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Body composition and socioeconomic factors in patients with hepatic steatosis

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ABSTRACT. The study aimed to evaluate the association of the components of body composition (body mass index – BMI, waist circumference, basal metabolism, body fat percentage, fat weight, fat free percentage and lean weight) with gender, age, income and schooling in patients with hepatic steatosis. Descriptive and survey study, with quantitative analytical approach. Data were collected through ultrasound and bioimpedance tests. The significance was $p < 0.05$ and software used was SPSS 22.0. A sample of 114 patients with hepatic steatosis, 70.1% were women. The mean age was 46.2, only 11.4% had normal BMI. The mean BMI was 30.4, waist circumference 100.2 cm, fat percentage 37.97%, basal metabolism 1451.9 kcal, fat weight 31.0 kg. Statistical differences in several variables in relation to gender and age were found. However, no statistically significant differences were found regarding schooling and income. Changes in body composition were obvious in patients with hepatic steatosis.

Keywords: fatty liver, social indicators, ultrasonography, anthropometry, obesity.

Composição corpórea e fatores socioeconômicos em pacientes portadores de esteatose hepática

RESUMO. O estudo teve como objetivo avaliar a associação dos componentes da composição corporal (índice de massa corporal – IMC, circunferência abdominal, metabolismo basal, percentual de gordura, peso gordo, percentual livre de gorduras e peso magro) com gênero, idade, renda e escolaridade em pacientes com esteatose hepática. Estudo descritivo tipo *survey*, com abordagem analítica quantitativa. Os dados foram coletados através de exames de ultrassonografia e bioimpedância. A significância foi $p < 0,05$ e o *software* usado SPSS 22.0. Uma amostra de 114 pacientes com esteatose hepática, 70,1% de mulheres. A média de idade foi 46,2 apenas 11,4% tinham IMC normal. As médias de IMC foram: 30,4, circunferência abdominal: 100,2 cm, percentual de gordura: 37,97%, metabolismo basal: 1451,9 Kcal, peso gordo 31,0 kg. Foram encontradas diferenças estatísticas em diversas variáveis em relação ao gênero e idade. Entretanto, não foram encontradas diferenças estatisticamente significantes a respeito da escolaridade e da renda. Mudanças da composição corporal foram óbvias em pacientes com esteatose hepática.

Palavras-chave: fígado gorduroso, indicadores sociais, ultrassonografia, antropometria, obesidade.

Introduction

Hepatic steatosis is defined as the accumulation of fat that exceeds 5% of liver weight, it is also the simplest component of Non-Alcoholic Fatty Liver Disease (NAFLD), the most common cause of chronic liver disease being able to progress to steatohepatitis, cirrhosis, and hepatocellular carcinoma (Santos & Cotrim, 2006; Ahmed, Abu, & Byrne, 2010).

Factors such as obesity, insulin resistance, dyslipidemia and other metabolic syndrome components have been promoting a steady increase in the prevalence of hepatic steatosis worldwide, thus making the liver more and more susceptible, modifying its response pattern and favoring the worsening or appearance of liver lesions. NAFLD has been considered as the hepatic representation of the metabolic syndrome (Marchesini et al., 2003; Stepanova, Rafiq, & Younoss, 2010; Kwon, Oh, Hwang Lee, Kwon, & Chung, 2012).

Obesity is characterized by excess adipose tissue and its distribution is irregular throughout the body, concentrated mostly on the trunk, especially in the abdominal area (Yi & Kansagra, 2014). Central obesity is an important component of the metabolic syndrome, reflecting the fact that the prevalence of the syndrome is driven by the strong relationship between waist circumference and increased adiposity (Eckel, 2008). Although obesity is associated with several diseases, it is the excessive body fat, or fat mass, that is characterized as an important factor for its evolution. The identification of people with body fat excess has been playing a key role in creating preventive strategies and improving specific interventions. The body mass index (BMI) has been used to classify overweight and obesity, but due to the simplicity of this approach, it doesn't provide information on fat percentage and muscle mass (Völgyi et al., 2008).

The basal metabolic rate (BMR) is used to determine the energetic needs of individuals and population groups and to express their physical activity level. BMR depends on age, sex, body mass index, body fat, heart rate and insulin plasma levels, and it is mainly influenced by lean body mass (Francischi, Pereira, & Júnior, 2001; Wahrlich & Anjos, 2001).

Abdominal ultrasound is the first option for the diagnosis of hepatic steatosis since it is a simple method, that doesn't use ionizing radiation, it is inexpensive, more accessible and has no side effects (Boente et al., 2007). The bioimpedance, or bioelectrical impedance, is an excellent method for measuring body composition through various parameters such as weight, height, basal metabolism, fat mass, lean body mass and fat-free mass percentage (Alvero-Cruz et al., 2001).

The purpose of this study is to assess the body composition in patients with hepatic steatosis diagnosed by routine abdominal ultrasound and its association to their socioeconomic aspects, out lining the profile of the population with this disease.

Material and methods

This is a descriptive research, conducted by surveys, non-experimental, with quantitative analytical approach, submitted to and approved by the Research Ethics Committee of Tiradentes University, number 010513.

Data were collected in four ultrasound centers in Aracaju City between July 2013 and July 2014. The exams were performed by the same doctor, experienced in the diagnosis of hepatic steatosis. The instruments used are similar and have good resolution: PHILLIPS (ENVISION model, HD or HD 7 15), GE (VOLUSON 730 Pro model), TOSHIBA (Nemio 17 model), TOSHIBA (model Nemio XG SSA 580 A) and Phillips (ENVISION C HD model). The bioimpedance analysis has been performed by a tetra-polar Inbody 230 model appliance.

Patients from both genders between the ages of 18 and 60 were included and referred for routine abdominal ultrasound in specialized centers for the diagnosis of hepatic steatosis after signing the Written Informed Consent (WIC). They answered the questionnaire with socio demographic data, and then made ultrasound and bioimpedance tests. The exclusion factors were: non-presentation of hepatic steatosis on ultrasound, presence of hepatocarcinoma or other malignancies, patients with previous liver disease (hepatitis as an example) and alcohol consumption ≥ 40 g day^{-1}. The sample consisted of 114 patients.

The analysed variables were body mass index (kg m^{-2}), waist circumference (cm), basal metabolism (kcal), body fat percentage (%), fat mass (kg), fat free mass percentage (%) and lean body mass (kg).

Data collection procedures

Stage 1: Ultrasound examination

The ultrasonography was performed with a convex and dynamic transducer (which provides continuous and automatic image) of 3.75 MHZ frequency. The patient preparation consisted of a fast of at least 6hours and the use of antiflatulent. In the ultrasound examination were obtained: liver dimensions, edge features, parenchyma echo texture and classification of liver fat in grades according to the criterion used by Saadeh et al. (2002). Grade 1 is defined by fine echoes of the hepatic parenchyma with normal visualization of the diaphragm and the intrahepatic vessels, grade 2 is defined by a diffuse increase in fine echoes with impaired visualization of the intrahepatic vessels and diaphragmand grade 3 is defined by a significant increase in fine echoes with impaired or absent visualization of the intrahepatic vessels.

Stage 2: Bioimpedance examination

Patients with hepatic steatosis diagnosed by abdominal ultrasonography were submitted to a second phase, which consisted of bioimpedance examination and waist circumference measurement. Bioimpedance is a method based on the principle that lean tissues are better conductors than fatty tissues, and that the fat contains no water, therefore being resistant to electric current. The electrodes are placed on the hands and/or feet with a small current passing to measure the resistance between the electrodes. Bioimpedance provides an assessment of body composition by measuring various parameters (Alvero-Cruz et al., 2001). The parameters used in this present study were weight, height, basal metabolism, fat body mass, lean body mass, body fat percentage and fat free mass percentage.

The bioimpedance test had a standardization to be followed with all the evaluated ones, in order to minimize the errors of measurement. The pre-bioimpedance procedures were: removing metal objects attached to the body of all evaluated; discontinue use of diuretic medications for at least 24 hours prior to the examination; avoid consumption of food and drink until 4 hours before the evaluation; always with patient at rest, suspension of exercise in the 8 hours before the examination and withdrawal, if possible, medicines that have water retention during the 24 hours before the exam (Kyle et al., 2004).

Weight and height data were used to calculate the Body Mass Index (BMI), according to the criteria of the World Health Organization (WHO, 2012), through the formula BMI = weight (kg) / height $(m)^2$ and classified according to the values shown in Table 1.

Table 1. Classification of the Body Mass Index (BMI).

BMI (kg m^{-2})	Classification
< 18.5	Underweight
18.5 – 24.9	Normal Range
25 – 29.9	Overweight
30 – 34.9	Obesity (Class I)
35 – 39.9	Severe Obesity (Class II)
> 40	Morbid Obesity (Class III)

Source: World Health Organization (2012).

Statistical Analysis

For each dependent variable, the analysis was performed with a linear model involving the following factors: hepatic steatosis degree, income, schooling and gender, and covariance. When necessary, the Bonferroni post-test was performed. Values are expressed as mean and standard deviation of the mean. Statistical significance was set at 5% ($p < 0.05$). For all analyzes, the SPSS® program (Statistical Package for Social Sciences, version 22.0) was used.

Results and discussion

From a total of 114 individuals with hepatic steatosis, it was observed that 80 (70.1%) were females and 34 (29.9%) males. The mean age in patients with steatosis was 46.2 (SD = 8.3) and 95% CI [44.6; 47.7].

When assessing the BMI according to the values established by the World Health Organization, it was observed that only 13 (11.4%) had normal value, 44 (38.6%) were overweight, 32 (28%) presented grade I obesity, 20 (17.6%) grade II obesity and 5 (4.4%) grade III obesity. The mean BMI of the sample was 30.4 kg m^{-2} (SD = 5.3) and 95% CI [29.7; 31.7].

The waist circumference presented a mean of 100.2 cm (SD = 12.4) and 95% CI [97.8; 102.5]. Basal metabolism had a mean of 1451.9 Kcal (SD = 252.5) and 95% CI [1404.1; 1499.7]. The mean fat percentage of the evaluated patients was 37.97% (SD = 7.9) and 95% CI [36.4; 39.4], and fat weight averaging31.0 kg (SD = 10.3) and 95% CI [29.1; 32.9]. The fat free percentage presented a mean of 61.8% (SD = 8.3) and 95% CI [60.3; 63.4]. While the lean weight presented a mean of 50.0 kg (SD = 11.8) and 95% CI [47.8; 52.2].

The values of fat weight and BMI did not present statistical differences between the genders. Regarding age, subjects were divided into two groups: between ages of 18 and 39 years and 40 years or older. Twenty-four (21%) were between 18 and 39 years old and 90 (79%) were 40 years or older. The variables fat percentage and fat-free percentage had no statistical difference between the age groups.

Regarding schooling, 49 patients were illiterate or had first grade (43%), 34 second grade (29.8%) and 31 third grade (27.2%). The association between variables and schooling was not statistically significant.

Regarding income, 31 patients with steatosis had no income (27.2%), 31 (27.2%) received a salary or family grant, 43 (37.7%) received two to four salaries and 9 (7.9%) received five or more salaries. The association between variables and income was not statistically significant.

The values compared between genders, ages, income, schooling and grades of hepatic steatosis are presented in Tables 2, 3, 4,5 and 6, respectively.

Table 2. Comparison of means of body composition variables according togender.

Body composition variables	Gender		p**
	Female	Male	
Basal metabolism	1318.4 (109.8)*	1766.15 (230.7)*	0.000
Fat percentage	41.24 (6.6)*	30.3 (5.3)*	0.000
Fat weight	31.9 (10.5)*	28.9 (9.8)*	0.061
Fat free percentage	58.5 (7.04)*	69.7 (5.3)*	0.000
Lean weight	43.9 (5.05)*	64.35 (10.9)*	0.000
BMI	30.3 (5.44)*	31.6 (4.9)*	0.389
Abdominal circumference	97.8 (12.4)*	105.7 (10.9)*	0.007

*Values expressed as mean and standard deviation; **Calculated considering F-test of the general linear model involving the main effects of the five independent factors.

Table 3. Comparison of means of body composition variables according to age.

Body composition variables	Age (yearsold)		p**
	20 - 39	40 or more	
Basal metabolismo	1558.8 (301.7)*	1423.4 (238.2)*	0.001
Fat percentage	39.1 (8.25)*	37.6 (8.0)*	0.119
Fat weight	36.7 (13.2)*	29.5 (8.9)*	0.002
Fat free percentage	60.9 (8.25)*	62.1 (8.3)*	0.226
Lean weight	54.8 (14.0)*	48.7 (11.0)*	0.001
BMI	33.6 (7.1)*	29.9 (4.4)*	0.004
Abdominal circumference	105.4 (16.8)*	98.8 (10.7)*	0.031

*Values expressed as mean and standard deviation; **Calculated considering F-test of the general linear model involving the main effects of the five independent factors.

Table 4. Comparison of means of body compositon variables according to income.

Body composition variables	Income				
	Group 1	Group 2	Group 3	Group 4	P**
Basal metabolismo	1375.1 (188.5)*	1468.2 (229.0)*	1480.3 (297.8)*	1524.9 (327.1)*	0.976
Fat percentage	40.7 (6.1)*	37.7 (8.7)*	36.4 (8.1)*	36.7 (9.0)*	0.946
Fat weight	32.8 (10.76)*	31.5 (10.9)*	29.4 (9.8)*	30.8 (9.6)*	0.839
Fat free percentage	58.6 (7.4)*	62.3 (8.7)*	63.5 (8.1)*	63.2 (9.0)*	0.899
Lean weight	46.6 (8.7)*	50.6 (10.6)*	51.2 (13.7)*	53.5 (15.1)*	0.980
BMI	31.4 (5.6)*	31.3 (5.3)*	29.8 (5.0)*	30.1 (5.3)*	0.559
Abdominal circumference	100.2 (11.7)*	102.9 (13.0)*	98.0 (12.3)*	98.0 (14.4)*	0.413

Group 1: no income; Grupo 2: 1 salary or Family grant; Grupo 3: 2 to 4 salaries; Grupo 4: 5 or more salaries. *Values expressed as mean and standard deviation; **Calculated considering F-test of the general linear model involving the main effects of the five independent factors.

Table 5. Comparison of means of body composition variables according to schooling.

Body composition variables	Schooling			p**
	Illiteracyor elementar school	High school	Higher education	
Basal metabolismo	1430.3 (216.4)*	1507.5 (317.1)*	1425.2 (243.3)*	0.277
Fat percentage	37.9 (8.1)*	36.6 (7.7)*	39.5 (8.0)*	0.433
Fat weight	30.4 (9.7)*	31.0 (12.0)*	32.0 (9.6)*	0.625
Fat free percentage	61.7 (8.9)*	63.3 (7.7)*	60.5 (8.0)*	0.514
Lean weight	49.0 (10.0)*	52.6 (14.7)*	48.6 (11.1)*	0.221
BMI	30.8 (4.6)*	30.5 (6.4)*	30.6 (5.0)*	0.878
Abdominal circumference	100.8 (10.5)*	101.4 (16.0)*	97.9 (10.8)*	0.664

*Values expressed as mean and standard deviation; **Calculated considering F-test of the general linear model involving the main effects of the five independent factors.

Table 6. Comparison of the means of the variables of body composition according to the degrees of hepatic steatosis.

Body composition variables	Degrees of hepatic steatosis			p**
	I	II	III	
Basal metabolismo	1424.5 (221.4)*	1453.2 (256.3)*	1674.7 (441.7)*	0.125
Fat percentage	37.1 (7.4)*	38.8 (8.2)*	39.3 (11.0)*	0.038
Fat weight	29.2 (9.2)*	32.1 (10.3)*	39.1 (15.9)*a	0.010
Fat free percentage	62.9 (7.4)*	60.17 (9.0)*	60.7 (11.0)*	0.040
Lean weight	48.6 (10.1)*	50.1 (11.9)*	60.4 (20.4)*	0.096
BMI	29.7 (4.6)*	31.2 (5.2)*	35.4 (8.6)*a	0.017
Abdominal circumference	97.6 (11.6)*	101.7 (11.8)*	111.7 (17.0)*a	0.012

*Values expressed as mean and standard deviation; **Calculated considering F-test of the general linear model involving the main effects of the five independent factors. a. $p < 0.05$ when compared to grade I by the Bonferroni post-test.

The higher frequency of hepatic steatosis in females in the present study may be related to the greater obesity prevalence in this genre, data shown by the WHO in 2012, that 10% of men and 14% of women worldwide were obese. The WHO also concluded that in all regions of the world, women were more likely to be obese than men (World Health Organization [WHO], 2012; 2014). In addition, there is greater demand for health services by women.

The prevalence of obesity has reached epidemic proportions over the last years, it is estimated that over one billion people worldwide are overweight of which 312 million are obese (World Health Organization, 2012). In Brazil, it is estimated that 40% of adults present some degree of overweight or obesity. Nowadays, obesity is a major public health problem worldwide, in both developed and developing countries(Instituto Brasileiro de Geografia e Estatística [IBGE], 2010). In 2008, 35% of adults older than 20 years of age were overweight. The highest overweight and obesity rates (62% for overweight and 26% for obesity) are found in the American countries, while Southeast Asia has the lowest rates (14% for overweight and 3% for obesity) (World Health Organization, 2012). In this study, the younger age group showed a significantly higher BMI mean when compared to older individuals. This may be a reflection of how the elderly has been paying more attention to their health, adopting healthier lifestyles and protecting themselves from obesity-related diseases.

Rocha et al. (2005) suggested that measuring the BMI is useful in the evaluation of patients with NAFLD and Novaković, Inić-Kostić, Milinić, Jovićević and Dželetović (2013) showed that the BMI values were significantly higher in patients with metabolic syndrome and hepatic steatosis than in patients with metabolic syndrome without steatosis.

Patell et al. (2014) examined 60 obese patients and divided them into two groups, being the group A formed by patients with NAFLD, and the group B formed by individuals without this disease. Regarding gender, they found a relation between genders female : male of 2 : 1 in group A and of 3 : 1 in Group B. The BMI in Group A mean was 35.15 (SD = 4.20) and in group B was 33.54 (SD = 4.19). The present study confirmed that the presence of is a risk factor for NAFLD.

Besides BMI, body fat percentage and other indexes are commonly used for the evaluation of obesity. Community-based studies have reported positive associations between these obesity-related indexes in both adults and children (Taylor, Keil, Gold, Williams, & Goulding, 1998; He, Ding, Fong, & Karlberg, 2000; Sorof & Daniels, 2002). For this evaluation, the bioimpedance has gained acceptance in clinical practice, being highly effective and easy to use, allowing the evaluation of fat mass and lean tissue mass, replacing advantageously the measurement method of the thickness from skin folds that has great inter- and intra-examiner variability (Donini et al., 2013). The results of body composition by bioelectrical impedance are consistent and helpful in monitoring weight loss and change in fat body mass and lean body mass (Leal et al., 2011).

According to the classification, a fat percentage of ≥ 25% in men and ≥ 32% in women is considered as a high risk for developing obesity-related diseases (Heyward & Stolarczyk, 2000). The present study obtained a body fat percentage mean of 41.24% (SD = 6.6) in women and 30.3% (SD = 5.3) in men, representing a high risk for developing these disorders. It is worth mentioning the significant difference between the means of men and women, which can be explained by hormonal influences. For the other variables, the younger ones had a higher mean of fat percentage, as well as those who reported having no income and had higher education, however this difference was not statistically significant. The increase in body fat percentage is also associated with increased mortality and establishes risk for developing metabolic syndrome (Zhu, Wang, Shen, Heymsfield, & Heshka, 2003; Mota, Rinaldi, Pereira, Orsatti, & Burini, 2011).

The basal metabolic rate (BMR) resulted in 60 to 75% of daily energy expenditure and it is associated with the maintenance of most of the functions. The rest of the daily energy expenditure comes from the food thermal effect (10%) and the thermal effect of physical activity (15 to 30%). This daily energy expenditure directly affects body composition (Schneider & Meyer, 2007). A lower BMR can cause accumulation of body fat and a greater predisposition to diseases. There are evidences in the literature, about the inverse relationship between energy expenditure by systematic and regular physical activity and the accumulation of fat, verifying excellent results of physical activity for reducing weight and fat percentage, which may help increase lean body mass, as well as improve metabolic features (Frainer, Adami, & Vasconcelos, 2008). In the present study BMR was significantly lower in females and in older individuals which may contribute to the greater number of obese people in these groups.

Although the present study did not find a statistically significant difference between the variables of body composition and schooling and income, the Brazilian study by Lins et al. (2013) showed that even in a low-income population, a higher level of schooling has an impact on the prevention of obesity and on food choices. Studies have already shown a tendency of the ratio of large percentage of obese people with low schooling (Monteiro, Conde, & Castro, 2003).

Abdominal obesity assessed by waist circumference (WC) is related to a higher risk of mortality (Meller et al., 2014). This reflects the accumulation of visceral fat directly related to the genesis of the metabolic syndrome by promoting insulin resistance, glucose intolerance and a chronic inflammatory state. The establishment of this homeostatic imbalance leads to the development of dyslipidemias and to hepatic steatosis. It was observed in the present study, a statistically significant relationship between increased waist circumference and more advanced degrees of hepatic steaosis (Vanhoni, Xavier, & Piazza, 2012).

Novaković et al. (2013) reinforced that BMI values were significantly higher in patients with metabolic syndrome with hepatic steatosis than in patients with metabolic syndrome without hepatic steatosis. In the present study, a statistical significance was found between the increase in BMI and the degree of hepatic steatosis found during the ultrasound examination. In this way, the BMI in conjunction with the components of the body composition – fat weight, fat percentage, fat free percentage – are important parameters of correlation with the degree of hepatic steatosis.

Conclusion

The present study observed a higher frequency of hepatic steatosis in female subjects, which can be explained by the higher prevalence of obesity in this gender. There was no statistically significant association between BMI values with gender. It was evident an association between the components of body composition in patients with hepatic steatosis and socio demographic variables such as gender and age. It is suggested to carry out other studies with new anthropometric indicators to characterize new population profiles vulnerable to obesity-related diseases in other to adopt preventive strategies including regular physical exercise and nutritional guidance.

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