# Usefulness of Neck Circumference as Predictive Tool for Obstructive Sleep Apnoea in Adults

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**ABSTRACT –**
**INTRODUCTION**- Obstructive sleep apnea (OSA), which is characterized by repeated pharyngeal collapse during sleep, is associated with excessive daytime sleepiness, resulting in decline in the patient's quality of life and may affect his/her performance in tasks requiring sustained vigilance . Obesity is a major risk factor for the development of obstructive sleep apnea (OSA). Clinically, neck circumference (NC) has been known to be a strong predictor of OSA

**OBJECTIVE** - A cross-sectional review to assess the ability of the neck circumference(NC) to predict obstructive sleep apnoea syndrome(OSAS) in adults.

**MATERIALS AND METHODS** – This study was conducted on 150 patients with obstructive sleep apnoea coming in Midland healthcare and research centre, Lucknow for snoring difficulties. Overnight polysomnography was performed for all patients at the sleep laboratory and their neck circumference as measured. The apnea/hypopnea index (AHI) was measured to evaluate the severity of OSAS. Statistical analysis was carried out by using SPSS for Windows version 16.0.

**RESULTS** - NC was higher in severe OSAS patients as compared to non-severe patients (p=0.021. p<0.001). Neck circumference proved to be a good predictor of both the presence and severity of OSA in our group of patients with severe obesity.

**CONCLUSION** - NC measurement was higher in severe OSAS patients compared to non-severe patients so it can be used as a precious tool for predicting OSA.

**Keywords**: neck circumference, obstructive sleep apnea syndrome, apnea-hypopnea index

## I.    INTRODUCTION –

Obstructive sleep apnea is a common disorder that causes patients to temporarily stop or decrease their breathing repeatedly during sleep. This results in fragmented, nonrestful sleep that can lead to symptoms such as morning headache and daytime sleepiness[1]. Obstructive sleep apnea affects persons of all ages, with an increasing prevalence in those older than 60 years. In India, the obesity has become an epidemic especially in young adults due to improper dietary intake and sedentary lifestyle. The obesity can lead to several severe health impairments like cardiovascular, metabolic disorders. This may drive obstructive sleep apnoea syndrome (OSAS) to an increasingly important public health issue over the next few years There are many health conditions associated with obstructive sleep apnea, including hypertension, coronary artery disease, cardiac arrhythmias, and depression[7]. Loud snoring, gasping during sleep, obesity, and enlarged neck circumference are predictive clinical features. The diagnostic standard for obstructive sleep apnea is nocturnal polysomnography in a sleep laboratory. Continuous positive airway pressure , weight reduction, oral appliance therapy, and bariatric surgery are the treatment options for this disorder[1].

It has been proved in a study that in Indian population, obese individuals were nearly four times more prone to develop OSA than non obese after adjusting for age and gender . Obesity is considered as an important risk factor for developing OSA as obesity can increase fat deposits around the upper airway, narrow the upper airway, and diminish the activity of the muscles in this region, collapsing the airway during sleep. Neck circumference (NC) is relatively new anthropometric measure which can predict upper airway soft tissue enlargement due to deposition of fat[8]. The present study was designed to determine the association between neck circumference and risk of OSA.

Although polysomnograpy is an essential tool for diagnosis of OSA, it is costly, complex, and, in many countries, difficult to access. Therefore, determining patients who are at a high risk patient for is very important when considering the use of full overnight polysomnography to diagnosis OSA. Obesity measures for predicting of OSA may be useful.

Recently, it was indicated that neck circumference (NC) is a useful predictor of OSA, and the variance in the severity of OSA explicable by central obesity

depends on the variation in the NC. Thus we used neck circumference as a tool for predicting patients with OSA.

## II. MATERIALS AND METHODS –

Our study was done on 150 patients referred for the investigation of sleep disorders(snoring, sleepiness) from June 2020 to August 2022.Each underwent clinical examination and 8 hour overnight sleep study at sleep laboratory in Midland healthcare and research centre, Lucknow. Subjects with history of alcoholism, chronic anxiolytic/sedative drug use, associated respiratory, renal, hepatic or cardiovascular disease or upper respiratory tract infection within the past one week as well as those who were pregnant were excluded from the study. The presence of obstructive sleep apnoea( quantified as the number of >4% arterial O2 saturation dips per hour of sleep) was then correlated with neck size.

The study was approved by the ethics committee of the institute and all patients gave written informed consent to participate.

All subjects underwent full general medical examination including measurement of neck circumference at the level of the cricothyroid membrane. NC was measured in centimeters in all the subjects at mid-neck, between the mid-cervical spine and the mid-anterior neck standing upright and facing forwards, with shoulders relaxed using a non-elastic measuring tape.

To establish the presence or absence of OSA all patients underwent full polysomnography,overnight pulse oximetry. Full polysomnography included recordings of electroencephalogram, electromyogram, electrooculogram, pulse oximetry, oro-nasal airflow, ribcage and abdominal movement. OSA was quantified as the number of >4% dips in arterial oxygen saturation per hour of sleep.

Descriptive analysis was carried out to determine the general characteristics of the subjects. The association of NC with risk of OSA in both male and female subjects was analyzed by Independent t-test. A p value of $\leq$ 0.05 was considered significant. SPSS 16 was used to analyze the data thus obtained.

## III. RESULTS –

All 150 patients(78 males and 72 females) reported snoring episodes. We observed that 84% of the patients had OSAS, 34.3% of them with light apnea (AHI between 5 and 15), 25.7% with moderate apnea (AHI between 15 and 30), and 40% with severe apnea (AHI above 30). Only 16% had an AHI within normal limits and reported no clinical complaints, indicating that this group of obese patients did not have OSAS. We found that the largest neck circumferences and the youngest ages were more prevalent in the group with OSAS (Table 1). The average age of the patients was 51.5 $\pm$ 13.3 years and the average neck circumference was 40.4 $\pm$ 3.2 cm.

**Table 1. General characteristics of the studied sample**

| Variables | Non-OSA patients (n = 24) | OSA patients (n = 126) | P value |
|---|---|---|---|
| Males | 11.5% | 88.5% | 0.01 |
| Females | 20.8% | 79.2% | 0.01 |
| Age | 43.4+/-19.2 | 55.5+/-12.3 | <0.001 |
| Neck circumference(cm) | 37.4+/-4 | 39.7+/-7.8 | <0.001 |

Data as mean +-SD,OSA = obstructive sleep apnoea,*Based on chi-square test, **based on student t test , NS = non-significant

**Table 2 Polysomnographic findings of studied sample**

| | Non-OSA patients | OSA patients |
|---|---|---|
| AHI | 4.6 ± 2.1 | 35.5 ± 21.7* |
| SaO2 min (%) | 79 ± 6.7 | 76 ± 8.9* |

Data reported as mean ± SD, OSA = obstructive sleep apnoea, AHI = apnoea and hypopnoea per sleep hour index, SaO2 min = minimum oxyhemoglobin saturation, *p<0.001 (student t test)

## IV. DISCUSSION –

The present study was designed to determine association between NC with risk of OSA. The pathogenesis of OSA is believed to be due to unfavorable pharyngeal anatomy that promote reduction in diameter of pharyngeal opening including cervical soft tissue, vessels, and bony structures. Many of these factors promote pharyngeal collapsibility by decreasing the caliber of the upper airway or by increasing the upper airway surrounding pressure . As evident from our study, increased NC is associated with higher risk of OSA as it is linked to increased neck fat deposition which may be an important factor promoting pharyngeal narrowing and hence predispose an individual to OSA.

In all of the 150 patients taken for sleep study, all reported snoring as primary difficulty. Only 16% patients did not have any clinical complaint and their apnoea- hypopnoea index as less than 5 indicating that no sign of OSA was present in these patients. Though the prevalence of OSA in the general population is higher among males. In our study also we found 88.5% male patients were having OSA and 79.2% female patients had OSA which did not show a highly significant association.

In most of the studies, OSA was seen among old patients , similar to that, in our study OSA was seen among older individuals. Neck circumference proved to be a good predictor of both the presence and severity of OSA in our group of patients with severe obesity. Our study results are comparable to other similar studies done in India and abroad. A study done by Ahbab et al., stated that NC is an independent risk factor for severe OSAS. NC in severe OSAS patients was significantly higher than in non-severe OSAS patient[2] . Another study done by Cizza et al., in short-sleeping obese men and premenopausal obese women also revealed an association of greater NC with OSAS and metabolic syndrome[9] . Obese patients with sleep apnoea had fatter necks than equally obese non-apnoeic snorers was the conclusion of Hoffstein et al., implying that NC could be a significant determinant of apnoea and snoring[19] .

Antonio et al concluded that neck circumference is the best anthropometric measurement of respiratory disorder severity and it correlated more with AHI as in our study[5].

Another study which compared various risk factors of OSA with apnea-hypopnea index found that neck girth correlated with AHI of 15 or more independently and significantly with an odds ratio of 1.5.

Similar results were found by Soylu et al who did retrospective study on 499 subjects[14], Bouloukaki et al who did their study on 2690 patients[17]. Contrary to our study, Papanas et al found that waist circumference was correlated with OSA but this study was done in only male subjects[21]. Another study by Cielo et al found no association between neck fat and OSA[24] may be due to African-American cohort group taken.

Overall,we found out that a larger neck circumference was a good predictor of both presence and severity of OSA.

## V. CONCLUSION –

This study shows that larger neck circumference predisposes to obstructive sleep apnoea with the limitation of our study being the smaller sample size.

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