advice) vs intervention (I, interdisciplinary advice) vs intervention + food supplement (IW, I+30 g walnuts/day)	- The interdisciplinary protocol produced greater and more clinically significant effects on weight loss than usual care (−1.2 kg, p = 0.045 I; −1.3 kg, p = 0.025) and at six months for IW (−2.1 kg; p = 0.010)
Katzmarzyk et al. [11].	Weekly sessions (16 conducted in person and six conducted by telephone): The intensive-lifestyle group: increase their physical activity to 175 min per week, portion-controlled foods (e.g., bananas, apples, soups, and frozen entrees) and prepackaged foods and meal-replacement shakes during the first month then instruction on how to purchase, prepare, and package foods. The usual-care group: regular, usual care from their primary care team throughout the 24 months and three newsletters per year on selected topics and a listing of health promotion events offered in their community.	The intensive-lifestyle group vs the usual-care group	- The intensive-lifestyle group had lost significantly more weight of 5%, and 51% of the patients maintained at least 5% weight loss at 24 months with a mean difference of −4.51% points (95% CI, −5.93 to −3.10) between the groups (P < 0.001)
Benito et al. [8].	All participants have prescribed a balanced, individualized hypocaloric diet with 25% less energy (50%–55% carbohydrates, 30%–35% fat). The exercise training for S, E, and SE groups was three times/week with the same intensity and volume of exercise. The S group included shoulder presses, squats, barbell rows, lateral splits, bench presses, front splits, biceps curls, and French presses for triceps. Running, cycling, or elliptical exercises were included for the E group, while the SE group followed a combination of cycle ergometry, treadmill, or elliptical exercises intercalated with squats, rowing machine, bench presses, and front split exercises (15 lifts per set or 45″ SE endurance phase). The C subjects undertook to exercise for at least 200–300′ of moderate-intensity physical activity/week (30–60 min/day)	strength training group (S), vs endurance training group (E), vs strength + endurance training group (SE), vs 'adhering to physical activity recommendations' group (control; C)	While following a balanced, individualized, hypocaloric diet, SE exercise protocol had a more significant effect on reducing total fat mass than other exercise protocols. Improvements were observed in body weight and total fat mass
Francois et al. [17].	LCD (1000–1200 kcal/day): meal replacement shakes for breakfast and lunch providing 160 kcal carbohydrate and protein, dinner option that did not exceed 600 kcal (e.g., lean protein with vegetables or salad), two 100 kcal snack options. LCD + INT: 12 sessions of interval exercise with one rest day. Each exercise session was supervised and alternated 3 min cycling periods at 50% and 90% of heart rate peak (HR peak); ten repetitions of 50% and 90% were completed per 60 min session. The duration progressed from 30 min on day 1–45 min on day 2 and 60 min after. After each exercise session, a mixed-meal shake (350 kcal, 13 g protein, 11 g fat, 50 g carbohydrate) was provided.	low-calorie diet (LCD) vs an energy matched LCD with interval exercise training (LCD + INT)	LCD + INT reduced glucose and total-phase glucose-stimulated insulin secretion more than LCD alone. Both interventions reduced body and muscle mass and decreased blood glucose.

Abbreviations: S: strength training; E: endurance training; SE: strength plus endurance training; LCD: low calorie diet; INT-interval exercise training.

Table 4
Physical activity guidelines from various associations.

Associations	Recommended physical activity in adults
World Health Organization (WHO) [28]	Minimum of 150–300 min of MPA or 75–150 min of VPA
American Academy of Family Physicians (AAFP) [29]	At least, 150–300 min of MPA each week.
Canadian Society for Exercise Physiology, 2021 (CSEP) [30]	At least 150 min per week of MPA to VPA
Australian Government Department of Health and Aged Care [31]	2.5–5 h of MPA per week or 1.25 to 2.5 hors of VPA
Our recommendation	Minimum of 175 min per week of MPA

Abbreviations: MPA: moderate-intensity physical activity, VPA: vigorous-intensity physical activity.

compared the effects of different types of exercises. The study conducted by Benito et al. compared physical activity programs such as strength training (S), endurance training (E), strength & endurance training (SE), all participants in each group were given an individualized hypocaloric diet. Their findings reported that combining strength and endurance exercises had a more significant effect on reducing total fat mass than other exercise protocols [8]. This may be because a combined exercise protocol produces higher energy expenditure with less perceived exertion [19,20]. Similarly, efforts have been shown to compare the effects of different levels of caloric restriction when combined with the same aerobic training on overall body health. Findings from studies conducted by Nicklas et al. and Villareal et al. showed that energy deficit during exercising increased by almost 2-fold peak oxygen consumption and functional ability [15,21]. Adding that also moderate caloric restriction has a positive effect on exercising. Therefore, caloric restriction is highly recommended to older adults with obesity to increase their exercise efforts [15,21].

In conjunction with an energy-restricted diet, a high dairy product intervention (dairy food and dairy supplements) was associated with greater body weight and fat mass loss and lower lean mass loss [9,22,23]. Although most studies reported clinically significant weight loss and reduction of BMI, change in body composition after weight management must also be considered. For example, the total body fat and visceral fat distribution were reported as risk factors for metabolic syndrome [24]. Jiang et al. reported a reduction of body fat percentage (BFP), body fat mass (BFM), and visceral fat area (VFA) with a mild decrease of fat-free mass (FFM) and skeletal muscle mass (SMM). They highlighted the passive role of Multi-aspect Weight Management in improving glucose metabolism and liver fat metabolism [13].

4.1. Diet and obesity

Alternate day fasting (ADF) is fast becoming popular, proven to be effective in obesity management via weight loss. The study by Kroeger et al. used ADF, which involves an alternating day of fasting and feasting to assess weight loss [7]. The study showed that individuals who attained clinically significant weight loss with ADF reported better satiety, increased intake of protein, and better response to calorie restraints on fast days [7]. Caloric restriction has also been shown to help manage obesity and lower the risk of type 2 diabetes mellitus, and it had a strong positive effect in reducing endogenous glucose production and hepatic insulin resistance [12].

Visceral obesity has been linked to cardiovascular diseases and diabetes. A relevant nutritional change is a low fat and low caloric diet. However, some studies showed no statistical difference in the body weight and visceral fat of patients who took two energy-restricted diets-the Mediterranean and Central European [16]. Irrespective of the diet intervention administered, adherence to dietary modifications plays a vital role in the overall positive effect of obesity management. In a study conducted by Gibson et al. Participants who adhered to their dietary interventions had more weight loss and an overall reduction in the risk of cardiovascular disease when compared to patients who did not [25]. It is therefore crucial for obese patients to adhere to their customized dietary plans for a better outcome.

4.2. Exercise and obesity

Exercise plays a vital role in maintaining normal body functions and weight. Aerobic exercise has been shown to decrease the overall prevalence of metabolic syndromes among middle-aged and older adults with obesity. In addition, resistance training combined with aerobic exercise also leads to favorable changes [12]. Lifestyle modifications like exercise have been shown to decrease the incidence of type 2 diabetes by 28–59% [26]. Patients with obesity are advised to participate in approximately 150 min of exercise every week consisting of 75 min of vigorous-intensity or moderate-intensity aerobic exercise according to their physical ability [26]. Patients should also adhere to an exercise and diet regimen; adherence has proved to be a significant predictor of long-term weight loss among participants in clinical trials [25]. More importantly, overweight and obese patients should be encouraged to participate in regular exercise and avoid sedentary living, which increases the risk of all mortality and doubles the risk of cardiovascular complications [27].

5. Study limitations

There are various diet types not included in this review which may influence obesity management. This may have added more information about other dietary types from other cultures that may influence obesity management. Also, the most obvious limitation of this review is its restriction to English-language publications. Studies from countries with other primary languages such as French and Arabic were notably absent which may also have provided more information about dietary types in these parts of the world. However, we have studies from places like Spain, China, and Poland with decent information to capture other cultures. During our research process, we found behavioral modification and support systems to be modifiable factors in the management of obesity which might have played a role in the outcomes of reviewed articles. We did not find a paper that synthesized or worked on analyzing different types of exercises and their effect on obesity management from our search. However, we believe this systematic review has addressed the most questions about the effectiveness of diet and exercise for the management of obesity.

6. Conclusion

In conclusion, our findings suggest that a combination of exercise and diet helps manage obesity by decreasing BMI and improving metabolic parameters like lipid profile and blood sugar. A combination of a hypocaloric diet and a minimum of 175 min per week endurance plus strength training exercise is recommended for a more effective result. Therefore, patients need to work with their primary care provider, dietitian or nutritionist to formulate a

customized practical hypocaloric diet based on their goals, BMI and metabolic needs, and a sustainable exercise regimen to achieve and maintain weight loss. There is a need for further studies comparing different diet programs and their effect on obesity and other indices of metabolic syndrome.

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