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Relationship between obstructive sleep Apnea Syndrome and Anthropometric Measures

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***Abstract*— *Anthropometric measures characterized by body mass index and waist and neck circumferences, are considered strong predictors of sleep disorders. Thus, the objective of this research was to evaluate the relationship between anthropometric data and sleep disorder in adults and elderly individuals. The research was carried out with patients attending at a Cardiology Clinic in a city in the interior of the center-west of São Paulo. In addition to personal identification data, anthropometric measures of weight, height, waist (CC) and neck circumferences (NC) and body mass index (BMI) were calculated. The occurrence of sleep disturbance was assessed under the aspect of the risk of occurrence of obstructive sleep apnea (OSA) using the STOP-Bang questionnaire. The study was approved by the Research Ethics Committee of the University of Marília - Unimar. Adult and elderly patients (n=197) participated in the study, 47% of them male. The mean age of participants was 59.52 ± 13.41 years. With regard to the risk of OSA, 50% of the participants presented intermediate risk, whereas 22% and 28% were classified as low and high risk, respectively, and such risk was significantly related to the anthropometric measures. The Mean Confidence Interval (95%) indicated that BMI, CC and NC values greater than 26.3 kg / m2, 90.4 cm and 26.3 cm, respectively, carry a risk of OSA. In conclusion, in view of the results found, more research is needed to improve the understanding of the determinants of sleep disorders in order to prevent or improve the diagnosis and treatment of these conditions.*

Keywords*— *Anthropometry. Sleep apnea. STOP-Bang questionnaire.

I. INTRODUCTION

Modern societies have achieved more benefits and comfort for everyday life, but these advantages have led to profound modifications in the way of life. The consequence was a rapid transition between the effort to search for food (and consequent energy expenditure) by the purchase of industrialized products that generally contain high levels of sugar and fat. Allied to this, there was also a reduction in the practice of physical activity, facts that led to the increase of overweight and obesity worldwide (BARBALHO et al., 2015; SADEGUI et al., 2016; BEMMOHAMMED et al., 2016).

These lifestyle changes have an impact on the incidence of metabolic disorders such as the development of type 2 diabetes, dyslipidemias, systemic arterial hypertension (HAS), and metabolic syndrome (MS) that aggravate the risk of developing cardiovascular disease (CVD), which are the most common chronic-degenerative diseases related to mortality (SALTIEL et al., 2017; CALABUIG et al., 2016; ZAHID et al., 2016; FURUHASHI et al., 2015)

Anthropometric measures that mark overweight (overweight or obese), including body mass index and waist and neck circumferences, are considered to be strongly related to the occurrence of sleep disorders (CARTER and WATTENPAUGH, 2008). Sleep is one of the natural functions of the living being controlled by the biological clock. The occurrence of sleep disorders plays a significant role in the aetiology of diseases associated with MS, such as obesity, diabetes and hypertension (SPIEGEL et al., 2004). In addition, studies have shown that poor sleep quality, especially in combination with increased visceral adiposity, is strongly linked to the development of a chronic, low-intensity inflammatory state leading to the release of cytokines and chemokines, including interleukin-1 beta (IL-1β), tumor necrosis factor alpha (TNF-α) and IL-6, as well as hs-CRP and cortisol, factors that contribute to the aggravation of numerous metabolic complications (HUANG et al., 2017;

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PRATHER et al., 2014; LIU et al., 2014; OPP, 2005; PRINZ et al., 2000).

These findings led to the objective of this research to evaluate the relationship between anthropometric data and sleep disorder in adults and elderly individuals.

II. METHODS

This is an exploratory, analytical, primary and observational, cross-sectional, single center study. The research was carried out with patients attending a Cardiology Clinic in a city in the interior of the center-west of São Paulo.

Patients were invited to participate in the study receiving clarification on the research protocol and those who accepted confirmed the acceptance by signing the informed consent form.

In addition to the personal identification data (name, sex and age), information was collected on the level of schooling, previous diagnosis of diseases or clinical conditions, use of medication on a continuous basis, presence of smoking, consumption of alcoholic beverages and practice of physical activity.

The anthropometric measurements were weight and height, from which the body mass index (BMI) was calculated. The waist (WC) and neck circumferences (NC) were also collected. For the collection of weight, stature and WC we used techniques recommended by Lohman et al. (1988) and Gibson (2005). The BMI was calculated according to Quetelet's formula (COLE et al., 1981). NC was measured at the mean neck height and in men just below the laryngeal prominence (BEN-NOUN; LAOR, 2003). NC was classified according to Ben-Noun et al. (2001), which values less than 34 cm and 37 cm are considered in normality for women and men, respectively.

The occurrence of sleep disturbance was assessed in terms of the risk of occurrence of obstructive sleep apnea (OSA) using the STOP-Bang (Snoring, Tiredness, Observed Apnea, and High Blood Pressure - Body mass index, Age, Neck Circumference, and Gender) consisting of eight issues relating to snoring, fatigue / fatigue / drowsiness, and apnea observed during sleep, blood pressure, BMI, age, NC, and gender. Questions can be answered affirmatively by a point or negatively by zero point, and the final score of this instrument can range from zero to 8 points. Summation between zero and two points indicates low risk of OSA, while three to four points indicates intermediate risk and five to eight points high risk (FONSECA et al., 2016).

The statistical treatment of the quantitative data was performed with the support of the BioEstat 5.0 program. The data were presented by means of relative frequency and the descriptive statistics in table presenting the mean ± standard deviation, median and minimum and maximum values. In order to evaluate the significance of the relationship between the studied variables, Student's t-tests, Anova followed by Tukey, Kruskal-Wallis followed by Dunn, and Pearson's correlation tests and the mean confidence interval (Bootstrap Resampling Technique) were used. The tests were selected according to the purpose of the analysis and the variance of the data to be analyzed. The probability of significance considered was 5% ($p \leq 0.05$) for the operations performed.

This study was approved by the Research Ethics Committee of the University of Marília - Unimar under protocol number 1,989,745.

III. RESULTS AND DISCUSSION

A total of 197 adult and elderly patients were included in this study, 47% of them male. The mean age of participants was 59.52 ± 13.41 years, with no significant difference between the two sexes ($p = 0.4329$).

The anthropometric measures evaluated are presented in Table 1.

Table.1: Descriptive presentation of age and anthropometric measures evaluated.

Parameters	Mean±standard deviation	Median	Minimun	Maximun
Age (years)	59.52±13.41	61	25	89
BMI (kg/m^2)	28.85±5.58	28	18	58
WC (cm)	100.15±14.3	100	59	139
NC (cm)	38.32±4.24	38	29	52

BMI: body mass index. WC: waist circumference. NC: circumference of the neck.

The application of the STOP-Bang questionnaire resulted in an average score of 3.63 ± 1.56 (minimum-maximum = 0-8). With regard to OSA risk, 50% of the participants presented intermediate risk, while 22% and 28% were classified as low and high risk, respectively.

A significant relationship was found between the risk of OSA and the anthropometric measures analyzed in this study. The higher the BMI, WC and CP, the higher the risk (Table 2).

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Table.2: Anthropometric measures (BMI, WC and NC) according to the risk of obstructive sleep apnea (OSA).

Risk of OAS	Measure	BMI (kg/m^2)	WC (cm)	NC (cm)
Low (n=44)	Mean±standard deviation	27.45±3.88[A]	93.61±10.91 [A]	36.45±3.91 [A]
	CI of the mean (95%)	26.3 - 28.4	90.4 – 96.3	35.3 – 37.4
Intermediary (n=99)	Mean±standard deviation	28.20±5.42 [A]	98.09±13.12 [A]	37.78±3.61 [A]
	CI of the mean (95%)	27.2 – 29.1	95.5 – 100.2	37.1 – 38.4
High (n=54)	Mean±standard deviation	31.20±6.37 [B]	109.25±14.62 [B]	40.85±4.47 [B]
	CI of the mean (95%)	29.6 – 32.6	105.5 – 112.5	39.6 – 41.8
	p-value	0.0037*	0.0000**	0.0000**

CI: Confidence interval. BMI: body mass index. WC: waist circumference. NC: circumference of the neck. ns: non significative. *Kruskal-Wallis / Dunn. **Anova one way / Tykey. Means followed by the same capital letter in the columns do not differ from each other by the statistical test at 5% probability.

The Confidence Interval (CI) of Mean (95%) allows us to infer that BMI values above 26.3 kg / m2 entail risk, at different levels, of OSA. The same reasoning is possible for WC and NC measurements, whose risk-related values are 90.4 cm and 35.3 cm, respectively.

In our study, 50% of the patients presented intermediate risk and 28% high risk of OSA. These values are superior to those found in other studies using the same instrument, the STOP-Bang.

Bamgbade et al. (2017) in a study with women undergoing abdominal surgery showed 18.1% and 11.3% had intermediate and high risk of OSA, respectively.

Dixon et al. (2016) evaluated 1635 patients from a surgical hospital and found that 14.89% had intermediate risk of OSA and only 3.93% were at high risk.

Patients from a hospital in Nigeria were evaluated by Ozoh et al. (2014). These authors found that the risk of OSA was 36.3% of patients at high risk.

Obesity was positively associated with the risk of OSA in our study as well as in others, such as that of Ozoh et al. (2014), from Bamgdage et al. (2017), from Dixon et al. (2016), de Ruiz et al. (2016) and Kiełbasa et al. (2016).

Dixon et al. (2016), Bamgdage et al. (2017) observaram que a CP aumentada (> 40 cm) leva a maior risco de AOS. Ruiz et al. (2016) observaram correlação positiva entre CP e risco de AOS.

Dobrosielski et al. (2016) and Soler et al. (2017), as well as in this study, found that the higher the CP measure, the greater the risk of OSA.

The occurrence of OSA is a common condition among patients treated at the aforementioned Cardiology Clinic, with percentages higher than that of other populations. Although the instrument used to assess such a disorder is widely known, its performance may vary among populations.

IV. CONCLUSION

The IMC, WC and NC are anthropometric measures that presented a positive and significant relationship with the occurrence of sleep disorders, since the increase of these measures led to an increased risk of OSA.

We suggest that further research is necessary to improve the understanding of the determinants of sleep disorders in order to provide prevention or even improve the diagnosis and treatment of these conditions.

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