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Research Article

Comparison of Respiratory Strength of Eutrophic Individuals and People with Obesity Class II

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Abstract

Introduction: The excess of adipose tissue present in the obese individuals, can cause alteration in the respiratory functions and thus, the respiratory muscles have been characterized as insufficient.

Objective: To evaluate the respiratory force in sedentary individuals with class II obesity and eutrophic individuals, comparing the values obtained in the groups and discussing results of greater discrepancy.

Methods: We evaluated 87 sedentary individuals, being 45 individuals classified as having class II obesity and 42 eutrophic individuals. To compare the mean values of maximum respiratory pressures obtained and predicted values using the equations proposed by Costa., et al. the manovacuometer was used, and also the Student's t test with significance level $p < 0.05$. for the association between these values, the Spearman correlation coefficient was used.

Results: The results measured for respiratory pressures in patients with class II obesity, measured in cmH2O was MIP 80.1 and MEP 58.2 ± 22; while for the eutrophic group the MIP was 77.4 ± 28.2 and MEP 108.6 ± 20.2.

Conclusion: The data obtained indicated that patients with class II obesity presented statistically higher values of MIP ($p = 0.005$), but the MEP values were lower than those obtained by eutrophic ones and also in the predicted values, being able to be justified by the accumulation of fat in the abdominal region, consequently affecting the function of the expiratory muscles. The results obtained with the eutrophic volunteers pointed out that the sedentary lifestyle can be very harmful, influencing more than the weight gain for the respiratory pressures.

Keywords: *Obesity Grade II; Eutrophic; Respiratory Muscle Strength; Sedentary Lifestyle*

Introduction

Currently in Brazil, more than half of the adult population is overweight and, of this portion, 18.9% have obesity, according to data from the Vigitel [17] survey (Surveillance of Risk and Protection Factors for Chronic Diseases by Telephone Survey) published in the year 2016 by the Ministry of Health, also pointing out factors that can lead to the emergence of chronic diseases and what measures can be taken to

minimize the problem. Among them, the weight of Brazilians is one of the most worrying points, as it is directly linked to the emergence of diseases such as hypertension, diabetes, some types of cancer and cardiovascular diseases, being the main causes of death in the country.

Obesity can affect the chest and the diaphragm, determining changes in respiratory function even when the lungs are within the normal range [22].

The excess of adipose tissue in the thoracic cavity generates mechanical compression, leading to a reduction in anatomical dimensions, in addition to a decrease in pulmonary and thoracic compliance, causing diaphragmatic compression and consequently hindering the movement of the rib cage during inspiration [5,9].

The results shown by the Ministry of Health, in Brazil, sedentary people are 26.3% of the general population, with the highest percentage among men (29.5%) and the lowest among women (23.5%) [18]. According to Gregg., *et al*. [13], physical inactivity is associated with mortality, obesity, higher incidence of falls and physical weakness, dyslipidemia, depression, dementia, anxiety and mood changes.

Physical inactivity has been increasing in many countries, increasing the impact of chronic non-communicable diseases and affecting overall health worldwide. Low-active people have a 20% to 30% higher risk of death when compared to those who practice at least 30 minutes of moderate physical activity on most days of the week [18,21]. Sedentary lifestyle can contribute to the loss of lean mass in a relevant way, directly interfering with functionality [1,3].

With technological advances, modern society is increasingly exposed to comforts and conveniences, which favors people to lead a sedentary life, a habit that is considered an important risk factor for the development of cardiovascular diseases. Since the risk of having a heart attack is twice as high in sedentary individuals when compared to those who are regularly active [19].

Physical exercise is an important component in the daily life of the individual capable of promoting psychological, physical and cognitive benefits to health, regardless of age and gender and can be practiced in the form of sport or leisure [17]. Since the regular practice of exercise helps in the loss of body weight by helping to reduce or maintain body fat and preserve or increase lean mass, which contributes positively to the reduction of diseases [5].

Due to the compression occurring in the entire chest, reflecting the accumulation of fatty tissue and the increase in abdominal circumference, diaphragmatic work overload occurs because obesity has a direct mechanical effect on the diaphragm muscle and the accessory muscles of breathing, present in the rib cage, changing lung compliance and pulmonary resistance [14].

Respiratory muscle strength can be directly assessed using static measures, such as maximum respiratory pressures. The measures of Maximum Inspiratory Pressure (MIP) and Maximum Expiratory Pressure (MEP) can be used to quantify the strength of the respiratory muscles of healthy individuals of different ages, in patients with disorders of different origins, as well as to evaluate the response to respiratory muscle training [8,12].

Aim of the Study

This study aimed to assess the maximum inspiratory and expiratory pressures and to compare the results obtained between eutrophic volunteers and patients with class II obesity, both sedentary groups. In addition, correlate with the reference equation of Costa., *et al*. [8] in order to verify possible discrepancies and whether they may be more linked to weight gain, with the idea of verifying a possible change in respiratory muscle strength, highlighting the need for treatment specific targeting these findings in a multidisciplinary way.

Methods

In this research were selected 87 sedentary individuals of both genders were selected, with 45 individuals classified as having class II obesity and 42 individuals of normal weight, classified by the body mass index value. Normal weight volunteers were selected at the Physiotherapy clinic at the University of Taubaté. The obese volunteers, on the other hand, belong to the group of patients assisted at Clínica Vida Vale and the Institute of Gastrosurgery and Obesity - IGASTRO, who underwent multiprofessional follow-up in the process for bariatric surgery by the teams.

The inclusion criteria for participation in this study were: sedentary individuals, distributed in two groups, using the body mass index (BMI) and classified as grade II obesity at the beginning of the multiprofessional surgery care protocol and individuals with weight within the index normality, also sedentary. The two groups aged 18 to 40 years, both genders, who did not have current dependence on alcoholism and illicit drugs and with adequate cognitive conditions to understand simple orders, necessary for carrying out the tests.

The exclusion criteria for participation in this study were: individuals who had thoracic and/or spinal deformities, diagnosed with lung disease, smokers or with a smoking history, with uncontrolled heart problems and who were unable to follow the commands in the evaluation.

Results

The sample of the group of patients with class II obesity in the study was composed of 45 participants of both genders, 42 of whom were female (93.3%). The volunteers obtained between 18 and 40 years of age with an average of 31.8 years (SD = 5.5). As for anthropometric measurements, the mean body weight was 102.8 kg (SD = 8.6) with a range from 86.0 to 125.0 kg. The average of the general body mass index was 38.0 kg/m^2 (SD = 1.3) with a range from 35.1 to 39.8 kg/m^2.

The sample of the eutrophic group in the study was composed of 42 participants of both genders, 28 of whom were female (56.1%). Participants were between 18 and 40 years old with an average of 27.3 years (SD = 6.8). As for anthropometric measurements, the average body weight was 64.5 kg (SD = 8.5) with a range from 49.8 to 79.0 kg. The average of the general body mass index was 22.7 kg/m^2 (SD = 1.5) with a variation from 19.9 to 25.1 kg/m^2.

In relation to the group of patients with grade II obesity, the mean values for MEP found were significantly lower than the predicted values. The mean of the MIP presented better results than predicted, as shown in table 1.

Respiratory pressures Maximum	Measured values	Predicted values	P
MIP (cmH_2O)	80,1 ± 28,0	69,0 ± 34,8	0.000*
MEP (cmH_2O)	58,2 ± 22,0	101,0 ± 12,8	0.000*

Table 1: *MIP and MEP values measured and predicted for class II obesity patients. Data are expressed as mean ± standard deviation, *: Statistical significance (p < 0.05).*

In the sample, 61.1% (30 volunteers) of the participants exceeded the values predicted for MIP. PEmax only 4.7%, (2 volunteers) managed to reach the predicted value.

As for the eutrophic group, the mean values for MIP and MEP found were significantly lower than the predicted values.

In the sample, only 25% of the volunteers reached MIP. As for MEP, no participant was able to reach the predicted value. The values are expressed in the table 2 below.

Respiratory pressures Maximum	Measured values	Predicted values	P
MIP (cmH_2O)	77,4 ± 28,2	119,5 ± 38,3	0.000*
MEP(cmH_2O)	68,6 ± 20,2	120,9 ± 24,4	0.000*

***Table 2**: MIP and MEP values measured and predicted by the eutrophic group.*
*Data are expressed as mean ± standard deviation, *: Statistical significance (p < 0.05).*

Table 3 presents the comparative data between the groups in relation to the maximum pressures. For both pressures, there was a statistical difference between the groups.

Respiratory pressures Maximum	Obesity patient (45)	Eutrophic (42)	P
MIP measured (cmH_2O)	80,1 ± 28,0	77,4 ± 28,2	0.005*
MEP measured (cmH_2O)	58,2 ± 22,0	68,6 ± 20,2	0.000*

***Table 3**: Comparison of MIP measured between obesity II and eutrophic patients.*
*Data are expressed as mean ± standard deviation, *: Statistical significance (p < 0.05).*

Discussion

During the last few years, due to technological development and modern life, life habits have been gradually modified, which refers to a diet with excessive consumption of foods high in saturated fat, hypercaloric drinks and low levels of physical activity. Such facts culminated in a pandemic of overweight and obesity and its consequent comorbidities [1,18].

We know that obesity and physical inactivity are factors that directly interfere in various systems of the body, bringing impacts on functionality and on the values found for muscle strength [23,24]. The objective of this study was to compare respiratory muscle strength between two groups, one formed by patients with class II obesity and the other by eutrophic people, both sedentary groups; The comparison was also performed with the values predicted by the equation developed by Costa., *et al* [8,12].

In people with obesity, excess fat in the abdominal cavity and thorax limit the two main inspiratory movements: diaphragmatic contraction, pushing the abdominal contents down and forward and increasing the chest diameter by moving the ribs [15,24]. Therefore, investigating and properly treating these disorders is extremely important, as we can minimize respiratory problems, reduce the number and length of hospital stay, if necessary.

In the results found in this research, the mean values for maximum inspiratory pressure (MIP) in the group of patients with class II obesity were higher than predicted. Similar to the results found in the research by Forti., *et al*. [12] which involved morbidly obese women and showed that morbidly obese women, when compared to the group of eutrophic women, had greater inspiratory muscle strength.

The research carried out by Cardoso [4], with 33 women with class II and III obesity, showed that the muscular strength, although greater, did not present a statistically significant difference when compared to that of eutrophic women.

As for the mean maximum expiratory pressure (MEP) values of the group of patients with class II obesity, they were significantly lower than the values predicted both among men and women, which is in agreement with the findings of Barros and Santos [2], who evaluated 20 volunteers with overweight and obesity and the results showed a difference between the MEP measured and predicted, justifying that the expiratory muscle strength is directly linked to the strength of the abdominal muscles, which are muscles that accumulate large amounts of fat.

In the study by Marchesi [16], it was observed that the group with class I and II obesity showed a decrease in MEP in this male population, corroborating ours, and MEP values were lower than predicted and also when compared with the values eutrophic individuals. Thus, the results make us reflect on the greater the degree of obesity, the greater the decrease in MEP, affecting respiratory strength.

Between the groups, for both pressures, we found a statistical difference. The group of patients with class II obesity, obtained, on average, higher MIP values, when compared to the eutrophic ones, reaching those with class II obesity 116% of the predicted. In addition, MEP was higher on average for eutrophic individuals, reaching 56.74% of the value predicted by the equation of Costa., *et al* [8,10,16].

If we only consider MIP, our study indicates higher values in patients with obesity II, when compared with the eutrophic group and also in relation to the value predicted by the equation of Costa., *et al* [2,8].

However, our results show that in the eutrophic group, the mean values for MIP and MEP found were significantly lower than the predicted values, which leads us to reflect in the direction of two hypotheses. First, the fact that our groups are sedentary and how much and how this can have a direct impact on the maximum inspiratory and expiratory pressures.

Second, how assertive the predictive equations of MIP and MEP are for this obese population, since despite the accelerated growth of these overweight individuals, we have not yet described in the literature, an equation that is aimed at this special group.

Studies on the behavior of respiratory muscle strength in morbidly obese individuals have produced conflicting results [12]. According to Magnani and Cataneo [15], both excess body mass and fat distribution in the upper abdomen do not promote respiratory muscle dysfunction. On the other hand, authors report respiratory muscle dysfunction in this population, which is justified by the increase in elastic resistance caused by the excess of adipose tissue in the rib cage and abdomen, which causes mechanical disadvantage to the muscles [23,24].

However, there are reports of increased respiratory muscle strength in morbidly obese individuals justified by the adaptations present in skeletal muscle fibers, which is attributed to the daily physical efforts to move the body and a greater attempt by the musculoskeletal structures to keep the body in shape. erect position [6,14]. Queiroz [22] carried out a study with obese and non-obese individuals (n = 100) separated by sex. The respiratory muscle strength of these groups was evaluated and the finding was that the obese group, regardless of gender, has a higher respiratory muscle strength than non-obese individuals, which is similar to our data, if we look at the MIP values.

The obese muscles have specific histological and metabolic characteristics, with an increase in muscle mass and a more potent contraction [6,11]. Obese individuals have a higher proportion of skeletal muscle mass and type II fibers [11,17]. According to Cezar [7], in his review of the literature regarding the characteristics of the obese population in terms of body composition, these individuals have an increased proportion of lean mass due to the physical effort required for body displacement.

However, until today, there is no consensus in the literature when we analyze respiratory muscle strength, increasing obesity worldwide and the comorbidities that this chronic disease can cause. Among so many changes, we know that physical inactivity is directly related to low caloric expenditure, favoring the accumulation of fat, this excess of fat mass, has an impact on functionality, on the muscular system and overload on the joints for movement in daily activities, making it difficult to movement [19,21].

Therefore, it is of fundamental importance to carry out new research, with a large number of individuals, multifactorial analysis and constant studies in search of increasingly more consistent information and better treatments with a specific look and correct choices for greater functionality and quality of life for these individuals. individuals.

Conclusion

Evaluating our results, we found that people with class II obesity had higher MIP values, however the MEP values in the obese group were lower than those reached by eutrophic people and lower than the values predicted by Costa's equation, which can be justified by the accumulation of fat in the abdominal region that impairs the mechanics of expiratory muscles. The results obtained from the eutrophic volunteers, on the other hand, point out that possibly, a sedentary lifestyle can be just as harmful or more than the increase in weight for respiratory pressures.

However, many studies are still found in the literature with divergent results on the findings with groups with obesity, which can be justified by the difference in the methods used in the evaluation.

Further studies are needed, with different groups, and comparing not only the weight variables, but also a comparison with other predictive equations of MIP and MEP, so that new conclusions can be defined, thus improving the treatment of chronic disease and multifactorial obesity.

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