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ORIGINAL ARTICLE

Risk prediction for Obstructive Sleep Apnea prognostic in Obese patients referred for bariatric surgery

Adriana Fontes Hora[1], Lara Maris Nápolis[1], Débora Strose Villaça[1], Renata dos Santos[1], Thales Delmondes Galvão[1], Sonia Maria Guimarães Togeiro[1], Lia Rita Bittencourt[1], Luiz Eduardo Nery[1]

1. Departamento de Pneumologia, Universidade Federal de São Paulo, São Paulo (SP), Brasil.

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Study carried out in the a private clinic in the city of São Paulo, (SP), Brasil.

ABSTRACT

Objectives: (i) To assess the anthropometric measurements, along with the clinical characteristics and quality of life profiles of the studied patients; (ii) To determine the occurrence and severity of Obstructive Sleep Apnea (OSA), using polysomnography; and (iii) To identify the best anthropometric and clinical indicators to predict OSA in obese patients who are candidates for bariatric surgery. **Methods:** a prospective observational study conducted in a private clinic, using consecutive sampling of patients eligible for bariatric surgery with a BMI ≥ 40, or with a BMI of ≥ 35 kg/m² accompanied by comorbidities associated with obesity. **Results:** Sixty patients were initially selected, of whom 46 agreed to take part in the preoperative evaluation. OSA was observed in 76% of patients, 59% of whom had moderate-to-severe OSA, with a predominance of men in these groups. Among the variables suggesting statistical difference between groups, waist-to-hip ratio (WHR) was the only clinical factor associated with scores the apnea hypopnea index (AHI) ≥ 15, with a cut-off value of 0.95. The results showed that patients scoring above 0.95 are three times more likely to have moderate-to-severe apnea. **Conclusion:** The best risk factor for the prognostic of moderate-to-severe OSA was presenting a WHR score with a cut-off value of 0.95 or above.

Keywords: Obstructive sleep apnea; Bariatric surgery; Anthropometry; Waist-to-hip ratio.

INTRODUCTION

Obesity is considered one of the top ten public health problems in the world by the World Health Organization (WHO), and it is described as an increasingly frequent disease, with its prevalence tripling in the last 40 years, affecting around 13% of the world's adult population, and 18.9% of adults in Brazil.[1,2]

This rise in the occurrence of obesity is related to an increase of other comorbidities, including the obstructive sleep apnea (OSA), presenting a well-established causal association. Obesity and OSA are exceptionally common health problems, characterized by the disturbance of glucose homeostasis, insulin resistance, hypercholesterolemia and hyperlipidemia[3-6]. OSA is strongly associated with visceral adiposity, and both conditions are related to cardiovascular as well as with metabolic complications.[7,8] In an epidemiological study (EPISONO) conducted with a representative sample comprised of adults from the capital of São Paulo, Brazil, OSA was found in 32.8% of the target population.[9]

Among the various therapeutic options for patients with severe obesity, the metabolic and bariatric surgery (MBS) is a both restrictive and malabsorptive procedure, and it can lead to significant weight loss as well as modulate the patient's metabolic profile.[10] Several studies have shown that the prevalence of OSA in individuals who are candidates for MBS is higher than in the general population[11-13]. However, it is not known whether the occurrence of OSA in a population composed of predominantly young individuals seeking this type of private treatment in São Paulo differs from that described in the literature regarding the general population.

Although polysomnography (PSG) is the gold standard test for diagnosing OSA[14] in clinical practice, it is not always possible to apply it to all subjects, either because of the cost, or the availability of services able to perform a high-quality PSG test. Thus, it is necessary to gather clinical and anthropometric data for patient stratification regarding high risk of OSA, for the referral of PSG. In the reviewed literature, no measures or criteria that could meet this objective have been described as yet. That being said, neck and abdominal circumference measurements as well as waist-to-hip ratio have been suggested in previous studies as assessment strategies alternative to using only BMI, but without determining a specific cut-off value for this purpose.[3,15-17] Although

Correspondence to:
Adriana Fontes Hora. Universidade Federal de São Paulo, Rua Coronel Lisboa, 966, Vila Clementino, CEP 04039-002, São Paulo, SP, Brasil.
Tel.: +55 (11) 5576-4848 voip 1494. E-mail: hdri21@yahoo.com.br
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there are already numerous studies addressing the prevalence of Obstructive Sleep Apnea in bariatric surgery candidates, the main attribute that differs this study from others is that it objectively defines anthropometric measures easily obtained during clinical evaluation, establishing a cut-off point in order to define who should be referred for polysomnography. Other studies lack this objectivity and clarity.

Therefore, the present study of obese patients eligible for MBS intervention in a private clinic aimed to (i) Assess the anthropometric measurements, along with the clinical characteristics, and quality of life profiles of these patients; (ii) Determine the occurrence and severity of OSA using polysomnography; and to (iii) Identify the best anthropometric and clinical indicators to predict OSA in obese subjects.

METHODS

To achieve the aforementioned proposed objectives, a prospective observational study was carried out from June 2015 to October 2018, using consecutive sampling of patients eligible for bariatric and metabolic surgery in a private clinic Gastro Obeso Center in the city of São Paulo, Brazil (GOB) with a diagnosis of obesity and a BMI ≥ 40, or a BMI of ≥ 35 kg/m² accompanied by comorbidities associated with obesity. The present study was approved by the Ethics and Research Committee of the Federal University of São Paulo (Universidade Federal de São Paulo), under No. 503.590, approved on: 12/20/2013, with the Certificate of Presentation for Ethical Consideration (CAAE, acronym in Portuguese) number: 18258413.4.0000.5505.

The inclusion criteria for the study were: patients diagnosed with obesity referred for metabolic and bariatric surgery, being over 18 years old, being of either sex, having a body mass index (BMI) ≥ 40, or ≥ 35 kg/m² with associated comorbidities, and agreeing to participate in the study by signing an informed consent form.

The exclusion criteria were: individuals with sleep deprivation (<4 hours/night); with psychiatric disorders that could hinder the participation in the tests; with insomnia; being diagnosed alcoholics; working in shifts; patients using neuroleptic and hypnotic drugs; having decompensated clinical diseases; individuals with learning disorders unable to complete the questionnaires; having movement disorders (neuromuscular, rheumatic or orthopedic diseases), since questionnaires concerning quality of life refer to movement skills; and patients undergoing OSA treatment.

The clinical evaluation consisted of a physical examination, which assessed the patients' anthropometric characteristics, general health status and comorbidities. A review of the patient's medical record was also carried out in order to obtain information along with a full abdominal ultrasound.

For the classification of the nutritional status, the body mass index (BMI) was calculated in kg/m² . Abdominal and hip circumference were assessed using a tape measure with the undressed patient in an upright position, measured at the level of the umbilicus and at the largest part of the hip, respectively. This data was then used to calculate the waist-to-hip ratio (WHR). Neck circumference was measured using a horizontal line at the middle point of the thyroid cartilage.[15-17]

As for the soft tissues, the palatine tonsils were measured and the modified Mallampati classification was evaluated.[18]

The Epworth Sleepiness Scale (ESS) is a subjective assessment of excessive daytime sleepiness (EDS).[19,20] The maximum score is 24 points, and patients with a score greater than or equal to 10 were considered somnolent.

The Berlin Questionnaire contains questions about sleep, snoring, the presence of respiratory pauses, daytime sleepiness, BMI as well as about systemic arterial hypertension, and the answers obtained were used to classify the patients' risk of OSA.[21-23]

The Functional Outcomes of Sleep Questionnaire (FOSQ) test measures quality of life and is designed specifically for people with sleep disorders.[24] The results allow health professionals to analyze how therapy would improve the patient's quality of life related to sleep. By completing the questionnaire periodically, the patients provided important information about the treatment effectiveness.

The Medical Outcomes Short-Form Health Survey (SF-36) is a multidimensional questionnaire comprising 36 items, in 8 scales or components: functional capacity (10 items), physical aspects (4 items), pain (2 items), general health status (5 items), vitality (4 items), social aspects (2 items), emotional aspects (3 items), mental health (5 items), as well as one question related to a comparative assessment between current and previous health conditions. It assesses both negative (disease or illness) and positive aspects of health (well-being).[25]

Full-night PSG was performed before and at least three months after the operation at the XX Institute, (XXX) using a digital polysomnography (Embla Ò N7000, Embla Systems, Inc., Broomfield, CO, USA). Surface electrodes were used to record a electroencephalography (EEG) (C3-A2, C4-A1, O2-A1, O1-A2); a chin and anterior tibialis electromyography; a bilateral electrooculogram and an electrocardiography (modified lead V1). Breathing was monitored with a nasal cannula with flow measurement using a pressure transducer along with a thermistor, and respiratory effort was assessed by inductance plethysmography of the chest and abdomen.

Pulse oximetry was used to measure oxygen saturation. Body position was evaluated by placing a sensor over the region of the sternum bone. A tracheal microphone allowed for the snoring to be recorded.

Sleep staging, respiratory events, arousals and periodic limb movements were assessed using the criteria of the American Academy of Sleep Medicine (AASM)[14], both apneas and hypopneas scores were evaluated according to the recommended protocols of the American Academy of Sleep Medicine.[14,26]

The following parameters were obtained: sleep latency in minutes; REM sleep latency in minutes; total recording time (TTR) in minutes; total sleep time (TST) in minutes; sleep efficiency; sleep stages (0, 1, 2, 3 and REM) calculated as a percentage of TST; number of microarousal and arousal index (AI) (per hour of sleep); respiratory events (apneas and hypopneas, and arousals related to respiratory effort); oxyhemoglobin saturation in percentage (baseline, average, minimum and percentage of total recording time with SpO_2 <90%); oxyhemoglobin desaturation index, REM sleep desaturation index, non-REM sleep desaturation index; where the oxygen desaturation Index (ODI) = total number of desaturations/total sleep time (min) x 60.

The sample calculation was made using the G Power software and was based on previous data from a pilot study with an effect size of f: 0.25 (F Test Manova), and p ≤0.05, as well as an observed power of 0.90 for comparison of baseline AHI score between the four groups, as described in the polysomnographic evaluation: i) without OSA ii) with mild OSA (≥5-15) iii) with moderate OSA (> 15-30) iv) with severe OSA (> 30). Thus, the sample size required was estimated to be n = 40 volunteers, with the assumption of a 20% sample loss, amounting to a required sample of n = 48 volunteers).

The statistical analysis was performed using the SPSS software (IBM, SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.). To verify the normality of the continuous variables, the Kolmogorov-Smirnov test was used. The z-score was used to standardize data that did not follow the normal distribution curve.

For the characterization of the studied groups, a descriptive analysis was applied (mean ± standard deviations). For the polysomnographic variables analysis and the questionnaires, the univariate General Linear Model (GLM) was used to compare the groups. The categorical data analysis was performed using the Chi-square test and, when necessary, the Fisher's test.

The significance level adopted for the study was α ≤ 0.05. The receiver operating characteristic (ROC) curve was explored and constructed in order to establish cut-off points for anthropometric measurements as risk prediction of OSA prognosis (considering an AHI ≥ 15).

RESULTS

Sixty patients were initially selected, 46 of whom agreed to take part in the preoperative evaluation (ten did not want to undergo the medical examination, three did not meet the inclusion criteria due to the absence of comorbidities associated with a BMI bellow 40, and one was excluded due to the use of neuroleptics.

In our sample, OSA was observed in 76% of patients, 17% with mild apnea, 24% with moderate, and 35% with severe. Table 1 shows the descriptive data of the sample with the comparison of the four groups: The severe group had the highest values of waist circumference(p=0.008), WHR (p=0.03), EDS (p=0.04), highest percentage risk of apnea (p=0.009),as well as a greater association with hepatic steatosis (p=0.04) and arterial hypertension (p=0.009). The mild OSA group presented a higher prevalence of women.

Table 2 shows the comparison between the polysomnographic variables among the four groups: without OSA, and groups with OSA (mild, moderate and severe). In the evaluation of the apnea hypopnea index (AHI), as expected, there were significant differences between the groups, as this variable was the classification criterion for patient stratification (p<0.001) (Table 2).

In the evaluation of sleep stages, there was a statistical significance only in the N1 stage, with a statistical difference between the groups, the highest percentage seen in the severe OSA group, which also showed a higher rate of arousals (p<0.001). The severe OSA group also showed greater values for supine AHI, REM AHI, NREM AHI, followed by the moderate OSA group (p<0.001). In the assessment of the mean (p=0.002), the baseline (p=0.03) and the minimum SpO_2 (p=0.001), as shown in Table 2, the severe OSA group showed lower levels of saturation. In the evaluation of SpO_2 <90%, a higher percentage of desaturation was found in the severe OSA group, when compared with the other groups(p<0.001). In the assessment of the desaturation index regarding REM, non-REM and oxygen desaturation index (ODI), the severe OSA group had higher rates, followed by the moderate OSA group (p<0.001)

When exploring the total sample of obese patients with OSA (moderate-to-severe category, AHI ≥ 15), and based on a preliminary analysis of the descriptive data, the variables identified a statistical difference between groups, namely: somnolence (ESS), abdominal circumference, and WHR (see Table 1). When exploring these variables as risk factors of AHI ≥ 15, we analyzed the anthropometric variables and identified WHR as the best indicator, with an area under the curve of 0.77 (p = 0.02) with a cut-off value of 0.95. Another strong risk prediction for OSA prognostic investigated was neck circumference (AUC:0.59, p:0.30), but it was not considered a significant factor. (Figure 1). Figure 1 depicts the WHR as a predictor variable of moderate-to-severe OSA.

Figure 2 shows the comparison of WHR between the groups: "without OSA + mild" and "moderate + severe".

Table 1. Descriptive data of the sample.

Variables	Total (n = 46)	Without OSA (n = 11)	Mild OSA (n = 8)	Moderate OSA (n = 11)	Severe OSA (n = 16)	P
Age (years)	39 ± 9	32 ± 7	40 ± 10	37 ± 7	40 ± 9	0.07
Female Gender	26 (56.5%)	7 (63.6%)	8 (100%) ¤	5 (45.5%)	6 (37.5%)	**0.02** ¤
Weight (kg)	120.0 ± 2.5	115.0 ± 15.0	110.0 ± 12.8	112.0 ± 23.0	130.5 ± 22.0	0.11
Height (m)	1.6 ± 8.0	1.6 ± 9.0	1.6 ± 5.0	1.6 ± 10.0	1.7 ± 6.5	0.06
WHR	0.90 ± 0.08	0.90 ± 0.06	0.85 ± 0.09 *	0.93 ± 0.08	0.95 ± 0.08	**0.03 ***
WC (cm)	123.0 ± 13.6	117.0 ± 7.6 Δ	115.5 ± 6.0 *	118.0 ± 12.0	130.0 ± 14.0	**0.008 Δ***
CC (cm)	38.0 ± 4.0	39.0 ± 3.0	35.9 ± 3.6	38.0 ± 4.0	40.0 ± 4.0	0.11
BMI (kg/m)	42.0 ± 5.0	41.0 ± 5.0	41.0 ± 4.0	40.8 ± 5.5	43.0 ± 5.0	0.54
Modified Mallampati Classification						
Grade 2	11 (23.9%)	5 (45.4%)	3 (27.3%)	1 (9.1%)	2 (18.2%)	
Grade 3	22 (47.8%)	4 (18.2%)	5 (22.7%)	7 (31.8%)	6 (27.3%)	0.07
Grade 4	13 (28.3%)	2 (15.5%)	0 (0%)	3 (23.0%)	8 (61.5%)	
Tonsils						
Grade 1	41 (89.1%)	11 (26.8%)	7 (17.1%)	10 (24.4%)	13 (31.7%)	0.41
Grade 2	5 (10.9%)	0 (0%)	1 (20.0%)	1 (20.0%)	3 (60.0%)	
SAH						
Yes	15 (32.6%)	1 (6.7%)	0 (0%) *	5 (33.3%)	9 (60.0%)	**0.009** ¤
DM2						
Yes	4 (8.7%)	0 (0%)	0 (0%)	1 (25.0%)	3 (75.0%)	0.27
DLP						
Yes	7 (15.1%)	1 (14.3%)	2 (28.6%)	1 (14.3%)	3 (42.8%)	0.70
Hypothyroidism						
Yes	5 (10.9%)	0 (0%)	1 (20.0%)	2 (40.0%)	2 (40.0%)	0.56
Hepatic steatosis						
Yes	38 (82.6%)	6 (15.8%)	7 (18.4%)	10 (26.3%)	15 (39.5%) ¤	**0.04** ¤
Questionnaires						
ESS	13.0 ± 4.2	8.3 ± 2.3 Δ	12.0 ± 3.7	12.4 ± 5.2	14.7 ± 3.6	**0.04** Δ
Berlin						
(Risk of OSA)	32 (69.6%)	2 (6.3%)	4 (12.5%)	10 (31.2%)	16 (50.0%) ¤	**0.009** ¤
Quality of life						
SF-36 total	39.9 ± 15.5	43.0 ± 17.5	39.5 ± 19.6	32.5 ± 70	44.0 ± 15.0	0.22
Total FOSQ	14.0 ± 3.0	14.7 ± 4.0	14.3 ± 3.0	15.0 ± 2.0	14.0 ± 4.0	0.96

WC: waist circumference; CC: cervical circumference; WHR: waist-to-hip ratio; ESS: Epworth Sleepiness Score; SAH: systemic arterial hypertension; DM2: type 2 diabetes mellitus; DLP: dyslipidemia, SF36: Short-Form Health Survey; FOSQ: Functional Outcomes of Sleep Questionnaire (FOSQ); BMI: Bone Mass Index.
WHR: * mild vs severe , p = 0.02; Abdominal circumference : Δ without OSA vs severe, p = 0.03; * mild vs severe , p = 0.02 ; ESS: Δ group without OSA vs severe, p = 0.002; Gender: ¤ intra group statistical difference mild OSA: female (8) vs. male (0); Berlin: ¤ intra group statistical difference severe OSA, yes (n: 16) vs no (n: 1); Hepatic steatosis: ¤ intra group statistical difference severe OSA group, yes (n: 15) vs no (n: 1); SAH: * statistical difference between severe OSA group, yes (n: 9) vs mild OSA (n: 0).
Chi Square/Fisher test; p <0.05; Univariate GLM test.

In Table 3 indicates that, when evaluating WHR in patients with moderate-to-severe OSA (AHI> 15 events/h), 57% of subjects with AHI> 15 presented altered WHR (> 0.95) (true positive), and 19% of volunteers with mild OSA or without OSA (AHI <15) presented WHR> 0.95 (false positive).

In table 4, a PPV of WHR demonstrated that 83% of patients with WHR > 0.95 have OSA (AHI>15), with diagnostic accuracy of 66%. Table 4 shows the likelihood ratio of variables, being either a positive test (WHR > 0.95 in the sample with AHI> 15) or a negative test (WHR <0.95 in the sample with AHI> 15).

Table 2. Comparison of polysomnography between groups.

Variables	Total (n = 46)	Without OSA (n = 11)	Mild OSA (n = 8)	Moderate OSA (n = 11)	Severe OSA (n = 16)	p
Sleep efficiency	82.6 ± 10.2	83.7 ± 9.6	86.0 ± 13.3	79.4 ± 14.6	83.4 ± 3.8	0.70
TST	341.3 ± 62.2	366.7 ± 79.0	329.0 ± 64.6	318.0 ± 70.0	346.0 ± 35.4	0.29
N1	12.4 ± 11.0	11.3 ± 13.3	8.2 ± 4.9	7.6 ± 2.9 ◊	18.6 ± 13.0	**0.05** ◊
N2	51.8 ± 7.2	49.4 ± 8.9	52.5 ± 7.3	51.5 ± 4.0	53.4 ± 7.8	0.56
N3	18.6 ± 9.0	21.5 ± 9.3	21.0 ± 5.6	21.4 ± 6.6	13.5 ± 10.3	0.13
REM	17.0 ± 6.7	17.8 ± 8.6	18.2 ± 5.4	19.5 ± 5.8	14.5 ± 6.0	0.24
AI	25.7 ± 23.1	14.2 ± 15.2 Δ	12.8 ± 8.1 *	12.5 ± 5.0◊	49.2 ± 22.2	**<0.001** Δ * ◊
AHI	30.0 ± 30.5	2.2 ± 1.34 Δ #	10.0 ± 3.0 *	21.4 ± 4.4◊	65.1 ± 29.9	**<0.001** Δ * ◊ #
AHI REM	39.2 ± 26.7	7.4 ± 8.41 Δ #	22.0 ± 9.1 * •	47.7 ± 17.9	62.0 ± 19.0	**<0.001** Δ * • #
AHI NREM	30.4 ± 40.4	1.3 ± 1.0 Δ	7.6 ± 4.7 *	14.9 ± 5.2 ◊	72.4 ± 43.6	**<0.001** Δ * ◊
AHI Supine	31.3 ± 31.9	2.7 ± 1.9 Δ #	12.2 ± 11.8 *	27.7 ± 8.6◊	65.8 ± 30.0	<0.001 Δ * ◊ #
AHI Non supine	7.2 ± 11.5	2.2 ± 4.8	1.2 ± 2.1	6.8 ± 7.5	14.6 ± 16.5	0.08
Basal SpO_2	94.3 ± 2.1	95.4 ± 1.2 Δ	94.5 ± 1.5	94.9 ± 2.0	93.2 ± 2.5	**0.03** Δ
Mean SpO_2	92.2 ± 2.4	94.3 ± 0.8 Δ	92.9 ± 1.0 *	93.1 ± 1.7◊	89.8 ± 4.6	**0.002** Δ ◊ *
Min SpO_2	81.1 ± 9.8	87.9 ± 3.4 Δ	85.7 ± 3.0 *	80.0 ± 9.5	74.9 ± 11.3	**0.001** Δ *
SpO_2 <90%	12.2 ± 21.8	0.5 ± 0.8 Δ	3.8 ± 7.2 *	4.4 ± 5.0 ◊	29.9 ± 29.4	**<0.001** Δ * ◊
Desat ind REM	32.8 ± 24.0	7.0 ± 7.3 Δ #	20.6 ± 9.5 * •	42.6 ± 10.0	52.5 ± 22.4	**<0.001** Δ * • #
Desat ind NREM	21.5 ± 27.6	1.00 ± 0.99 Δ	5.6 ± 4.1 *	16.0 ± 7.2 ◊	49.9 ± 30.2	**<0.001** Δ * ◊
ODI	28.4 ± 31.0	2.1 ± 1.0 Δ	8.6 ± 3.0*	21.7 ± 8.3 ◊	61.0 ± 30.7	**<0.001** Δ * ◊

N1: sleep stage 1; N2: sleep stage 2; N3: sleep stage 3; REM: rapid eye movement; AI: Arousal index; SpO_2: saturation; SpO_2 min: Minimum saturation; Desat ind: Desaturation index; ODI: oxygen desaturation index = total number of desaturations/total sleep time (min) x 60.
Statistical differences between groups: Δ Without OSA vs severe OSA; # Without OSA vs moderate; * OSA mild vs severe OSA; • moderate OSA vs mild OSA; ◇ moderate OSA vs severe OSA; N1: ◦ p = 0.05; Arousal: Δ, p <0.001; *, p <0.001; ◦ p <0.001; AHI: Δ p <0.001; * p <0.001; ◇p <0.001; # p: 0.02; Average saturation: Δ p: 0.002; ◇ p: 0.04; Basal saturation: Δ p: 0.04; Minimum saturation: Δ p: 0.002; * p: 0.02; Sat <90: Δ p: 0.001; * p: 0.01; ◇ p: 0.005; Supine AHI: Δ p <0.001; *, p <0.001; ◇ p <0.001; REM desaturation index: Δ, p <0.001; * p <0.001; • p: 0.03; NREM desat index: Δ p <0.001; * p <0.001 *; ◇ p: 0.001; ODI: Δ p <0.001; * <0.001; ◇ p <0.001; AHI REM: Δ, p <0.001; * p <0.001; • p: 0.005; AHI NREM: Δ p <0.001; * p <0.001; ◇ p <0.001.
Univariate GLM test, p <0.05 * Bonferroni *post hoc*.

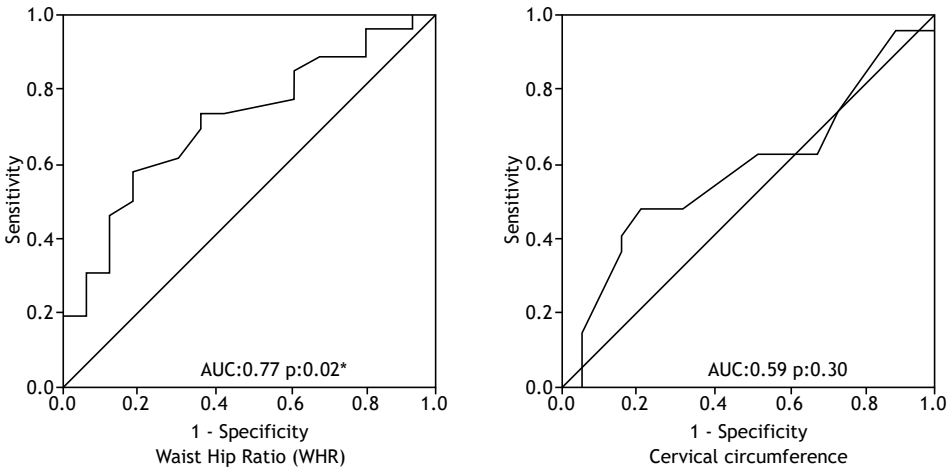

Figure 1. ROC Curve Analysis_WHR as a predictive variable of moderate and severe OSA.

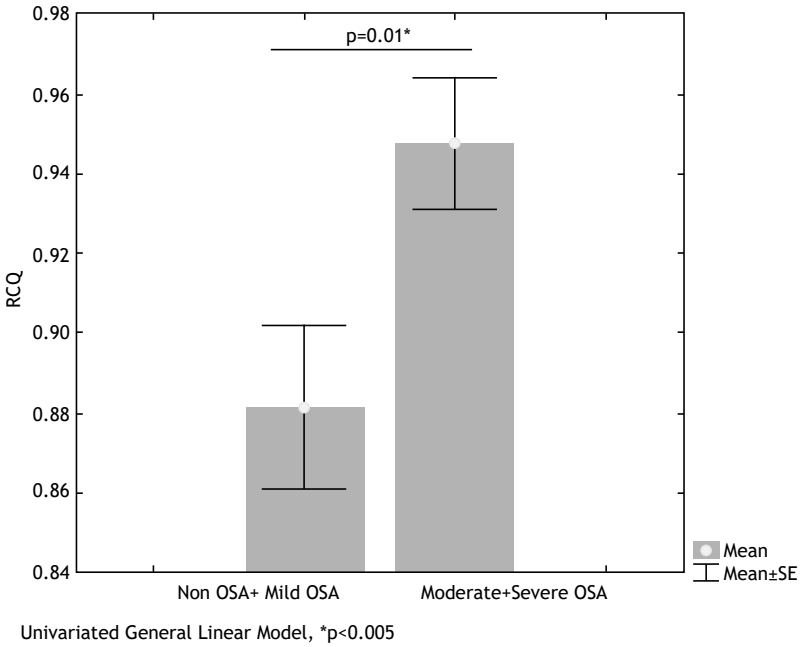

Figure 2. Comparison of WHR in patients with different severities of OSA. Univariated General Linear Model.

Table 3. Evaluation of association between WHR and moderate –to-severe OSA.

	AHI <15	AHI> 15	Total***
WHR <0.95	13 (81.3%)	11 (42.3%) **	24
WHR> 0.95	3 (18.7%) **	15 (57.7%)	18

WHR: waist-to-hip ratio. Fisher's exact test. **difference between OSA groups, p<0.01; ***4 missing - WHR.

Table 4. Likelihood ratios of positive and negative test in AHI>15 events/h samples.

Variable	Sens.	Sp.	NPP	PPV	LR (+)	LR (-)	Accuracy
WHR	57%	**81%**	54%	**83%**	3.07	0.52	66%
ESS	**88%**	76%	**90%**	72%	2.44	0.18	73%
Abdominal Circumference	33%	65%	33%	67%	0.95	1.02	54%
Neck Circumference	77%	37%	80%	33%	1.24	0.59	68%

WHR: waist-to-hip ratio; ESS: Epworth Scale Somnolence; Sens. = sensitivity; Sp. = Specificity; NPP = negative predictive value; PPV = positive predictive value; LR(+) = positive likelihood ration; LR(-) = negative likelihood ratio.

DISCUSSION

In summary, the analysis of a sample of patients referred to a private clinic for MBS intervention allowed us to conclude that there was a predominance of young morbidly obese women, with an increased daytime somnolence, higher visceral fat and waist-to-hip-ratio (WHR). Among the most frequent comorbidities found were the systemic arterial hypertension (SAH) and the hepatic steatosis. OSA was observed in 76% of patients, 59% of whom had moderate-to-severe OSA, with a predominance of men (p: 0.01). Among the variables with statistical difference between the groups, WHR was the only indicator of an AHI ≥ 15, with a cut-off value of 0.95 and accuracy of 66%, with higher positive predictive values than negative predictive values, being demonstrated as a powerful risk factor for prognostic screening of these patients, also being three times more likely to present an increase in moderate-to-severe apnea patients

The study sample profile was consistent with that described in the literature, with a greater demand from young women for surgery to treat obesity, as well as a higher occurrence of OSA among the comorbidities[27,28] A systematic review of patients eligible for bariatric surgery from the Brazilian Unified Health System (SUS) showed prevalence of patients with an average age of 41 years, an average BMI of 48.6 kg/m², with 79% being female, and 60.8% hypertensive.[29] A

meta-analysis published by Chang et al. with a total of 161.756 candidates for bariatric surgery reported the prevalence of participants with an average age of 44.6 years, 79% being female, and with a BMI of 45.6 kg/m^2. Among the studies that provided information on obesity-related comorbidities, 26% of patients had type 2 diabetes, 47% had hypertension, 28% dyslipidemia, 7% cardiovascular diseases and 25% OSA.[30] In our sample, the population profile consisted of patients with less clinical severity than the described in the literature (33% with SAH, 9% with type 2 diabetes, with insulin resistance and increased LDL observed in 57% and 72% of the sample, respectively), which can be attributed to the origin of our patients, with a more privileged socioeconomic profile and with easier access to surgical treatment. The prevalence of somnolence in our sample, evaluated using the ESS, was similar to that described in the literature.[31-33]

The occurrence of OSA found in the present study is similar to that reported in other studies.[12,13,34] Patients with moderate-to-severe OSA showed a greater somnolence, and more significant alterations from an anthropometric and clinical point of view, when compared to groups without OSA or with mild OSA, with no difference in BMI. In addition, these patients presented greater desaturation as well as a lower baseline, mean and minimum saturation values. On the other hand, when comparing the anthropometric, clinical, somnolence, quality of life and polysomnographic variables in the groups of individuals without apnea with those with mild apnea, we did not find any statistically significant difference between them.

All of this corroborates the growing evidence that mild OSA is not a significant independent risk factor for cardiovascular and metabolic comorbidities, including endothelial dysfunction, reduced baroreflex sensitivity, systemic inflammation, as well as systemic arterial hypertension and insulin resistance.[35-38] In moderate-to-severe OSA, several studies have indicated an association with cardiovascular morbidity and its complications.[35-38] It is worth mentioning that it is a well-known fact that intermittent hypoxia plays a fundamental role in the development of cardiovascular variability in OSA, propagating the production of reactive oxygen species, resulting in oxidative stress and inflammation.[39]

The findings of our study show the greater effects of moderate-to-severe OSA in patients, since this data reflects visceral adiposity, and its full potential for associated complications.

Obesity alone is a risk factor for OSA. Large epidemiological studies have reported a dose-response relationship linking the prevalence of OSA with an increased BMI, neck and abdominal circumference.[15-17] Some variables have been used previously in clinical practice, but there is no standardized measurement in the literature for a predictive model regarding OSA, with neck and abdominal circumference, and waist-to-hip ratio (WHR) being the most used, as they are easy to obtain and demonstrate greater accuracy than other measures such as BMI, which does not include the fat distribution patterns.[3,16,17,40]

In this study, the most important finding was that WHR was the best indicator for identifying patients with moderate–to-severe OSA, with a sensitivity of 57% and specificity of 81%. As indicated in Tables 3 and 4, 57% of subjects with an AHI> 15 have a WHR> 0.95 (true positive) and 19% with an AHI <15 have a WHR> 0.95 (false positive). Thus, we found that WHR was three times more likely to be increased (> 0.95) in the sample with AHI> 15. This finding is of paramount clinical importance, since it can be used to screen patients with moderate-to-severe OSA with associated greater cardiovascular risk and consequently a higher surgical risk.

Additionally, the prevalence of OSA in the bariatric surgery population is higher than in the general population, and although polysomnography remains the gold standard for diagnosing these patients, it is not always easily accessible for everyone, requiring time to schedule, even in large urban centers. Therefore, the WHR measurement in our study was useful as a surrogate of moderate-to-severe OSA and, coupled with other clinical criteria, it could be used in preferential referral for polysomnography and the identification of patients with a greater severity of OSA.

Despite the small sample size, when compared to some studies described in the literature, our study included a broad assessment of all polysomnographic parameters, not only those related to respiratory events during sleep. Another limitation of our study was the lack of imaging methods for evaluation of the upper airway that might better explain individual patient differences, that being said, a visual analysis of the airway was performed and did not identify any changes among the groups.

This study allowed us to conclude that OSA was observed in 76% of patients, with 59% having moderate-to-severe apnea. In addition, the best indicator of moderate-to-severe OSA was WHR, with a cut-off value of 0.95, being three times more likely to show an increase in this group of patients.

CONFLICT OF INTEREST

The authors declare that there were no conflicts of interest in this study.

AUTHOR CONTRIBUTIONS

AFH: administration of this study, supervision, writer, investigator. LMN: supervision. DSV and RS: investigators. TDG: acquisition of financing/ resources. SMGT and LRB: supervision, writer. LEN: supervision, writer, investigator.

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