

Effects of physical activity in adults with severe obesity: a systematic review Efectos de la actividad física en adultos con obesidad severa: una revisión sistemática

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Abstract. The primary objective of this research was to identify effective modes of physical exercise to optimize the quality of life and health of individuals affected by severe obesity. To conduct this systematic review, the PubMed, Web of Science, and Dimensions databases were consulted. The inclusion criteria encompassed original articles publicly available, written in Portuguese, English, or Spanish, addressing exercise protocols targeted at individuals with severe obesity, aged between 18 and 65 years, and with a body mass index (BMI) equal to or greater than 40 kg/m². The methodological quality of randomized clinical trials (RCTs) was individually assessed by reviewers based on the Physiotherapy Evidence Database (PEDro) scale. Anthropometric measurements, functional capacity, parameters of physical fitness, and quality of life were employed as performance indicators in the results. A notable heterogeneity was observed in the protocols adopted, encompassing variation in the number of sessions, intervention duration, outcome criteria, and sample size, among other factors. The results indicated that intervention programs for severe obesity, regardless of the training modality, demonstrated effectiveness in reducing various anthropometric parameters and improving biochemical variables. Additionally, these programs encouraged the adoption of a healthier lifestyle by individuals affected by severe obesity.

Keywords: Severe obesity; Activities Physical; Exercise; Multiprofessional treatment; Lifestyle; Sedentary Behavior.

Resumen. El objetivo principal de esta investigación fue identificar modos efectivos de ejercicio físico para optimizar la calidad de vida y salud de las personas afectadas por obesidad severa. Para realizar esta revisión sistemática se consultaron las bases de datos PubMed, Web of Science y Dimensions. Los criterios de inclusión abarcaron artículos originales disponibles públicamente, escritos en portugués, inglés o español, que abordaran protocolos de ejercicio dirigidos a personas con obesidad severa, con edades comprendidas entre 18 y 65 años y con un índice de masa corporal (IMC) igual o superior a 40 kg/m². Los revisores evaluaron individualmente la calidad metodológica de los ensayos clínicos aleatorios (ECA) según la escala Physiotherapy Evidence Database (PEDro). En los resultados se utilizaron como indicadores de desempeño medidas antropométricas, capacidad funcional, parámetros de aptitud física y calidad de vida. Se observó una notable heterogeneidad en los protocolos adoptados, que abarca variación en el número de sesiones, duración de la intervención, criterios de resultado y tamaño de la muestra, entre otros factores. Los resultados indicaron que los programas de intervención para obesidad severa, independientemente de la modalidad de entrenamiento, demostraron efectividad en la reducción de los parámetros antropométricos y la mejora de las variables bioquímicas. Además, estos programas alentaron la adopción de un estilo de vida más saludable por parte de personas afectadas por obesidad severa.

Palabras clave: Obesidad severa; Actividades físicas; ejercicio; Tratamiento multiprofesional; Estilo de vida; Comportamiento sedentario.

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Introduction

Obesity constitutes one of the most impactful public health problems, presenting a high risk of early onset of complications associated with excess body fat. Obesity is a complex chronic disease with many contributing factors, so it is important to initiate treatment as early as possible. Changes resulting from excess weight are becoming increasingly common in children, adolescents, and adults (Westphal et al., 2023., Westphal-Nardo et al., 2023; Dietz, 2001; Hu F. B., 2023).

The World Obesity Federation (WOF, 2022) states that by 2035, the estimate is that 51% of the global population will be overweight, with 4 billion adult individuals worldwide suffering from obesity. According to the new edition of the World Obesity Atlas 2023, Brazil will have 41% of its adult population suffering from obesity in the next 13 years. The constant growth of obesity prevalence rates and

other cardiometabolic disorders has led to a significant increase in studies worldwide. These research efforts aim to identify and understand the behavioral risk factors that play a fundamental role in the genesis and progression of these diseases. It is noteworthy that adults with severe obesity (Body Mass Index [BMI] ≥ 40 kg/m²) often have a high risk of comorbidities, low physical fitness, as well as functional limitations, which hinder autonomy in performing daily routine activities (Pitanga et al., 2019; Pataky et al., 2014; Westphal-Nardo et al., 2023; Kitahara et al., 2014).

The development of metabolic diseases and dysfunctions (e.g., dyslipidemia, type 2 diabetes) directly impacts the quality of life of the population. For this reason, various therapeutic strategies have been developed both to prevent and to treat these disorders (Han & Lean, 2016).

In Brazil, Ordinances No. 424 and 425/2013 of the Ministry of Health establish that the treatment of severe obesity should primarily be based on health promotion and

longitudinal clinical care, which includes guidance and support for behavior change, dietary counseling, psychological attention, prescription of physical activity, and, if necessary, pharmacotherapy. It emphasizes that surgical treatment is only the last resort among the available interventions. In this context, the relevance of formulating clear strategies and setting goals in behavior modification programs is highlighted. These programs have the primary objective of reducing excess weight and promoting health improvement (Bim, 2019; Goospaster et al., 2010).

Scientific literature emphasizes that the treatment of obesity is primarily based on multidisciplinary interventions, which include nutritional therapy, physical exercise, psychological treatment, and pharmacological intervention. These approaches aim to direct behavioral changes related to eating and physical activity, with the goal of promoting significant improvements in lifestyle (Bianchini et al., 2016; Nardo Junior et al., 2018; Westphal et al., 2023., Westphal-Nardo et al., 2023). Therefore, the aim of this study was to identify effective forms of physical exercise to improve health and quality of life for individuals with severe obesity.

Materials and Methods

In this study, a systematic review of scientific articles was conducted to investigate the effectiveness of physical exercise programs in the treatment of severe obesity. The research was carried out in the Virtual Health Library, with searches conducted in the PubMed, Web of Science, and Dimensions databases. The articles were assessed using the Physiotherapy Evidence Database (PEDro), (Bhugal et al., 2005) to determine their methodological quality (Table 1). The PRISMA 2020 statement (Page et al., 2021) was employed in the elaboration of this study, adopting the systematic review protocol as a guide for proper execution (Figure 1). This section meticulously outlines the methodological procedures undertaken, providing detailed descriptions of each stage.

Search and Selection of Articles

To conduct the review, we performed a search in the Virtual Health Library, using the databases PubMed, Web of Science, and Dimensions. The bibliographic search was conducted in Portuguese, English, and Spanish. Three assessors conducted a critical analysis of the titles and abstracts resulting from the search, proceeding to select the articles that appeared to align with the predefined inclusion criteria. Subsequently, we conducted a joint analysis among the assessors to deliberate on the selection of the articles that were found in full. During the assessors' thorough reading of the articles, consideration was also given to the inclusion of any other cited and found articles, as long as they aligned with the predefined inclusion criteria.

Those articles that, after thorough reading, were not presented in accordance with the inclusion criteria, were excluded from the study. In the selection, only articles about interventions with human subjects were included, published from January 2013 to May 2023, which employed physical exercise programs as part of the treatment, leading to changes in weight loss or improvements in the overall health of adults with severe obesity (with participants' average BMI ≥ 40 kg/m²). These studies were conducted through pre- and post-intervention tests and retests of the dependent variables, and may or may not have included control groups. Initially, we used the terms "severe obesity," "severe obesity," "grade 3 obesity," "free access," "exercise," or "physical activity" for the search. However, we observed that the terms "grade 3 obesity" and "physical activity" limited the effectiveness of the search, as many of the titles found with these insertions were duplicates of previous studies without these additions. In PubMed, we used the terms "severe obesity," "severe obesity," "grade 3 obesity," "free Access," "exercise," and "physical activity," applying filters according to the proposed inclusion criteria. It is worth noting that this systematic review was conducted following the PRISMA review system protocols (Figure 1).

Criteria for Inclusion and Exclusion

In this study, the inclusion criteria were original articles with open access, written in Portuguese, English, or Spanish, that conducted comparisons between one or more physical exercise programs. The participants included in the study were adults, aged between 18 and 65 years, with a BMI equal to or greater than 40 kg/m², associated with comorbidities. The research focused on randomized controlled trials, prospective trials, and case-control studies, all published over a decade, from 2013 to 2023. Additionally, the selected studies needed to provide a detailed description of the exercise program, covering the type of exercise (strength training, aerobic training, high intensity interval training, among others) and assessment criteria (such as physical fitness, body composition, quality of life, among others). The primary goal was to investigate the effectiveness of severe obesity treatment. Exclusion criteria included studies that did not report final outcomes; studies in which the investigated population did not consist of humans; review studies, guidelines, interviews, comments, or case studies. Studies that were not written in English, Portuguese, or Spanish and did not describe an intervention, such as those involving individuals who had undergone bariatric surgery, pharmacological treatment, children, and adolescents, were also excluded. The reviewers individually assessed the titles and abstracts, classifying them according to their relevance. This literature review was conducted independently and simultaneously by the reviewers. Any discrepancies between the researchers were resolved through mutual consensus.

Methodological Quality Assessment

The methodological quality of the scientific clinical trials (RCTs) was individually assessed by the reviewers using the Physiotherapy Evidence Database (PEDro). This instrument is highly recognized and widely used for evaluating the methodological quality of RCTs, and is frequently employed in various systematic reviews and bibliographic studies. The PEDro scale was developed by Verhagen et al. in 1998, and incorporates techniques from the Delphi Consensus, as described by Ayala & Baranda in 2013. This scale

consists of 11 criteria, where positive values are scored as "1" and negative values as "0". Criteria from 2 to 9 pertain to internal validity and methodology used, while criteria 10 and 11 refer to the statistical treatment employed by the authors (see Table 1). Through this scale, we assessed the quality of the studies, with an emphasis on physical exercise training for adults with severe obesity, analyzing pre-test and post-test studies selected in the literature.

Table 1. PEDro Methodological Assessment Scale

#	Criterion	Yes	Não
1	Were the criteria for participant selection clearly specified in the study?		
2	Were individuals randomly assigned to study groups?		
3	Was allocation concealed?		
4	Was concealed randomization used to ensure that participant allocation was not known beforehand?		
5	Were all study participants blinded?		
6	Were the researchers responsible for administering the training blinded to the treatment groups?		
7	Were the assessors who measured the key outcomes blinded to the treatment groups?		
8	Were the key outcome measures obtained on more than 85% of the participants originally assigned to groups?		
9	Were results reported for all participants, both those who received training and those in the control group? When this was not possible, were data for at least one key outcome analyzed on an intention-to-treat basis?		
10	Were the results of the statistical analyses between the groups presented for at least one key outcome?		
11	Does the study provide measures of central tendency and variability for at least one key outcome?		

Results

Characteristics of Included Studies

The primary search yielded 601 results, including 58 duplicates. Eighteen studies were identified as potentially relevant and underwent a critical full-text assessment, resulting in nine exclusions. Two studies investigated individuals with obesity <40 BMI, two studies were non-randomized, four studies did not report the type of exercise performed, and one study did not meet PEDro scale criteria (Yamada et al., 2015).

The studies included in this review ranged from 5 to 9 points with an average of 6.77, as shown in Table 2. Within the studies, two articles scored 8 and 9 points (22.2%), three articles scored 7 points (33.3%), three articles scored 6 points (33.3%), and one article scored 5 points (11.1%). The study flowchart is presented in Figure 1 and Table 2

shows the quality of the studies according to the checklists (PEDro scale).

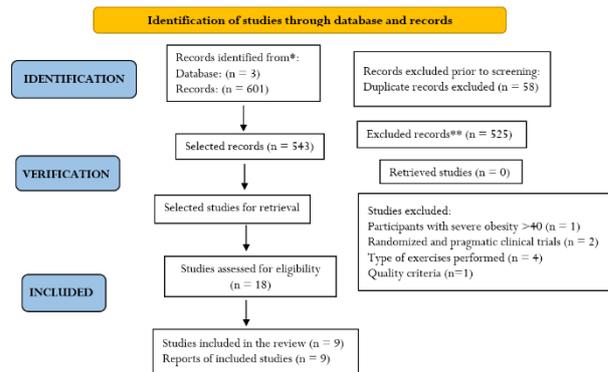


Figure 1. PRISMA Flowchart of Systematic Search. Note. adapted to the PRISMA 2020 statement (Page et al., 2021).

Table 2. Assessment of articles using the PEDro methodological assessment scale...

Nº	Studys	1	2	3	4	5	6	7	8	9	10	11	Points
1	(Berge et al., 2021)	1	2	1	1	0	0	0	1	0	1	1	6
2	(Bergeet al., 2022)	1	1	1	1	0	0	0	1	0	1	1	7
3	(Bo et al., 2018)	1	1	1	1	0	0	0	1	1	1	1	8
4	(Castilho et al., 2021)	1	1	1	1	0	0	0	0	1	1	1	7
5	(Danielsen et al., 2019)	1	0	1	1	0	0	0	0	0	1	1	5
6	(Delgado-Floody et al., 2019)	1	1	1	0	1	0	0	0	0	1	1	6
7	(Erickson et al., 2016)	1	0	1	1	0	0	0	0	1	1	1	6
8	(Fedele et al., 2017)	1	0	1	1	0	0	0	1	1	1	1	7
9	(Marcon et al., 2017)	1	1	1	1	1	1	0	1	1	1	0	9

Participants

This study presents the results of research that investigated the outcomes of 552 individuals with severe obesity, who participated in nine clinical trials dedicated to weight

reduction interventions. Notably, the majority of subjects involved in these studies were females. Clinical trials employed a set of scientific parameters to assess outcomes, including anthropometric measurements (such as body mass

index and waist circumference), physical fitness tests, and monitoring of vital signs (such as blood pressure and heart rate) throughout the intervention period.

Exercise duration

The effects of physical training have been investigated in several studies, each with different intervention durations. Three studies analyzed the impact of a training program over 24 weeks (Berge et al., 2021; Berge et al., 2022; Castilho et al., 2021). One study spanned a period of 12 months, with assessments carried out every 3 months (Bo et al., 2018). Another study lasted 10 to 14 weeks, with assessments carried out at 6 and 12 months (Danielsen et al., 2013). Two studies addressed a 20- and 16-week intervention, respectively (Delgado-Floody et al., 2019; Marcon et al., 2017). One study lasted just 8 weeks (Fedele et al., 2017). Additionally, one study explored the effects of physical training over a period of just 30 days (Errickson et al., 2016). As a result of this investigation, it was found that only 3 of the 9 studies analyzed the effects of behavioral change with the assistance of a multidisciplinary team, incorporating weekly sessions with professionals in the areas of psychology and nutrition. As indicated by the findings, the protocols used in the studies varied significantly in relation to the number of sessions, duration of the intervention, outcome criteria, sample size, among others. Within the

scope of this study, it was observed that exercise programs varied in duration, ranging from 4 weeks to 12 months. The frequency of sessions varied between 3 and 5 per week, and the average duration of each session covered a range of 30 to 90 minutes, with a considerable distribution across the different studies.

Exercise program

Table 3 presents the evaluation parameters adopted in clinical trials. The most frequently used assessment parameters included anthropometric measurements, assessments of functional capacity, physical parameters related to physical fitness and quality of life indicators. In the context of studies on physical activity (PA) in individuals with severe obesity, six investigations focused on the effects of aerobic exercise training (Berge et al., 2021; Berge et al., 2022; Bo et al., 2018; Danielsen et al., 2013; Fedele et al., 2017; Marcon et al., 2017), while three focused on the impact of strengthening exercise training (Danielsen et al., 2013; Delgado-Floody et al., 2019; Errickson et al., 2016). And two other studies incorporated high-intensity interval training (HIIT) as part of their interventions (Berge et al., 2021; Berge et al., 2022). It is important to note that, in some of the studies, exercise practices carried out in the home environment were also included as a component of the intervention (Bo et al., 2018; Danielsen et al., 2013)

Table 3. Characteristics of Interventions and Main Results

Author	measure (n)	Group of Intervention	Physical Activity Volume			Intensity of Physical Activity	Type of Physical activity	Team work Multi-professional	Variables Used	Main results
			Total Duration	Frequency (Weekly)	Session Time (min)					
(Berge et al., 2021)	n= 71	HIIT/MICT	HIIT/MICT	24 weeks	3	40'	95%	N/D	Anthropometric and body composition measurements; Free physical activity during the day (ActiGraph wGT3x-BT); Ergospirometry Relatively lower energy during exercise (EEDe); Resting metabolic rate (RMR); Food frequency questionnaire; Appetite control (using visual analogue scales)	The 24-week HIIT/MICT did not achieve a higher EEDe compared to those who completed a 24-week MICT program. The HIIT/MICT group experienced, on average, 3 kg more weight loss than the MICT group.
				24 weeks	3	49'				
		MICT	MICT							
(Berge et al., 2022)	n = 71	HIIT/MICT	HIIT/MICT	24 weeks	3	40'	95%	N/D	Short Form Health Survey (SF-36) Quality of life (IWQOL-Lite) Weight Specific Symptoms of Obesity (WRSM) Maximum cardiorespiratory fitness (VO 2max)	The 24-week HIIT/MICT did not improve their overall health any more than those who completed a 24-week MICT program. No differences were found in the other seven dimensions of SF-36 scores, obesity-specific HRQoL scores, or weight-related symptoms. However, regardless
				24 weeks	3	49'				
		MICT	MICT							

											of exercise intensity, overall health improved in both groups after 24 weeks of exercise.
(Bo et al., 2018)	n = 120 N/D	EG (n = 60) CG (n = 60).	12 months (followed every 3 months)	N/D	N/D	N/D	Intervention 20 min/d of brisk walking, according to the Borg scale criteria	N/D	self-hypnosis Minnesota Leisure Time Physical Activity Questionnaire Satiety Labeled Intensity Magnitude Scale EuroQol-5D satisfaction and well-being questionnaire Anthropometric and blood pressure measurements blood samples	Self-hypnosis is a non-invasive, side-effect free intervention that was not associated with greater weight loss when added to lifestyle recommendations, but improved satiety, quality of life and CRP values after 12 months. In fact, regular self-hypnosis users lost more weight and significantly reduced their energy consumption.	
(Castilho et al., 2021)	n = 13 M (n= 06) W (n= 07)	EG	24 Weeks	3	1	N/D	Aquatic Exercises (1 hour) didactic theoretical classes (1 hour)	physical education professional cardiologist doctor Nutritionist psychologist	Body mass index. Neck Circumference Waist circumference Fat percentage Fat Mass Blood glucose HbA1C Insulin CRP Total cholesterol Triglycerides Flexibility Hand grip strength Static abdominal muscle resistance Dynamic lower limb muscular resistance Freq. Cardiac pre-test at rest 6MWT Freq. Post-test cardiac Freq. Cardiac Recovery 1min. Post-test ABS (Adapted Borg Scale)	BMI, percentage (%fat), absolute body fat, flexibility, handgrip strength, abdominal strength/endurance showed significant improvements (p<0.05). PMTO in adults with severe obesity has been shown to effective in improving several parameters related to health and physical fitness, therefore, promising for more studies to evaluate its applicability, including interventions in the context of primary health care.	
(Danielson et al., 2013)	n = 104 N/D	Group III (n=71) CG (n=33)	10 a 14 weeks (with follow-up 6 and 12 months)	5	90'		Lifestyle modification increase PA level (aerobic, strength, agility and balance training as well as different sports activities, games, walking and day trips) adjust energy and nutrition intake (1900 kcal/d for men and 1600 kcal/d for women)	Doctor Psychologist clinical nutritionist nurses exercise scientists physiotherapists	Body composition Risk Factors for Cardiovascular Diseases Eating Behavior (Three-Factor Eating Questionnaire (TFEQ-R21)) Exercise Capacity.	III including high-volume PA resulted in weight loss with near maintenance of fat-free mass, favorable changes in CVD risk factors, and eating behavior in severely obese individuals.	
(Delgado-Floody et al., 2019)	n = 21 N/D	EG (n=14) CG (n=7)	20 Weeks	3	60'		learn training strategies.	N/D	MetS markers waist circumference blood pressure fasting blood glucose, high-density lipoprotein	Significant reductions in MetS markers were observed in the GC and GE groups (P < 0.05 to P < 0.0001), more significant reductions in diastolic BP	

									proteins and tri- glycerides Total cholesterol low density lipo- protein, one rep max bi- ceps curl manual pretension force 6MWT	and increases in HDL-C were ob- served only in the GE group (P < 0. 0001). Changes in waist circumference and systolic and dias- tolic BP were signifi- cantly greater only in the EG group (P < 0.001), but the CG showed a greater decrease in fasting blood glucose (P < 0.0001). The preva- lence of non-re- sponders among GC and EG was similar to the MetS results. TR promotes better overall results of MetS, waist circum- ference, BP and plasma triglycerides in morbidly obese patients than in obese peers, with no differences in the prevalence of non- responders.
(Errick- son et al., 2016)	n=72 M (n= 40) W (n= 32)	Base 4 weeks	30 days	5	60	N/D	Functional ex- ercise educational classes (on nu- trition, health, fitness and be- havior change).	Nutritionist Psychologist Exercise physio- logy	BMI 6MWT Circumferences Blood pressure	Significant improve- ments included a de- crease in BMI (2.7 + 1.7 kg m ² , p < 0.001) and an in- crease in the 6MWT distance (66.4 + 73.0 m, p < 0.001). The TC6M improved by 66m on average, a reported clinically significant difference. Greater improvements in the 6MWT significantly correlated with greater weight loss and reduced BMI.
(Fedele et al., 2017)	n= 14 N/D	EG (n = 14) CG (n = 14)	8 weeks	N/D	N/D	N/D	Aerobic and anaerobic ex- ercise Hypocaloric dietary inter- vention.	N/D	anthropometric measurements (BMI, waist cir- cumference and body composition) blood pressure blood samples (creatinine, blood glucose, insulin, total and HDL cholesterol, tri- glycerides and uric acid) two-dimensional M-mode echocar- diography.	An almost twofold increase in NTproBNP levels was evidenced after a very short period of lifestyle interven- tion in severely obese normotensive patients without heart disease. This finding may have clinical relevance, considering the role of NT-proBNP as a risk factor for glu- cose intolerance.
(Marcon et al., 2017)	n= 66 N/D	Group EXER (n = 22) Exercise group + Lifestyle EXER + CBT (n = 17) CG (n = 18)	4 month	3	25'	N/D	Aerobic exer- cises (TCC) after the train- ing session and lasted 1 h	N/D	BMI 6MWT FCrest HR post exercise VO ₂ máximo (H= [7,57*height (m)*100] - [5,02* age (years)] - [1,76*weight(kg)] - 309) (M = [2,11*height (m)*100] - [2,29* age (years)] - [5,78*weight (kg)] + 667)	A supervised low-in- tensity physical ac- tivity program for 4 months, twice a week, that encour- ages individuals to adopt a more active lifestyle, can posi- tively influence weight loss and im- prove capacity and functional paramet- ers. Cardiometab- olic results of mor- bidly obese people

Nota: n: number of participants; PA: Physical activities; m: men; m: women; EG: experimental group; CG: group control; min: minutes; RHR: resting heart rate; n/d: not declare; ILI: intensive lifestyle intervention; RSDE: relatively smaller during exercise; RMR: resting metabolic rate; HIIT: high intensity interval training; MICT moderate-intensity continuous training.; HR: heart rate; CRP: C-reactive protein; MOTP_ multidisciplinary obesity treatment program; BMI: body mass index; CD: cardiovascular diseases. 6MWT: 6-minute walk test; METS: metabolic equivalent of the task; CBT: cognitive behavioral therap.

Regarding the approaches employed in programs aimed at weight reduction and improving the health of individuals with severe obesity, the analysis of the selected studies revealed that aerobic activities play a predominant role in virtually all interventions (Berge et al., 2021; Berge et al., 2022; Bo et al., 2018; Danielsen et al., 2013; Marcon et al., 2017; Castilho et al., 2021; Fedele et al., 2017). These activities encompass modes such as walking, aerobic exercises, low-intensity continuous training (MICT, Moderate-Intensity Continuous Training), and aquatic exercises. Furthermore, the inclusion of strength training was evident through functional and resistance exercises, as observed in three studies (Danielsen et al., 2013; Delgado-Floody et al., 2019; Errickson et al., 2016). It is also worth noting the significance of high-intensity training, as evidenced by recent studies (Berge et al., 2021 and 2022).

In the context of multidisciplinary weight reduction treatment programs, the analysis of the selected studies revealed that only three of them explicitly indicate the collaboration of multiprofessional teams, comprised of professionals from fields such as medicine, psychology, nutrition, physical education, among others (Westphal-Nardo et al., 2023; Westphal et al., 2023; Danielsen et al., 2013; Errickson et al., 2016). This limited adherence to multidisciplinary approaches can be attributed, in part, to the constraints of resources available for research in the field of physical activity, as well as the deficiency in the integration among healthcare professionals (Goodman et al., 2007). Regarding specialized guidance in each professional domain, only two of the studies unequivocally emphasized that the prescription and supervision of physical activities were conducted by professionals specialized in the field of physical education (Errickson et al., 2016; Westphal et al., 2023., Westphal-Nardo et al., 2023). In a similar manner, three articles mentioned that nutritional strategies were outlined by nutritionists with educational guidance on healthy eating. In a study involving a hypocaloric dietary intervention (Fedele et al., 2017), psychological support was provided by professional psychologists (Danielsen et al., 2013; Errickson et al., 2016; Westphal et al., 2023., Westphal-Nardo et al., 2023), following the approach advocated by Barrear et al. (2003) for an interdisciplinary and multi-professional approach.

Discussion

The review aimed to identify effective types of physical activities or exercise programs applied for improving the quality of life and health of individuals affected by severe

obesity. After the selection of studies, it is important to emphasize that only nine of the studies met the inclusion criteria. This appears paradoxical, considering that governments of various nations, at multiple levels (national, regional, local, etc.), are promoting Physical Activity (PA) programs targeted at adults with varying degrees of obesity. These initiatives represent a cost-effective prevention strategy with the potential to reduce medical expenses by delaying the development of chronic diseases (Wunderlich et al., 2009). Scientific literature has demonstrated the beneficial effects of PA, both in chronic forms and in single sessions (Maureira, F. & Flores, E. 2017). The main challenges identified in conducting these studies include the difficulty in establishing an appropriate control group.

The predominant time frame utilized in intervention programs ranged from 16 to 24 weeks, adopting a methodological approach that supports the demonstration of the importance of long-term exercise programs in the context of weight loss. These findings corroborate the observation that, regardless of the type of physical activity performed, the most significant benefits are achieved in reducing body weight and adiposity in individuals with severe obesity. Additionally, these interventions have been associated with substantial improvements in other parameters, including cardiometabolic risk and cardiorespiratory fitness (assessed through the 6-minute walk test, 6MWT), as well as overall physical fitness. Finally, it is worth noting that studies incorporating multidisciplinary teams excelled in demonstrating the most favorable results in terms of quality of life and intervention efficacy.

On the other hand, it is possible to observe that some of the selected studies adopted a relatively shorter intervention period, as seen in the study conducted by Danielsen et al. (2013), where temporary hospitalization was employed as a therapeutic approach. This approach is justified by its ability to provide more precise monitoring and more effective maintenance of results over time. Furthermore, Erickson et al.'s study (2016), despite its shorter intervention duration, also revealed promising results regarding weight loss, emphasizing the significance of the acute effect of exercise in this specific population. These findings align with those presented by Aparecida et al. (2023) regarding the acute effects of exercise in individuals with obesity, enhancing our understanding of the immediate impact of physical activities in this particular demographic.

It is worth noting that, although the studies in question have presented encouraging results, significant optimization could be achieved by including details related to the planning and nature of the implemented physical activities (PA).

It is evident that the analyzed studies often left gaps in this aspect, with only two articles providing comprehensive information regarding volume, frequency, intensity, and type of PA conducted (Berge et al., 2021; Berge et al., 2022). It is relevant to emphasize that these elements are considered fundamental in designing PA programs for individuals with severe obesity, aligning with the guidelines proposed by Barrear et al. (2003). These aspects also align with the recommendations of the World Health Organization (2012; 2020), which establishes globally science-based guidelines addressing aspects such as expected benefits, type, quantity, frequency, intensity, duration, and total volume of physical activity necessary for health promotion.

A robust emerging evidence from the studies is the prevalence of high discontinuation rates reported in virtually all the reviewed research. Additionally, it is noticeable that the adopted success criteria primarily focus on reducing body weight and body mass index (BMI) as central variables, setting as second outcome indicators that significantly contribute to improving the quality of life in individuals with obesity. For example, biochemical parameters such as blood glucose, hemoglobin A1c (HbA1c), insulin, C-reactive protein (CRP), total cholesterol, and triglycerides are not always taken into account.

Furthermore, the assessment of physical fitness, including flexibility, hand grip strength, static abdominal muscle endurance, lower limb muscle endurance, and the 6-minute walk test (6MWT), as well as the reduction of circumference measures, such as neck, waist, abdomen, and hip circumferences, are equally relevant indicators. These variables were proposed as an integral part of the studies, as suggested by Nardo et al. (2018), aiming to provide a more comprehensive and accurate evaluation of the treatment benefits in individuals with obesity.

The main strengths of this review deserve recognition. Firstly, the methods used for the selection and assessment of studies followed the guidelines recommended by PRISMA 2020 (Page et al., 2021), ensuring rigor and transparency in the process. Secondly, robust and comprehensive protocols were adopted for the inclusion of a wide range of generic and specific databases, optimizing information retrieval and minimizing the likelihood of bias in the obtained results. However, some limitations should be acknowledged. Firstly, the restriction to include studies written exclusively in English, Spanish, or Portuguese may have excluded valuable sources of information in other languages. Moreover, there is a lack of clear evidence regarding the exercise's impact on improving the anthropometric and biochemical profile of individuals with severe obesity. The diversity of measurement instruments and analyzed variables in the selected studies hindered the comprehensive synthesis of all presented information. One of the limitations concerns whether the participants underwent dietary treatment or any other form of pharmacological treatment, which could have impacted the full comprehension

of the results. However, it is worth noting that the field of physical activity (PA) in individuals with severe obesity still lacks consensus regarding assessment criteria and training protocols. This is, in part, due to the prevalence of success criteria that, in many cases, are limited to simply reducing body weight, without adequately addressing the complexity of the needs and objectives of this population.

Conclusion

The results stemming from the literature analysis based on the selected studies reveal that multiprofessional programs involving psychologists, nutritionists, and physical educators, regardless of the adopted physical training modality, demonstrated effectiveness in reducing various anthropometric parameters. It was also noted that interventions conducted over 8 to 16 weeks, supervised in aerobic and strength training, lead to positive improvements in the functional capacity and biochemical variables of the participants.

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