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CORRELATION BETWEEN SARCOPENIA AND OBESITY IN PATIENTS SEEN IN A CLINIC IN ARACAJU

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Abstract: Introduction: The term sarcopenic obesity means the co-presence of obesity and sarcopenia. The complex interaction of common pathophysiological mechanisms marks the close relationship between these two conditions. Sarcopenia reduces physical activity, which leads to decreased energy expenditure and increases the risk of obesity. In contrast, an increase in visceral fat induces inflammation, which contributes to the development of sarcopenia. The aim of this study was to evaluate the correlation between sarcopenia and obesity using data obtained from patients at a private clinic in Aracaju, in the state of Sergipe. **Methods:** Clinical, cross-sectional, descriptive study with a quantitative analytical approach. Data were collected between November 2021 and March 2022. The following variables were analyzed: BMI, waist-to-hip ratio, subcutaneous fat measurement, intra-abdominal fat measurement, Elbow flexion strength and Knee extension strength. This project was approved by the Research Ethics Committee of Universidade Tiradentes (Aracaju-SE) under opinion 2,795,512. In all hypothesis tests performed, the conclusion was obtained through the interpretation of the P-value, adopting a significance level P-value < 0.05. The software used was R, version 4.0.4. **Results:** A total of 79 people aged between 16 and 70 years old were evaluated. There was no statistically significant correlation between biceps (elbow flexion) and hamstring (knee extension) strength with BMI, hip circumference, waist/hip ratio, intra-abdominal fat and subcutaneous fat. Regarding Waist Circumference, there was a statistically significant correlation with biceps strength, which showed direct proportionality between both. **Conclusions:** There was no statistically significant association between obesity and biceps and hamstring strength, except for that found between Waist Circumference and biceps strength. Based on this outcome,

further studies must be encouraged to assess obesity in the sarcopenic population in relation to the healthy population.

Keywords: Obesity. Sarcopenia. Muscle strength.

INTRODUCTION

Defined by The European Working Group on Sarcopenia in Older People (EWGSOP), sarcopenia is a syndrome characterized by the progressive and generalized loss of musculoskeletal tissue and strength with risk of adverse outcomes such as physical disability, poor quality of life and death (ZHAI; XIAO, 2017).

With aging, changes in body composition occur, such as increased adiposity and decreased lean body mass, particularly skeletal muscle mass. Rosenberg (1997) pioneered the use of the term sarcopenia to describe the skeletal muscle loss associated with aging. Some authors define sarcopenia as a disease only if it is associated with some functional limitation. (PIERINE et al, 2009).

Skeletal muscle tissue decreases by about 40% between 20 and 60 years of age. These changes are also related to aging in healthy and physically active individuals, who may experience muscle loss of 1-2% per year, particularly in the lower limbs, and body fat gain of 7.5% per decade, starting at age 40, with more pronounced changes after 50 years of age. (PIERINE, 2010).

The term sarcopenic obesity, therefore, was first defined by Baumgartner in the year 2000, which means the co-presence of obesity and sarcopenia. The complex interaction of common pathophysiological mechanisms, such as the increase in pro-inflammatory cytokines, oxidative stress, insulin resistance, hormonal changes, mark the close relationship between these two conditions (CHOI, 2013). Sarcopenia reduces physical activity, which leads to decreased energy expenditure and increases the risk of obesity. In contrast, an increase in visceral fat induces inflammation, which contributes to the development of sarcopenia. (SPERETTA, 2014).

To elucidate the relationship of the metabolic axis between liver, adipose tissue and muscle, studies with rats have shown that myostatin, a member of the TGF-beta superfamily of proteins, which was initially discovered as a limiting factor in muscle growth, when blocked, not only increases the muscle mass of rats, but also protects them from hepatic steatosis and insulin resistance (ZHANG et al., 2011; BONALA et al., 2013). Thus, there are several injuries caused by sarcopenia (Figure 1).

Adiponectin is another potential mediator of the adipose-muscle tissue axis that alters hepatic metabolism. Adiponectin receptors in muscle tissue have been reported to regulate insulin signaling and increase fatty acid oxidation. Obesity and increased inflammatory adipose tissue are accompanied by hypoadiponectinemia, which results in impaired insulin signaling. Since myostatin increases adipose tissue mass, and this, in turn, decreases adiponectin secretion, the disturbance in adipose-muscle-liver tissue may actually start in skeletal muscle and act on both the liver and adipose tissue (ZHANG et al., 2011; BONALA et al., 2013).

For the diagnosis of sarcopenia, the European Working Groupon Sarcopenia in Older People (EWGSOP) recommends the identification of decreased muscle mass combined with reduced muscle function identified by muscle strength or compromised physical performance (CRUZ-JENTOFT et al., 2010). Thus, a limitation to establish the diagnosis of sarcopenia is the difficulty of accurately quantifying muscle mass. A number of methods have been described,

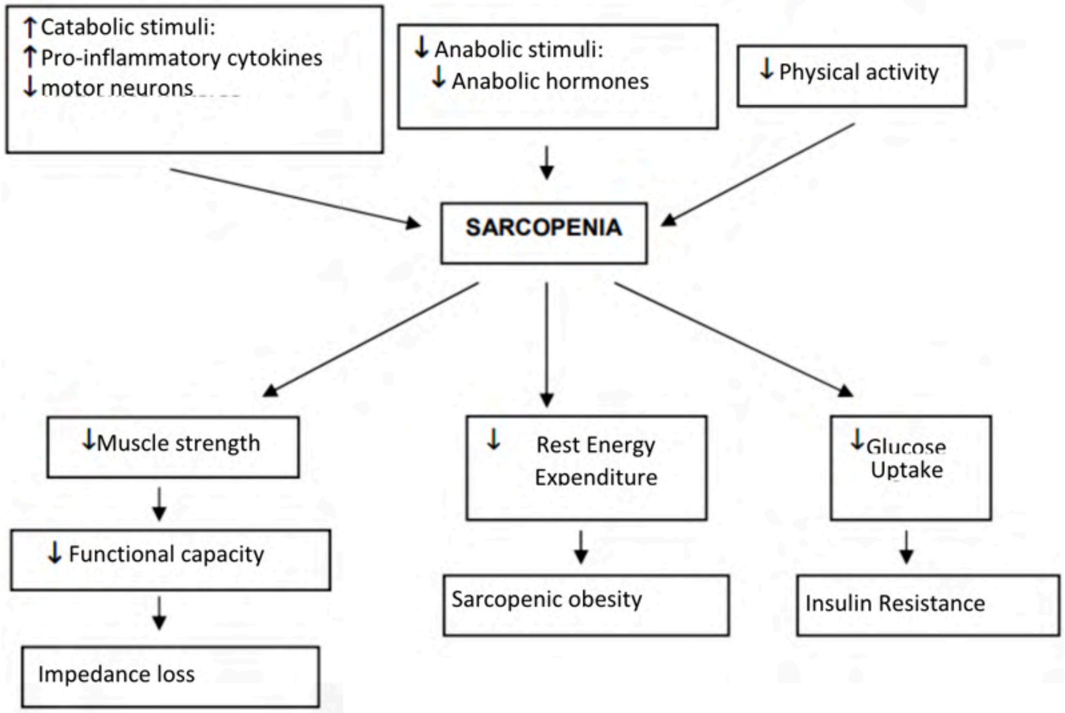

Figure 1. Diseases caused by sarcopenia.

Source: PIERINE, Damiana, et al., 2009.

including dual energy absorption by X-ray beams (DXA), computed tomography (CT) and magnetic resonance imaging (MRI). The limiting point of CT, MRI and DXA is that, despite its recognized accuracy in identifying skeletal muscle, it is expensive and difficult in population studies (TICINESI et al., 2017). The assessment of muscle strength is an important clinical consideration for patients with pathologies ranging from musculoskeletal, neurological or metabolic, so manual dynamometry is an accessible alternative in the clinical scenario of patients to assess muscle strength (VERMEULEN et al., 2015).

Hand dynamometry was first described by Lovett and Martin (1916), being a convenient device that can be placed between the practitioner's hand and the tested body part, demonstrating accuracy when compared to isokinetic measurement. The Lafayette Manual Muscle Testing Dynamometer is an ergonomic hand-held device for objectively quantifying muscle strength. Therefore, the technique presents Minimums risks, since manual dynamometry is not an invasive method (BOHANNON, 2006).

In addition, for obesity, the parameters of the World Health Organization on the Body Mass Index (BMI) can be used, despite its limitations. The ratio of waist-hip circumferences, subcutaneous fat and intra-abdominal fat can also be taken into account. After all, the diagnosis of sarcopenic obesity is based on individual definitions of sarcopenia and obesity. There is no consensus on the cut-off point for each of these diseases. The variety of diagnostic criteria makes comparisons between study results difficult (BATSIS and VILLAREAL, 2018).

For treatment, there is evidence that nutritional strategies and physical exercise are potentially beneficial with the aim of reversing or attenuating the negative effects of aging on body composition and physical fitness. These lifestyle changes, including avoiding smoking and drinking, are critical. The most important and recommended therapeutic options include a balanced diet – rich in protein, vegetables and whole grains; low in red meat and saturated fat; good protein intake (1.2-1.5 g/kg/day or more for those who exercise); diversified physical activity protocols; vitamin supplementation in those with specific deficiencies and/or testosterone replacement (for men with low serum levels of this hormone). (GAGO, 2016).

The aim of this study was to evaluate the correlation between sarcopenia and obesity using data obtained from patients at a private clinic in Aracaju, in the state of Sergipe.

METHODOLOGY

STUDY DESIGN

Clinical, cross-sectional, descriptive study with a quantitative analytical approach, whose sample consisted of 79 patients.

PLACE

Data were collected in a private clinic in Aracaju-SE between October 2021 and March 2022.

INCLUSION CRITERIA

Adults of both sexes from 16 to 70 years of age;

EXCLUSION CRITERIA

- Stroke sequelae carriers;
- People with physical disabilities.

ETHICAL ASPECTS

A Free and Informed Consent Term (ICF) was written according to the norms of the National Health Council of the Ministry of Health explained in resolution 466/12, which was signed by all participants.

This project was sent to the Research Ethics Committee of Universidade Tiradentes (CEP), located in Aracaju - SE, and was approved (opinion 2,795,512).

VARIABLES ANALYZED

The following variables were analyzed: BMI, waist/hip ratio, subcutaneous fat measurement, intra-abdominal fat measurement, Elbow flexion strength and Knee extension strength.

DATA COLLECTION PROCEDURE

The collection procedure was divided into three stages:

STEP 1

All patients after signing the informed consent answer a questionnaire with sociodemographic and comorbidity information, called a health questionnaire. In the aforementioned questionnaire, information was presented on the following variables: name, age, date of birth, place of birth, occupation, stroke sequelae, physical disability.

At this time, anthropometric measurements were performed. Anthropometric assessment consisted of measuring weight, height, Waist Circumference and hip. For body weight, a portable TECHLINE scale was used. The patient remained standing, barefoot in the center of the scale, with the weight distributed on both feet. Height was measured using a FILIZOLA portable stadiometer with the reading taken to the nearest millimeter (mm). The patient was positioned barefoot, vertically with arms extended along the body, musters relaxed, heels together and head positioned.

Weight and height data were used to calculate the Body Mass Index, calculated using the Quetelet index: the ratio between body weight in kilograms and height in meters squared. Waist Circumference (CC) was measured with the patient standing, using an inelastic measuring tape at the midpoint between the last rib and the iliac crest (LOHMAN et al., 1988). The measurement of hip circumference (HC) was measured in the region of greatest circumference determined by the gluteal in patients standing and with feet together. The waist/hip ratio (q WC/HC) was evaluated in the study by dividing the Waist Circumference by the hip circumference.

STEP 2

The quantification of abdominal fat (intra-abdominal and subcutaneous) was performed, B-mode ultrasonography, 3.75 MHz and 7.5 MHz transducers were used, respectively. For intra-abdominal adiposity, a 3.75 MHz transducer was used, positioned transversely at 1.0 cm cranial to the umbilicus, on the Average line, where the distance between the internal fascia of the rectus abdominis muscle and the anterior wall of the abdominal aorta is measured. In the case of subcutaneous fat, a 7.5 MHz transducer was used and its measurement was made by the distance between the skin and the external fascia of the rectus abdominis muscle, also 1.0 cm cranially from the umbilicus.

STEP 3

Knee extension strength (hamstring strength) and elbow flexion (biceps strength) tests were performed, both in the dominant limbs, by a specialized physical therapist with a manual dynamometer device, brand LAFAYETTE, which records the maximum strength, providing readings of Reliable, accurate and stable muscle strength. The first test, Knee extension strength, was performed as a measure of force applied to the ankle, with the patient seated in a chair with an adjustable straight back, the leg unsupported and the knee flexed at 90º. The second test, Elbow flexion strength, was performed as a measure of the force applied to the anterior region of the forearm, also with the patient seated in a chair with an adjustable straight back, and the arm extended at 180°. After the participants were familiarized with the test procedure, three tests of each test were performed with Maximum effort, with a 1-minute interval between each measurement. The mean value of measurements from both Newton force tests was recorded and the patients were divided into two male and female groups.

STATISTICAL ANALYSIS

In this study, nominal qualitative variables and quantitative variables were obtained, where data analysis was performed in two ways, descriptive and inferential. For the qualitative variables, the descriptive analysis proceeded with the categorization of data and obtaining the respective frequencies and percentages, and for the quantitative variables, the Average, standard deviation and Minimum and Maximum values were calculated.

For the crossing between the quantitative variables, the normality of the distributions of the quantitative variables was initially verified through the Shapiro-Wilk test, when normality was observed (P-value < 0.05), Pearson's correlation was used, otherwise, Spearman's coefficient was used.

The correlation coefficient can vary in terms of value from -1 to +1. The higher the absolute value of the coefficient, the stronger the relationship between the Variables. The sign of each coefficient indicates the direction of the relationship. If both Variables tend to increase or decrease together, the coefficient is positive. If one Variable tends to increase as the others decrease, the coefficient is negative.

In all hypothesis tests performed, the conclusion was obtained through the interpretation of the P-value. Adopting a significance level of 5%, whenever the calculated P-value is less than 0.05, we will say that there is an association between the analyzed variables. The software used was R, version 4.0.4.

RESULTS

In this study, 79 patients with a minimum age of 16 years and a maximum of 70 years were evaluated, with an average age of 45.2 (±13.2) years. Regarding gender, 33 were male and 46 (58.2%) were female.

Average Elbow flex strength (biceps) was 69.5N (±16.6), with a minimum of 35.3N and a maximum of 121N. Knee extension strength (hamstring) ranged from 45.0N to 200.5N, with an average of 102.5N (±28.4).

With regard to the Body Mass Index (BMI), the Average was 28.8 (±5.1) kg/m2, ranging from 17.7 to 40.8 kg/m2. In relation to Waist Circumference, the Average of 93.8 (±15.6) cm ranged from 46.0 to 127.0 cm. As for the hip circumference, the Average was 102.5 (±10.5) cm, ranging from 81.0 to 129.0 cm. When the waist-hip ratio (WR/Q) was evaluated, the Average was 0.9 (±0.1), ranging from 0.5 to 1.1.

In relation to GSC, it ranged from 1.1 to 4.2 cm, with an average of 2.4 (±0.7). As for the GIA, the Average was 4.3 (±1.5) cm, ranging from 1.4 to 8.7 cm.

Table 2 presents the correlation between BMI and elbow flexion and knee extension forces. From the P-value, it was found that there was no statistically significant correlation between the Body Mass Index (BMI) and the forces.

Table 3 presents the correlation between Waist Circumference and forces (biceps and hamstrings). From the P-value, it was found that there was a statistically significant correlation between Waist Circumference and biceps strength, which showed direct proportionality between both.

Table 4 presents the correlation between hip circumference and forces (biceps and hamstrings). From the P-value, it was found that there was no statistically significant correlation between hip circumference and biceps and hamstring strength.

Table 5 presents the correlation between CR/Q and strengths (biceps and hamstrings). From the P-value, it was found that there was no statistically significant correlation between CR/Q and biceps and hamstring strengths.

Table 6 presents the correlation between GIA and forces (biceps and hamstrings). From the P-value, it was found that there was no statistically significant correlation between GIA and biceps and hamstring strengths.

Table 7 presents the correlation between GSC and forces (biceps and hamstrings). From the p-value, it was found that there was no statistically significant correlation between GSC and biceps and hamstring strengths.

DISCUSSION

Contrary to expectations, studies that analyzed muscle strength between obese and non-obese individuals have found similar or higher absolute strength values in their non-obese peers. These findings have been attributed to a probable neuromuscular adaptation induced by excess body weight in the musculoskeletal structure. It is also known that most of these studies verified the muscle strength of the lower limbs, which are more influenced by excess body weight, thus

Variable	Average	Standard deviation	Minimum	Maximum
Age	45,2	13,2	16,0	70,0
Elbow flexion strength(N)	69,5	16,6	35,3	121,0
Knee extension strength(N)	102,5	28,4	45,0	200,5
Waist circumference (cm)	93,8	15,6	46,0	127,0
Hip circumference(cm)	102,5	10,5	81,0	129,0
RC/Q	0,9	0,1	0,5	1,1
IMC (Kg/m^2)	28,8	5,1	17,7	40,8
GSC (cm)	2,4	0,7	1,1	4,2
GIA (cm)	4,3	1,5	1,4	8,7

Table 1: General characteristics of patients.

Subtitle: RC/Q: waist-hip ratio; BMI: body mass index; GSC: subcutaneous fat; GIA: intra-abdominal fat.

Source: Author himself.

Variables	*p*	P- value
IMC X Elbow flexion strength	0,1145[1]	0,3148
IMC X Knee extension strength	0,0034[2]	0,9762

Table 2: Correlation between BMI and elbow flexion and knee extension forces.

[1] Spearman's correlation coefficient; [2] Pearson's correlation coefficient.

Variables	*p*	P- value
Waist Circumference **X Elbow flexion strength**	0,2650[1]	**0,0183**
Waist Circumference **X Knee extension strength**	0,0676[2]	0,5534

Table 3: Correlation between Waist Circumference and forces.

[1]Spearman's correlation coefficient; [2]Pearson's correlation coefficient.

Variables	*p*	P- value
Hip circumference **X Elbow flexion strength**	0,2028[1]	0,0729
Hip circumference **X Knee extension strength**	0,1101[2]	0,3339

Table 4: Correlation between hip circumference and forces.

[1]Spearman's correlation coefficient; [2]Pearson's correlation coefficient.

Variables	*p*	P- value
RC/Q **X Elbow flexion strength**	0,2074[1]	0,0665
RC/Q **X Knee extension strength**	0,0066[1]	0,9536

Table 5: Correlation between RC/Q and forces.

[1]Spearman's correlation coefficient; [2]Pearson's correlation coefficient.

Variables	*p*	P-value
GIA **X Elbow flexion strength**	0,1977[1]	0,0806
GIA **X Knee extension strength**	0,1524[2]	0,1800

Table 6: Correlation between GIA and forces.

[1]Spearman's correlation coefficient; [2]Pearson's correlation coefficient.

Variables	*p*	P- value
GSC **X Elbow flexion strength**	-0.0714[1]	0,5317
GSC **X Knee extension strength**	0,0696[2]	0,5422

Table 7: Correlation between GSC and forces.

[1]Spearman's correlation coefficient; [2]Pearson's correlation coefficient.

making it difficult to identify the probable effects of obesity on the expression of muscle strength.

In the literature, according to dos Santos et. al. (2017) and Hollanda et. al. (2020), results have indeterminate a consensus on the effect of obesity and muscle strength. In the present study, obesity did not present statistical significance in relation to muscle strength by comparing hamstring and biceps strength with the other parameters of body fat. Obese individuals have an altered metabolic profile compared to non-obese individuals, with higher basal insulin levels, which can lead to a systemic anabolic state. This higher body mass index in obese patients is related to fat, which could imply physical limitations such as decreased muscle strength, however, the level of physical activity can influence muscle strength levels and this impact on the strength of obese patients. was not investigated.

Studies by Pilat et. al. (2020) and de Lopes et. al. (2013) already stated that obesity and sarcopenia are correlated through the complex interaction of common pathophysiological mechanisms, such as increased pro-inflammatory cytokines, oxidative stress, insulin resistance, hormonal changes, reduced physical activity and induction of inflammation by visceral fat, however, few studies are able to find this due influence in practice. The present study, despite having evidenced a statistically significant association between waist circumference and muscle strength, its correlation was positive, translating an effect contrary to what was expected. Excess body mass represents an additional load on the musculoskeletal structure of obese individuals, leading to favorable adaptations in muscle mass, bone mass and muscle strength. The combination of the anabolic environment with the additional overload, which may account for greater muscle strength.

It is necessary to recognize the methodological limitations of the study, such as the analysis of sarcopenia only by muscle strength, without considering muscle volume. In addition to not including the practice of physical activity in patients, which is known to change the patterns of strength related to BMI. That said, it is important to recognize sarcopenic obesity as a consistent clinical entity with a pathophysiology, although it is often not evidenced in the population studied.

CONCLUSIONS

There was no statistically significant association between obesity and biceps and hamstring strength, except for that found between waist circumference and biceps strength.

The statistically significant association between waist circumference and biceps strength showed a positive correlation, meaning an increase in circumference with an increase in muscle strength, in line with the negative influence of obesity on muscle depletion.

Further studies must be carried out in order to establish a more reliable comparison of this dichotomy in the spectrum of sarcopenic obesity.

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