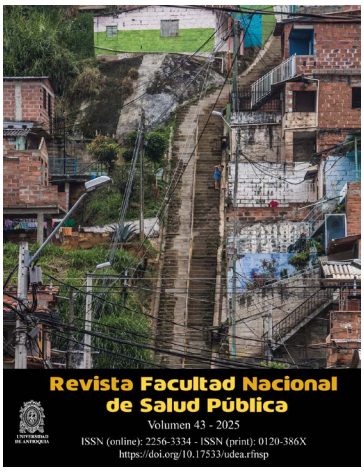

Title: Stairs
Author: Juan Fernando Ospina - Photographer
Medellín, 2016

Volume 43, 2025
DOI: https://doi.org/10.17533/udea.rfnsp.e356821

Received: 07/06/2024
Approved: 02/12/2024
Published: 11/03/2025
English version: 24/10/2025

Cite:
Carvajal-Tello N, Caballero-Lozada AF, Marín-Herrada S, Hidalgo-Santander JF, Barahona-Guzmán JP, Segura-Ordoñez A. Effectiveness of the 6-minute walk test in the assessment of aerobic capacity in people with obesity: a scoping review. Rev. Fac. Nac. Salud Pública. 2025;43:e356821. DOI: https://doi.org/10.17533/udea.rfnsp.e356821

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Effectiveness of the 6-minute walk test in the assessment of aerobic capacity in people with obesity: a scoping review*

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Abstract

Objective: This scoping review aimed to systematize the available evidence on the effectiveness of the 6-minute walk test in the assessment of aerobic capacity in people with obesity, and its usefulness for the prescription of physical exercise.
Methods: PubMed, Science Direct, Springer, Scopus and LILACS databases were reviewed. The search was limited from 2013 to 2023. Randomized controlled studies and prospective longitudinal studies were included. The data obtained were analyzed using the checklist proposed by the PRISMA Extension for Scoping Reviews (PRISMA-ScR).
Results: A total of 10 papers reporting results from randomized controlled studies and prospective longitudinal studies (50% of each) were analyzed, with 70% being from the Americas and 90% being written in English. The total number of participants was 1,575, and they were aged between 18 and 75 years. In the studies that specified sex, 66.3% were women. The body mass index for the experimental group ranged from 30.5 ± 2.8 to 48.99 ± 11.61 kg/m2. The distance traveled in the 6-minute walk test was observed to range from 428.3 ± 85.7 m, $p < 0.0001$, to 602.6 ± 70.2 m, $p = 0.001$. The VO2 max ranged between 16.9 ± 2.7 mLO2/kg/min-1 ($p < 0.05$) and 25.1 ± 4.7 mLO2/kg/min-1 ($p = 0.001$).
Conclusion: The 6-minute walk test is an effective and complementary tool in the design of exercise programs aimed at people with obesity, as it is a useful, simple and objective measure for exercise prescription and clinical follow-up.

----------*Keywords:* aerobic capacity, obesity, 6-minute walk test

* This article is a product of the research project "Effectiveness of the 6-minute walk test in patients with obesity: An exploratory review 2013-2023." Start date: February 24, 2023; end date: August 17, 2023. Minutes 618/2023.

Efectividad de la prueba de caminata de 6 minutos en la evaluación de la capacidad aeróbica de personas con obesidad: una revisión exploratoria

Resumen

Objetivo: Esta revisión exploratoria buscó sistematizar la evidencia disponible en relación con la efectividad de la prueba de caminata de 6 minutos en la evaluación de la capacidad aeróbica de personas con obesidad, y su utilidad para la prescripción del ejercicio físico.
Métodos: Se revisaron las bases de datos PubMed, Science Direct, Springer, Scopus y LILACS. Se limitó la búsqueda desde 2013 a 2023. Se incluyeron estudios controlados aleatorizados y estudios longitudinales prospectivos. Los datos obtenidos fueron analizados mediante la lista de chequeo planteada por Extension for Scoping Reviews - (PRISMA-ScR) para revisiones exploratorias.
Resultados: Se analizaron 10 artículos, resultados de estudios controlados aleatorizados y estudios longitudinales prospectivos (50 % cada uno); el 70 % del continente americano y el 90 % en inglés. El total de participantes fue de 1575, con edades entre los 18 y los 75 años. En los estudios que especificaron el sexo, el 66,3 % eran mujeres. El índice de masa corporal para el grupo experimental osciló entre 30,5 ± 2,8 y 48,99 ± 11,61 kg/m^2. La distancia recorrida en la prueba de caminata de 6 minutos se observó en un rango de 428,3 ± 85,7 m, $p < 0{,}0001$, a 602,6 ± 70,2 m, $p = 0{,}001$. El VO_2 máx se observó entre 16,9 ± 2,7 mLO_2/kg/min^{-1}, $p < 0{,}05$ y 25,1 ± 4,7 mLO_2/kg/min^{-1}, $p = 0{,}001$.
Conclusión: La prueba de caminata de 6 minutos es una herramienta efectiva y complementaria en el diseño de programas de ejercicio dirigido a personas con obesidad, siendo una medida útil, sencilla y objetiva para la prescripción del ejercicio y el seguimiento clínico.

----------*Palabras clave*: capacidad aeróbica, obesidad, prueba de caminata de 6 minutos.

Eficácia do teste de caminhada de 6 minutos na avaliação da capacidade aeróbica em indivíduos obesos: uma revisão de escopo

Resumo

Objetivo: Esta revisão exploratória buscou sistematizar as evidências disponíveis sobre a eficácia do teste de caminhada de 6 minutos na avaliação da capacidade aeróbica de pessoas com obesidade e sua utilidade na prescrição de exercícios físicos.
Métodos: Foram revisadas as bases de dados PubMed, Science Direct, Springer, Scopus e lilacs. A busca foi limitada de 2013 a 2023. Foram incluídos ensaios clínicos randomizados e estudos longitudinais prospectivos. Os dados obtidos foram analisados utilizando o checklist proposto pela Extension for Scoping Reviews - (PRISMA-ScR) para revisões exploratórias.
Resultados: Foram analisados dez artigos, resultados de ensaios clínicos randomizados e estudos longitudinais prospectivos (50% cada); 70% do continente americano e 90% em inglês. O número total de participantes foi de 1.575, com idades entre 18 e 75 anos. Nos estudos que especificaram sexo, 66,3% eram mulheres. O índice de massa corporal do grupo experimental variou de 30,5 ± 2,8 a 48,99 ± 11,61 kg/m2. A distância percorrida no teste de caminhada de 6 minutos variou de 428,3 ± 85,7 m, p < 0,0001, a 602,6 ± 70,2 m, p = 0,001. O VO2 máx foi observado entre 16,9 ± 2,7 mLO2/kg/min–1, p < 0,05 e 25,1 ± 4,7 mLO2/kg/min–1, p = 0,001.
Conclusão: O teste de caminhada de 6 minutos é uma ferramenta eficaz e complementar no desenho de programas de exercícios direcionados a pessoas com obesidade, sendo uma medida útil, simples e objetiva para prescrição de exercícios e acompanhamento clínico.

----------*Palavras-chave:* capacidade aeróbica, obesidade, teste de caminhada de 6 minutos.

Introduction

The World Health Organization (WHO) defines obesity as a condition in which there is abnormal or excessive accumulation of body fat tissue with detrimental effects on health [1]. The superior form of energy storage within the organism is mainly distributed in lipid deposits [2]. Despite the availability of this resource, it is well known that the energy consumption used primarily during metabolic stress in general for the maintenance of basic survival functions comes from the oxidative metabolism of carbohydrates for the resynthesis of adenosine triphosphate (ATP) [3]. The release of energy in the catabolism of macronutrients is aimed at the phosphorylation of adenosine diphosphate, which regenerates the energy rich compound into ATP, where oxygen utilization plays a key role. From a physiological point of view, obesity results in an imbalance between energy intake and energy consumption. In this imbalance, the nutrients that are not utilized as an energy resource are stored for later use [4].

There are more than one billion overweight adults in the world, of which approximately 300 million suffer from obesity. Being overweight or obese implies a higher risk of mortality, as well as the development of multiple pathologies, especially coronary heart disease, type 2 diabetes, and cancer, which are listed as the main causes of death globally [5]. In United States, obesity exhibits prevalence values between 5 and 20% in adult men, and between 8 and 30% in women [6]. In Colombia, the prevalence of obesity is similar, being more frequent in women (22.4%), than in men(14.4%) [7].

An indicator frequently used to identify overweight and obesity in adults is the body mass index (BMI). This establishes the ratio between weight and height. The WHO considers that an adult is overweight when his or her BMI is equal to or greater than 25, and that he or she has grade I obesity when the BMI is equal to or greater than 30 [8]. However, it should be noted that, although this indicator is the most widely used, it may not adequately assess overweight status and obesity, since it works well when the ratio between fat and muscle proportion is normal, but it can generate erroneous classifications when there is a higher percentage of lean mass than fat [9].

Obesity impacts multiple body systems in a person. At the pulmonary level, obesity causes mechanical compression of the lungs, restricts the thoracic cavity, and increases both respiratory rial neural drive and thoracic blood volume. This results in reduced thoracic compliance, impairment of diaphragmatic function, and an increase in respiratory work, greatly limiting the functional performance of the patient in daily motor activities such as walking or climbing stairs. This limitation, in turn, affects the oxygen consumption (VO_2) of the patient [10].

In most cases, obesity is treated with exercise and lifestyle modification. This type of interventions has been found to reduce insulin resistance sensitivity, optimize the lipid profile, and decrease BMI and fat-free mass [11]. Aerobic exercise, in particular, has been reported to improve body composition and has multiple benefits for activation and metabolic regulation, which, in turn, allow for an optimal energy balance between caloric intake and caloric loss and have direct effects on the decrease of adipose tissue [12].

The assessment of oxygen consumption in people with obesity is fundamental in the integral approach to their health. This group of patients has a higher oxygen demand due to excess body mass [13], which can compromise bodily functions. Assessing oxygen consumption allows health professionals to identify limitations in aerobic capacity, plan personalized exercise and nutrition interventions, and monitor the efficacy of treatments, which improves quality of life and reduces the risk of mortality associated with obesity [14].

Considering the above, the literature reports the use of different tests to determine aerobic capacity in people with obesity such as the incremental exercise [15], the Nordic walking [16], and ergospirometry tests [17]. However, one of the most widely implemented tests in exercise prescription programs in obesity for monitoring and evaluation is the 6-minute walk test (6MWT) [18].

The 6MWT is a measure of functional capacity and is a reliable tool for the diagnosis, prognosis, and follow-up of individuals with chronic diseases. It is also low cost and easy to administer [19], and it assesses in an integrated manner the response of the cardiovascular pulmonary, neuromuscular, and metabolic systems to the stress imposed by exercise [20]. Besides, it analyzes the maximum distance that an individual can walk as fast as possible, in a time of 6 minutes, in a corridor of 30 meters [21]. Although it is usually considered a submaximal exercise test, some people can reach their maximum exercise capacity, which allows the calculation of VO_2 in an indirect manner [22]. Thus, it is a useful tool for assessing aerobic capacity in different populations. Particularly, it is considered useful in the estimation of VO_2 [23] in patients who suffer from obesity. In sum, evaluating the effectiveness of 6MWT to determine aerobic response and its implementation in clinical practice is of extreme relevance.

Hence, the objective of this exploratory review was to systematize the available evidence regarding the effectiveness of the 6MWT in the assessment of aerobic capacity and its usefulness for the prescription of exercise in people with obesity. The specific question guiding the study was: what is the effectiveness of the 6MWT in

the estimation of aerobic capacity in people with obesity according to the scientific literature?

Methods

This section maps the exploratory review conducted, also known as *scoping review*, where from a research question, existing knowledge is synthesized with a systematic methodology and key concepts [24].

Sources of information

Articles with the following priority outcomes were included: obese population, 6MWT, distance traveled and VO_2 peak, in the period 2013-2023. For the search, the electronic databases PubMed, Science Direct, Springer, Scopus and LILACS were used in Spanish, English and Portuguese between March 1, 2023 and June 1, 2023.

Eligibility criteria

Inclusion criteria: randomized clinical trials (RCT) and prospective longitudinal studies (PLS), whose participants were adults with obesity, BMI>30, that took the 6MWT to evaluate peak VO_2.

Exclusion criteria: articles such as systematic reviews or meta-analysis, case series, or case reports.

Search strategy

The following is a description of the search strategy using the PICO methodology: P: Participants, I:Intervention, C:Comparison, O:Outcomes.

Participants: people with BMI > 30 (obesity grade 1).

Intervention: exercise prescription with the 6MWT.

Comparison: people with normal weight (BMI between 18.5 and 24.9) and overweight people (BMI between 25.0 and 29.9) to which other aerobic tests were applied to estimate aerobic capacity.

Results: measurement of the distance covered for indirect calculation of VO_2 max.

The search included terms found in the multilingual thesaurus Descriptors of the Medical Subject Headings (DeCS/Mesh) library and used Boolean operators to look up the following term combinations in the three selected languages: (obesity OR overweight) AND (six-minute walking test OR oxygen consumption) AND (exercise OR cardiac performance).

The literature review resulted in 2353 studies from the five databases. A total of 1885 records were eliminated before the selection phase due to being duplicates. In total, 468 records were evaluated according to their title and abstract, of which 430 were excluded because they did not meet the aforementioned inclusion criteria, leaving 44 studies for full-text reading. Of these, six studies were not retrieved, 38 were evaluated for eligibility, and 28 were excluded because they were using evaluation strategies other than 6MWT or it did not match the study type.

The extraction of information from the included articles was done by two researchers: the first collected the data, and the second verified whether the data met all the inclusion criteria described in the eligibility criteria. The researchers, through a critical reading of the selected articles, elaborated a matrix in Excel®, which contained a checklist with the inclusion criteria. The purpose of this stage was to identify the studies that met the variables to be analyzed in the study, and to eliminate duplicate records.

After extracting the information from the two researchers, if no consensus was reached regarding the articles to be included, a third member of the research team was summoned to make the final decision. This step avoided the risk of selection bias in the articles included. In the end, 10 studies were included. A PRISMA flowchart with details about the reviewed articles is presented in Figure 1 [25].

Risk of bias and quality assessment

To assess the quality of the articles in the RCTs, the TESTEX scale was used. This is a tool for assessing the quality of exercise training studies that addresses the following: the crossover from sedentary control to exercise, the periodic adjustment of the intensity of exercise training with respect to the adaptation to physical training, and the report of the characteristics of the exercise program. It consists of 12 criteria, some of which have more than one possible point, for a maximum score of 15 points (5 points for study quality and 10 points for reporting) [26].

The MINORS (Methodological Index for Non-Randomized Studies) scale was used for the PLS. This consists of 12 items, considering aspects such as defined objectives, prospective collection, study design, sample size calculation, and adequate statistical analysis [26]. Each of these items was rated as follows: 0 if not reported; 1 if reported but inadequate; and 2 if reported and adequate. At the end of the evaluation, the points were summed up and the ideal score was determined. This was 16 for non-comparative studies and 24 for comparative studies [27].

Data synthesis strategy

To synthesize the data, a qualitative and quantitative summary was prepared. This included metabolic changes, population characteristics, population selection strategies, methods for classifying and assessing obesity, exercise prescription, and VO_2 peak.

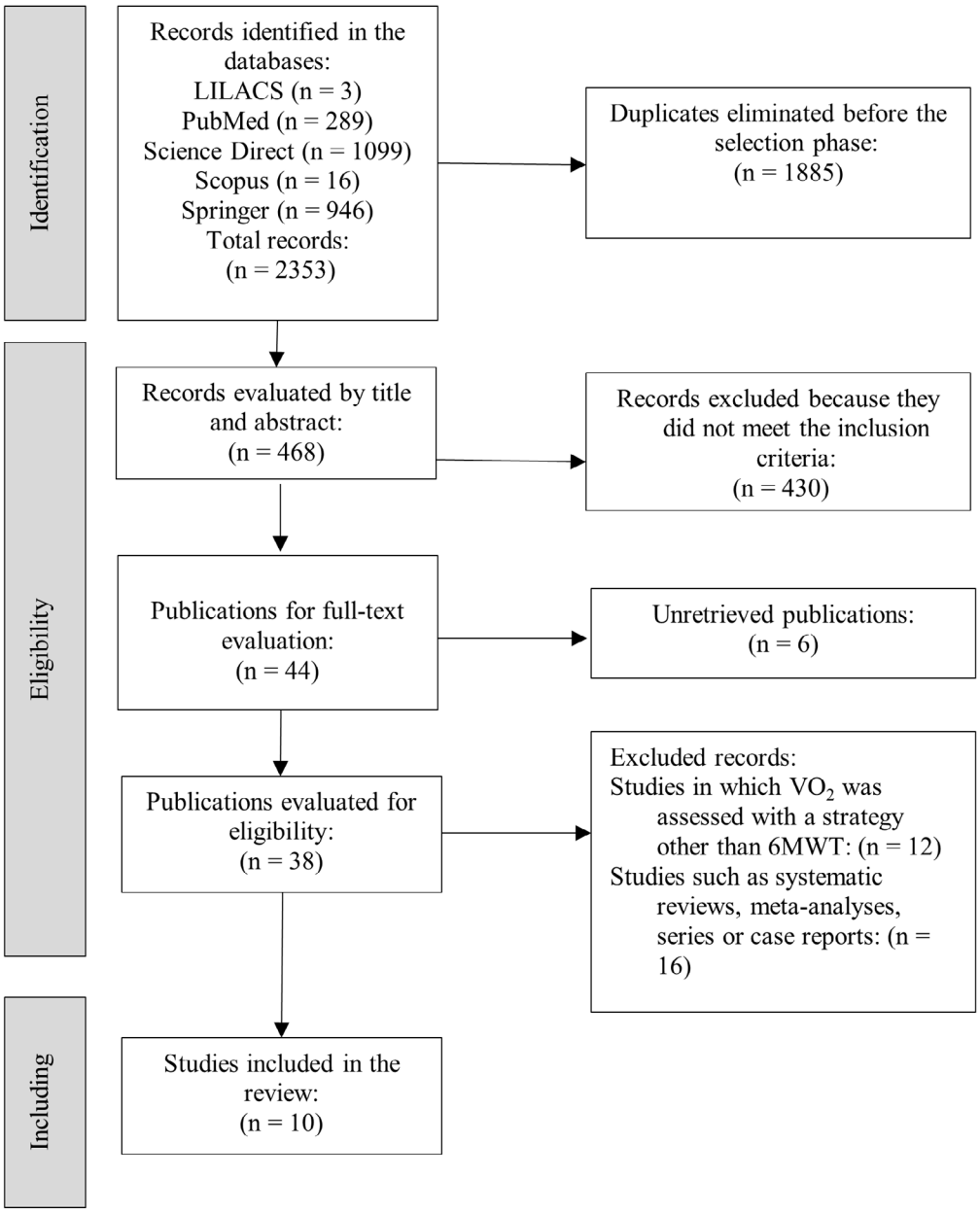

Figure 1. Identification of studies included

Data analysis

The data from each of the different studies were recorded in an Excel® template. The results of the variables analyzed were expressed as percentages, frequencies, and measures of central tendency, such as mean, median, and mode. In addition, a comparative analysis was performed for the RCT studies that had control and experimental groups. All results were presented on tables.

If the distance in the 6MWT had a correlation with BMI and VO_2 max, or if the physical exercise program had a significant improvement effect on VO_2 max, this was taken as significant.

Ethical considerations

Regarding ethical aspects, management of the clinical information of the patients reported in the studies

was taken into consideration. In particular, researchers looked at data protection, privacy and confidentiality.

Results

Results from this study cover two aspects: a) the characteristics of the bibliography, and b) the characteristics of the participants, the evaluation of the effect of 6MWT to establish the aerobic response to exercise, and the evaluation of the risk of bias and the quality of the articles.

Characteristics of the bibliography

Of the ten studies included, the types of study were 50% RCTs (n = 5), and 50% PLSs (n = 5). Of these, 70% (n = 7) came from the Americas, 20% (n = 2) from Europe and 10% (n = 1) from Asia. Regarding the language of the texts, 90% (n = 9) were written in English and the remaining 10% (n = 1) in Portuguese. None of the articles selected were written in Spanish. Table 1 shows the characteristics of the studies included.

Characteristics of the participants and evaluation of the effect of 6MWT to establish the aerobic response to exercise

The total number of participants was 1575, with ages ranging from 18 to 75,. Sex was specified in 1387 participants, of which 66.3% (n = 919) were female. The height of the participants in the experimental group ranged from 160 ± 0.1 cm [35] to 175 ± 0.07 cm [29]. As for weight and BMI, these ranged between 78.9 ± 12.6 kg [34] and 149.6 ± 37.8 kg [29], and between 30.5 ± 2.8 kg/m^2 [34] and 48.99 ± 11.61 kg/m^2 [29], respectively.

The distance traveled in the experimental group of the obese population ranged from 428.3 ± 85.7 m, $p <$ 0.0001 [28] to 602.6 ± 70.2 m [34], $p = 0.001$, while in the control group of population without obesity, a range was found between 610.0 ± 120.7 m, $p <$ 0,05 [33] to 616.86 ± 50.23 m, $p < 0.01$ [30]. VO_2 max was estimated in three studies [31,33,35]. For the experimental group, it ranged between 16.9 ± 2.7 mL O_2/kg/min^{-1}, $p < 0.05$ [33] and 25.1 ± 4.7 mL O_2/kg/min^{-1}, $p = 0.001$ [35]. For the control group, it was in the range of 21.4 ± 4.9 mL O_2/kg/min $^{-1}$, $p < 0.05$ [33] and 23.0 ± 2.5 mL O_2/kg/min^{-1}, $p = 0.001$ [35] (see Table 2).

Evaluation of other tests to establish aerobic response to exercise

In addition to evaluating the 6MWT, the study by Di Thommazo-Luporini et al.'s [33] analyzed two comparative tests: The first was the cardiopulmonary exercise test (CET), which consisted of four steps: it started with 2 minutes of rest in a sedentary position, followed by 2 minutes of rest in a bipedal position on the treadmill; then, it proceeded to an incremental phase, using the Bruce protocol; and, finally, it had a 3-minute recovery period. Exhaled gases were measured continuously on a breath-by-breath basis, using a portable instrument. The control group (CG) reported a distance covered of 849.1 ± 185.3 meters, and the experimental group (EG), 545.0 ± 150.1 meters. Regarding VO_2, the CG reported 29.7 ± 5.1 mL/kg/min, and the EG, 22.9 ± 4.7 mL/kg/min.

In the second test, called progressive walking test (PWT), subjects had to walk along a 10-meter circuit, delimited by two cones, and the speed was guided by a sound. The result was 389.6 ± 95.7 in VO_2; in the CG: 1444.9 ± 296.0, and in the EG: 1661.0 ± 301.4 mL/min.

On the other hand, the study by Muollo et al. [35] also compared 6MWT with Nordic walking, where the subjects had to walk a circuit supported by a cane to propel the gait. In the test, a distance at baseline of 131.0 ± 40 m, at 3 months of 139 ± 41.5 m and at 6 months of 45.7 ± 41.6 m was achieved. VO_2 at baseline was reported as 22.9 ± 4.7 mL O_2/kg/min^{-1}, at 3 months as 24.7 ± 4.7 mLO_2/kg/min^{-1} and at 6 months as 25.1 ± 4.7 mL O_2 / kg / min^{-1}.

Assessment of risk of bias and quality of articles

The mean MINORS score for PLS, for the five studies [28-32], was between 14 and 18, respectively. According to the interpretation of the results, the ideal score would be 16 for noncomparative studies. Three studies were found above this value. The mean TESTEX score for the five included RCT [33-37] was 13 out of 15. The most frequent omissions were the follow-up of activity in the control groups and the lack of precise information on exercise prescription parameters.

The results of the evaluation of the ten studies included are associated with the lack of unbiased assessment of the results (blinding) and the limited calculation of the study sample size. For the methodological quality assessments with TESTEX and MINORS, an agreement between two raters was achieved without requiring the support of a third person.

Discussion

The aim of the present exploratory review was to identify the effectiveness of the 6MWT in the assessment of aerobic capacity and its usefulness for exercise prescription in people with obesity. According to the 10 studies included, with a total of 1575 participants, statistically

Table 1. Characteristics of the bibliography

Number	Authors/Year	Title	Type of study	Country	Language	Objective(s)	Quality Methodological TESTEX/MINORS
1	Luchesa et al., 2020 [28]	Contribution of lung function in predicting distance covered in the 6-min walk test in obese Brazilian women	PLS	Brazil	English	To explore the determinants of 6MWT and evaluate the influence of lung function on distance traveled.	15 (MINORS)
2	Quaresma et al., 2021 [29]	Reference equation for the six-minute walk test in Brazilian patients with obesity	PLS	Brazil	English	Establish a reference equation for the predicted distance in 6MWT in obese Brazilian subjects.	14 (MINORS)
3	Moreira et al., 2021 [30]	Relationship between peak expiratory flow and impaired functional capacity in obese individuals	PLS	Brazil	Portuguese	To assess lung function and functional capacity in obese adults, and to determine if there is a correlation between reduced peak expiratory flow and impaired functional capacity.	17 (MINORS)
4	Metz et al., 2018 [31]	A new equation based on the 6-min walking test to predict VO_2peak in women with obesity	PLS	France	English	To investigate the relationship between the distance traveled during the 6MWT with the objectively measured peak VO2 and to propose a new equation to predict peak VO2 from the 6MWT in obese patients.	17 (MINORS)
5	Luchesa et al., 2021 [32]	Reference value for the distance walked in the six-minute walk test in obese Brazilian men in the preoperative period of bariatric surgery	PLS	Brazil	English	To establish a reference value for 6MWT in obese Brazilian men in the preoperative period of bariatric surgery.	18 (MINORS)
6	Di Thommazo-Luporini et al., 2016 [33]	Are cardiovascular and metabolic responses to field walking tests interchangeable and obesity-dependent?	RCT	Brazil	English	To investigate whether the cardiovascular and metabolic responses to the 6MWT and the ISWT agree with the CPX and to determine whether both submaximal tests are interchangeable in obese and eutrophic individuals.	13 (TESTEX)

Rev. Fac. Nac. Salud Pública -DOI: https://doi.org/10.17533/udea.rfnsp.356821

Number	Authors/Year	Title	Type of study	Country	Language	Objective(s)	Quality Methodological TESTEX/MINORS
7	Kuo et al., 2020 [34]	Six-week inspiratory resistance training ameliorates endurance performance but does not affect obesity- related metabolic biomarkers in obese adults: A randomized controlled trial	RCT	Taiwan	English	To examine the effects of a six-week IRT training on biomarkers of metabolic health, pulmonary function and endurance in obese individuals.	12 (TESTEX)
8	Muollo et al., 2019 [35]	The effects of exercise and diet program in overweight people - Nordic walking versus walking	RCT	Italy	English	To evaluate the effects of diet combined with long supervision in Nordic walking training versus the effect of 6MWT on body composition, aerobic capacity and endurance strength in overweight adults.	13 (TESTEX)
9	Wooldridge et al., 2019 [36]	Improvement in 6-min walk test distance following treatment for behavioral weight loss and disinhibited eating: An exploratory secondary analysis	RCT	United States	English	To examine whether a 4-week acceptance and commitment therapy intervention for uninhibited eating or a behavioral intervention for weight loss improve exercise capacity.	13 (TESTEX)
10	Baillot et al., 2015 [37]	The 6-min walk test reflects functional capacity in primary care and obese patients	RCT	Canada	English	To determine the association between 6MWT and physical functional capacity in primary care patients and obese individuals.	12 (TESTEX)

CPX: Cardiopulmonary exercise test, RCT: Randomized controlled trials, PLS: Prospective longitudinal study, IRT: Inspiratory endurance, ISWT: Incremental walking test on shuttle, NW: Nordic walking, VO_2: Oxygen consumption.

Number	Authors/Year	Title	Type of study	Country	Language	Objective(s)	Quality Methodological TESTEX/MINORS

TESTEX scale criteria:

1. Eligibility criteria specified.
2. Randomization specified.
3. Allocation concealment.
4. Similar groups at baseline.
5. Blinding of the evaluator (for at least one of the outcomes).
6. Outcome measures assessed in 85% of the patients.
7. Intention-to-treat analysis. This is an analysis in a clinical trial based on the group to which they have been initially assigned and not on the treatment finally received. It is used to reduce the risk of bias that could occur if dropouts or changes in a treatment study are not randomized.
8. Statistical comparisons between groups.
9. Point measures and measures of variability for all reported outcomes.

10. Monitoring of activity in control groups.
11. Relative exercise intensity was held constant.
12. Exercise volume and energy expenditure. For the rating of the scale, for each item, 1 point is assigned if compliant and 0 if not compliant. For item 6, up to 3 points can be assigned, and for item 8 up to 2 points, for a maximum of 15 points in the evaluation of the scale.

Criteria for the MINORS scale:

1. Clearly defined objective.
2. Consecutive inclusion of patients.
3. Prospective data collection.
4. Appropriate results for the objective of the study in accordance with the intention to treat.
5. Unbiased evaluation of the results (blinding).
6. Follow-up period appropriate to the study objective.
7. Loss to follow-up of less than 5%.
8. Study sample size calculation, 95 % confidence interval.
9. An adequate control group.
10. Control and experimental group managed at the same time.
11. Baseline equivalence of groups.
12. Adequate statistical analyses. 0=not reported; 1=reported but inadequate; 2 comparative studies such as RCTs.=reported and adequate. The ideal score would be 16 for non-comparative studies such as PLSs and 24 for comparative studies such as RCTs

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Table 2. General characteristics of the population

Number	Authors/Year	n	F/M	EG/CG	Age (years)	Height (cm)	Weight (kg)	BMI (kg/m^2)	6MWT Distance traveled (m)	VO_2 Max (mL O_2/kg/ min^{-1})
1	Luchesa et al., 2020 [28]	263	F = 263	263	41.8 ffl 11.1	161 ffl 0.07	116.2 ffl 20.6	45 ffl 8	428.3 ffl 85.7 $p <$ 0.0001	NS
2	Quaresma et al., 2021 [29]	460	F = 306 M = 154	460	F = 43 ffl 12.1 M = 40 ffl 11.2	F = 161 ffl 0.07 M = 175 ffl 0.07	F = 116.7 ffl 26.0 M = 149.6 ffl 37.8	F = 44.78 ffl 8.88 M = 48.99 ffl 11.61	F = (n = 306) 489 ffl 95.4 M = (n = 154) 506 ffl 110	NS
3	Moreira et al., 2021 [30]	30	NS	EG = 15 CG = 15	EG = 36.40 ffl 12.67 CG = 30.66 ffl 8.98	EG = 167 ffl 0.08 CG = 164 ffl 0.07	EG = 103.52 ffl 27.90 CG = 61.45 ffl 9.67	EG = 36.77 ffl 7.50 CG = 22.54 ffl 2.07	EG = 453.26 ffl 37.44 CG = 616.86 ffl 50.23 $p <$ 0.01	NS
4	Metz et al., 2018 [31]	137	F = 137	137	45.6 ffl 12.5	162 ffl 6.4	98.8 ffl 15.7	37.6 ffl 4.8	553.5 ffl 35.3 $p <$ 0.001	19.22 ffl 2.8 p < 0,001
5	Luchesa et al., 2021 [32]	104	M = 104	EG = 104	41.4 ffl 12.2	174 ffl 0.1	146.5 ffl 27.5	48.1 ffl 8.4	439.2 ffl 82.7 $p =$ 0.0005	NS
6	Di Thommazo-Luporini et al., 2016 [33]	72	F = 72	EG = 51 CG = 21	EG = 35.0 ffl 7.0 CG = 32.0 ffl 7.0	EG = 162 ffl 0.05 CG = 164 ffl 0.06	EG = 102.9 ffl 21.4 CG = 59.8 ffl 6.5	EG = 39.1 ffl 7.6 CG = 22.2 ffl 1.8	EG = 460, 7 ffl 148.2 CG = 610.0 ffl 120.7 $p <$ 0.05	EG = 16.9 ffl 2.7 CG = 21.4 ffl 4.9 p <0.05
7	Kuo et al., 2020 [34]	32	NS	EG = 15 CG = 16	EG = 37.6 ffl 8.8 CG = 37.5 ffl 8.5	EG = 161.1 ffl 6.7 CG = 163.3 ffl 9.3	EG = 78.9 ffl 12.6 CG = 80.9 ffl 14.0	EG = 30.5 ffl 2.8 CG = 31.1 ffl 3.1	EG = 602.6 ffl 70.2 CG = 604.2 ffl 62.4 $p =$ 0.001	NS
8	Muollo et al., 2019 [35]	38	NS	NW = 19 W = 19	NW = 66.0 ffl 6.7 W = 65.5 ffl 7.7	NW = 160 ffl 0.1 W = 160 ffl 0.1	NW = 83.1 ffl 12.4 W = 81.5 ffl 11.5	NW = 33.2 ffl 4.5 W = 32.0 ffl 5.3	EG = 625.5 ffl 57.2 CG = 606.9 ffl 44.2 $p =$ 0.001	EG = 25.1 ffl 4.7 CG = 23.0 ffl 2.5 p = 0.001
9	Wooldridge et al., 2019 [36]	88	NS	EG = 88	18–75	NS	NS	25	443.78 $p =$ 0.001	NS
10	Baillot et al., 2015 [37]	351	F = 141 M = 210	EG = 139 CG = 212	EG = 60.1 ffl 11.5 CG = 56.8 ffl 14.6	EG = 163.0 ffl 8.4 CG = 163.9 ffl 9.1	EG = 90.1 (80.6–101.1) CG = 78 (65.9–89.3)	EG = 33.4 (31.7–36.6) CG = 28.8 (25.5–32.6)	EG = 488.9 ffl 108.7 CG = 441.1 ffl 103.9 $p <$ 0.05	NS

CG: Control group; EG: Experimental group; M: Men; F: Women; NS: Not specified; NW: Nordic walking; VO_2 max: Maximal oxygen consumption; W: Walking.

significant results were found with p value < 0.05 in relation to the effectiveness of 6MWT in people with obesity. Therefore, implementing this walk in the exercise prescription plans and follow-up of this population is justified, according to the scientific evidence found.

The study of the obese population is essential for the prevention and treatment of one of the major chronic noncommunicable diseases worldwide, which can contribute to diseases that can be life-threatening or cause premature death and disability [38].

It is important to note that, in our study, 71% of the subjects were women, reflecting that the female population may be more susceptible than the male population to obesity and complications associated with type 2 diabetes and hypertension. According to Cooper et al. [39], obesity is more prevalent in women than in men in most countries. Women are more likely to be obese and to require treatments such as behavioral therapy, pharmacological therapy, and bariatric surgery.

After analyzing the results obtained in the consulted literature, Brazil reported the highest number of articles. Obesity levels in Brazil reach a prevalence of 19.8% of the population. This value is low compared to other countries in the region, as it is not as high as that of Mexico or Argentina, which report high consumption of ultra-processed foods. According to Canhada et al. [40], higher consumption of processed foods predicts large gains in overall and central adiposity and may contribute to the inexorable rise of obesity observed worldwide.

Hernandez Rodriguez et al. [41] mention that, according to WHO, in 2016, there were more than 1900 million overweight adults, and of these, more than 650 million were people with obesity. These numbers have been steadily increasing over the last decades and represent a major challenge for health systems and society in general. Obesity figures vary considerably by geographic region. For example, in North America and Western Europe, more than 50% of adults are overweight and approximately 20% are obese. In Oceania, Australia and New Zealand also show alarming figures, with more than 60% of adults being overweight and around 25% obese. In Latin America, obesity rates are also of concern. In countries such as Mexico and Chile, more than 30% of adults are obese. In addition, childhood obesity has reached epidemic levels in several countries, with rates of over 30%. In our study, the tendency of articles found was mostly from Latin America, reflecting a need for further research in this population and for implementing plans to provide a comprehensive health care approach for people with obesity, in both developed and developing countries.

VO_2 max is an important measure of aerobic capacity in people with obesity. In particular, in our study it is evident that VO_2 at rest and during exercise was significantly higher in subjects with obesity than in control subjects without obesity. This has been related to a higher energetic cost in locomotion, due to the additional load on the cardiovascular and respiratory systems. The 6MWT, through the distance covered, allows estimating peak VO_2 indirectly. The study by Di Thommazo-Luporini et al. [42] presents an interesting comparison of the results obtained from a 6MWT and other tests. In it, in addition to comparable VO_2 results, it was found that in obese individuals minute ventilation, systolic and diastolic blood pressure, and perception of dyspnea were higher, whereas the respiratory exchange rate was lower, compared to eutrophic individuals. 6MWT results in patients with obesity correlate negatively with BMI and induce ventilatory, metabolic, and cardiovascular responses in proportions comparable to a maximal test. Thus, the 6MWT test demonstrates its utility for functional assessment in routine and interventional testing of the obese population.

VO_2 peak is considered to be a good indicator of aerobic capacity. All reported studies show a negative correlation between BMI and peak VO_2, suggesting that obese patients have less aerobic capacity than non-obese patients. This is explained by the increase in body mass, which requires more energy for its movement and, therefore, an increase in oxygen demand. The amount of fat tissue reduces muscle mass and, consequently, the strength of the individual. This easily leads to fatigue and decreased distance run, intolerance to exertion, and a high metabolic demand of patients with obesity compared to non-obese subjects [43].

A strength of the present study is that its results provide relevant information to health professionals who direct exercise programs oriented towards people with obesity. It does this by establishing the effectiveness of the 6MWT for exercise prescription and clinical follow-up, which strengthens public health care and improves the quality of life of this population..

Limitations of this study have to do with the lack of standardization in the way 6MWT is performed, which makes comparison of the results between different studies difficult. In addition, there was a lack of information about the test in the studies included. The surfaces on which the test is performed, the shapes of the protocol, and the patient's motivation are all aspects that can affect the validity of the test. Although the values reported after the use of the 6MWT are, in general, the distance covered and the indirect VO2 after the performance of an equation, it is important to take these variations into account when interpreting the results. Finally, the researchers limited the search exclusively to English, Spanish and Portuguese, which could have reduced the number of potential articles that could be included in the review.

In conclusion, 6MWT in patients with obesity is clinically useful and its results are an adequate clinical

utility for the cardiovascular and respiratory health of the patient with obesity. Indirect VO_2 obtained from distance traveled seems to be an adequate and reproducible follow-up indicator in the obese population.

Acknowledgments

Our thanks go to the Universidad Santiago de Cali and the Health and Movement research group for providing academic support for the research.

Declaration of sources of funding

The authors declare that they have received financial support for the research, authorship, or publication of this article from Dirección General de investigaciones at Universidad Santiago de Cali, Call No. DGI-01-2025.

Declaration of conflict of interest

None.

Declaration of responsibility

The authors declare that they have participated in the design, acquisition, analysis and interpretation of the data, as well as in the drafting and revising of the article, as stated in the authors' contribution.

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References

1. World Health Organization. Obesity and overweight [internet]. 2024 [citado 2023 ene. 17]. Disponible en: https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight
2. Podlogar T, Wallis GA. New horizons in carbohydrate research and application for endurance athletes. Sports Med. 2022;52(Supl. 1):5-23. DOI: https://doi.org/10.1007/s40279-022-01757-1
3. Lin X, Li H. Obesity: Epidemiology, pathophysiology, and therapeutics. Front Endocrinol. 2021;12:706978. DOI: https://doi.org/10.3389/fendo.2021.706978
4. Bray GA, Frühbeck G, et al. Management of obesity. Lancet. 2016;387(10031):1947-56. DOI: https://doi.org/10.1016/S0140-6736(16)00271-3
5. Mantilla M. Frecuencia de obesidad y sobrepeso en una institución de salud de la ciudad de Barranquilla. Ciencia e Innovación en Salud. 2013;1(1):33-39. https://revistas.unisimon.edu.co/index.php/innovacionsalud/article/download/82/68/68#:~:text=De%20acuerdo%20con%20los%20%C3%BAltimos,del%20sobrepeso%20y%20la%20obesidad
6. Hales CM, Carroll MD, et al. Prevalence of obesity and severe obesity among adults: United States, 2017-2018. NCHS Data Brief [internet]. 2020 [citado 2023 feb. 22]; (360):1-8. https://pubmed.ncbi.nlm.nih.gov/32487284/
7. Salazar Blandón DA, Alzate Yepes T, et al. Sobrepeso, obesidad y factores de riesgo: un modelo explicativo para estudiantes de Nutrición y Dietética de una universidad pública de Medellín, Colombia. Perspect Nut Hum. 2020;22(1):47-59. DOI: https://doi.org/10.17533/udea.penh.v22n1a04
8. Mahadevan S, Ali I. Is body mass index a good indicator of obesity? Int J Diabetes Dev Ctries. 2016;36(2):140-2. DOI: https://doi.org/10.1007/s13410-016-0506-5
9. Jeong SM, Lee DH, et al. Different correlation of body mass index with body fatness and obesity-related biomarker according to age, sex and race-ethnicity. Sci Rep. 2023 Mar 1;13(1):3472. DOI: https://doi.org/10.1038/s41598-023-30527-w
10. Dixon AE, Peters U. The effect of obesity on lung function. Expert Rev. Respir. Med. 2018;12(9):755-67. DOI: https://doi.org/10.1080/17476348.2018.1506331
11. Nystoriak MA, Bhatnagar A. Cardiovascular effects and benefits of exercise. Front Cardiovasc Med. 2018;5:135. DOI: https://doi.org/10.3389/fcvm.2018.00135
12. Muscella A, Stefàno E, Lunetti P, et al. The regulation of fat metabolism during aerobic exercise. Biomolecules. 2020;10(12):1699. DOI: https://doi.org/10.3390/biom10121699
13. Thompson, W. R., Gordon, N. F., Pescatello, L. S. ACSM's guidelines for exercise testing and prescription. United Kingdom: Lippincott Williams & Wilkins [internet]. 2010 [citado 2023 may. 5]. Disponible en: https://edisciplinas.usp.br/pluginfile.php/7965558/mod_resource/content/1/Colegio%20Americano%20de%20Medicina%20do%20Esporte_Guidelines%20for%20Exercise%20Testing%20and%20Prescription%20-%20ACSM%202018.pdf
14. Hussien J, Brunet J, Romain AJ, et al. Living with severe obesity: Adults' physical activity preferences, self-efficacy to overcome barriers and motives. Disabil Rehabil. 2022;44(4):590-9. DOI: https://doi.org/10.1080/09638288.2020.1773944
15. Lanzi S, Codecasa F, Cornacchia M, et al. Long maximal incremental tests accurately assess aerobic fitness in class II and III obese men. PLoS One. 2015;10(4):e0124180. DOI: https://doi.org/10.1371/journal.pone.0124180
16. Gobbo S, Bullo V, Roma E, et al. Nordic walking promoted weight loss in overweight and obese people: A systematic review for futu-

re exercise prescription. J Funct Morphol Kinesiol. 2019;4(2):36. DOI: https://doi.org/10.3390/jfmk4020036

17. Marino F, Vidal R, Parada L, et al. Respuestas cardiovasculares de mujeres con obesidad mórbida sometidas a un test ergoespirométrico con ergómetro de brazo. Rev Colomb Cardiol. 2017;24(5):532-6. https://doi.org/10.1016/j.rccar.2017.05.012
18. Brunelli A, Belardinelli R, Refai M, et al. Peak oxygen consumption during cardiopulmonary exercise test improves risk stratification in candidates to major lung resection. Chest. 2009;135(5):1260-7. DOI: https://doi.org/10.1378/chest.08-2059
19. Vásquez-Gómez J, Castillo-Retamal M, Carvalho RSd, Faundez--Casanova C, Portes Junior MDP. Prueba de caminata de seis minutos ¿es posible predecir el consumo de oxígeno en personas con patologías? Una revisión bibliográfica. MHSalud. 2019;16(1):1-17. DOI: https://doi.org/10.15359/mhs.16-1.1
20. Gochicoa-Rangel L, Mora-Romero U, Guerrero-Zúñiga S, et al. Prueba de caminata de 6 minutos: recomendaciones y procedimientos. Neumol Cir Torax [internet]. 2015 [citado 2023 jun. 9]; 74(2):127-36. https://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S0028-37462015000200008
21. Agarwala P, Salzman SH. Six-minute walk test: Clinical role, technique, coding, and reimbursement. Chest. 2020;157(3):603-11. DOI: https://doi.org/10.1016/j.chest.2019.10.014
22. Bohannon RW, Crouch R. minimal clinically important difference for change in 6-minute walk test distance of adults with pathology: A systematic review. J. Eval. Clin. Pract. 2017;23(2):377-81. DOI: https://doi.org/10.1111/jep.12629
23. Nolen-Doerr E, Crick K, Saha C, et al. Six-minute walk test as a predictive measure of exercise capacity in adults with type 2 diabetes. Cardiopulm Phys Ther J. 2018;29(3):124-9. DOI: https://doi.org/10.1097/CPT.0000000000000080
24. Colquhoun HL, Levac D, O'Brien KK, et al. Scoping reviews: Time for clarity in definition, methods, and reporting. J Clin Epidemiol. 2014;67(12):1291-4. DOI: https://doi.org/10.1016/j.jclinepi.2014.03.013
25. Tricco AC, Lillie E, Zarin W, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and explanation. Ann Intern Med. 2018;169(7):467-73. DOI: https://doi.org/10.7326/M18-0850
26. Smart NA, Waldron M, Ismail H, et al. Validation of a new tool for the assessment of study quality and reporting in exercise training studies: TESTEX. Int J Evid Based Healthc. 2015;13(1):9-18. DOI: https://doi.org/10.1097/XEB.0000000000000020
27. Slim K, Nini E, Forestier D, et al. Methodological index for non-randomized studies (MINORS): Development and validation of a new instrument. ANZ J Surg. 2003;73(9):712-6. DOI: https://doi.org/10.1046/j.1445-2197.2003.02748.x
28. Luchesa CA, Mafort TT, Silva RR, et al. Contribution of lung function in predicting distance covered in the 6-min walk test in obese Brazilian women. Braz. J. Med. Biol. Res. 2020;53(12):e10279. DOI: https://doi.org/10.1590/1414-431X202010279
29. Quaresma JC do V, Carneiro JRI, Marschhausen NF, et al. Reference equation for the six-minute walk test in Brazilian patients with obesity. Int. J. Cardiovasc. Sci. 2021;34(3):307-14. DOI: https://doi.org/10.36660/ijcs.20190175
30. Moreira GMS, Ribeiro AM, Carvalho PM de M, et al. Relationship between peak expiratory flow and impaired functional capacity in obese individuals. Fisioter. Mov. [internet]; 2021 [citado 2023 mar. 15]; 34:e34105. Disponible en: https://www.scielo.br/j/fm/a/8dpq5jmR3VxTPSBVdgdThzH/?lang = en
31. Metz L, Thivel D, Peirrera B, et al. A new equation based on the 6-min walking test to predict VO_{2peak} in women with obesity. Disabil Rehabil. 2018;40(14):1702-7. DOI: https://doi.org/10.1080/09638288.2017.1304582
32. Luchesa CA, Mafort TT, Silva RR, et al. Reference value for the distance walked in the six-minute walk test in obese Brazilian men in the preoperative period of bariatric surgery. J Obes. 2021;9577412. DOI: https://doi.org/10.1155/2021/9577412
33. Di Thommazo-Luporini L, Carvalho LP, Luporini RL, et al. Are cardiovascular and metabolic responses to field walking tests interchangeable and obesity-dependent? Disabil Rehabil. 2016;38(18):1820-9. DOI: https://doi.org/10.3109/09638288.2015.1107645
34. Kuo YC, Chang HL, Cheng CF, et al. Six-week inspiratory resistance training ameliorates endurance performance but does not affect obesity-related metabolic biomarkers in obese adults: A randomized controlled trial. Respir Physiol Neurobiol. 2020;273:103285. DOI: https://doi.org/10.1016/j.resp.2019.103285
35. Muollo V, Rossi AP, Milanese C, et al. The effects of exercise and diet program in overweight people - Nordic walking versus walking. Clin Interv Aging. 2019;14:1555-65. DOI: https://doi.org/10.2147/CIA.S217570
36. Wooldridge JS, Herbert MS, Hernandez J, et al. Improvement in 6-min walk test distance following treatment for behavioral weight loss and disinhibited eating: An exploratory secondary analysis. Int.J. Behav. Med. 2019;26(4):443-8. DOI: https://doi.org/10.1007/s12529-019-09796-1
37. Baillot A, Baillargeon JP, Brown C, et al. The 6-min walk test reflects functional capacity in primary care and obese patients. Int J Sports Med. 2015;36(6):503-9. DOI: https://doi.org/10.1055/s-0034-1398533
38. Lemamsha H, Randhawa G, Papadopoulos C. Prevalence of overweight and obesity among Libyan men and women. Biomed Res. Int. 2019:8531360. DOI: https://doi.org/10.1155/2019/8531360
39. Cooper AJ, Gupta SR, et al. Sex/gender differences in obesity prevalence, comorbidities, and treatment. Curr Obes Rep. 2021;10(4):458-66. DOI: https://doi.org/10.1007/s13679-021-00453-x
40. Canhada SL, Luft VC, Giatti L, et al. Ultra-processed foods, incident overweight and obesity, and longitudinal changes in weight and waist circumference: the Brazilian longitudinal study of adult health (ELSA-Brasil). Public Health Nutrition. 2020;23(6):1076-86. DOI: https://doi.org/10.1017/s1368980019002854
41. Hernández Rodríguez J, Domínguez YA, Moncada Espinal OM. Prevalencia y tendencia actual del sobrepeso y la obesidad en personas adultas en el mundo. Rev Cubana Endocrinol [internet]. 2019 [citado 2023 jul. 5]; 30(3):e193. Disponible en: Prevalencia y tendencia actual del sobrepeso y la obesidad en personas adultas en el mundo (sld.cu)
42. Di Thommazo-Luporini L, Jürgensen SP, Castello-Simões V, et al. Metabolic and clinical comparative analysis of treadmill six-minute walking test and cardiopulmonary exercise testing in obese and eutrophic women. Braz. J. Phys. Ther. 2012;16(6):469-78. DOI: https://doi.org/10.1590/s1413-35552012005000036
43. Nonaka K, Murata S, Shiraiwa K, et al. Effect of skeletal muscle and fat mass on muscle strength in the elderly. Healthcare. 2018;6(3):72. DOI: https://doi.org/10.3390/healthcare6030072