UFSM
Saúde (SANTA MARIA)
CCS CENTRO DE CIÊNCIAS DA SAÚDE UFSM
ISSN 2236-5834
OPEN ACCESS

Revista Saúde (Santa Maria), 51, e91750, 2025 https://doi.org/10.5902/2236583491750
Submitted: 26/04/2025 Approved: 21/10/2025 Published: 11/18/2025

Artigo original

Inspiratory muscle endurance and functional capacity in obese men and women

Resistência muscular inspiratória e capacidade funcional em homens e mulheres obesos

Carolina Franco Cardoso[I*], Alessandra Hofstadler Deiques Fleig[I], Stéfany Giacomello Piccinin[I], Janina Lied da Costa[I], Carine Cristina Callegaro[I]

[I] Universidade Federal de Santa Maria, Santa Maria, RS, Brasil

***Autor correspondente:**
Carolina Franco Cardoso
Fisioterapeuta
carolinacardoso999@hotmail.com

Endereço para correspondência:
Carine Cristina Callegaro. Laboratório de Fisiologia e Reabilitação- LAFIR. Av. Roraima, n° 1000, Universidade Federal de Santa Maria, Centro de Ciências da Saúde, prédio 26, anexo B, sala 002, Bairro Camobi, Santa Maria - RS. CEP: 97105-900.

Como citar esse artigo:
Cardoso CF, Fleig AHD, Piccinin SG, Costa JL, Callegaro CC. Inspiratory muscle endurance and functional capacity in obese men and women. Revista Saúde (Sta. Maria). [Internet] 2025; 51, e91750. Disponivel em: https://periodicos.ufsm.br/revistasaude/article/view/91750. DOI: https://doi.org/10.5902/22365834691750. Acesso em XX/XX/XXXX

ABSTRACT

Objective: This study aimed to investigate whether obese men and women experience changes in IME and functional capacity. **Methods:** Ten obese women, 10 normal-weight women, 9 obese men, and 10 normal-weight men underwent assessments of inspiratory muscle strength using maximal inspiratory pressure (MIP), IME through an inspiratory load, and functional capacity using the 6-Minute Walk Test (6MWT). **Results:** IME was lower in obese men and negatively associated with BMI and waist circumference. Among obese women, the distance covered in the 6MWT was shorter than that of normal-weight women and was negatively correlated with BMI and waist circumference. **Final Considerations:** Obese men have reduced IME, while obese women demonstrate lower functional capacity. Both findings are associated with larger waist circumference and higher BMI. Furthermore, waist circumference is an independent predictor of IME in men and functional capacity in women.

Keywords: Respiratory Muscles; Adipose Tissue; Waist Circumference; Body Mass Index; Muscle Fatigue

RESUMO

Objetivo: Este estudo teve como objetivo investigar se homens e mulheres obesos apresentam alterações na EMI e na capacidade funcional. **Métodos:** Dez mulheres obesas, 10 mulheres com peso normal, 9 homens obesos e 10 homens com peso normal foram submetidos à avaliação da força muscular inspiratória por meio da pressão inspiratória máxima (PImáx), da EMI utilizando uma resistência inspiratória e da capacidade funcional pelo Teste de Caminhada de 6 Minutos (TC6). **Resultados:** A EMI foi menor em homens obesos e apresentou associação negativa com o IMC e a circunferência da cintura. Entre as mulheres obesas, a distância percorrida no TC6 foi menor em comparação às mulheres com peso normal e apresentou correlação negativa com o IMC e a circunferência da cintura. **Considerações finais:** Homens obesos têm redução na EMI, enquanto mulheres obesas demonstram menor capacidade funcional. Ambos os achados estão associados a maior circunferência da cintura e IMC elevado. Além disso, a circunferência da cintura é um preditor independente da EMI em homens e da capacidade funcional em mulheres.

Palavras-chave: Músculos Respiratórios; Tecido Adiposo; Circunferência da Cintura; Índice de Massa Corporal; Fadiga Muscular

INTRODUCTION

The World Health Organization[1] defines obesity based on a body mass index (BMI) ≥ 30 kg/m². In Brazil, 22.8% of men and 30.2% of women were considered obese in 2019.[2] These are worrying data, as obesity is associated with increased early morbidity and mortality.[3]

Accumulated fat, especially in the central part of the body, increases resistance to diaphragm contraction and hinders breathing mechanics.[4] Studies indicate that obese people have less respiratory muscle endurance despite increased inspiratory muscle strength.[5]

Besides obesity, a person's sex can also influence inspiratory muscle endurance (IME). Various studies have reported differences between the sexes regarding diaphragm muscle fatigue, respiration anatomy, and cardiopulmonary responses to endurance breathing exercises. [6,7,8,9,10] A study has demonstrated that women have greater diaphragm muscle endurance. During inspiratory endurance exercises, the sympathetic response was smaller, and the mean arterial pressure increased less in women than in men, which suggests an attenuation of the inspiratory metaboreflex.[9] Similar findings were obtained from bicycle exercise associated with IME.[11] These studies indicate that IME must be assessed in men and women separately. Even though previous studies have demonstrated decreased IME in obese people of both sexes[5] the effects of obesity on men's and women's IME still need to be separately clarified.

Obese people may also have decreased functional capacity (FC).[12] Another variable influenced by obesity is the pulmonary function, as both men's and women's waist circumferences are inversely associated with their forced expiratory volume in the first second (FEV_1).[13] However, few studies have assessed the influence of anthropometric measures such as waist and hip circumferences on respiratory muscle endurance.

This study aimed to investigate whether obese men and women have changes in IME and FC and verify the determining factors.

METHODS

The study was developed at Cruz Alta University from June 2016 to March 2017. The study sample comprised ten obese women (32 ± 6 years old, BMI 36.8 ± 6.2 kg/m^2), ten normal-weight women (29 ± 8 years old, BMI 23.1 ± 2.08 kg/m^2), nine obese men (29 ± 5 years old, BMI 37.9 ± 2.9 kg/m^2), and ten normal-weight men (29 ± 8 years old, BMI 23.3 ± 0.7 kg/m^2), recruited by publicizing the inclusion and exclusion criteria in social media, family health strategy units, and clinics specializing in obesity treatment. All volunteers, aged 18 to 46 years, were sedentary, nonsmokers, and did not have a history of cardiovascular, pulmonary, neuromuscular, or infectious diseases. The BMI of the obese individuals was > 30 kg/m^2, and that of normal-weight ones was ≥ 18.5 and < 25.0 kg/m^2. Normal-weight individuals were matched with obese ones for sex and age. Subjects who had acute health problems or emergency clinical conditions (viral or bacterial infections, accidents, allergic reactions) in the previous month, nervous system diseases or conditions that might affect the understanding or participation in the study, pregnant women, type 1 diabetes mellitus patients, symptomatic coronary artery disease, left ventricular dysfunction, bronchial asthma, chronic obstructive pulmonary disease, chronic neuropathies, or taking drugs such as corticosteroids or bronchodilators were excluded from the study. The study was approved by the Ethics Committee of the University of Cruz Alta (UNICRUZ) under CAAE: 51573315.7.0000.5322 and registered in Clinical Trials under number: NCT03056937.

BMI was calculated by dividing the weight (Kg) by the square of the body height (m^2). The weight was measured on a scale (PlennaSlim Digital, Brazil), and the height was measured on a stadiometer (Compacto E210 – WISO®, Brazil). BMI was classified according to the WHO guidelines.[1]

The waist and hip circumferences were measured with a measuring tape ranging from 0 to 250 centimeters. The waist-hip ratio was calculated by dividing the waist circumference by the hip circumference. The individuals were measured in the orthostatic position.

The inspiratory and expiratory muscle strength was determined with the maximum inspiratory pressure (MIP) and maximum expiratory pressure (MEP), measured with a manovacuometer (Famabras, Brazil), calibrated in cmH_2O and with an operational limit of +/-300 cmH_2O. Respiratory maneuvers were repeated until obtaining six measures with a variance smaller than 10% – MIP was defined as the highest of these values.[14] Predicted MIP values for sex and age were calculated using the equation by Neder et al.[15]

The FC was assessed with the 6-Minute Walk Test (6MWT) performed in a 30-meter-long hallway with markings every 3 meters. Cones were placed at the ends of the route to indicate the turning points. Patients were instructed to walk as far and fast as possible for 6 minutes. The distance they walked was measured to determine their FC.[16]

The endurance of the inspiratory muscles was evaluated using progressive inspiratory loading. Firstly, MIP was determined. After a 15-minute rest, the IME test was performed, in which individuals wore a nose clip and breathed continuously through a mouthpiece connected to an inspiratory resistance (POWERbreathe, Southam, United Kingdom) at 50% of the MIP, increasing by 10% of the MIP every 3 minutes until they were unable to continue the test. Participants should maintain a rate of 15 breaths per minute, following different metronome acoustic signals to inhale and exhale. IME measures were defined as the highest inspiratory pressure value sustained for at least 60 seconds and presented as the percentage of MIP (TP50MIP/MIP), as well as test duration in seconds.[17,18].

Data were presented as means and standard deviations. The results were analyzed in SPSS, version 22. The normality of data distribution was verified with the Shapiro-Wilk test. Variables were compared between obese and normal-weight individuals using the Student's independent samples t-test. The association between variables was determined using Pearson's correlation test. IME and FC predictors were determined with linear regression. The level of significance was set at $p < 0.05$.

RESULTS

Clinical and anthropometric characteristics are shown in Table 1. As expected, obese individuals differed from normal-weight ones regarding body weight and waist and hip circumferences.

Table 1 – Clinical and anthropometric characteristics of the obese and normal-weight individuals

	OW (n = 10)	NWW (n = 10)	OM (n = 9)	NWM (n = 10)	P OW x NWW	P OM x NWM
Age (years)	32.6 ± 6.1	29.6 ± 8.4	29.2 ± 5.5	29.3 ± 8	0.374	0.981
Weight (kg)	98.2 ± 20.7*	60.2 ± 8.2	116.2 ± 12*	71.8 ± 4.6	< 0.001	< 0.001
Height (m)	1.63 ± 0.05	1.61 ± 0.08	1.75 ± 0.06	1.76 ± 0.07	0.523	0.813
BMI (kg/m²)	36.8 ± 6.2*	23.1 ± 2.08	37.9 ± 2.9*	23.3 ± 0.7	< 0.001	< 0.001
Waist circumference (cm)	110.1 ± 11.7*	76.9 ± 9.2	115.9 ± 8.7*	86.5 ± 4.9	< 0.001	< 0.001
Hip circumference (cm)	122.9 ± 11.1*	87. 8 ± 8.01	120.7 ± 9.9*	91 ± 8.3	< 0.001	< 0.001
Waist-hip ratio (cm)	0.9 ± 0.01	0.88 ± 0.08	0.96 ± 0.07	0.95 ± 0.06	0.581	0.769

Data presented as mean and standard deviation. OW: obese women; NWW: normal-weight women; OM: obese men; NWM; normal-weight men; BMI: body mass index; * $p < 0.05$

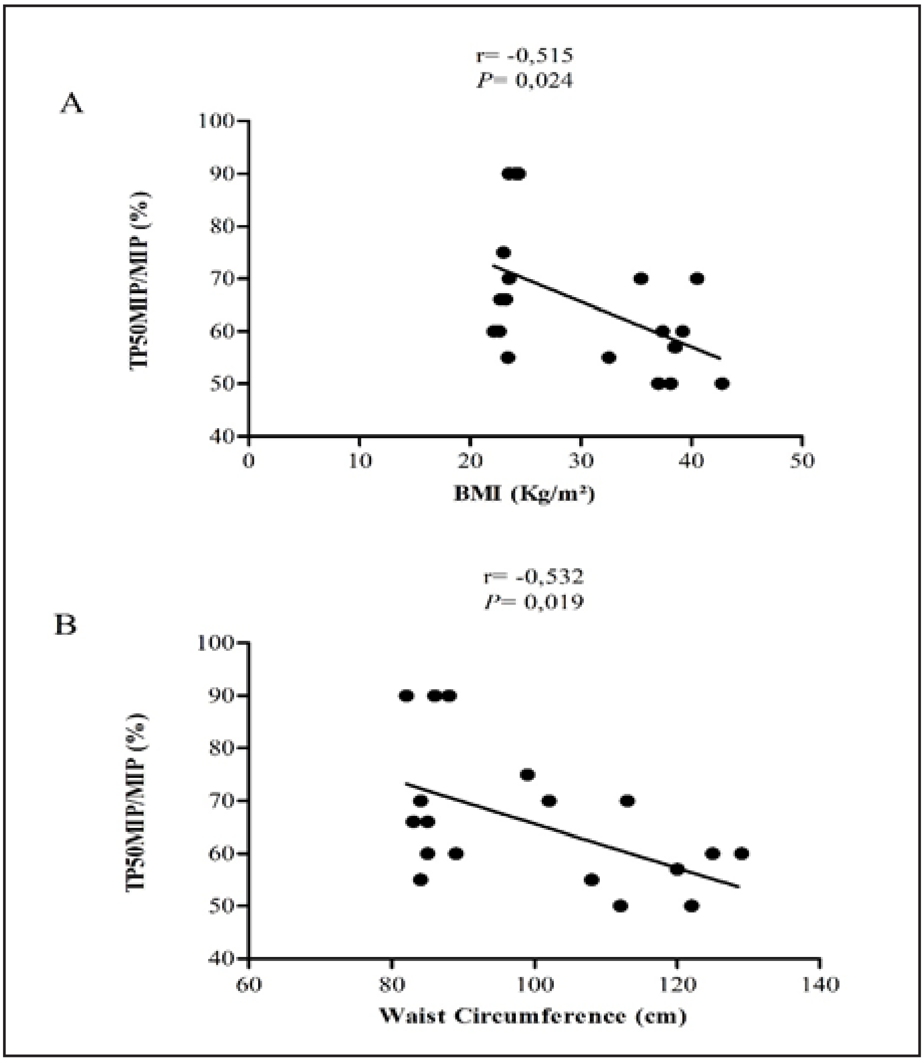
Table 2 – Respiratory muscle function

	OW (n = 10)	NWW (n = 10)	OM (n = 9)	NWM (n = 10)	P OW x NWW	P OM x NWM
MIP (cmH_20)	83 ± 14.9	102.5 ± 31.6	163.2 ± 30.8*	133.5 ± 23.1	0.102	0.028
Predicted MIP (cmH_20)	95 ± 3.7	96.8 ± 3	131.9 ± 4.4	131.9 ± 6.4	0.259	0.981
Percentage of predicted MIP (%)	87.4 ± 15.3	105.6 ± 31	123.7 ± 23.1*	101.9 ± 20.7	0.119	0.044
TP50MIP (cmH_20)	64.3 ± 24	72.4 ± 24.2	93.1 ± 13.8	96.2 ± 23.6	0.46	0.731
TP50MIP/MIP (%)	76.4 ± 21.7	70.6 ± 10.1	57.9 ± 7.9	72.2 ± 13.5*	0.447	0.013
TP50 duration (seconds)	615.1 ± 333	611.5 ± 195	307.2 ± 243.8	691.9 ± 236.5*	0.977	0.003

OW: obese women; NWW: normal-weight women; OM: obese men; NWM; normal-weight men; MIP: maximum inspiratory pressure; TP50 MIP: MIP at the end of the endurance test; TP50MIP/MIP: MIP at the end of the endurance

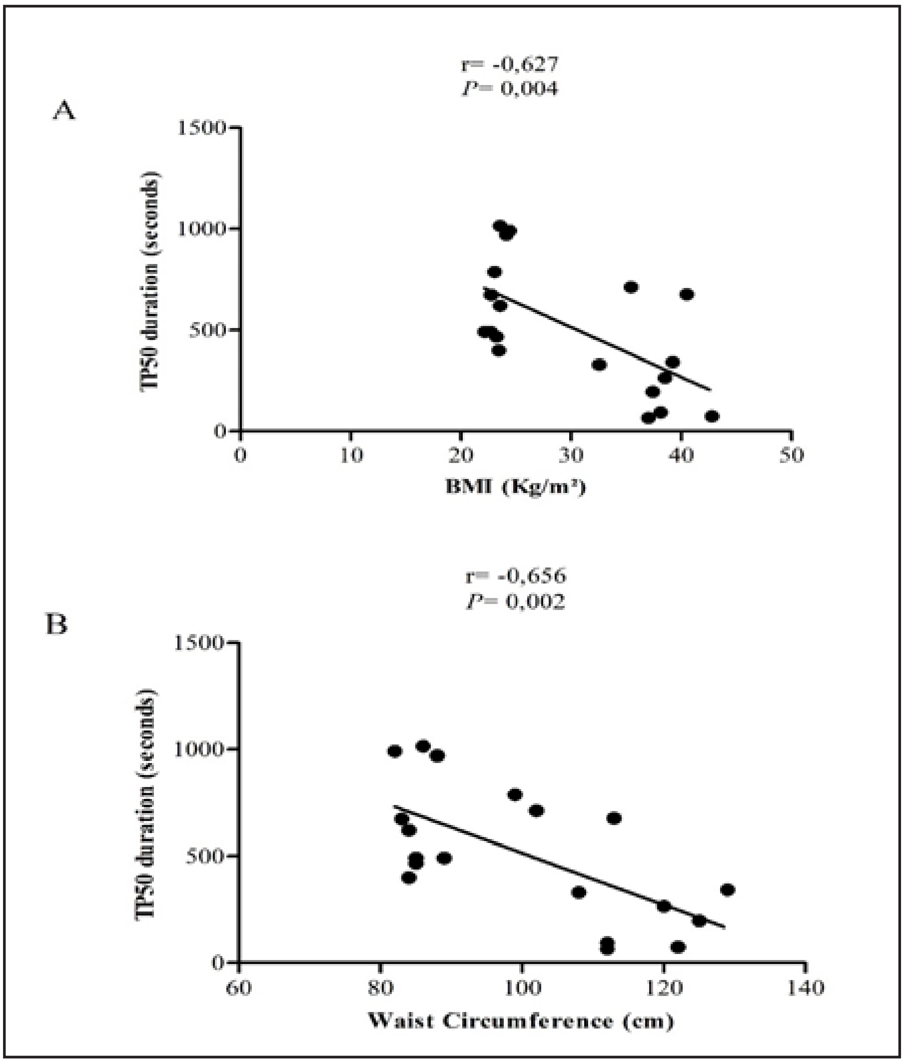
Data on respiratory muscle strength and IME are shown in Table 2. Obese and normal-weight women were not different regarding inspiratory muscle strength absolute values (MIP) and predicted percentage for their sex and age. Obese men, however, had greater inspiratory muscle strength than normal-weight ones in both absolute values (MIP) and predicted percentages for their sex and age. The absolute inspiratory pressure values obtained at the end of the IME test (TP50MIP) were not different between obese and normal-weight men and women. On the other hand, the percentage of the inspiratory pressure obtained at the end of the IME test in relation to MIP (TP50MIP/MIP) was smaller in obese men than in normal-weight ones. Only in men, TP50MIP/MIP was inversely associated with BMI (r = -0.515; *P* = 0.024 Figure 1-A) and waist circumference (r = -0.532; *P* = 0.019, Figure 1-B). The IME test was shorter among obese men than normal-weight ones. Only among men the endurance test duration was inversely associated with BMI (r = -0.627; *P* = 0.004 Figure 2-A) and waist circumference (r = -0.656; *P* = 0.002, Figure 2-B).

Figure 1 – A: Correlation between body mass index and TP50MIP/MIP in obese and normal-weight men. B: Correlation between waist circumference and TP50MIP/MIP in obese and normal-weight men



Fonte: Autores, 2025

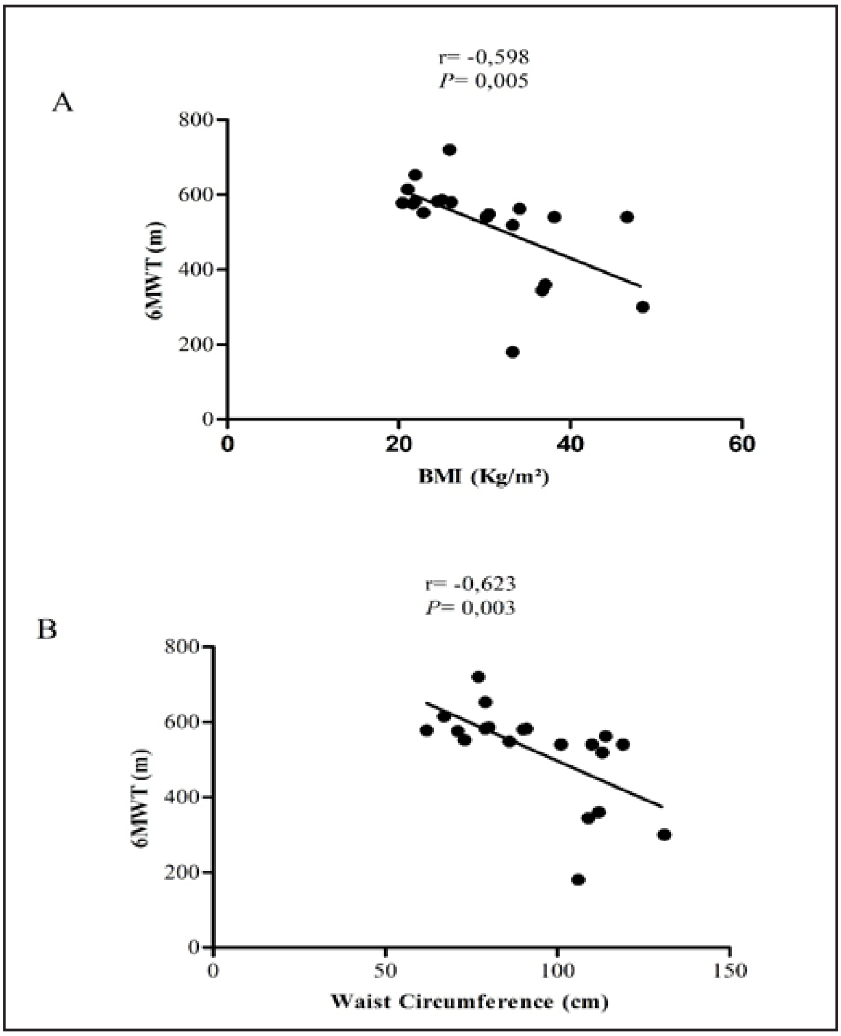
Figure 2 – A: Correlation between body mass index and TP50 duration in obese and normal-weight men. B: Correlation between waist circumference and TP50 duration in obese and normal-weight men



Fonte: Autores, 2025

The distance walked in 6MWT was shorter among obese women than normal-weight ones (obese women: 443.3 ± 135.6 m; normal-weight women: 602.4 ± 49.4 m). The distance walked by obese men was not different from that by normal-weight ones. In either group, the distance walked in the test was not correlated with TP50MIP, TP50MIP/MIP, or endurance test duration. The distance walked by women was inversely correlated with BMI (r = -0.598; *P* = 0.005, Figure 3-A) and waist circumference (r = -0.623; *P* = 0.003, Figure 3-B).

Figure 3 – A: Correlation between body mass index and 6MWT in obese and normal-weight women. B: Correlation between waist circumference and 6MWT in obese and normal-weight women



Fonte: Autores, 2025

The prevalence of obese women was 50%, 30%, and 20% respectively in obesity degrees I, II, and III, while that of men was 11.1%, 66.7%, and 22.2% respectively in degrees I, II, and III. Among men, 28% of the IME variance was explained by the waist circumference variance, thus indicating that the waist measure was an independent predictor of IME (R^2 = 0.283). In women, 38% of the variance in FC was explained by the variance in waist circumference, which was an independent predictor of IMR (R^2= 0.38).

DISCUSSION

This study pioneered the investigation of IME in obese men and women. Obese men had lower IME, which was associated with higher BMI and larger waist circumference. Obese women had decreased FC associated with higher BMI and larger waist circumference.

Obese men in this study had greater inspiratory muscle strength than normal-weight ones (MP). As mentioned in a previous study,[19] obese people have greater respiratory muscle strength but lower IME. However, other previous studies indicate that obese individuals may have inspiratory muscle strength similar to that of normal-weight ones or even smaller, due to diaphragm inefficiency.[20] Even though obese men in the present study had greater inspiratory muscle strength, it was not so with obese women, which indicates a difference in respiratory muscle strength between the sexes. This agrees with a previous study in which obese women had less inspiratory muscle strength than men,[19] which can be explained by the difference in the amount of lean mass.[21] A possible explanation for the greater inspiratory muscle strength in obese people is their physical conditioning – although all individuals in the present study were sedentary. Obese men had a lower increase in MIP at the end of the IME test in relation to the initial MIP than normal-weight ones, which suggests a lower IME. This agrees with previous studies,[5,9] even though their authors did not match subjects by sex.

Lower IME in obese men but not in obese women may be explained by their greater prevalence in obesity degree II, whereas women had a greater prevalence in obesity degree I. This hypothesis corroborates a previous study,[5] in which IME was inversely correlated with BMI – hence, the higher the BMI, the less the inspiratory endurance test lasted. Furthermore, a previous study demonstrated that the inspiratory muscle tension time index was greater in obese individuals than in normal-weight ones, which indicates that obese people are more prone to inspiratory muscle fatigue.[22]

This information agrees with the fact that waist circumference is an independent predictor of IME, suggesting that abdominal obesity can impair the mechanics of breathing, leading to early respiratory muscle fatigue.[22] Accumulated fat hinders thoracic and abdominal movement, causing perfusion changes that increase the demands on the diaphragm.[20] Other factors may explain the lower IME in obese people, such as increased inflammatory response and interleukin-6 production.[23]

In the present study, only obese women had decreased tolerance to exercise, determined by the distance walked in 6MWT, which was inversely correlated with BMI. These data agree with a previous study that verified that BMI explains 59% of the variance in the distance walked in 6MWT.[24] Moreover, moderate weight loss by obese women helped diminish the respiratory load imposed during the exercise, which consequently affects directly the tolerance to physical activity.[25]

The distance walked in 6MWT was inversely associated with obese women's waist circumference, which corroborates a previous study.[26] Obese women who had to stop 6MWT had greater body weight, higher BMI, larger waist circumference, and a higher percentage of fat than obese women that completed the test.[27] On the other hand, another study failed to associate cardiorespiratory endurance with waist circumference in adults submitted to the 3-minute step test.[28]

Thus, obesity was verified to be an independent determinant of intolerance to exercise in women, although it was not found likewise in men.[29] On the other hand, another previous study observed that obese men had a higher breathing rate and more dyspnea during stationary bicycle exercises than controls.[30] It was also demonstrated that obese individuals had greater inspiratory muscle activity both exercising and at rest, which may indicate intolerance to exercise in the case of more intense ones. The present study did not find an association between IME and the distance walked in 6MWT, probably because inspiratory muscle fatigue occurs in high-intensity exercises, whereas 6MWT is a low-intensity one.

Lastly, IME assessment has been widely recommended because patients tolerate it, and its results are clear. As observed in this study, obese people with preserved inspiratory muscle strength can have a lower IME. This finding may indicate a decreased oxidative capacity of the inspiratory muscles, which is associated with hyperactive inspiratory metaboreflex and decreased tolerance to exercise.[9]

In conclusion, obese men have lower IME related to larger waist circumference and higher BMI. Obese women have lower FC related to waist circumference and BMI. Waist circumference is an independent predictor of IME in men and of FC in women.

REFERENCES

1. World Health Organization. Obesity and overweight. 2024 Mar 01. Available from: https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight

2. Instituto Brasileiro de Geografia e Estatística. Pesquisa do IBGE mostra aumento da obesidade entre adultos. 2023 Jan 10. https://www.gov.br/pt-br/noticias/saude-e-vigilancia-sanitaria/2020/10/pesquisa-do-ibge-mostra-aumento-da-obesidade-entre-adultos

3. Blüher M. Obesity: global epidemiology and pathogenesis. Nat Rev Endocrinol. 2019 May;15(5):288–98.

4. Peters U, Dixon AE. The effect of obesity on lung function. Expert Rev Respir Med. 2018 Sep;12(9):755–67.

5. Hoffmeister AD, Lima KS de, Albuquerque IM de, Binotto V, Callegaro CC. Endurance muscular inspiratória em indivíduos obesos e eutróficos. Fisioter Pesqui. 2018 Dec;25:438–43.

6. Bruce CD, Yacyshyn AF, Ruggiero L. Sex differences in diaphragmatic fatigue and the metaboreflex following inspiratory pressure-threshold loading. J Physiol. 2018 Oct 1;596(19):4579–80.

7. Archiza B, Reinhard PA, Welch JF, Sheel AW. Sex differences in diaphragmatic fatigue: Effects of hypoxia during inspiratory loading. J Physiol. 2021;599(4):1319–33.

8. DeLucia CM, Craighead DH. Sex differences in diaphragmatic fatigue: do young women have an advantage? J Physiol. 2018 Nov 15;596(22):5303–4.

9. Welch JF, Archiza B, Guenette JA, West CR, Sheel AW. Sex differences in diaphragmatic fatigue: the cardiovascular response to inspiratory resistance. J Physiol. 2018 Sep 1;596(17):4017–32.

10. Smith JR, Broxterman RM, Hammer SM, Alexander AM, Didier KD, Kurti SP, et al. Sex differences in the cardiovascular consequences of the inspiratory muscle metaboreflex. Am J Physiol Regul Integr Comp Physiol. 2016 Sep 1;311(3):R574-581.

11. Katayama K, Smith JR, Goto K, Shimizu K, Saito M, Ishida K, et al. Elevated sympathetic vasomotor outflow in response to increased inspiratory muscle activity during exercise is less in young women compared with men. Exp Physiol. 2018 Apr 1;103(4):570–80.

12. Luchesa CA, Mafort TT, Silva RR, Paro IC, Souza FM, Lopes AJ. Contribution of lung function in predicting distance covered in the 6-min walk test in obese Brazilian women. Braz J Med Biol Res. 2020 Oct 21;53:e10279.

13. Ochs-Balcom HM, Grant BJB, Muti P, Sempos CT, Freudenheim JL, Trevisan M, et al. Pulmonary function and abdominal adiposity in the general population. Chest. 2006 Apr;129(4):853–62.

14. Callegaro CC, Martinez D, Ribeiro PAB, Brod M, Ribeiro JP. Augmented peripheral chemoreflex in patients with heart failure and inspiratory muscle weakness. Respir Physiol Neurobiol. 2010 Apr 15;171(1):31–5.

15. Neder JA, Andreoni S, Lerario MC, Nery LE. Reference values for lung function tests: II. Maximal respiratory pressures and voluntary ventilation. Braz J Med Biol Res. 1999 Jun;32:719–27.

16. American Thoracic Society. ATS statement guidelines for the six-minute walk test. Am J Respir Crit Care Med. 2002 Jul;166(1):111–7.

17. Magnani KL, Cataneo AJM. Respiratory muscle strength in obese individuals and influence of upper-body fat distribution. Sao Paulo Med J. 2007 Jul;125:215–9.

18. Woszezenki CT, Heinzmann-Filho JP, Vendrusculo FM, Piva TC, Levices I, Donadio MVF. Reference Values for Inspiratory Muscle Endurance in Healthy Children and Adolescents. PLoS One. 2017 Jan 25;12(1):e0170696.

19. Gonçalves MJ, do Lago STS, Godoy E de P, Fregonezi GA de F, Bruno SS. Influence of neck circumference on respiratory endurance and muscle strength in the morbidly obese. Obes Surg. 2011 Aug;21(8):1250–6.

20. Sood A. Altered Resting and Exercise Respiratory Physiology in Obesity. Clin Chest Med. 2009 Sep;30(3):445–vii.

21. Simões RP, Auad MA, Dionísio J, Mazzonetto M. Influência da idade e do sexo na força muscular respiratória. Fisioterapia e Pesquisa. 2007 Apr 30;14(1):36–41.

22. Kwok S, Adam S, Ho JH, Iqbal Z, Turkington P, Razvi S, et al. Obesity: A critical risk factor in the COVID‐19 pandemic. Clin Obes. 2020 Dec;10(6):e12403.

23. Ouchi N, Parker JL, Lugus JJ, Walsh K. Adipokines in inflammation and metabolic disease. Nat Rev Immunol. 2011 Feb;11(2):85–97.

24. Hulens M, Vansant G, Claessens AL, Lysens R, Muls E. Predictors of 6-minute walk test results in lean, obese and morbidly obese women. Scand J Med Sci Sports. 2003 Apr;13(2):98–105.

25. Bhammar DM, Stickford JL, Bernhardt V, Babb TG. Effect of weight loss on operational lung volumes and oxygen cost of breathing in obese women. Int J Obes (Lond). 2016 Jun;40(6):998–1004.

26.Wang Y, Yang H, Nolan M, Negishi K, Burgess J, Marwick TH. Association of waist circumference with impaired six-minute walk in type 2 diabetes mellitus is independent of cardiac function. J Diabetes Complications. 2016 Apr;30(3):542–4.

27. Donini LM, Poggiogalle E, Mosca V, Pinto A, Brunani A, Capodaglio P. Disability Affects the 6-Minute Walking Distance in Obese Subjects (BMI>40 kg/m2). PLoS One. 2013 Oct 11;8(10):e75491.

28. Chen PH, Chen W, Wang CW, Yang HF, Huang WT, Huang HC, et al. Association of Physical Fitness Performance Tests and Anthropometric Indices in Taiwanese Adults. Front Physiol. 2020 Nov 20;11.

29. Jung MH, Ihm SH, Lee DH, Han S, Jung HO, Youn HJ, et al. Sex-specific associations of obesity with exercise capacity and diastolic function in Koreans. Nutr Metab Cardiovasc Dis. 2021 Jan 4;31(1):254–62.

30. Chlif M, Keochkerian D, Feki Y, Vaidie A, Choquet D, Ahmaidi S. Inspiratory muscle activity during incremental exercise in obese men. Int J Obes (Lond). 2007 Sep;31(9):1456–6

STATEMENTS

Authorship Contribution

Carolina Franco Cardoso
Graduação em Fisioterapia pela Universidade Federal de Santa Maria
https://orcid.org/0000-0002-7111-5310 • carolinacardoso999@hotmail.com
Contribuições: Conceituação, Escrita – revisão e edição

Alessandra Hofstadler Deiques Fleig
Mestrado em Ciências Pneumológicas pela Universidade Federal do Rio Grande do Sul
https://orcid.org/0000-0001-6457-9179 • alefleig@yahoo.com.br
Contribuições: Conceituação, Escrita – revisão e edição

Stéfany Giacomello Piccinin
Graduação em Fisioterapia pela Universidade Federal de Santa Maria
https://orcid.org/0000-0001-8139-0917 • stepiccinin@outlook.com
Contribuições: Conceituação, Escrita – revisão e edição

Janina Lied da Costa
Mestrado em Gerontologia pela Universidade Federal de Santa Maria
https://orcid.org/0000-0002-9444-7406 • liedjanina@gmail.com
Contribuições: Conceituação, Escrita – revisão e edição

Carine Cristina Callegaro
Doutorado em Ciências Cardiovasculares pela Universidade Federal do Rio Grande do Sul
https://orcid.org/0000-0001-9482-5457 • carine.callegaro@ufsm.br
Contribuições: Conceituação, Escrita – revisão e edição

Conflict of Interest

The authors declare that they have no conflict of interest.

Availability of research data and other materials

Research data and other materials can be obtained by contacting the authors.

Copyright

Plagiarism Check

The journal maintains the practice of submitting all documents approved for publication to plagiarism verification, using specific tools, such as: Turnitin.

Chief Editor

Rosmari Horner

How to cite this article

Cardoso CF, Fleig AHD, Piccinin SG, Costa JL, Callegaro CC. Inspiratory muscle endurance and functional capacity in obese men and women. Revista Saúde (Sta. Maria). [Internet] 2025; 51, e91750. Disponivel em: https://periodicos.ufsm.br/revistasaude/article/view/91750. DOI: https://doi.org/10.5902/22365834691750. Acesso em XX/XX/XXXX

