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Collar Size as Predictor of Obstructive Sleep Apnea

ABSTRACT

Objective: This study focuses on evaluating the relationship between physical findings, particularly collar size and Body Mass Index (BMI), and polysomnographic parameters in male patients seen at a Sleep Disorders Laboratory, suspected to have Obstructive Sleep Apnea (OSA).

Methods:
  Design: Cross-sectional study
  Setting: Academic tertiary private hospital
  Subjects: Charts of 149 adult male patients referred for polysomnography between July 1, 2005 and June 30, 2006 were reviewed. Height, weight and external neck circumference measurements were obtained. The data from polysomnography results were noted and correlated with the physical measurements.

Results: The mean collar size for the OSA group was 42.03 cm with a mean BMI of 29.14 while the mean collar size for the normal group was 39.05 cm with a mean BMI of 25.36. A significant difference was noted in both the collar size and body mass index (BMI) between the OSA group and the normal group ($p < 0.005$). Results showed a significant correlation between collar size and BMI. Collar size and BMI measurements were also correlated with increasing severity of sleep apnea in the OSA group. The ≥40 cm collar size among male adults with symptoms of OSA was 80% sensitive and 67% specific with a positive predictive value of 94% in predicting true OSA.

Conclusion: This study suggests that the external neck circumference and the degree of obesity determined through BMI measurement may be important predictors of sleep apnea in adult Filipino males suspected to have OSA. Given the high probability of having true OSA in symptomatic male adults with a collar size ≥ 40 cm, outright definitive management may be opted for in these patients, while those with a collar size < 40 cm may need to undergo further confirmatory tests.
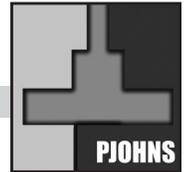
Key words: obstructive sleep apnea, external neck circumference, collar size, body mass index, polysomnography, obesity

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Because of the significantly increased risk of morbidity and mortality, patients with obstructive sleep apnea (OSA) must be diagnosed and treated vigorously. Clinical evaluations following previous studies consider tonsil size, Mallampati score, Body Mass Index (BMI), neck circumference and lateral craniofacial assessment. Of these, the BMI has been found to be the most important physical parameter for the prediction of OSA.[1]

For a BMI higher than 28 kg/m^2 in males and 27 kg/m^2 in females, the incidence of OSA has been reported at approximately 30%.[1] Even a 5% to 10% decrease in body weight in some obese individuals with OSA can lead to substantial clinical and objective improvement in sleep-disordered breathing.[2] Although a positive correlation has been found between BMI and severity of OSA, BMI does not necessarily predict the presence of OSA.[1]

Although neck circumference correlated significantly with BMI in both men and women, the neck circumference measured independently from the BMI is thought to be a very important parameter for the diagnosis of OSA. OSA is reported to be present in 30% of patients with a neck circumference of 43 cm in males or 38 cm in females in one study.[3] Others, on the other hand, reported no correlation between increasing neck circumference and severity of OSA. Currently, Polysomnography (PSG) is regarded as the most valuable standard and definitive method for establishing the diagnosis of OSA. PSG continues to be the gold standard for the diagnosis of OSA.[4] Unfortunately, the role of physical findings in the diagnosis of sleep apnea is unclear.

This study focuses on evaluating the correlation between physical findings, particularly collar size and BMI, and polysomnographic parameters in patients attending our clinic suspected to have OSA.

METHODS

Design: Cross-sectional study

Setting: Academic tertiary private hospital

Subjects: All charts of adult Filipino male patients referred for polysomnography (PSG) to the Center for Snoring and Sleep Disorders between July 1, 2005 and June 30, 2006 were retrospectively reviewed. Included were males 19 years old and above with no craniofacial or neurologic abnormalities and no previous operations in the head and neck region, suspected to have OSA based on history (loud snoring, cessation of breathing during sleep, frequent arousals at night, chronic daytime sleepiness or fatigue) and physical examination findings (tonsil size, Mallampati scores). Height in meters, weight in kilograms and external neck circumference in centimeters (or collar size) taken prior to PSG were obtained from patient's charts as well as records of co-morbidities for sleep apnea: hypertension, stroke, heart disease or adult-onset diabetes. The BMI was obtained by weight in kg divided by the square of height in meters.

Outcome measure: The results of the PSG were noted and correlated with the physical measurements.

Data and Statistical Analysis: Based on the objectives, statistical analyses included Spearman rho correlation for categorical data and chi-square test for association significance.

RESULTS

One hundred forty nine (149) male patients fulfilled the inclusion criteria. Of these, 128 were diagnosed with obstructive sleep apnea (OSA) by polysomnography while 21 had normal results. The mean age was 45.23 years with a standard deviation of 10.72. The mean collar size for all patients was 41.61 cm and the mean BMI was 28.61.

There was no significant difference in age between the group with OSA (n=128) and the normal group (n=21). The mean collar size for the OSA group was 42.03 cm with a mean BMI of 29.14 while the mean collar size for the normal group was 39.05 cm with a mean BMI of 25.36. A significant difference was noted for both the collar size and body mass index (BMI) between the OSA group and the normal group (p<0.005). (*Table 1*)

In the OSA group, 16 (12.5%) were in the mild category (RDI of 5 to <10) with a mean collar size of 38.4 cm and a mean BMI of 25.96; forty-one (32%) were in the moderate group (RDI of 10 to <30) with a mean collar size of 41.58 cm and mean BMI of 29.39; seventy-one (55.5%) were classified as severe (RDI of >/= 30) with a mean collar size of 43.09 cm and a mean BMI of 29.7.

The severity of OSA was subsequently classified into normal, mild, and moderate-severe categories as multiple comparison tests showed no significant difference in collar size between those with moderate OSA and those with severe OSA (*Table 2*). The collar size increased progressively with increasing severity of sleep apnea.

Likewise, the body mass index (BMI) was related to the severity of sleep apnea and different among the groups mentioned (p<0.005). (*Table 3*)

Search for a cut-off point

Collar sizes for the normal group ranged from 33.02 cm to 48 cm. Collar sizes for the OSA group ranged from 30.37 cm to 48.26 cm. Twenty-three percent (23%) of the total patients and 24% of patients diagnosed with OSA had a 40-centimeter collar size. Only 2-5% of subjects had other collar sizes. On account of the considerable number of the study population clustering in the 40-centimeter collar size, it was selected as the cut-off point and was tested for its predictive value.

Of the study population, a total of 109 subjects had a collar size ≥ 40 cm, while 40 subjects had a collar size of < 40 cm. For purposes of screening patients with OSA as a positive test, the ≥40 cm collar size had a sensitivity, specificity and positive predictive value of 80%, 67% and 94%, respectively. (*Table 4*)

DISCUSSION

OSA is currently thought to be caused by a dynamic process with contributions from structural upper airway narrowing and abnormal upper airway neuromotor tone.[5] Subjective complaints have not yielded enough sensitivity and specificity, prompting attempts to clinically evaluate physical parameters and their relevance to the diagnosis of OSA.[1]

External neck circumference, particularly collar size, has been assessed in several studies with conflicting outcomes.[1] Our results may suggest that collar size may be an independent parameter for determining OSA. This correlation between sleep apnea and neck circumference may reflect "mass loading," with the static pharyngeal size modulated by dynamic loading of the airway due to the weight of fatty neck tissue contributing to the pathogenesis of OSA.[6]

Statistical analyses suggested a significant difference between the mild and moderate OSA groups, but no significant difference between moderate and severe stages. This may support a classification

Table 1. Demographic and anthropometric parameters for normal and OSA subjects

Total subjects N=149	w/OSA n=128		Normal n=21			
	Mean	SD	Mean	SD	Mean Diff	P-value
AGE (yrs)	45.49	10.35	43.67	12.96	1.83	0.545
COLLAR (cm)	42.03	3.53	39.06	3.17	2.98	*0.001**
BMI	29.14	4.84	25.36	5.19	3.78	*0.004**

Table 2. Severity of OSA classified into normal, mild, and moderate-severe

	w/OSA N=128		MILD n=16		MODERATE n=41		SEVERE n=41		Multiple Comparison Test
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
AGE	45.5	10.3	45.6	11.3	45.0	10.58	45.8	10.14	No diff accoss age
COLLAR	42.0	3.53	38.5	3.46	41.6	3.28	43.1	3.13	mild < Moderate & Severe
BMI	29.1	4.84	26.0	4.23	29.4	6.05	29.7	3.88	Mild < Moderate & Severe

Table 3. Collar size and BMI related to severity of OSA

	w/OSA		MILD		MODERATE		SEVERE		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	P-value
AGE (yrs)	45.49	10.35	45.56	11.30	45.05	10.58	45.73	10.14	0.945
COLLAR (cm)	42.03	3.53	38.50	3.46	41.58	3.28	43.09	3.13	*0.000**
BMI	29.14	4.84	25.97	4.23	29.39	6.05	29.72	3.88	*0.017**

Table 4. Sensitivity-specificity analysis of 40-centimeter cut-off point in screening patients for OSA

Positive Predictive Value	94%	102 out of 109
Negative Predictive Value	35%	14 out of 40
False Positive %	33%	7 out of 21
False Negative %	20%	26 out of 128
Sensitivity	80%	102 out of 128
Specificity	67%	14 out of 21

*Significant Difference

consisting of a normal group, a mild OSA group and a moderate-severe OSA group. Collar size and BMI were significantly different among these groups and increased progressively with increasing severity of sleep apnea. The importance of this classification may guide the treatment plan within each category and the management differences between each category.

Among Caucasians, OSA is reported to be present in 30% of patients with a neck circumference of 43 cm in males.[3] Data in the Philippine setting is lacking with regards a good collar size cut off point for predicting OSA prompting utilization of results from this study as preliminary data to establish associations between collar size and diagnosis of OSA locally. Forty centimeters was suggested as a cut-off point for predicting OSA in Filipinos owing to the major percentage of the study population as well as subjects diagnosed with OSA falling into this measurement. Validation studies in the future may require ROC (receiver operating characteristics) analysis for identification of cut-off values with a balanced negative and positive prediction for OSA. Results have shown that a ≥ 40 cm collar size presents with 94% probability of OSA in adult Filipino male subjects referred for polysomnography. Hence, given the high probability of true OSA in symptomatic male adults with a collar size ≥ 40 cm, outright definitive management may be opted for in these patients, while those with a collar size < 40 cm may need to undergo further confirmatory tests. Standard criterion studies may validate these results.

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