ORIGINAL ARTICLE

ANNALS OF PUNJAB MEDICAL COLLEGE

Association of Body Mass Index with Neck Circumference and Snoring in Adult Patients with Hypertrophic Tonsils

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Submitted for Publication: 07-03-2023
Accepted for Publication 04-09-2023

How to Cite: Mehwish A, Ambreen Usmani, Mariya Azam Khattak, Yasmeen Mahar, Maryam Faiz Qureshi, Syed Wajahat Hasib. Association of Body Mass Index with Neck Circumference and Snoring in Adult Patients with Hypertrophic Tonsils. APMC 2024;18(1):0-0. **DOI: 10.29054/APMC/2024.1445**

ABSTRACT

Objective: We aimed to determine association of Body mass index (BMI) with neck circumference and snoring in patients with hypertrophic tonsils. **Study Design:** Cross-sectional research. **Settings:** Ear Nose and Throat Department of a tertiary care hospital situated in Karachi Pakistan. **Duration:** January to July 2021. **Methods:** It was a cross-sectional research and non-probability consecutive sampling technique was utilized for data collection. A written informed consent was obtained by each enrolled participant following by recording of data by filling subject valuation proforma. Detailed history of participants and anthropometric data was noted followed by grading of tonsils during oral examination. The study was conducted at Otorhinolaryngology department of PNS Shifa hospital from January to July 2021.Data was entered and analyzed using SPSS 23.0 software. **Results:** The current study enrolled adult subjects (n=54) with hypertrophic tonsils between 18-60 years with mean age of 25.72 ± 7.9 SD. There were 29 (54%) males and 25(46%) females. There were 31(57%) subjects with normal BMI, 14(26%) overweight and 9 (17%) obese subjects. There were 24(44%) snorers and 30(55.5%) non-snorers. Regarding neck circumference 1(3%) male had neck circumference ≥42 cm whereas 28(97%) had neck circumference ≤ 37.5 cm. Statistically significant association was observed when compared BMI and snorers p-value 0.001, whereas regarding neck circumference significant association with BMI was observed in females (p-value 0.0001) as compared to males (p-value 0.310). **Conclusion:** Snoring was associated with raised BMI whereas increased neck circumference in females was seen to be associated with raised BMI as compared to male individuals. It is important to consider these anthropometric measurements when assessing patients with obstructive sleep apnea.

Keywords: *Body mass index, Palatine tonsils, Tonsil grading, Neck circumference, Snoring.*

INTRODUCTION

A medical disorder, which is diagnosed less frequently and described by repeated disruptions in sleep due to decrease airflow triggering breathlessness is termed as Obstructive sleep apnea syndrome (OSAS). A sudden turbulence in respiratory function leads to irregular breathing pattern, fluctuation in intrathoracic pressure and disrupted sleep, causing harm not only to standard of life, but also leaves a significant damaging impression on physical and mental health.[1] An estimate showed that approximately 4% of general adult residents of China and 19–40% middle aged population of united states of America, have some degree of this disorder. A number of severe outcomes are connected to this disorder that includes high blood pressure, heart diseases, paralysis and road traffic accidents. Morbidity rate and further medical treatment costs for these associated outcomes could be decreased by timely diagnosis of OSAS as indicated in many researches. It is vital to recognize the risk factors for OSAS in order to formulate improved strategies for treatment and screening.[2]

Despite being a matter of great concern and repeated awareness given by health care workers, it's upsetting that the incidence of obesity and excess weight remains to grow towards an alarming point that leads to dangerous consequences. In view of its fatal concerns that results in blocking of air passage during sleep, obesity is still a major risk factor with increased body mass index (BMI) it amplifies its effects.[3,4] These relations are predominantly noteworthy amid male adults who show moderately increased central fat accumulation.[5] When considering the accumulation of fat and structure of upper airway, its location continues to reflect significant risk of OSAS. Measuring adiposity by using specific investigations is a valuable information in selecting and screening risk.[6] A sample of upper airway MRI results from small clinic showed that thickness of pharyngeal fat pad was unable to depict OSAS. Nevertheless, adults with OSAS revealed shape differences in airway, specially, at lower transverse level a reduction was noted whereas thickness in pharyngeal muscle was increased.[7] Obesity in adults associates well with neck circumference (NC) and also works as a reasonable predictor. Recently for evaluation of increased weight in men, NC was measured by placing a measuring tape around the neck base underneath laryngeal prominence (Adams apple).[8]

Comparing the size of NC with OSAS and snoring has been done in adults for its height correction. A raised respiratory disturbance index defined this breathing disorder. The evaluation of sleeping patterns and snoring frequency in adults is important. If the probability of this pattern is high than polysomnography is done (PSG) by physician[9]. A study that deduced reference ranges for NC in adults concluded that in males with NC ≥ 95th percentile, it was 3.3 times higher the comparative risk for OSAS than those with NC ≤ 95th percentile, but then connection was punier in females.[10] Lymphoid tissue plays an important part in immune system of the body whose masses forms tonsils. They are mainly present at the entry point of respiratory tract and it forms a Waldeyer's ring around the pharynx. Increase in size of tonsils manifests sleep apnea, hinders normal breathing leading to irregularity in sleep and if misdiagnosed may result to death.[11]

The basic evaluation showed that those patients having increased neck circumference due to fat accumulation has noticeable decreased airway leading to risk of OSAS and its perseverance in spite of adenotonsillectomy. The knowledge of increased neck fat causes and its association with OSAS is vital when taking the preventive measures in adults. The findings may help in our understanding of complications related to this disorder.[12]

The present study designed with an objective to investigate the association of BMI with snoring and neck circumference in subjects with hypertrophic tonsils so that assessment of morbidity and disease burden can be done. A comprehensive clinical approach needed to be developed that can be used to diagnose sleep disorders.

METHODS

It was a cross sectional study and was steered at ear nose and throat department of a tertiary care hospital situated in Karachi from January to July 2021.The research methods were in consistent with Helsinki's declaration and approved by ethical committee and institutional review board of Bahria University Medical and Dental College with ERC number 09/2020. An open-source calculator known as "Open Epi version 3" was utilized to calculate sample size which was computed to be 45 at 95% confidence interval and 5% margin of error for tonsillar hypertrophy with or without sleep disordered breathing. Fifty-four adults with hypertrophic tonsils with or without sleep apnea aged between 18-60 years were enrolled. Those below 18 and above 60 years, history of trauma, removed tonsils, pregnant or lactating women, subjects with thyroid or Cushing disorder were excluded. A questionnaire was filled by the principal investigator after obtaining informed consent from the enrolled participants which cover demographic, anthropometric data medical history and noted physical examination findings of the subjects. Physical examination involved examination of the oral cavity and grading of tonsils by Brodsky grading scale.[13] Morphological oral features were assessed while subjects were sitting in relaxed state with spontaneous breathing. Snoring symptoms (Yes/No) and nasal obstruction was also noted on the proforma. Height in meters and weight in kilograms were recorded and incorporated into standard formula for Body Mass Index. Neck circumference was also noted using non stretchy plastic tape placing around the neck beneath laryngeal prominence. Subjects were instructed to sit in erect position and look in front with shoulders in neutral state. Measurements were recorded carefully and extra muscle mass was excluded. For males cut off value was 42 cm whereas 37.5cm in females.[14] All the data was coded and entered on SPSS version 23 for statistical analysis. Results for the quantitative variables were depicted as mean ± standard deviation and for qualitative data it was expressed in numbers/percentages. Fischer exact test was applied to see nonrandom associations between categorical variables like body mass index, snoring and neck circumference. After analysis, results with P value ≤ 0.05 were considered significant.

RESULTS

Fifty-four adults included in the current study with mean age of 25.72 ± 7.9 SD. Majority 29 (54%) subjects were male and 25 (46 %) were female. While noting history questions personal habits of subjects were asked from participants, 15 (28 %) were smokers, 7 (13 %) beetle nut

chewers, 2 (4 %) were addicted to naswar whereas majority 30 (55 %) were not addicted to anything. In the present study 9 (17%) were on hypertensive medications whereas 11(20 %) were diabetic and on oral hypoglycemics.

Regarding tonsil size estimation grading was done and it was noted that majority of the subjects had grade 2 and 3 hypertrophy that is 60 and 34 tonsils respectively, for grade 1 there were 5 tonsils and for grade 4 there was 9 tonsils, this included right and left sides in total. Enrolled participants had acute tonsillitis 26 (48 %), recurrent tonsillitis 22 (40.7%) and obstructive sleep apnea 6 (11%). Tonsillectomy was advised to 21(39%) study participants due to recurrent tonsillitis 16 (76 %) and obstructive sleep apnea 5 (24 %).

Regarding anthropometric measurements 1(3%) male had circumference of neck ≥ 42 cm whereas 28 (97 %) had ≤ 42 cm. Among females 8 (32 %) had neck circumference ≥ 37.5 cm whereas 17 (68 %) had ≤ 37.5 cm. Thirty-one (57%) subjects had normal BMI,14 (26%) were overweight and 9(17%) were obese.

There were 24(44%) snorers and 30(55.5%) non-snorers, out of snorers males15(62.5 %) predominate over females 9 (37.5%). When association was seen between BMI, snorers and non-snorers' significant relationship was observed (Fischer Exact test, *P=0.00*). It was noted that majority of the snorers were overweight 10 (41.7 %), whereas 7 (29.2 %) were obese and 7 (29.2 %) were categorized to have normal BMI as depicted in table 1.

Table 1: Association of BMI with Snoring (n=54)

BMI	Snoring		Total	p-value
	No	Yes		
Normal	24 (80 %)	7 (29.2 %)	31 (57.4%)	0.001*§
Overweight	4 (13.3 %)	10 (41.7 %)	14 (25.9 %)	
Obese	2 (6.7 %)	7 (29.2 %)	9 (16.7 %)	
Total	30 (100 %)	24 (100 %)	54 (100 %)	

p-value of ≤0.05 is significant and shown with asterisk, §-Fischer Exact test was applied to see the significance, Normal BMI, 18.5-24.9; overweight, 25-29.9; and obesity, 30-34.9. N=Total number of study participants*

Nonrandom association was observed in male between neck circumference and BMI, non-significant results (Fischer Exact test, *P*=0.310) were seen. There was one subject with neck circumference greater than 42 cm belongs to overweight category whereas 28 males had normal BMI with less than 42 cm neck circumference as demonstrated in table 2.

Table 2: Association of BMI with Neck Circumference (Male) (N=29)

BMI	Neck circumference male		Total	p-value
	> 42 cm	≤42 cm		
Normal	0 (0%)	20 (71.4 %)	20 (69 %)	0.310 §
Overweight	1 (100 %)	7 (25.0 %)	8 (27.6 %)	
Obese	0 (0 %)	1 (3.6 %)	1 (3.4 %)	
Total	1 (100 %)	28 (100 %)	29 (100 %)	

p-value of ≤ 0.05 is significant and shown with asterisk, §-Fischer Exact test was applied to see the significance, Collar size should not exceed 42cm in males and 37.5cm in females*
Normal BMI, 18.5-24.9; overweight, 25-29.9; and obesity, 30-34.9, N=Total number of male participants

Regarding neck circumference in 25 females, it was noted that 7 (87.5 %) were obese and 1 (12.5 %) was in overweight category. There were 17 females who had neck circumference less than 37.5 cm, out of which 11 (64.7 %) females had normal BMI, 5 (29.4 %) were overweight and 1 (5.9 %) was obese. In this way statistical association was observed (Fischer Exact test, *P=0.00*) as seen in table 3.

Table 3: Association of BMI with Neck Circumference (Female) (N=25)

BMI	Neck circumference Female		Total	p-value
	> 37.5 cm	≤ 37.5 cm		
Normal	0 (0.0 %)	11 (64.7 %)	11 (44.0 %)	0.0001 * §
Overweight	1 (12.5 %)	5 (29.4 %)	6 (24.0 %)	
Obese	7 (87.5 %)	1 (5.9 %)	8 (32.0 %)	
Total	8 (100 %)	17 (100 %)	25 (100 %)	

p-value of ≤0.05 is significant and shown with asterisk, §-Fischer Exact test was applied to see the significance, Collar size should not exceed 42cm in males and 37.5cm in females*
Normal BMI, 18.5-24.9; overweight, 25-29.9; and obesity, 30-34.9, N=Total number of female participants

DISCUSSION

Obstructive sleep apnea is a deadly disorder. It is characterized by breathing disorder involving obstruction of upper airway leading to interruption of gas exchange and sleep patterns. The present study depicted use of anthropometric parameters and snoring in clinical setups in context of hypertrophic tonsils. This is in accordance with the literature that OSAS with higher BMI has complex etiology such as lymphoid hyperplasia, change in upper airway anatomy, increased collar size and neuro motor aspects.[15]

As a momentous consequence snoring may direct to sleep apnea which may occur independently or can be seen with allergic rhinitis[16]. According to the current research it was revealed that out of 54 adults there were 24 subjects who were snorers and out of which males were in majority and there were 7(29.2%) obese, 10 (41.7%) overweight and 7(29.2%) normal weight individual snorers. Statistically significant association was observed between BMI and snoring. Concurrently significant association of BMI and snoring in women was found in another study, whereas for men significant association was demonstrated in normal weight category and detectable association was found among obese and overweight individuals but not to the significant level.[17]

It was reported in a study that 40.1% snorers were obese and majority of them were males as compared to females.[18] Similar results were found in another study which reported high frequency of snoring in OSAS patients and with male predominance.[19] This showed that snoring affects male population more as compared to females.

Anthropometric measurement like collar size is more convenient, cost effective and culturally acceptable tool to be used in the current era where obesity is the leading health issue. Obesity creates negative psychosocial and emotional disturbance which is linked with deadly disorders such as hypertension, heart diseases, diabetes and diminished life.[20]

For detection of overweight and obese individual BMI calculation is noteworthy. Assessment of BMI and neck circumference was studied in the current research, significant relationship was observed among females where as non-significant association was observed in males which is due to a smaller number of reported obese males. Tantawy *et al*., discovered weak correlation of collar size with BMI.[20] Likewise in an MRI based study obesity was found to be linked strongly with neck fat and neck circumference in adolescents, but no association was observed with severity of obstructive sleep apnea furthermore their results revealed that female subjects had significantly more neck tissue as compared to males.[21]

A recent Pakistani study evaluated BMI and neck circumference and found strong association of these two parameters in male and female.[22] In another study waist and neck circumference linked to be related with obstructive sleep apnea specially in peri and postmenopausal women.[23]

Correspondingly other studies also found positive association on neck circumference and BMI and demonstrated that these tools can be used to detect obesity.[24,25]

CONCLUSION

In accordance with findings of the current study obese subjects are more at peril of having snoring issues and increasing neck circumference was associated with BMI in females as compared to males. This suggests that a population with increased neck circumference, hypertrophic tonsils, and BMI>30 have an increased risk of having OSAS.

LIMITATIONS

The present study encountered limitations, including a small sample size and its single-centered nature. Additionally, children were excluded from the analysis due to variations in growth parameters assessment

SUGGESTIONS / RECOMMENDATIONS

Future studies aiming to find regional fat distribution, anthropometric measurements and its association with OSAS in different age groups recommended.

CONFLICT OF INTEREST / DISCLOSURE

The authors declare that there are no conflicts of interest regarding the publication of this article. This article originates from the thesis of the corresponding author, forming a segment of her M.Phil. project. The co-authors served as faculty members and M.Phil. scholars (co-researchers) at Bahria University Health Sciences Campus Karachi, Pakistan, concurrently. As such, the authors assert that there are no disclaimers associated with the content presented herein.

ACKNOWLEDGEMENTS

We extend our heartfelt appreciation to the entire team of the ENT Department at PNS Shifa Hospital, as well as to all the participants, for their gracious consent and valuable collaboration.

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