A STUDY TO ASSESS RELATIONSHIP BETWEEN BODY WEIGHT AND OBSTRUCTIVE SLEEP APNOEA

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ABSTRACT: Background:OSA has been a rising problem in today's world but people who are overweight or obese are more prone to suffer from it because of greater deposition of fat on all body parts especially neck which causes narrowing of airway causing greater difficulty in breathing especially in sleep. Though polysomnography is the gold standard method of diagnosing sleep apnoeabut anthropometric measurements can be helpful in ruling out high risk people likely to suffer from OSA.**Objectives:** This study was carried out to assess relationship between OSA & BMI and OSA & anthropometric measurements **Methods:** The Study was conducted in Sleep Lab of Physiology Department of B. J. Medical college on 90 people out of which controls were taken from society and cases from the patients referred from different department of civil hospital. Polysomnography was done using Quest 201 Ambulatory PSG by RMS and 6 hrs recording was done. Subjects having ESS score >10 were included in study after routine medical examination and detailed history along with anthropometric measurements and thyroid profile. **Results and Conclusion:**From our study we found that OSA severity increases with increase in body weight and hence it is more severe in obese and overweight group which was statistically significant. We also found that increase in anthropometric measurements especially neck circumference increases the severity of OSA which was also statistically significant.

Key Words: OSA, anthropometric measurements, neck circumference

Abbreviation: OSA-Obstructive Sleep Apnoea, BMI- Body Mass Index, PSG- Polysomnography, RMS- Recorders & Medicare Systems Pvt. Ltd., ESS- Epworth Sleep Score

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INTRODUCTION:

As per **INOSA** Guidelines (**IN**dian initiative on **O**bstructive **S**leep **A**pnoea), OSA is the occurrence of an average 5 or more episodes of obstructive respiratory events per hour of sleep with either sleep related symptoms or comorbidities or >15 such episodes without any sleep related symptoms or comorbidities. OSAS is defined as OSA associated with daytime symptoms, most often excessive sleepiness[5].

Patients who are overweight or obese are much more likely to have sleep apnoea than patients maintaining a healthy body weight[1,2,3]. In the adult population the prevalence of OSA is roughly 25% of the population, but can be as high as 45% in overweight or obese patients[3, 6, 7]. Also people with greater neck circumferences (>17 inches in men &>16 inches in women) are at higher risk for developing OSA because of excessive fatty tissues throughout the body including the throat.These soft and fatty tissues around the neck can make the airway narrower and when the patient is sleeping, these soft tissues collapse more readily into the airway. This can impede or pinch-off airflow leading toapnoea events.

It has been suggested through previous studies that 70% of adult OSA patients have obesity which indicates that higher the BMI greater the prevalence [1]. As per the analyses from the Wisconsin Sleep Cohort Study, it suggests that 41% of adult OSA cases, including 58% of moderate-to-severe cases, are attributable to overweight or obesity [6]. As per previous studies, an increase in BMI of one standard deviation was associated with a fourfold increase in risk for OSA [2,6]. Previous studies support that neck circumference was the strongest predictor of OSA among all anthropomorphic variables studied

Although polysomnography is an essential tool for diagnosis of OSA, it is costly, complex, and, in many countries, difficult to access [8]. Therefore, a simpler and less costly method is needed as a screening method for OSA [4, 10].

Several studies have been performed using anthropometric measurements of obesity in patients with OSA, e.g., body mass index (BMI),

neck circumference (NC), waist circumference (WC) and hip circumference (HC)[8, 10- 17]. These measurements may be used both to assess the need for patient referral to polysomnographic evaluation and to anticipate treatment in high-risk patients.

MATERIAL AND METHODS:

The cross-sectional study was conducted in the Sleep Lab of Physiology Department, B. J. Medical College & Civil Hospital, Ahmedabadfrom January 2019 to September 2020 and the sample size was 90which were divided into 3 groups:

Group 1 (Control group)including 30 subjects having normal body weight. (BMI: 18.5-24.9 kg/m²)

Group 2 (Overweight group) including 30 subjects who were overweight. (BMI: 25-29.9 kg/m²)

Group 3 (Obese group)including 30 subjects who were obese. (BMI:->30 kg/m²

Prior permission of Institutional Ethical Committee, B. J. Medical College, Civil Hospital, Ahmedabad was obtained for conducting the study.

Inclusion criteria: -

During the study, subjects of age group 30 to 65 yrs., both males and females who were having Epworth score >10 with history of snoring were included in the study.

Patients referred from different clinical departments of Civil Hospital; Ahmedabad were taken in this study whereas controls were recruited from the society and those who were referred to sleep lab by hospital with complains of sleep disturbances and snoring problems.

Exclusion criteria: -

Patients with conditions likeRespiratory disorders, Neuromuscular disorders, Craniofacial abnormalities, Psychiatric illness, Pregnant ladies and H/O Smoking and Alcohol consumption. were excluded from the study

They were assessed by Epworth Sleep Score(ESS) and those with ESS>10 was subjected to this study.

Written informed consent was obtained from all and were asked to fill a Performa and detailed history regarding their sleep pattern after which their physical and clinical examination including anthropometric measurements was done. Anthropometric measurements were based on the National Health and Nutrition Examination Survey (NHANES) guidelines[9].

Polysomnography was done using machine QUEST-201 AMBULATORY PSG by RMS and 6 hr recording of all the subjects was done. The data obtained from polysomnography report and from the clinical examination were plotted in the Microsoft Excel sheet 2011. OSA severity was measured on the basis of AHI (Apnoea Hypopnea Index). BMI was classified on the basis of WHO Classification.

Data analysis: -Recorded information of patients was entered in Microsoft Excel 2011 Worksheet and Statistical analysis was performed using GraphPad Prism 6.01 software. The quantitative variables were expressed as Mean ± Standard Deviation (SD).A normality test (Kolmogorov Smirnov) was applied and the adequate statistical test was chosen for each type of variable (parametric or nonparametric). One-way ANOVA was used for the Gaussian variables and the non-parametric Kruskal–Wallis test for the non-Gaussian variables to compare the means of more than two independent samples. Pearson's Correlation coefficient was used to find the strength of correlation between AHI and BMI, NC, WC, HC and WHR. P values less than 0.05 were considered statistically significant.

RESULTS:

Table 1: Comparison of anthropometric measurements among control, overweight and obese groups.

	control (n=30)	overweight (n=30)	obese (n=30)	p value
Age(yr.)	52.1 ± 8.6	50.93 ± 8.6	54.73 ± 9.9	0.29
Weight (kg)	66.37 ± 8.06	76.64 ± 8.5	99.81 ± 20.95	<0.0001
Height (cm)	1.65 ± 0.09	1.64 ± 0.08	1.65 ± 0.10	0.91
BMI (kg/m²)	24.18 ± 1.06	28.19 ± 1.30	36.16 ± 5.37	<0.0001
WC (cm)	79.56 ± 6.4	91.33 ± 6.46	106.73 ± 10.44	<0.0001
HC (cm)	87.6 ± 4.7	94.33 ± 5.4	105.46 ± 8.6	<0.0001
NC (cm)	33.74 ± 2.68	37.22 ± 2.49	42.15 ± 3.26	<0.0001

W:H ratio	0.90 ± 0.04	0.96 ± 0.07	1.01 ±0.08	<0 .000 1
ESS score	11.7 ± 0.78	17.83 ± 1.46	18.76 ± 1.87	<0 .000 1
AHI (per hr)	4.35 ± 1.50	26.12 ± 9.8	50.08 ± 18.04	<0 .000 1
ODI(per hr)	3.95 ± 2.21	23.08 ± 9.03	35.15 ± 29.95	<0 .000 1

Individual characteristics of all three groups, control, overweight and obese are expressed in table as mean and SD.On comparing weight, BMI, WC, HC, NC, W:H Ratio, AHI & ODI among the three groups we found it statistically significant.

Table 2: Comparison of anthropometric indices as per OSA severity

	Mild OSA (n=14)	moderate OSA (n=16)	severe OSA (n=35)	p value
Age (yr.)	52.71 ± 7.81	53.3 ± 7.8	52.71 ± 10.42	0.9606
Weight (kg)	74.96 ± 12.33	77.35 ± 6.76	98.41 ± 20.67	<0.0001
Height (cm)	1.65 ± 0.11	1.64 ± 0.06	1.65 ± 0.09	0.9308
BMI (kg/m^2)	27.18 ± 3.20	28.44 ± 1.45	35.67 ± 6.22	<0.0001
WC (cm)	88.07 ± 8.83	91.68 ± 7.17	104.31 ± 6.22	<0.0001
HC (cm)	95.28 ± 8.42	94.37 ± 5.46	102.8 ± 11.11	0.001
NC (cm)	35.87 ± 3.04	37.6 ± 2.20	41.45 ± 3.53	<0.0001
W:H RATIO	0.92 ± 0.06	0.97 ± 0.07	1.01 ± 0.08	0.022

Above table shows that increasing severity of AHI was associated with significant increase in weight, BMI, waist circumference, neck circumference, hip circumference and waist hip ratio which was also statistically significant.

Table 3: Correlation of AHI with anthropometric parameters

	AHI	control	Overweight	obese
BMI	r value	0.1171	0.5852	0.6908
	p value	0.5376	**0.0007**	**<0.0001**
NC	r value	0.1546	0.4537	0.6381
	p value	0.4145	**0.0118**	**<0.0001**
WC	r value	0.1903	0.3672	0.5784
	p value	0.3137	**0.0459**	**0.0008**
HC	r value	0.2125	0.096	0.2781
	p value	0.2534	0.6138	0.1367
W:H ratio	r value	0.0769	0.387	0.1931
	p value	0.6862	0.0346	0.3067

Analyzing the relationship between BMI and AHI showed a highly significant positive correlation indicating increase in severity of OSA with increase in BMI. This correlation was strongly correlated among obese group followed by overweight. We also found statistically significant correlation of AHI with anthropometric parameters like NC & WC indicating increase severity of OSA with increase in NC and WC.

DISCUSSION:

Obesity is an independent risk factor for the development of OSA[2, 12], and several studies have demonstrated that visceral obesity, in particular, is strongly associated with the prevalence of OSA[19]. Even though obesity is not essential for the development of OSA, a significant percentage of patients with OSA are obese and the onset of sleep apnoea frequently follows a marked increase in body weight [1]. Significant sleep apnoea is present in approximately more than 40% of obese individuals and 70% of OSAS patients are obese.

Table 1represents in an all-general characteristic of all the three groups, control, overweight and obese, showing mean age, anthropometric parameters like weight, height, BMI, WC, HC, NC and WHR and PSG parameters like ESS, AHI and ODI. On comparing them statistical significance was seen among weight, BMI, WC, HC, NC, W:H

Ratio, AHI & ODI which denotes that obese group had significant higher anthropometric measurements.

As per table number 2 shows the comparison of various anthropometric measurements in subjects confirmed with OSA differentiated on the basis of severity into mild, moderate and severe. It was evident from the results that the values of anthropometric indices increased as per the increase in severity and this was found statistically significant among the groups. Increasing severity of OSA was associated with a significant increase of body weight, BMI, neck, waist and hip circumferences which is also seen in many previous studies [1,11].

As per table 3, we used anthropometric measurements like BMI, NC, HC, WC and WHR, relating each with OSA severity. It was observed that BMI was highly positively correlated with AHI, allowing us to infer that more severe OSA occurs in subjects with a higher BMI, which is concordant with most published studies. [4, 10, 18]. We also found statistically significant correlation of AHI with anthropometric parameters like NC & WC indicating increase severity of OSA with increase in NC and WC.Many studies have shown a significant correlation of indices including weight, BMI, neck/ waist circumference (WC), HC, AC/HC ratio with AHI [8, 11-17, 19].Contrasting with other published papers, many authors believe neck circumference as the strongest predictor [4, 8, 11, 13, 16]whereas many believe WC as strong predictor [18]. The most significant correlation of AHI was found in our studies of BMI followed by NC, and lastly WC.These findings confirm other published results, suggesting that circumference measures are predictive factors for OSA severity.

CONCLUSION:

We derived following conclusions from our study:

1. There is a direct relationship between BMI and OSA. The correlation between BMI and AHI is statistically significant.It was observed that BMI was highly positively correlated with AHI, allowing us to infer that more severe OSA occurs in subjects with a higher BMI.
2. Severity of OSA is more in obese group than that in overweight group.There was statistical difference in ESS, AHI and O_2desat index among obese subjects as compared to overweight subjects.
3. Severity of OSA increase with increase in anthropometric measurements like NC and WC. Severity of OSA is significantly correlated with increase in Neck circumference followed by Waist circumference. This association is strongly correlated in obese group. Thus, in addition to BMI, NC and WC (measures of central obesity) are strong predictors of OSA.

Our study had some limitations. Firstly, our study was a cross sectional analysis. Secondly, the sample size of our study was small. Thirdly, because of the usual male predominance in referrals to sleep clinics, there was an unbalanced gender distribution. A longitudinal study with larger sample size and with equal gender distribution may bring about better results.

In conclusion, this study shows that OSA is more severe in the subjects having higher BMI which indicates that excess weight contributes to the increased incidence of OSA. There is a strong association between the body weight and OSA as seen from the significant correlation. Other measurements of obesity like NC and WC have also been found to have possible linkage to OSA other than BMI.During routine check-up, measurements of body weight, BMI, NC and WC can be used as a screening tool of OSA. Overweight and obese individuals should be educated about weight loss and improving fitness which can prevent OSA and its potential complications like metabolic disorders.

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REFERENCES:

1. Resta, MP Foschino-Barbaro , G Legari. Sleep-related breathing disorders, loud snoring and excessive daytime sleepiness in obese subjects. International Journal of Obesity (2001) 25, 669±675.
2. Paul E. Peppard, Terry Young, Mari Palta. Longitudinal Study of Moderate Weight Change and Sleep-Disordered Breathing. JAMA. 2000; 284:3015-3021

3. Durán J, Esnaola S, Rubio R, Iztueta A. Obstructive sleep apnea-hypopnea and related clinical features in a population-based sample of subjects aged 30 to 70 yr. Am J Respir Crit Care Med. 2001; 163 (3 Pt 1): 685 - 689.
4. Oğretmenoğlu O, Süslü AE, Yücel OT, Onerci TM, Sahin A. Body fat composition: a predictive factor for obstructive sleep apnea. Laryngoscope. 2005;115(8):1493-8.
5. Consensus & Evidence-based INOSA Guidelines 2014 (First edition), Reprinted from: Indian J Med Res 140, September 2014, pp 451-468.
6. Young T, Palta M, Dempse J, et al. The occurrence of sleep-disordered breathing in middle-aged adults. N Engl J Med 1993; 328:1230-5.
7. Sharma SK, Kumpawat S, Banga A, Goel A. Prevalence and risk factors of obstructive sleep apnea syndrome in a population of Delhi, India. Chest. 2006; 130 (1): 149 - 156.
8. Kang HH, Kang JY, Ha JH, Lee J, Kim SK, et al. (2014). The Associations between Anthropometric Indices and Obstructive Sleep Apnea in a Korean Population. PLoS ONE 9(12): e114463. doi: 10.1371/journal.pone.0114463.
9. National Health and Nutrition Examination Survey. Anthropometry procedures manual. cited [2018 Jul 18]. Available from: http://www.cdc.gov/nchs/data/ nhanes/nhanes_07_08/manual_an.pdf.
10. Pinto JA, Godoy LBM, Marquis VWPB, Sonego TB, Leal CFA, Ártico MS. Anthropometric data as predictors of obstructive sleep apnea severity. Braz J Otorhinolaryngol. 2011;77(4):516-21.
11. EmanRamzy Ali, Ahmad Mostafa Mohamad. Evaluation of the efficiency of anthropometric parameters and submental ultrasonographic indices as predictors for screening of obstructive sleep apnea and its severity. 2017 Egyptian Journal of Bronchology, Vol. 11 No. 4, October-December 2017.
12. Xiaoli Chen, Wipawan C. Pensuksan, VitoolLohsoonthorn, et al. Obstructive Sleep Apnea and Multiple Anthropometric Indices of General Obesity and Abdominal Obesity among Young Adults. Int J Soc Sci Stud. 2014 July; 2(3): 89–99.
13. Paulo de Tarso M Borges1, Edson Santos Ferreira Filho2, Telma Maria Evangelista de Araujo, et al. Correlation of cephalometric and anthropometric measures with obstructive sleep apnea severity. Int. Arch. Otorhinolaryngol. 2013;17(3):321-328. DOI:10.7162/S1809-977720130003000013
14. María José Arias Téllez, Francisco M. Acosta, Guillermo Sanchez-Delgado, et al. Association of Neck Circumference with Anthropometric Indicators and Body Composition Measured by DXA in Young Spanish Adults. Nutrients 2020, 12, 514; doi:10.3390/nu12020514.
15. A. Yilmaz, M. Akcaalan. What can anthropometric measurements tell us about obstructive sleep apnoea? Folia Morphol., 2017, Vol. 76, No. 2, pp. 301–306 DOI: 10.5603/FM. a2016.0058
16. Chloe Tom, Bhaswati Roy, Ruchi Vig, Daniel W. Kang, et al. Correlations between Waist and Neck Circumferences and Obstructive Sleep Apnea Characteristics. Sleep Vigil. 2018 December; 2(2): 111–118. doi:10.1007/s41782-018-0041-1.
17. Amra B, Pirpiran M, Soltaninejad F, Penzel T, Fietze I, Schoebel C. The prediction of obstructive sleep apnea severity based on anthropometric and Mallampati indices. J Res Med Sci 2019; 24:66.
18. Davidson TM, Patel MR (2008) Waist circumference and sleep disordered breathing. Laryngoscope 118: 339–347.
19. Daniel NinelloPolesel Karen TiemeNozoe Sergio BrasilTufik. Gender differences in the application of anthropometric measures for evaluation of obstructive sleep apnoea, Sleep Sci. 2019;12(1):2-9.

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Abbreviations:

OSA- Obstructive Sleep Apnoea
BMI- Body Mass Index
AHI- Apnoea Hypopnoea Index
ESS- Epworth Sleep Score
NC- Neck Circumference
WC- Waist Circumference
HC- Hip Circumference
W:H Ratio- Waist: Hip Ratio
ODI- Oxygen Desaturation Index