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Research Article

Evaluation of Obesity Hypoventilation Syndrome in Patients of Metabolic Syndrome Presenting with Sleep Disordered Breathing to a Tertiary Care Hospital.

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Summary

Obesity hypoventilation Syndrome (OHS) is defined by the combination of obesity (body mass index (BMI) ≥30 kg.m-2), sleep disordered breathing and daytime hypercapnia (arterial carbon dioxide tension ($PaCO_2$) ≥45 mmHg at sea level) during wakefulness occurring in the absence of an alternative neuromuscular, mechanical or metabolic explanation for hypoventilation.

The study is a single center study in the Sleep lab of Department of Respiratory Medicine of Indraprastha Apollo hospital, Delhi from January, 2020 to December, 2020.A sample size of 55 patients of metabolic syndrome (defined by previously mentioned criteria) who underwent complete overnight polysomnography were selected for the study and different clinical and lab parameters were used to diagnose patients of OHS. Ten patients were diagnosed with OHS and rest 45 had only OSAs. These patient groups were compared on the basis of different parameters and statistical significance were verified.

Out of all the parameters used to compare patients with and without OHS the study found significant difference for baseline SpO_2 levels and neck circumference only. This suggest that these parameters can be taken as predictors of OHS in patients of metabolic syndrome in the Indian patients.

We also found that percentage prevalence of patients with OHS was more in Class 2 obesity (moderate risk obesity, defined as BMI in the range of 35.0-39.9) than lower or higher BMI ranges. This finding may be confounded by the presence of smaller sample size and other confounders.

In our study all the patients with OHS had severe obstructive sleep apnoea (OSA) (defined by an apnoea/hypopnoea index (AHI) ≥30 events.h-1).

Introduction

Obesity hypoventilation syndrome (OHS) can be expressed as a combination of obesity (body mass index ≥ 30 kg/m2), chronic daytime hypercapnia (PaCO2>45 mmHg), and sleep-disordered breathing in the absence of other known causes of hypercapnia[1]. Compared to eucapnic patients with obstructive sleep apnea (OSA), patients with OHS have a lower quality of life[2], more health care expenses, and a greater risk of pulmonary hypertension[3].

Background of the Study

OHS prevalence has been estimated to be ∼0.4% of the adult population. OHS is typically diagnosed during an episode of acute-on-chronic hypercapnic respiratory failure or when symptoms lead to pulmonary or sleep consultation in stable conditions. The diagnosis is firmly established after arterial blood gases and a sleep study. The presence of daytime hypercapnia is explained by several co-existing mechanisms such as obesity-related changes in the respiratory system, alterations in respiratory drive and breathing abnormalities during sleep[4]. The most frequent comorbidities are metabolic and cardiovascular, mainly heart failure, coronary disease and pulmonary hypertension. Both continuous positive airway pressure (CPAP) and non-invasive ventilation (NIV) improve clinical sympt473oms, quality of life, gas 8exchange, and sleep disordered breathing. CPAP is considered the first-line 9treatment modality for OHS phenotype with concomitant severe obstructive sleep apnoea, whereas NIV is preferred in the minority of OHS patients with hypoventilation during sleep with no or milder forms of obstructive sleep apnoea (approximately <30% of OHS patients). Acute-on-chronic hypercapnic respiratory failure is habitually treated with NIV. Appropriate management of comorbidities including medications and rehabilitation programmes are key issues for improving prognosis[4]. Simply put, obesity hypoventilation syndrome (OHS) is defined as a combination of obesity (ie, body mass index (BMI) > 30 kg/m2) and awake chronic hypercapnia (ie, arterial partial pressure of carbon dioxide (PaCO2) ⩾ 45 mmHg) accompanied by sleep disordered breathing (SDB) in the absence of any other reason of hypoventilation[5]. OHS is often unrecognized and treatment is frequently delayed, and can cause secondary erythrocytosis, pulmonary hypertension, and corpulmonale. The delay in recognizing and treating this condition increases health care resource use and the likelihood of requiring hospitalization compared with patients who have similar degrees of obesity[6]. The prevalence of OHS in the general population is unknown, however; some reported prevalence of around 10–20% in outpatients presenting to sleep clinics and a current estimate suggests around 0.37% of the US population may have OHS[5]. In the view of rapidly increasing numbers of individuals joining the ranks of the morbidly obese, and the significantly greater need they have for medical care, OHS needs to be considered as a significant clinical and social problem. Unfortunately, it is also one that is frequently underestimated; despite the significant comorbidities and higher hospitalization rates were experienced[7]. An early identification is a key element in managing patients with OHS. Current data however suggest that this disorder is frequently overlooked despite the high rate of hospitalization and medical care interaction received by these individuals in the years prior to a diagnosis being made[6]. Those with chronic stable disease frequently present through sleep clinics, where screening for hypoventilation may not be undertaken. Sleep histories in these patients are usually indistinguishable from simple OSA, with reports of excessive daytime sleepiness, loud snoring and nocturnal choking episodes common[8]. Clinically, it is important to distinguish between those individuals with simple OSA and those with OHS. Although therapy directed towards correcting obstructed breathing at night will be effective in some patients with OHS, but in others persisting or worsening hypoventilation will occur[7]. Several alveolar laboratory findings are supportive of OHS, yet the definitive test for hypoventilation is an arterial blood gas performed on room air. Elevated serum bicarbonate level due to metabolic compensation of respiratory acidosis is common in patients with OHS and points toward the chronic nature of hypercapnia[7]. Therefore, serum bicarbonate from venous blood could be used as a sensitive test to screen for chronic hypercapnia[8]. Additionally, hypoxemia during wakefulness is not common in patients with simple OSA. Therefore, abnormal arterial oxygen saturation detected via finger pulse oximetry (SpO_2) during wakefulness should also lead clinicians to exclude OHS in patients with OSA[1].

Hence, this study is first of its kind from India to find out the prevalence of OHS and the for the evaluation of OHS in SDB patients. The definition and diagnostic criteria of OHS are BMI >30 kg/m −2, daytime partial pressure of carbon dioxide ($PaCO_2$) ≥45 mmHg and AHI ≥5, or sleep hypoventilation. 90% of the cases of OHS have AHI ≥5/h, whereas only 10% have sleep hypoventilation[4]. Sleep hypoventilation is assessed by nocturnal CO_2 monitoring during polysomnography. Nocturnal CO_2 monitoring is indicated in patients with daytime $PaCO_2$ ≥45 when polysomnography does not show OSA[4].There is also a new terminology called “obesity-related sleep hypoventilation” (ORSH), wherein the patient has only nocturnal hypoventilation without any daytime hypercapnia. This represents the early stage of hypoventilation in obesity which may eventually progress to OHS. The implication of ORSH on long-term consequences and management are not known.

Significance of the Study

Very few studieshave been done in India to evaluate obesity hypoventilation syndrome (OHS) among patients with sleep-disordered breathing (SDB). The known predictors of OHS, i.e., body mass index (BMI) >35 kg/m2 and forced vital capacity (FVC) <3.5 L for men and <2.3 L for women from western countries, cannot be applied to Indian patients. In this background the present study was performed to evaluate OHS in patients of metabolic syndrome presenting with sleep disordered breathing to a tertiary care hospital. We performed this study, one of its kind from India to find out the prevalence of OHS and the various predictors of OHS in patients of metabolic syndrome who had SDB.

Table 1: Definition of overweight and obesity

Overweight: BMI 25-29.9 kg/m2
Class 1 obesity: BMI 30-34.9 kg/m2
Class 2 obesity: BMI 35-39.9 kg/m^2
Class 3 obesity: BMI ≥ 40 kg/m2

Table 2: Diagnostic Criteria for OHS

-	BMI >30 kg/m2
-	Awake arterial hypercapnia (PaCO2 >45 mm Hg)
-	Rule out other causes of hypoventilation
-	Polysomnography reveals sleep disordered breathing
-	with or without obstructive apnea/hypopnea events

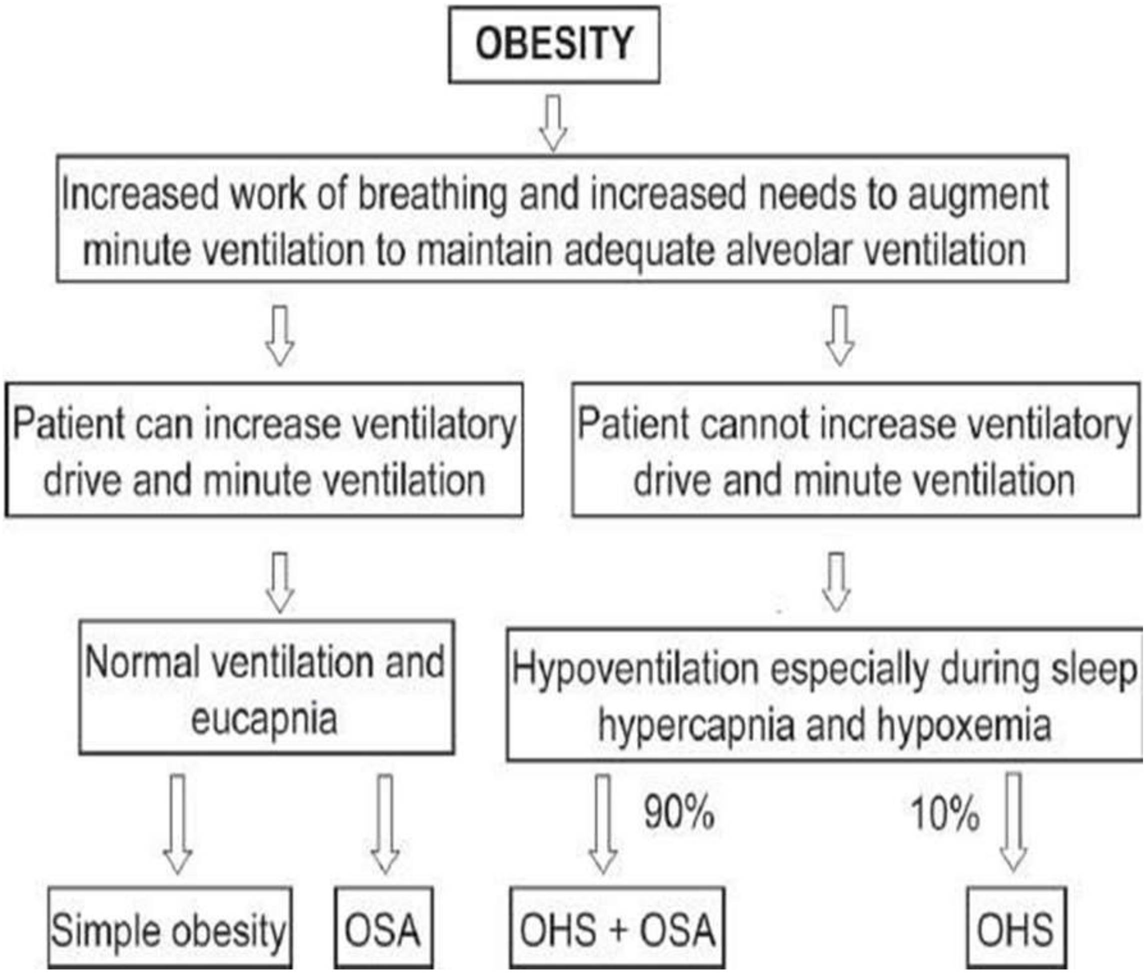

Figure 1: A simplified algorithm for the pathophysiology of OHS

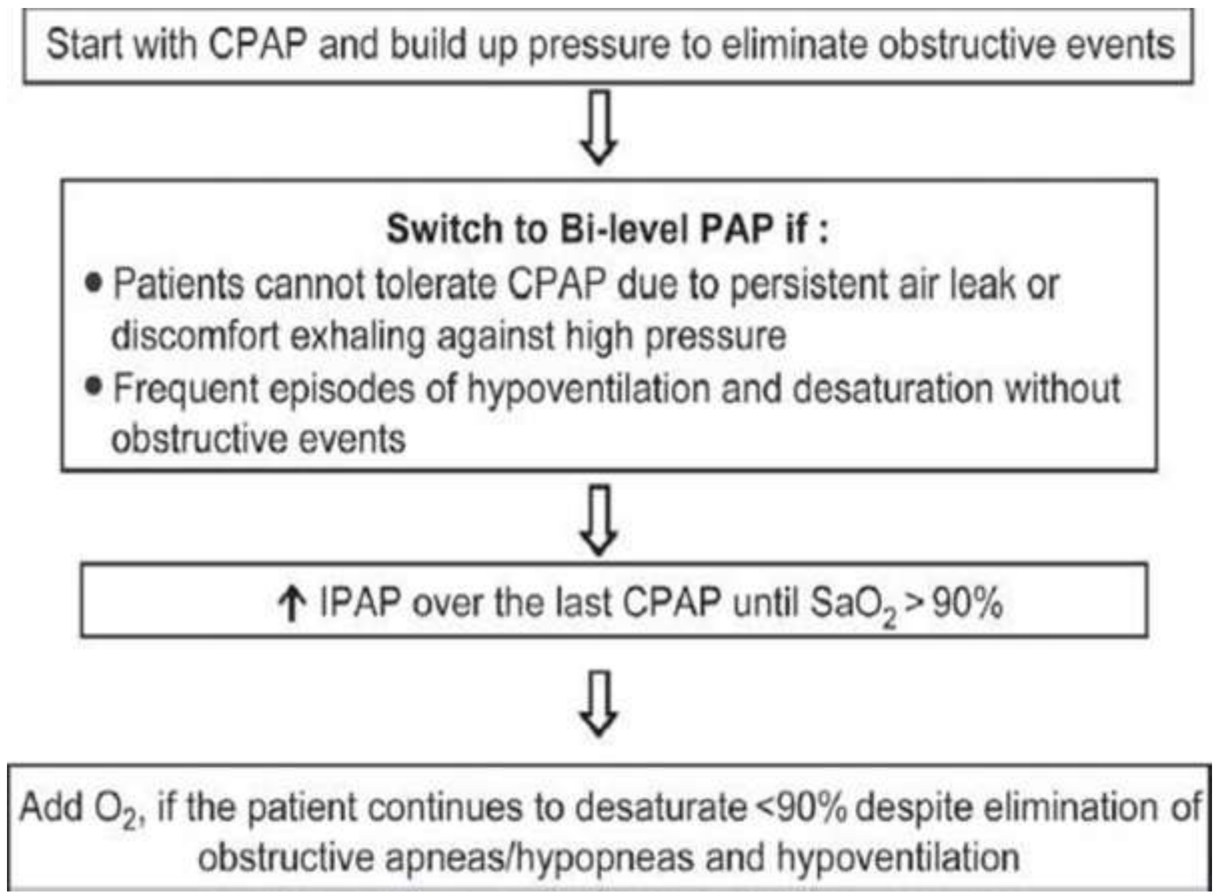

Figure 2: Therapeutic algorithm for positive airway pressure use in obesity hypoventilation syndrome patients. CPAP: Continuous positive airway pressure; PAP: Positive airway pressure; IPAP: Inspiratory positive airway pressure

Aims and Objectives

The aim and objective are highly focused and feasible. The objective of a research or thesis addresses the more immediate study outcomes. The justification of a sensible and precisely described objective is to clearly and concisely define the purpose of the study and emphasizing how the goals of the study are to be accomplished.

Primary Objective

- To evaluate the patients of Obesity Hypoventilation Syndrome in patients of Metabolic Syndrome presenting with sleep disordered breathing to a tertiary care hospital during the aforementioned period.

Secondary Objective

- To determine different classes of obesity in patients of OHS.
- To assess the clinical predictors of patients with and without Obesity Hypoventilation Syndrome in these patients of Metabolic Syndrome presenting with sleep disordered breathing in a Sleep Lab for overnight Polysomnography study.

Materials and Method

The topic "Research Methodology" deals with the description of methods that was applied in carrying out the research. It covers research design, population of study, sampling design, data collection, and data analysis.

Study Area

The study is a single center study in the Sleep lab of Department of Respiratory Disease, Critical Care and Sleep Medicine of Indraprastha Apollo hospital, Delhi.

Study Population

This observational study was based on the samples of patients older than 18 years of age referred to the sleep lab of large urban public hospital of Delhi.

After patients agree to participate and give their informed consent, they were subjected to detailed history taking, examination and investigation.

Study Design

The study design is the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure. For this study, the study design was a prospective observational study to evaluate OHS in patients of Metabolic Syndrome presenting in a sleep lab. A pre designed semi-structural proforma was used for each of the patient which was include

- Brief clinical information including particulars of the patient, chief complains, past medical history, personal history (including substance use and abuse), medication history, anthropometric measurements (particularly waist circumference, height, weight, neck circumference) etc were taken.
- Patient vitals were recorded along with daytime Spo2.
- Proper general physical examination and Systemic examination were done.

● Investigation - After obtaining informed consent, patients of Metabolic syndrome if not identified earlier were identified by measuring Blood Pressure, Blood Sugars (Fasting and Post Prandial) and Fasting Lipid Profile. After obtaining informed consent, OVERNIGHT POLYSOMNOGRAPHY test was done. Patients that were suspected to have OHS on the basis of having Severe OSA(AHI≥30) with prolonged desaturation (i.e., ≥ 4% fall of SPo2 from the baseline) in Nocturnal oximetry in both NREM and REM sleep& not improving at a CPAP of 5 cm H2O is highly suggestive of OHS

● These patients were further investigated with arterial blood gas analysis (only done whenever there is a very high suspicion of OHS) to confirm daytime hypercapnia (awake PaCO2 ≥ 45 mm of Hg). To rule out other causes of hypoventilation, tests like PFT, CXR, Sr TSH etc were done when necessary.

Sample Size

Out of the listed total patients, a convenient sample size of 55 patients was selected for the study.

Inclusion Criteria:

1) Patients of already diagnosed or newly diagnosed cases of Metabolic Syndrome, above age 18 years of age, who presented with sleep disordered breathing and was ready to participate with their consent, was included in the study.

2) All Adult (≥18 years of age) patients, irrespective of Sex and who underwent Overnight Polysomnography Test in the Sleep Lab of Indraprastha Apollo Hospital during the above-mentioned duration.

Exclusion Criteria:

1) Patients who was not give their consent to participate in the research and any patient who was not fulfill the inclusion criteria was excluded from the study.

2) Patients having

a) Significant pulmonary disease (COPD, ILD)

b) Chest wall disorders

c) Neuromuscular disease

d) Severe hypothyroidism

e) Use of sedative hypnotics, opiates, alcohol.

3) Patients who are <18 years of age

Study Duration

The duration of this study was from January, 2020 to December, 2020.

Data Collection Methods

Data collection: It was collected in the Proforma as attached in the annexure. Data was collected directly from patients after obtaining their consent with prior information of using the obtained data for the study. The information collected from patients through personal and direct interview to collect primary data, a detail and structured questionnaire was form to suit the objectives of the study which contain definite and predetermined questions, containing information relating to the present health condition, medical history, and demographic status of the patient. Laboratory values of the tests was taken from the hospital facility.

Questionnaire

In this study questionnaire method was used.

In this method, pre-printed list of questions arranged in a sequence which was used by the researcher for collecting data. The questionnaire is filled by the respondents. The questionnaire is considered as the heart of the research. The questionnaire was designed in such a way that it was provide the all required information related to medical history, demographic, socio-economic condition etc. The data was collected in a specific manner and was further used for analysis.

Methods of Measurement of Outcome of Interest

a)Measurement of height and weight

- Standing height was measured using a stadiometer and the reading noted up to the nearest cm.
- Weight was measured up to the accuracy of 500 gm. by a standard personal weighing machine. The ratio of weight (in kg) / height (m)2 is referred to as a Body Mass Index. It indicates reasonable indication of the nutritional status of the adults. Because BMI changes substantially as children get older. For and adult the BMI classification is as follows

Table 3: Classification of BMI (kg/m2)

Category	For Adults
Underweight	<18.5
Normal	18.5-24.9
Obesity	≥30

BMI

Body mass index (BMI) is calculated using height and weight. It was used to estimate body fat (obesity). Starting at 25.0, higher the BMI, the greater is patient risk of developing obesity- related health problems. These ranges of BMI are used to describe levels of risk:

- Overweight (not obese), if BMI is 25.0 to 29.9
- Class 1 (low-risk) obesity, if BMI is 30.0 to 34.9
- Class 2 (moderate-risk) obesity, if BMI is 35.0 to 39.9
- Class 3 (high-risk) obesity, if BMI is equal to or greater than 40.0

Statistical Analysis

The collected data was arranged in a systematic manner using tables, graph and pie- charts. Statistical analysis was performed by using IBM SPSS Statistics 22 and results was tabulated in Microsoft Office Excel worksheet. The data was used for qualitative and quantitative analyses using statistical formulae such as mean, standard deviation, frequency tables. Hypothesis and T-test was used to compare the continuous parameters. Z-test of proportion was used for comparison of proportions of clinical parameters of patients grouped by age, Sex etc.

Ethical Issue

The study adheres to the prescribed guidelines from institution for the research work. Informed consent was taken from the patients prior to the study. The study proposal was presented before the ethical committee prior to the onset of the study. The researcher had followed all the suggestions and instructions made by the committee. Institutional Review Board and Ethical Committee have approved this study.

Results

This was a single center study in the Sleep lab of Department of Respiratory Disease, Critical Care and Sleep Medicine of Indraprastha Apollo hospital, Delhi. A convenient sample size of 55 patients was selected for the study. After patients agree to participate and give their informed consent, they were subjected to detailed history taking, examination and investigation. The data was collected in a specific manner and was further used for analysis. The results after the analysis of collected data is provided here:

Table 4: Prevalence of obesity hypoventilation syndrome as per various parameters

Parameter		Total no. of patients	No. of patients with OHS (prevalence in percentage)
Sex	Male	30	7 (23.3)
	Female	25	3 (12.0)
BMI	Low – Risk	21	3 (14.28)
	Moderate - Risk	33	7 (21.21)
	High – Risk	1	
Snoring	Mild	10	
	Moderate	8	
	Severe	37	10 (27.02)
Comorbidity	Hypertension	25	7 (28.0)
	Diabetes	31	9 (29.03)
	Dyslipidaemia	19	3 (15.78)

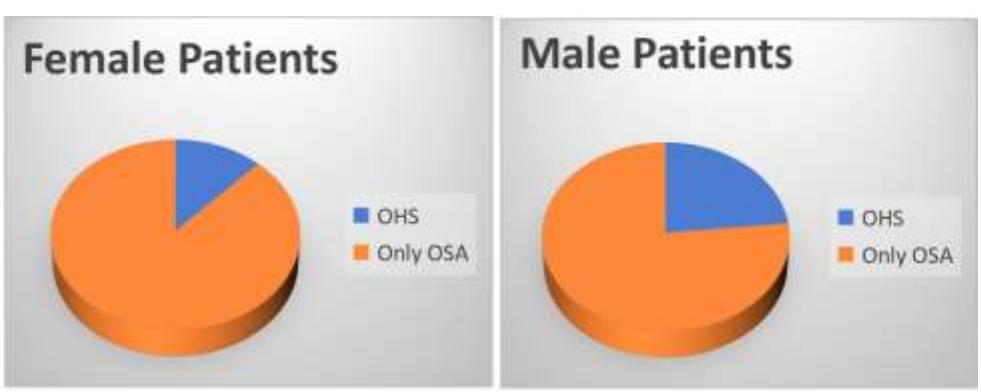

Figure 3 Sex

The above table presents the prevalence of obesity hypoventilation syndrome as per the various parameters. There were 30 male patients out of which 7 (23.3%) patients were identified with OHS while there were 25 female patients out of which 3 (12.0%) were identified with OHS

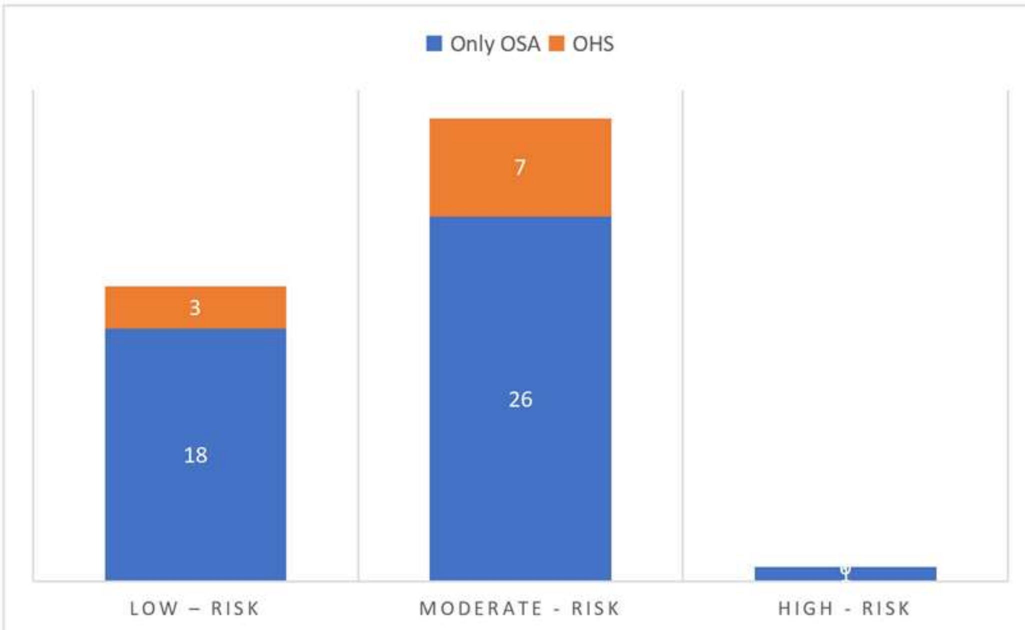

Figure 4: BMI

The above table signified that as per the BMI findings there were 21 patients identified with low-risk, 33 patients with moderate risk and 1 patient found at high risk. The study found that 3(14.28%) patients were identified with OHS among the patients at low-risk(class 1 obesity, i.e BMI = 30-34.9), while 7(21.21%) patients were identified with OHS among the patients at moderate-risk(class 2 obesity, i.e BMI = 35-39.9).

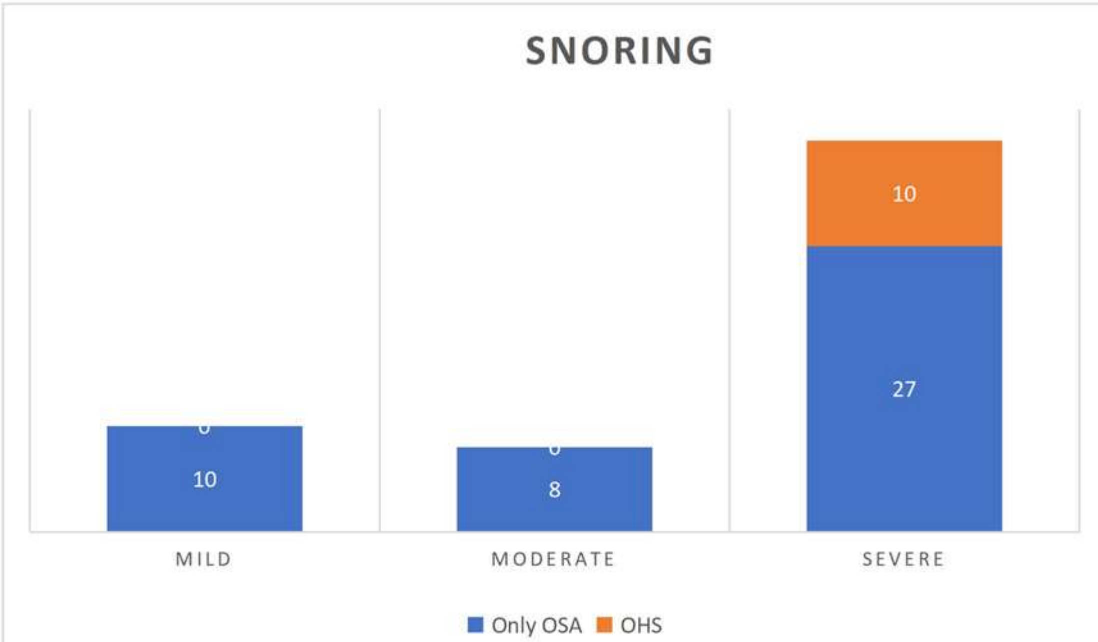

Figure 5: Snoring

Out of the total of 55 patients snoring was found mild in 10, moderate in 8 and severe in 37 patients. Out of the 37 severe snorers, 10 (27.02%) patients were identified with OHS.

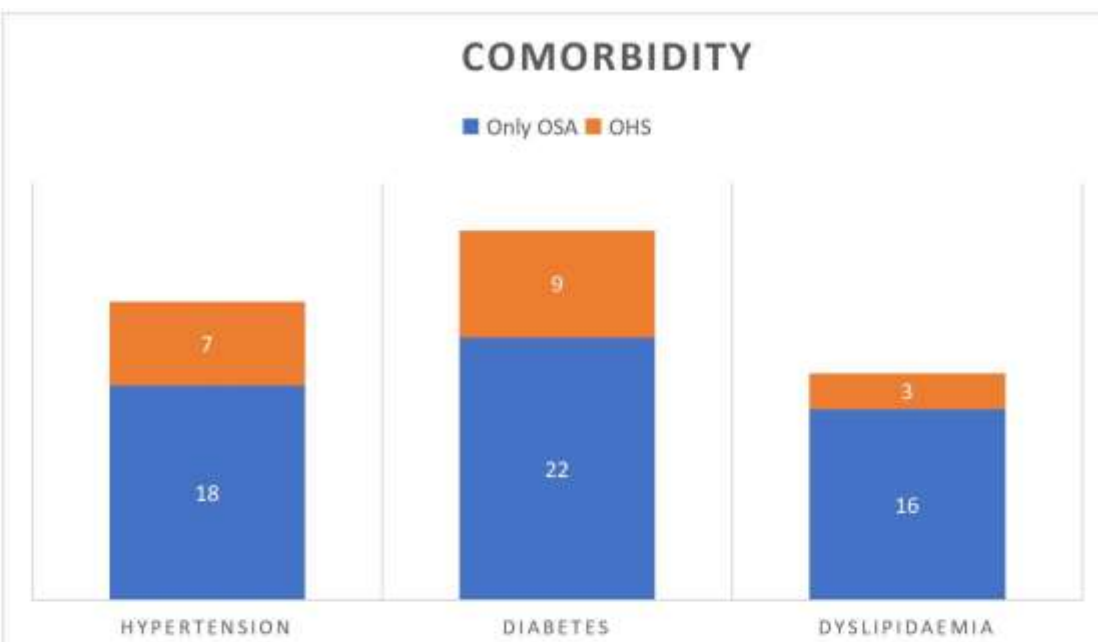

Figure 6: Comorbidity

From the above table it was found that among the 25 hypertensive patients, 7(28.0%) patients were identified with OHS,among the 31 patients with diabetes, 9(29.03%) were identified with OHS, among the 19 patients with dyslipidaemia, 3(15.78%) were identified with OHS.

Table 5: Various characteristics of patients with obesity hypoventilation syndrome compared to those without obesity hypoventilation syndrome

Parameter	With OHS (n=10)	Without OHS (n=45)	P
Demographic Parameters			
Age	37.10±13.22	43.78±13.49	0.980
Sex (Male: Female)	70:30	51.1:48.9	0.500
Anthropometry			
BMI	36.29±2.62	36.00±2.35	1.000
Waist Circumference	127.30±6.36	120.91±6.74	0.644
Neck Circumference	48.1±3.78	45.22±2.88	0.012
Sleep Scores			
ESS	18.10±4.50	10.89±5.19	0.895
Other lung functions			
Baseline SO_2	90.60±2.83	92.71±2.08	0.002
Lowest SO_2	69.40±16.30	79.13±8.43	0.831
pCO_2	54.54±13.14	41.74±1.39	0.998
Polysomnography			
AHI	85.20±30.01	58.16±34.70	1.00
AI	81.00±27.27	58.31±31.16	1.00

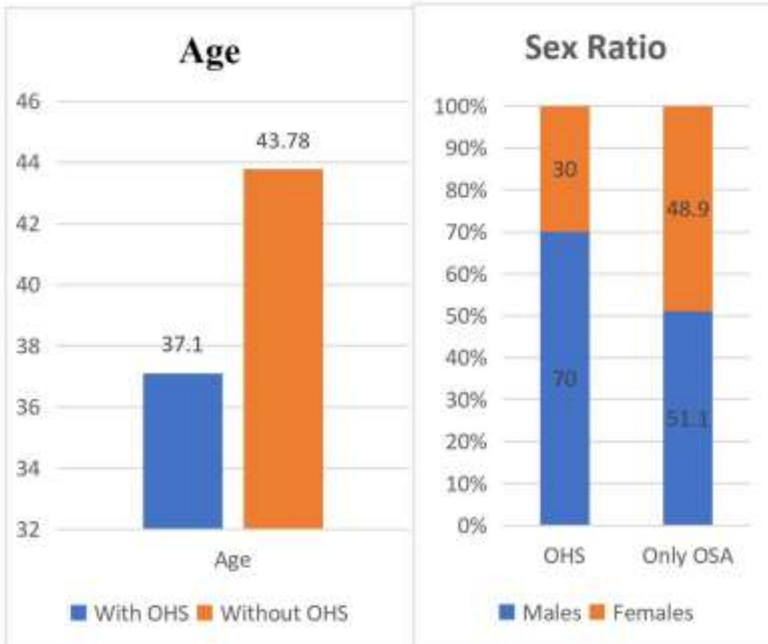

Figure 7: Demographic Parameters

The above table presents the various characteristics of patients with obesity hypoventilation syndrome compared to those without obesity hypoventilation syndrome.

The table signified that the mean age of the patients with OHS was 37.10±13.22 years while the mean age of patients without OHS was found to be 43.78±13.49 years.

The male: female ratio was found to be 70:30 in patients with OHS while it was 51.1:48.9 in patients without OHS.

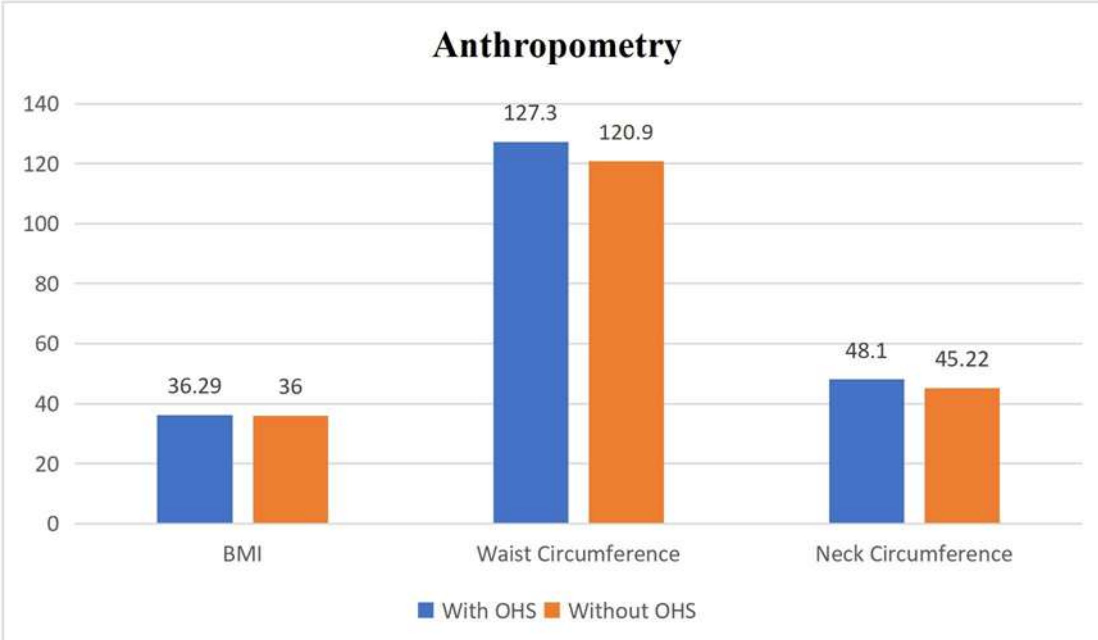

Figure 8: Anthropometry

The mean BMI was found to be 36.29±2.62 in patients with OHS while it was 36.00±2.35 in patients without OHS.

The mean waist circumference was 127.30±6.36 in patients with OHS while it was 120.91±6.74 in patients without OHS.

The results also signified that mean neck circumference was 48.1±3.78in patients with OHS while it was 45.22±2.88 in patients without OHS.

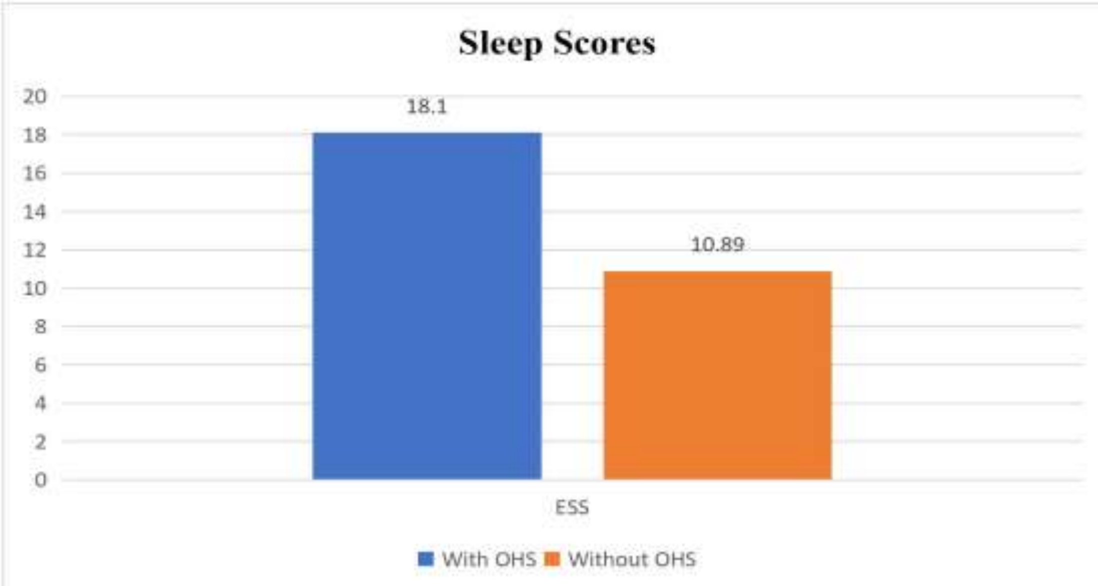

Figure 9: ESS Score

In our study it was found that mean sleep scores in patients without OHS was 18.10±4.50 while mean sleep score in patients without OHS was 10.89±5.19.

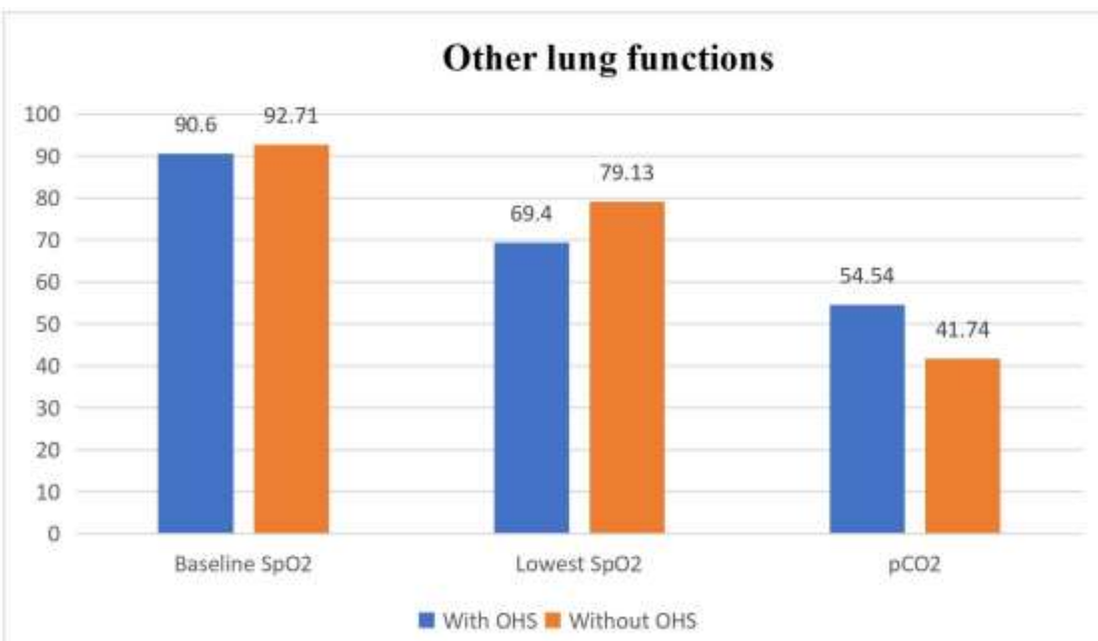

Figure 10: Other Lung Functions

The above table signified that baseline SpO_2 level was 90.60±2.83 in patients with OHS while it was 92.71±2.08 in patients without OHS.

The lowest SpO_2 level was 69.40±16.30 in patients with OHS while it was 79.13±8.43 in patients without OHS.

The pCO_2 level was 54.54±13.14 in patients with OHS while it was 41.74±1.39 in patients without OHS.

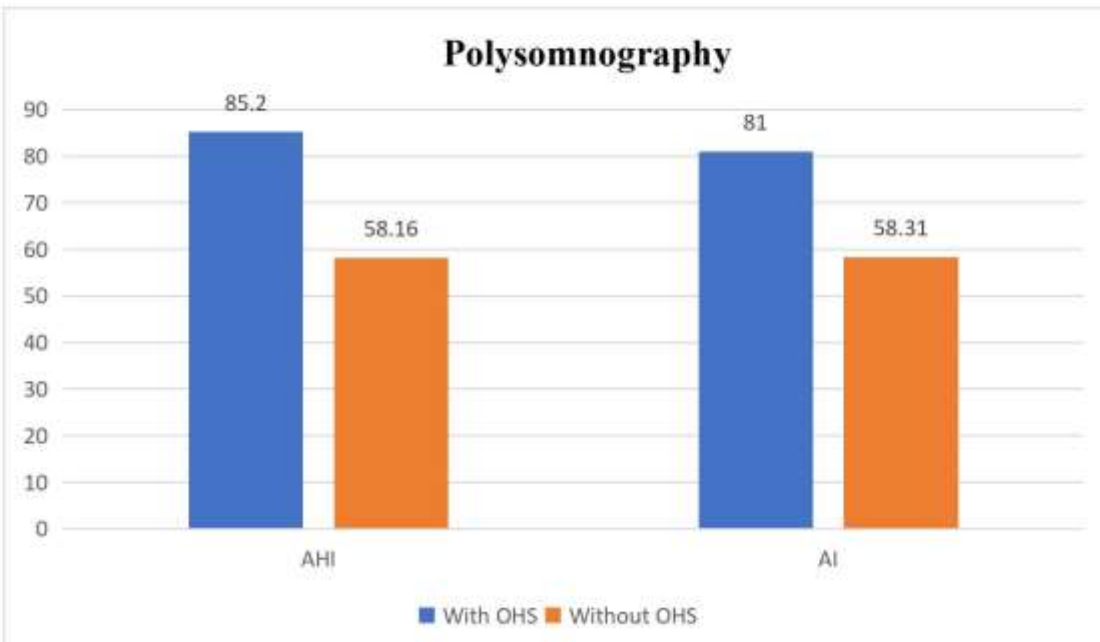

Figure 11: Polysomnography

The results of the study signified that the AHI was 85.20±30.01 in patients with OHS while it was 58.16±34.70 in patients without OHS.

The AI was 81.00±27.27 in patients with OHS while it was 58.31±31.16 in patients without OHS.

Discussion

This is an observational study that was based on the samples of patients older than 18 years of age referred to the sleep lab of large urban public hospital of Delhi. The study design was a prospective observational study to evaluate OHS in patients of Metabolic Syndrome presenting in a sleep lab. In order to collect the required data from the study subjects a pre designed semi-structural proforma was used. The collected data was analysed using the SPSS software. In this section the major findings of the study were discussed with the findings of the relevant studies.

A sample size of 55 patients was selected for the study. In our study 10 patients (18.18%) were diagnosed to have OHS (Obesity Hypoventilation Syndrome) while rest of the 45 patients of metabolic syndrome had pure OSA (Obstructive Sleep Apnea) only. The mean age of the patients with OHS was 37.10±13.22 years while the mean age of patients without OHS was 43.78±13.49 years.

Sleep-disordered breathing (SDB) refers to a group of disorders comprising obstructive sleep apnea (OSA), obesity hypoventilation syndrome (OHS), central sleep apnea, Cheyne–Stokes respiration, and upper airway resistance syndrome. OSA is the most common type of SDB. Central sleep apnea, Cheyne–Stokes respiration, and upper airway resistance can easily be identified on polysomnography whereas the diagnosis of OHS requires additional arterial blood gas (ABG) analysis[106]. Based on various studies from other countries, the prevalence of OHS in the general population varies from 0.15% to 0.4% [5,27] whereas that among patients of SDB is 10%–30%[110,18]. However, till date, there only a few studies from India on the prevalence of OHS. OHS is associated with significant morbidity and mortality. OHS patients as compared to eucapnic patients of SDB have lower quality of life, greater risk of pulmonary hypertension, cor pulmonale, higher need of mechanical ventilation with longer hospital stay, and more health-care expenses [18,3,24]. The management of OHS also differs in that OHS often requires bilevel positive airway pressure with or without oxygen[122].

The review of the available literature has signified that the prevalence of OHS in India is not known. In this context the present study was performed to evaluate the obesity hypoventilation syndrome in patients of metabolic syndrome presenting with sleep disordered breathing to a tertiary care hospital. [123,18,3].

In our study there were 23.3% male patients identified with OHS while there 12.0% female patients identified with OHS. The findings suggest that high prevalence of OHS was found in male patients. Majority of the study subjects were male in this study (n=30), this may be a reason behind the high prevalence of OHS in males.

There is variability regarding gender-specific prevalence in various studies, though most have reported a higher male prevalence. In our study, OHS was seen more frequently among males as compared to females. The findings of our study are in contrast to the study by Nowbar et al. (2004)[24] and Mokhlesi et al. (2006)[124] that have reported high prevalence of OHS among females.

In our study it was found that as per the BMI findings there were 21 patients identified with low-risk, 33 patients with moderate risk and 1 patient found at high risk. The study found that 14.28% were identified with OHS among the patients at low-risk while 21.21% were identified with OHS among the patients at moderate-risk. The findings suggest that the prevalence of OHS increased with increasing BMI. Our results are consistent with previous studies [123,125].

In our study that the mean age of the patients with OHS was 37.10±13.22 years while the mean age of patients without OHS was found to be 43.78±13.49 years. The male: female ratio was found to be 70:30 in patients with OHS while it was 51.1:48.9 in patients without OHS. Age and sex distribution in both the groups were comparable with no significant difference.

The mean BMI was found to be 36.29±2.62 in patients with OHS while it was 36.00±2.35 in patients without OHS. BMI in both the groups was comparable with no significant difference. In our study it was found that mean sleep scores in patients without OHS was 18.10±4.50 while mean sleep score in patients without OHS was 10.89±5.19. The patients in OHS group had higher sleepiness time as assessed with ESS though the difference was not statistically significant. In our study it was found that the baseline SpO2 level was 90.60±2.83 in patients with OHS while it was 92.71±2.08 in patients without OHS. The group without OHS has significantly higher baseline SpO2 levels (p=0.002). The lowest SpO2 level was 69.40±16.30 in patients with OHS while it was 79.13±8.43 in patients without OHS. The pCO2 level was 54.54±13.14 in patients with OHS while it was 41.74±1.39 in patients without OHS.

In a reference study by Bülbül et al. (2014)[26] in Caucasian population had shown that BMI >35 kg/m2 was a predictor of OHS. The variation may be due to the difference in morphology of different ethnic groups. The Japanese study by Akashiba et al., (2006)[21] involving 611 patients with OSA from 7 sleep centers, found that OHS may not be related to obesity alone as there was no significant correlation of BMI with daytime $PaCO_2$[21]. Although there is no direct comparison of Asian versus Caucasian patients having OHS, the craniofacial features have been studied regarding the development of OSA in both the populations. The Asian patients with OSA do have lower BMI and different cephalometric parameters compared to Caucasian.

The results of the study signified that the AHI was 85.20±30.01 in patients with OHS while it was 58.16±34.70 in patients without OHS. The AI was 81.00±27.27 in patients with OHS while it was 58.31±31.16 in patients without OHS. The AHI and AI in both the groups were comparable and no significant differences were found with regard to AHI and AI. Reportedly AHI was not found to be a predictor for OHS unlike other studies[61]. Furthermore, there was no significant difference in AHI and AI between OHS group and non-OHS group[126]. Small sample size is one of the limitations of the present observational study. A sample size larger than the present study would result in better precision of 5%.

Conclusion

The present study has evaluated the OHS in patients of metabolic syndrome presenting with sleep disordered breathing and reported a prevalence of OHS in metabolic syndrome patients. The prevalence of OHS in Indian patients is similar to Caucasians. In our study 10 patients (18.18%) were diagnosed to have OHS (Obesity Hypoventilation Syndrome) while rest of the 45 patients of metabolic syndrome had pure OSA (Obstructive Sleep Apnea) only. The predictors of OHS in the study subjects are baseline SpO2 levels and neck circumference. Among the study population, OHS was more prevalent in moderate risk i.e class 2 obesity (BMI 35- 39.9). There was no significant difference found between the patient group with OHS and without OHS for parameters such as sex, BMI, ESS, lowest SpO2, pCO2, AHI and AI. However, the study found significant difference for baseline SpO2 levels and neck circumference that suggest these parameters can be taken as predictors of OHS in patients of metabolic syndrome in the Indian patients.

Limitation

The limitations of the observational studies include small sample size, as the incidence of complication rate is very low, which leads to their inability to detect clinically meaningful risk factors.

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