

ORIGINAL ARTICLE

Correlation between Neck Circumference and Continuous Positive Airway Pressure among Patients of Obstructive Sleep Apnea

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ABSTRACT

Objective: To investigate the relationship between neck circumference (NC) and continuous positive airway pressure (CPAP) in patients with obstructive sleep apnea (OSA), as well as to assess CPAP requirements based on the neck circumference.

Material and methods: This study was carried out in the pulmonary, vascular, and sleep disorders department of the Dow University Hospital in Karachi. The study was done for six months of duration from January 2022 to June 2022. All of the patients who had obstructive sleep apnea (OSA), between the ages of 18 and 60 years, both genders and underwent CPAP therapy were chosen for this study. The polysomnography database was utilized in order to do an analysis on the Apnea-Hypopnea Index for the OSA. Neck circumference was measured at the neck's middle sit in every participant. The neck circumference was correlated with the CPAP therapy. The structured study proforma was used to collect all the data.

Results: A total of 181 individuals who presented with OSA were studied. Mean age of the cases were 52.86±12.26 years and mean neck circumference was 43.45±3.58 cm. Males were 58.0% and females were 42.0%. Majority of the cases 56.4% had severe OSA. There was a strong significant positive correlation between neck circumference and CPAP ($r = 0.177$, p -value 0.017) and significant positive correlation between neck circumference and CPAP ($r = 0.366$, p -value 0.001). Average of CPAP pressure was significantly high according to severity of OSA ($p < 0.0001$).

Conclusion: The neck circumference was observed to be the most reliable marker that significantly positively correlated with CPAP therapy and measurements of OSA and its severity, by AHI alone, seem to have a positive correlation with CPAP therapy. However, OSA evaluation and treatment can be measured for their responsiveness to CPAP based on their neck circumference.

Keywords: OSA, NC, CPAP, Relationship

INTRODUCTION

Obstructive sleep apnea (OSA), is characterized by multiple instances of either partially or completely obstruction of the upper airway during sleeping.¹ This obstruction causes a pause in breathing for longer than ten seconds (which is characterized as apnea or hypopnea), which is then accompanied by arousals and increased breathing rates.¹ The symptoms of this condition can include sleepiness, restlessness in the daytime, extreme fatigue, frequent awakenings, and morning headaches. It's a medical problem that is becoming more common, and there is a possibility that it is linked to a significant rise in comorbidities.² People who have obstructive sleep apnea tend to be overweight, have a history of snoring, and report feeling sleepy during the day. In addition to being of the male gender, being overweight and having a constricted pharyngeal air passages are the three most significant risk factors.² The diagnosis of obstructive sleep apnea is met by an estimated 34% of middle-aged males and 17% of middle-aged females.³ Older adults and the Middle-aged individuals have a higher prevalence of sleep disorders than younger adults, but these disorders are often misdiagnosed.³ Its prevalence also varies depending on a person's race or ethnicity, gender, and the status of obesity. Individuals who have cardiovascular diseases, or stroke have an obstructive sleep apnea prevalence rate ranged from 40% to 80%.³ Whenever a person seems to have an abnormally large or unnecessary energy reserve as in form of body fat, the WHO classifies that individual as obese and the excess weight remains the only potential risk for the OSAS development.⁴ Although the number of cases has been steadily rising over the past few years, they have now reached epidemic proportions across the globe, particularly in industrialized nations.⁴ It is possible that a higher percentage of individuals in the low income nations, such as Pakistan, remain undetected, while in a study reported that the estimated overall prevalence of people at high risk for the OSAS development is 10%.⁵ Since the thickness of the neck is an important predictor of OSA, the neck circumference (NC) measurement has become a common procedure in the recent medical assessments when there has been a suspicion of sleep apnea.^{6,7} Furthermore, epidemiological

data suggests that a neck circumference of more than or equal to 43 centimeters is a more accurate predictor of the incidence of obstructive episodes than BMI.^{6,8} There are nowadays a wide range of treatment choices available to choose from for the efficient management of such disorder.⁹ Continuous positive airway pressure CPAP, is still considered to be the most successful treatment for sleep apnea, even though it has been used for more than three decades.⁹ The use of CPAP lowers the respiratory events quantity during sleep, lessens the sleepiness during the day, and overall increases the quality of life. During this treatment, the pressure exerted by the air being breathed in is constant, fixed at a level that is somewhat higher compared to that of the air of surrounding, which is sufficient to keep the tubes leading to the upper airways open to decrease the snoring and obstructive sleep apnea. However, previously reported that the raised neck circumference positively linked to OSA development and its severity,¹⁰ this study has been done to determine the correlation between the neck circumference and continuous positive airway pressure among patients of obstructive sleep apnea, to assess the CPAP requirements in accordance to neck circumference.

MATERIAL AND METHODS

This study was carried out in the pulmonary, vascular, and sleep disorders department of the Dow University Hospital in Karachi. The study was done for six months of duration from January 2022 to June 2022. This was a cross-sectional study, which was done after taken approval from the ethical review board committee of Hospital. All of the patients who had obstructive sleep apnea (OSA), between the ages of 18 and 60 years, both genders and underwent CPAP therapy were chosen for this study. Individuals those had other types of pulmonary diseases, such as chronic obstructive pulmonary disease, any kind of psychological or neurological impairment, uncontrol hypertension, coronary heart disease, pregnant women, and patients having thyroid disorders were excluded. The polysomnography database was utilized in order to do an analysis on the Apnea-Hypopnea Index for the OSA. Neck circumference was measured at the neck's middle sit

in every participant, between the mid-cervical spine and the mid-anterior neck by the plastic tape (non-stretchable) in the straight standing position of every subject. In the males who seem to have a laryngeal prominence, the measurement was taken directly below the prominence. During this reading, the individuals were given the instruction to maintain their shoulders without slouching, as directed by the instructor. The structured study proforma was used to collect each and every piece of data. For the purpose of the data analysis, SPSS version 26 was utilized. The neck circumference was correlated with the CPAP therapy using Pearson's correlation for these two continuous variables. A p-value of less than or equal to 0.05 was deemed to be statistically significant.

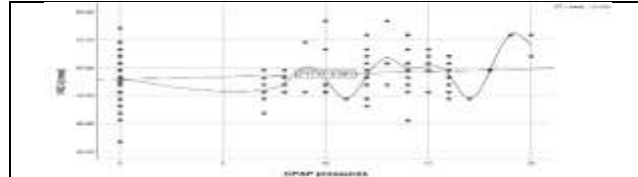
RESULTS

In this study, 181 individuals who presented with OSA were studied. Mean age of the cases were 52.86 ± 12.26 years and mean neck circumference was 43.45 ± 3.58 cm. Out of all study subjects, males were 58.0% and females were 42.0%. Most of the cases 92.3% were married, and only 7.7% were unmarried. The majority of the study participants 56.4% had severe OSA, 26.5% had moderate OSA, and 17.1% had mild OSA. Table.1

Table 1: Descriptive analysis of demographic characteristics n= 181

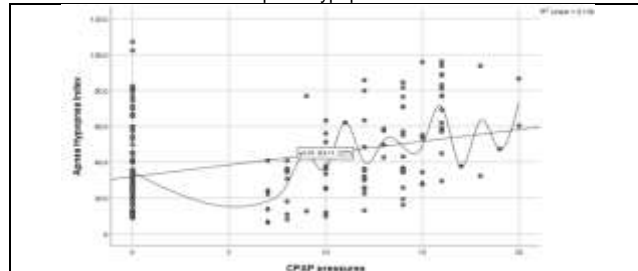
Variables		Statistics	
Age (mean)		52.86+12.26 years	
Neck circumference		43.45+3.58 cm	
Gender	Male	105	58.0
	Female	76	42.0
Marital status	Married	167	92.3
	Unmarried	14	7.7
Severity of OSA	Mild	31	17.1
	Moderate	48	26.5
	Severe	102	56.4

Table: 2 Correlation between neck circumference and CPAP n=181



		NC (cms)	CPAP pressures
NC (cms)	Pearson Correlation	1	.177*
	Sig. (2-tailed)		.017
	N	181	181
CPAP pressures	Pearson Correlation	.177*	1
	Sig. (2-tailed)	.017	
	N	181	181

Table 3: Correlation between apnea hypopnea index with CPAP n=181



		CPAP pressures	Apnea Hypopnea Index
CPAP pressures	Pearson Correlation	1	.366**
	Sig. (2-tailed)		.000
	N	181	181
Apnea Hypopnea Index	Pearson Correlation	.366**	1
	Sig. (2-tailed)	.000	
	N	181	181

There was a strong and significant positive correlation between neck circumference and CPAP (coefficient correlation 0.177, p-value 0.017). Table.2

There was also a significant positive correlation between neck circumference and CPAP (coefficient correlation 0.366, p-value 0.001). Table.3

Average of CPAP pressure was significantly high according to severity of OSA (p=0.0001). Table.4

Table 4: Average of CPAP according to severity of OSA n=181

Severity of OSA	N	CPAP		p-value
		Mean	Std. Deviation	
Mild	31	2.74	4.147	0.0001
Moderate	48	3.92	5.856	
Severe	102	8.68	6.884	
Total	181	6.40	6.730	

DISCUSSION

Obstructive sleep apnea, is characterized by persistent partial or the complete upper airway obstructive occurrences.³ These events can result in occasional autonomic fluctuation, hypoxemia and fragmentation of sleep. Such occasional cycles of interrupted breathing are the source of both acute and chronic physiological factors of stress.³ This study has been done to evaluate the correlation between the neck circumference (NC) and continuous positive airway pressure (CPAP) among patients of obstructive sleep apnea (OSA), to assess the CPAP requirements in accordance to neck circumference and in this study, mean age of the cases were 52.86 ± 12.26 years and mean neck circumference was 43.45 ± 3.58 cm, males were in majority 58.0% while females were 42.0%. Consistently Pataka A et al¹¹ reported that the mean of the males was 50.7 ± 14.5 years and mean age of the females was 55.5 ± 13.2 years. In another study, Sultan N et al¹² reported that the mean age of their study subjects was 50.84 years, and males were in the majority 66%, while females were 34%. On the other hand, Khan TM et al¹³ patients; average age was 58.66 year, while inconsistently they found females in majority 169 as compared to males 114, out of all study subjects. Discrepancies between genders could be explained by factors such as hormonal changes, the structure of the upper airways, body fat, and the morphological characteristics of the craniofacial region.¹¹ The symptoms of OSA can vary from person to person, depending on gender. The traditional symptoms of sleep apnea, including drowsiness, apnea, and the snoring are more frequently reported among males, while depression, fatigue, morning headaches, and the initial insomnia seem to be more frequent in females.¹¹

In this study, the majority of the study participants 56.4% had severe OSA, 26.5% had moderate OSA, and 17.1% had mild OSA. In accordance to these findings Dashzeveg S et al¹⁴ reported that, as per classification by apnea-hypopnea index, 50 cases had mild OSA, 41 cases had moderate OSA and 50 cases had severe OSA. Consistently, Agrawal R et al¹⁵ also reported that the 37 (23%) cases had mild OSA, 51 (31%) patients had moderate OSA, and 75 (46%) cases had severe OSA.

In this study there was a strong significant positive correlation between neck circumference and CPAP (coefficient correlation 0.177, p-value 0.017), and also a significant positive correlation between neck circumference and CPAP (coefficient correlation 0.366, p-value 0.001). These findings were thought to be similar to those of the Agrawal R et al. study.¹⁵ In the line of this study Mihaicuta S et al⁶ highlighted that the classification performance of neck circumference for CPAP accessibility, using a population cohort of individuals who had been kept referring to sleep health facilities for the assessment and the management of OSA. Our statistical study demonstrated the certain NC cut-off point for accurate treatment and prioritization and identified NC as the best marker that correlates with CPAP therapy.⁶ Further, they reported that the both the NC and the early AHI are strong indicators of the CPAP response, which is evaluated by the significant decrease in AHI.⁶ Obstructive sleep apnea, is a disease

that has a high prevalence all over the globe and is linked to a number of systemic consequences.¹⁶ Some of these consequences include excessive daytime sleepiness, impairment of neurocognitive function, and decreased driving ability. When left untreated, obstructive sleep apnea's long-term effects can include an increased risk for CVD, metabolic syndrome, and the cerebrovascular disorder, all of which can ultimately result in an earlier death.¹⁶ To prevent the associated comorbidities, the effective therapy is needed, and CPAP is the treatment that he recommends for the majority of patients who suffer from OSA.¹⁷ This treatment relieves obstruction of the upper airway by raising intramural pressure, which ultimately results in compression therapy of the airway.^{17,18} That clinical practice guideline offers suggestions for using PAP, methods for starting PAP treatment, and initiatives to encourage PAP compliance in people with OSA.¹⁹ Although in the past, a number of predicting algorithms based on various characteristics, including BMI, NC, the minimum oxygen saturation, as well as other criteria, were developed to estimate a therapeutic CPAP level.¹⁷ Despite their accuracy, numerous practitioners have not been compelled to use these formulas in routine medical care.^{17,20} However, there are certain limitations to our study that need to be considered in subsequent research.

CONCLUSION

As per the study conclusion, the neck circumference was observed to be the most reliable marker that significantly positively correlated with CPAP therapy, and measurements of OSA and its severity, by AHI alone, seem to have a positive correlation with CPAP therapy. However, based on their neck circumference, OSA evaluation and treatment can be measured for their responsiveness to CPAP. Due to many study limitations and a lack of data at the local level, it is recommended that additional large-scale studies be conducted on this subject for more confirmation.

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