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Evaluation of Quality of Life in Individuals at Risk of Obstructive Sleep Apnea and their Anthrometric Correlations

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***Abstract*—** *Sleep is a biological condition capable of restoring the body from daily activities, its deprivation can be caused by several disorders, which includes Obstructive Sleep Apnea (OSA). Obesity, among others anthropometric quantities, belongs to the risk factors for OSA. The aim of this study was to evaluate possible relationships between anthropometric factors and the risk of OSA and their correlations with quality of life in students. Analytical observational cross-sectional study carried out with undergraduate university students of both sexes. The characteristics of age, sex, weight and anthropometric measures were used and two questionnaires were applied: STOP-BANG and SAQLI. The sample consisted of 90 participants, of whom 87.8% were considered normal for OSA (Group 1) and 12.2% were at risk of OSA (Group 2). The most influential measures for the Body Mass Index (BMI) were neck circumference (NC) and waist circumference (WC), with associations of +0.311 and +0.580, respectively. The largest problem in the quality of life of the participants was regarding the symptoms of the disease, while the measures that most influenced it were the waist-to-hip ratio (+0.608) and WC (+0.406). Most of the participants had an adequate BMI, while in Group 2, most had a high BMI. The most related problems with quality of life were morning headache, excessive daytime sleepiness and fatigue. It is suggested that BMI and anthropometric measurements increase the likelihood that the individual is at risk for OSA and, consequently, interfere with quality of life.*

I. INTRODUCTION

Quality of life is related to the individual's ability to live and feel good. In this context, sleep is essential. Sleep is a biological condition whose main function is the homeostasis of the organism. For this, the organism adapts itself day and night through the sleep-wake cycle, thus determining a biological rhythm. However, when there is sleep deprivation, physical and mental well-being can suffer interference and cause physiological damage. Such deprivation can be a consequence of sleep disorders, in which Obstructive Sleep Apnea (OSA) stands out. It is a pathological condition still under-diagnosed, but very prevalent in the world [1,2].

Among the manifestations of OSA are excessive daytime sleepiness, tiredness, anxiety, irritability and morning headache. The risk factors for its development involve several mechanisms, from age and sex to chronic diseases. One of the main factors is obesity, especially for

individuals with a Body Mass Index (BMI) larger than 30kg/m^2, where different anthropometric aspects can contribute to the pathogenesis of this disorder. Anthropometric measurements have been shown to predict the severity of OSA, especially neck circumference (NC), an important predictor for snoring and disposition of fat around the upper airways [3,4.]

OSA can significantly affect the individual's quality of life, limiting everything from simple day-to-day activities to situations that require greater attention. In addition, when associated with obesity, it is estimated that the individual's limitations are even larger. It can cause reduction in social interactions and emotional functioning, which also trigger academic failure in many higher education students. Apnea carrier's snoring can cause problems with the roommates, it also affects the quality of sleep of those who live in the same household and share the same room, possibly resulting in reduced sexual desire[3,5,6].

Considering obesity an important risk factor for the onset of OSA and their influence on the individual's quality of life, the objective of this study was to evaluate the quality of life of university students at risk of OSA and their correlation with anthropometric factors.

II. METHODOLOGY

2.1 Type of study

This is a cross-sectional analytical observational study, based on resolution 466/2012 of the Conselho Nacional de Saúde (National Health Council, Brazil) and approved by the Research Ethics Committee of the Federal University of Alagoas under number 2.825.916.

2.2 Study location

The research has been held at the Federal University of Alagoas - Campus Arapiraca, located in the city of Arapiraca, Alagoas, Brazil. Data collections were performed at the institution's Laboratory of Anatomy.

2.3 Study population

Duly enrolled higher education students from different courses from Federal University of Alagoas took part in the study during research period (from October 2018 to April 2019). The minimal sample estimation (using alpha of 0.01 and standard deviation of 0.05) gave a total of 72 participants. The final total sample was 90 participants of both sexes. However, groups were not expected to have a very different number, due to the lack of predictability in this study to reduce differences between groups.

2.4 Inclusion criteria

The study included students duly enrolled at Federal University of Alagoas, Campus Arapiraca, aged between 18 and 40 years of both sexes.

2.5 Exclusion criteria

Individuals with arterial hypertension, diabetes mellitus, with other metabolic problems and / or using antidepressant pharmacological therapy were excluded, taking into account that the sleep of these individuals may be altered, due to the pathophysiology of their underlying diseases.

2.6 Data collect

Data were collected using an instrument to obtain profile of the participants and anthropometric measurements and two questionnaires to check OSA risk and quality of life.

For the research, the characteristics of age, sex, weight and anthropometric measurements (neck, waist and hip circumference and body height) were used. Two questionnaires were used: STOP-BANG (Snoring, Tiredness, Observed apnea, high blood Pressure, Body mass index, Age, Neck circumference and Gender) and SAQLI (Sleep Apnea Quality of Life Index).

The STOP-BANG questionnaire was developed in Canada, by the University of Toronto and, according to Fonseca et al. (2016), it is used to identify individuals with low and high risk for OSA through 8 objective questions [7,8]. Thus, this questionnaire was applied to all participants and, based on the evaluation criteria, the individual was classified as: low risk, intermediate risk and high risk for OSA.

As it is considered to be of low risk according to the criteria of the validated questionnaire, the participants who answered up to 2 questions were part of Group 1, above this value, fit in the group of individuals at risk of OSA, Group 2. Therefore, this second group also completed the Sleep Apnea Quality of Life Index (SAQLI) questionnaire, considered by Sampaio et al. (2012) a useful tool to measure the quality of life of patients with OSA[9].

The SAQLI, which was completed only by participants at risk of OSA, consists of 4 domains, distributed in 40 objective questions. The first domain (A) analyzes the participant's daily functioning, including situations such as the effort to perform the main activities of the day, stay awake and alert while performing such activities, have energy for physical exercises and leisure activities and have good concentration. For domain B, social interactions are addressed, such as snoring disturbing or irritating roommates, not wanting to interact with other people and having inappropriate or infrequent sexual intercourse. In domain C, emotional functioning is analyzed, with an

approach to the feeling of anxiety, frustration, irritability, depression and impatience. In the last domain (D), it addresses the symptoms in the individual, including reduced energy, excessive tiredness, waking up several times during the night, morning headache and non-restorative sleep[10,11].

2.7 Data analysis

Based on the evaluation criteria of the SAQLI questionnaire, it was possible to analyze the quality of life of participants at risk for OSA and thus perceive their interference in the daily lives of patients. The questionnaire was distributed to individuals individually, where each read aloud all questions, as they filled out them. To interpret it in the research, the average responses of each domain were classified as: very large problem (1 to 1.9), large (2 to 2.9), moderate to large (3 to 3.9), moderate (4 to 4.9), small to moderate (5 to 5.9), small (6 to 6.9) and no problem (7), reaching an average of the four domains at the end. The higher the SAQLI score, the less the effect of OSA on quality of life[10].

To make the statistical evaluation, tables with variables in percentage values (%) were formulated to describe the profile of the sample. Pearson's Correlation (r) was used for descriptive statistics, assessing the degree of correlation between BMI and anthropometric measures and each of these measures with the four SAQLI domains. The analyzes were classified as very strong (r between 0.9 and 1), strong (r between 0.7 and 0.89), moderate (r between 0.4 and 0.69), weak (r between 0.2 and 0.39) and very weak (0.0 and 0.19), whether positive or negative[12,13].

III. RESULTS

The sample consisted of 90 participants (59 women and 31 men) aged between 18 and 34 years. Eleven individuals (12.2%) were at risk for OSA, thus composing Group 2.

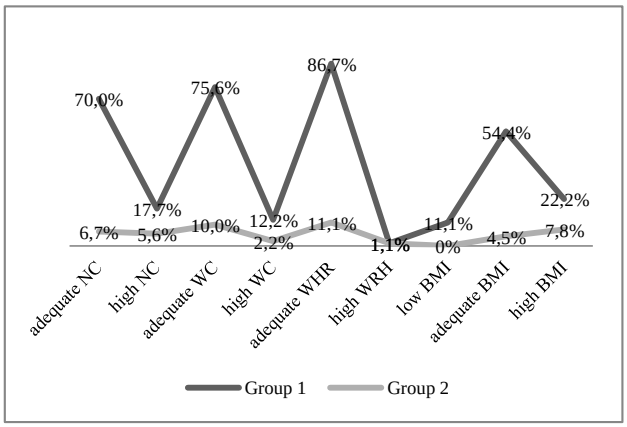
Table 1 - Characteristics of the studied sample.

	Frequency	%
Sex		
Male	31	34,4%
Feminine	59	65,6%
BMI		
Under weight	10	11,1%
Adequate	53	58,9%
Overweight and Obesity	27	30%
Group 1	79	87,8%
Group 2	11	12,2%

BMI= Body Mass Index.

According to the World Health Organization (WHO)[14], the appropriate measures for NC, WC and WHR (Waist-to-hip ratio) are, respectively, <37, ≤94 and <1 for males and <34, ≤80 and <0.84 for females. Thus, in this research, both Group 1 and Group 2 were within the parameters according to the general average, as well as group 1 was with adequate BMI (Graph 1), considering the classification of the Associação Brasileira para Estudo da Obesidade e da Síndrome Metabólica (ABESO / Brazilian Association for the Study of Obesity and Metabolic Syndrome)[15], with values between 18.5 and 24.99 kg/m^2. Although, in the total of participants, the majority had an adequate BMI, in group 2 (12.2%), the majority had a high BMI, inferring that overweight and obesity influence the appearance of OSA.

Graph 1 - Percentage of Individuals in Groups 1 and 2 on NC, WC, WHR and BMI.



NC = Neck Circumference; WC = Waist Circumference; WHR = Waist-to-Hip Ratio; BMI = Body Mass Index.

The application of Pearson's Correlation (Pearson's ρ) was used in order to verify the relationship between BMI and the variables NC, WC and WHR. Among the participants in group 1, there was a moderate positive correlation (+0.604) between BMI and NC and very strong between BMI and WC, analyzing that the higher the BMI, the greater the NC and WC.

When analyzing WHR, BMI had a weak positive correlation (+0.331). As in group 1, the main correlation in group 2 was between BMI and WC (+0.580), which was moderately positive. NC and WHR had a weak positive correlation (+0.311) and very weak (+0.079), respectively, with the BMI in this same group. Between the two groups, none of the anthropometric measurements showed a negative correlation with BMI (Table 2).

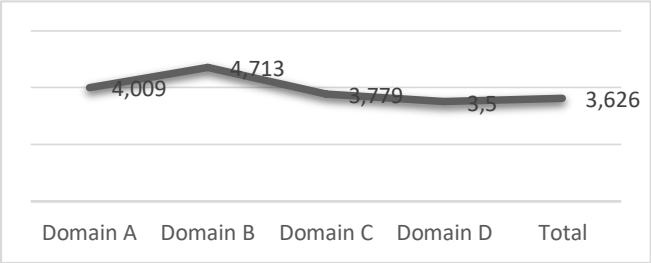
Table 2: Correlation between BMI and anthropometric measurements.

Variables	r (Group 1)	r (Group 2)
BMI e NC	+0,604	+0,311
BMI e WC	+0,902	+0,580
BMI e WHR	+0,331	+0,079

r = Pearson's correlation; BMI = Body Mass Index; NC = Neck Circumference; WC = Waist Circumference; WHR = Waist-to-Hip Ratio

According to the score of the domains of the quality of life questionnaire (SAQLI), none of the domains presented an average so that there was a major problem with the quality of life of the participants in group 2 (Graph 2). In general, the influence of OSA on quality of life is moderate to large (3,626). When analyzing the four domains, the one that has the greatest impact for the participants is the D (3,5) presenting a moderate to large problem in the symptoms of the disease, followed by the C domain (3,779), interfering in the participant's emotional functioning. As for the other two domains, A and B, which represent daily functioning and social interaction, respectively, OSA presented a moderate problem.

Graph 2 - Average Score of the SAQLI Questionnaire Domains.



SAQLI = Sleep Apnea Quality of Life Index

Also using Pearson's ρ, the relationship between the variables NC, WC, WHR and BMI with the 4 SAQLI domains was analyzed. The data presented in Table 3 show that for domain A, referring to daily functioning, the one that most influences quality of life is WHR, with a strong positive correlation (+0.783), followed by NC and BMI, presenting, respectively, weak negative and positive correlation. Thus, the greater the WHR, the greater its interference in domain A, the same happening for BMI. For domain B, only WHR showed a positive correlation, although very weak (+0.062), while BMI represented a weak negative correlation (-0.320). In domain C, all variables showed a weak or very weak correlation, whereas in domain D, only NC presented this way (-0.024). The greatest influence for this latter domain, as well as in A, is that of WHR, thus being a moderate positive correlation assessing that the higher the WHR, the greater its influence on the symptoms of the disease, including morning headache, excessive fatigue and non-sleeping repairman.

Table 3: Correlations of SAQLI domains with NC, WC, WHR and BMI

Variables	Domain A	Domain B	Domain C	Domain D
NC, cm	-0,309	-0,074	-0,266	-0,024
WC, cm	+0,035	-0,080	+0,250	+0,406
WHR	+0,783	+0,062	+0,164	+0,608
BMI	+0,382	-0,320	-0,228	-0,411

NC = Neck Circumference; WC = Waist Circumference; WHR = Waist-to-Hip Ratio; BMI = Body Mass Index.

IV. DISCUSSION

In the present research, the influence of obesity on OSA risk was identified, as well as the correlation between this sleep disorder and the quality of life in these undergraduate students. Some of our results shown discrepancies with previous studies on higher education student populations on different countries. Our study suggests that the increase in body mass index explains the frequency of OSA and that the presence of this sleep disorder affects the quality of life[16–18]. To our best knowledge, this is the first study of this correlation on a Northeast Brazilian population.

An original study by Saygin et al. (2016)[16] with 337 university medical students from Turkey identified that only 5 (1.5%) were diagnosed with higher OSA risk. According to Khassawneh et al. (2018)[17] this percentage reached 5.4% on higher education students from Jordan, whereas it was found by Carvalho et al. (2015)[19] that this percentage reached 23,13% on Sirian-Lebanese Hospital from southest Brazil, in our study OSA risk was 12.2% on the population studied.

On the other hand, Wosu et al. (2014)[20] have identified that 7,8% of Chilean college students had higher OSA risk, and these, 12,8% had general obesity and 42,7% had central obesity. The evidence on the relationship between obesity and OSA suggests that the increase in fat mass restricts the normal flow of air, in addition to the fact that this increase is capable of reducing residual capacity and tidal volume of air, changing pulmonary mechanics.

However, the presence of this disorder is not restricted to the physical size of individuals[21]. Although the complete mechanisms involved in the association of OSA and WC are not clear, disposition of fat around the upper airway is one of the explanations for its collapse during sleep[20,22–24]. Our results have demonstrated, as in other studies[25–27], that NC and WC have strong correlations with BMI.

Researches carried out with university students on Chile[20] and on Thailand[28] have found a *strong positive correlation* between WHR and BMI. This is in contrast with our findings, which identified a *weak positive correlation* (+0,331). When one analyzes all the anthropometric measures evaluated, those that most influenced the increase in BMI, *i.e.*, obesity, were NC and WC. Therefore, the higher these measures, the higher the individual's BMI and, consequently, increased physical and mental damage[18]. A study conducted with apnea patients in 2016 by Coman *et al.*[10] concluded that NC and BMI have little significance with the severity of quality of life, this is in agreement with the findings in our study. Whereas, for Dutt et al. (2013)[29], the SAQLI domain D, representative of symptoms, including BMI, had greater influence on this quality of life issue.

In our current study, the SAQLI four-domain analysis showed that the one most affected by anthropometric measurements and BMI is domain A, mostly influenced by WHR and BMI. Therefore, it is possible to infer that the higher WHR and BMI, the higher influence of OSA over the most important daily activities, such as staying awake while performing the main activities of the day or relaxing, or in general activities such as concentrating or having good memory. A study with medical students from Colombia, Barahona-Correa in 2018 identified that sleep problems are often reported and this condition can trigger psychological disorders and learning difficulties[30].

For Pacheco and dos Anjos[31], such losses are often observed, especially changes in mood, irritability, and lack of concentration and memory. The consolidation of memory and learning is totally influenced by the reactivation of mnesthetic traces during sleep, when the brain is protected from the interference of external stimuli, especially in the REM (Rapid Eye Movement) phase[1].

Thus, the losses resulting from poor sleep quality in students with OSA affect their daily activities, and may interfere with their academic learning, as perceived in our present study, although there was no statistically significant difference between the domains or in the global average of the questionnaire quality of life (SAQLI).

The most reported issues were those belonging to the SAQLI 4th domain, representing the symptoms associated with OSA, as morning headache, excessive daytime sleepiness, and fatigue. As such, this has shown that the larger the severity of OSA, the more expressive its perceived symptoms. The association between these symptoms and sleep can be explained by the change in the release of serotonin and melatonin and the increase in REM sleep, in addition, morning headaches are strongly influenced by the decrease in hours of sleep and high amount of nighttime awakenings[32].

In our study, most participants have adequate WHR, according to what was proposed by the WHO. As presented on the literature[33], WHR is the one factor that has largest influence on daily activities degradation from the OSA-risk population, as it interferes in waking state, concentration, and symptons appearance. This can be explained by the fact that WHR is one of the main indicators of central obesity, given the excess distribution of adipose tissue in overweight individuals.

In groups of military veterans with health-related low quality of life and presence of OSA, Vinnikov *et al.*[34] have identified the presence of increased fatigue. In addition, Vinnikov *et al.* realized that sleepiness and fatigue were important determinants for reducing the quality of life, consequently affecting sleep quality. Such result is in agreement with our findings on this report. It is also essential to understand that the effect of sleep disorders and excessive daytime sleepiness is influenced by external factors, such as culture, social, and economic environment. Thus, it is necessary to understand these external factors in order to correctly intervene in these points to improve general population health, since OSA is a public health problem[30,34].

In individuals with OSA-reduced quality of life, the functional capacity to perform daily activities can be compromised, especially when OSA is not treated. Other physiological impairments caused by poor sleep quality can be involved in the apnea process, as some pulmonary and cardiovascular disorders resulting from limitation of inspiratory flow and reduction in expiratory volume[7]. Strong OSA limitations and effects on the quality of life can origin further physical, physiological and psychological problems to these individuals.

V. CONCLUSION

This study has made it possible to analyze the presence of OSA risk among students from different courses of a Brazilian Northeast university, as well as the influence of BMI and anthropometric measures for their development.

In addition, it was possible to analyze the quality of life of students at risk for OSA (Group 2).

We have found that OSA, obesity and quality of life are interconnected. Thus, our results suggest that BMI and anthropometric (neck, waist and hip circumference and body height) measures can increase the likelihood of OSA incidence risk and, in consequence, interfere in the quality of life. This reflects on the answers obtained on questions related to daily activities. From mild symptoms like lack of energy, difficulties to perform physical exercises or to remain awake, social interaction problems (e.g., annoying snoring and frequent conflicts), and emotional functioning (e.g., impatience, frustration, and fear) to more severe OSA symptoms, fatigue, lapses of attention, and morning headache.

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