

Correlation of Apnea Hypopnea Index Severity with Fasting Blood Sugars and HbA1C Values in Patients with Metabolic Syndrome

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ABSTRACT

Introduction: The relationship between OSA and glycemic health is a topic of increasing clinical and research interest. Community-based studies have suggested that the presence and severity of OSA are independent predictors of insulin resistance and T2DM prevalence the aim of the present study was to examine the potential correlation of OSA and HbA1C values in patients with Metabolic Syndrome

Material and Methods: A cross-sectional study was conducted among a total of 63 patients with a history of metabolic syndrome and were divided into two groups diabetic and non-diabetic. The risk of OSA was assessed by three structured and validated questionnaires namely STOP-BANG, ESS, Modified Berlin. Fasting blood sugars and HbA1C was done. All patients were evaluated with Polysomnography level III. Results were analyzed using statistical methods (Descriptive analysis and correlation). Using SPSS version 22 used.

Results: Out of the total of 63 subjects, there was a male preponderance (Male - 61%) with a mean age of 50.9 ± 12.98 years. Increased AHI was seen in 91% of the subjects (more than 5) with the mean AHI of 29.63 ± 22.14 . The mean FBS & HbA1C was 151.62 ± 49.5 mg/dl & 7.22 ± 1.71 respectively. In both diabetic & non-diabetic groups, the correlation of FBS & HbA1C values with AHI was statistically not significant.

Conclusion: AHI severity did not correlate with FBS and HbA1c values in patients with metabolic syndrome. However, in the non-diabetic subgroup with severe AHI the fasting blood sugar levels were above a higher limit of normal.

Keywords: Metabolic Syndrome, OSA, AHI, FBS, HbA1C

and also is related with an increased risk of cardiovascular disease and type 2 diabetes. Recently, it has been suggested that obstructive sleep apnea (OSA), an increasingly prevalent condition, may contribute to the development of MS and diabetes.⁸

Newer studies show that the prevalence of the metabolic syndrome according to the ATP-III criteria is almost forty percent greater in patients with obstructive sleep apnea.⁹ The concept that OSA may be part of the metabolic syndrome is not new. In 1998, Wilcox I et al¹⁰, proposed the name "syndrome Z" for the combination of OSA and metabolic syndrome (syndrome X). Since then, a major challenge to the field has been to understand whether OSA is a mere epiphenomenon or an additional burden that exacerbates the cardiometabolic risk of obesity and metabolic syndrome.

We highlight the importance of identifying the largely undiagnosed and untreated population with OSA. By understanding the epidemiology of OSA and its association with MS, will allow the health care providers to appreciate the public health burden of OSA and prioritize the allocation of resources to predict and treat this disease at the earliest. Type 2 diabetes mellitus is associated with an increased risk of cardiovascular disease and death. The relationship between OSA and glycemic health is a topic of increasing clinical and research interest. Community-based studies have suggested that the presence and severity of OSA are independent predictors of insulin resistance and T2DM prevalence. Hence the present study was undertaken to assess the clinical profile of OSA in metabolic syndrome and to correlate the severity of OSA with components of metabolic syndrome.

MATERIAL AND METHODS

The present study was conducted at Chettinad Hospital and Research Institute in the department of Respiratory Medicine.

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The study was conducted between October 2018 to October 2019. The present study was a prospective study. We enrolled 63 participants in the age group of 20 to 85 years with a diagnosis of metabolic syndrome according to Modified NCEP ATP III criteria. We divided the participants into two groups. The first group consisted of Diabetic and the second group consisted of non-diabetic individuals. Individuals with Unstable cardiac status, Active PTB /infections, Pregnancy and/or lactation, critically ill patients were excluded from the study. Written informed consent obtained from all the recruited participants. All the participants underwent a thorough evaluation of medical history and a detailed physical examination. We used three structured and validated questionnaires namely STOP-BANG, ESS (Epworth sleepiness scale), Modified Berlin to assess the risk of OSA. Fasting blood sugars and HbA1C was performed. All subjects were evaluated with Polysomnography level III for Apnea hypopnea index, Oxygen desaturation index.

STATISTICAL ANALYSIS

All the collected data were analyzed using statistical methods (Descriptive analysis and correlation), Using SPSS version 22. Categorical outcomes were compared between study groups using Chi-square test /Fisher's Exact test (If the overall sample size was < 20 or if the expected number in any one of the cells is < 5, Fisher's exact test was used.)

RESULTS

A total of 63 participants were included in the analysis. The mean age was 50.9 ± 12.98 years. There was a slight male predominance (61.90 %). The mean height was 162.19 ± 8.86 cm. The mean weight was 88.49 ± 17.02 kg. The mean BMI was 33.94 ± 7.57 cm. Among the study population, 33(52.38%) participants had diabetes. The mean FBS was 151.62 ± 49.5. The mean HbA1c was 7.22 ± 1.71. (Table 1) The mean AHI value was 29.63 ± 22.14. Among the study population, 6 (9.52%) had a normal apnea-hypopnea index. 10 (15.87%) had mild apnea-hypopnea index, 20 (31.75%) had a moderate apnea-hypopnea index, 27 (42.86%) had severe apnea-hypopnea index. The mean STOP-BANG Total score was 5.21 ± 1.26. Among the study population, all 63 (100%) were snore loudly. Among the study population, all 63 (100%) were felt tired, fatigued, or sleepy during day time. Among the study population, 37 (58.73%) were treated for high blood pressure. Among the study population, 39 (61.90%) were stop breathing during your sleep. The mean ESS was 9.19 ± 4.44. Among the study population 42 (66.67%) people had modified berlin. (Table 2)

Among the study participants, 73% had a high risk of OSA by the STOPBANG questionnaire. Among the study population, 90.48% had abnormal AHI, of which 74.61 % of subjects had moderate to severe AHI. (Figure 1)

Among the people with Elevated fasting blood sugar, 12.12% had normal AHI, 12.12% had mild AHI, 30.3% had moderate AHI, 45.45% had severe AHI. The correlation between AHI severity and elevated fasting blood sugar was not statistically significant. (Figure 2) All patients with elevated FBS in the

Parameter	Summary
Age	50.9 ± 12.98
Gender	
Male	39 (61.9%)
Female	24 (38.1%)
Height (Cm)	162.19 ± 8.86
Weight (Kg)	88.49 ± 17.02
BMI	33.94 ± 7.57
Diabetic status	
Diabetic	33 (52.38%)
Non-Diabetic	30 (47.62%)
FBS	151.62 ± 49.5
HbA1c	7.22 ± 1.71

Table-1: Descriptive analysis of demographical parameter and lab parameter (N=63)

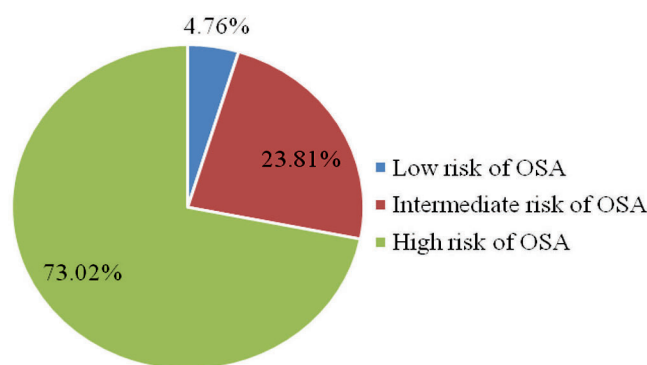


Figure-1: Pie chart for OSA risk by STOP-BANG in the study population (N=63)

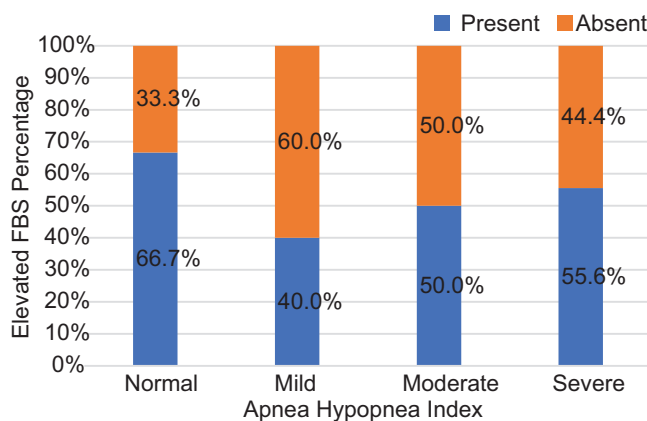


Figure-2: Cluster bar graph for comparison of diabetes with an apnea-hypopnea index (N=63)

study group were known Diabetics on treatment. The median FBS in normal AHI in diabetic people was 197.50, it was 200 in mild AHI, it was 200.50 in moderate AHI, it was 190 in severe AHI. The difference in FBS across AHI was statistically not significant (P value 0.638). The median HBA1C in normal AHI in diabetic people was 8.95, it was 8.95 in mild AHI, it was 8.90 in moderate AHI, and it was 8.90 in severe AHI. The difference in HBA1C across the apnea hypopnea index was statistically not significant (P-value 0.863). The median FBS in normal AHI in non-diabetic people was 111.50, it was 88 in mild AHI, it was 85 in moderate AHI, it was 110 in severe AHI. The difference

Parameter	Summary
AHI Value	29.63 ± 22.14
Apnea hypopnea index	
Normal	6 (9.52%)
Mild	10 (15.87%)
Moderate	20 (31.75%)
Severe	27 (42.86%)
Stop-bang total score	5.21 ± 1.26
Stop-bang category	
Do you snore loudly	63 (100%)
Do you often feel tired, fatigued, or sleepy during day time	63 (100%)
Are you being treated for high blood pressure	37 (58.73%)
Has anyone observed you stop breathing during your sleep	39 (61.90%)
ESS	9.19 ± 4.44
Modified Berlin	
Positive	42 (66.67%)
Negative	21 (33.33%)

Table-2: summary of sleep-related parameters (N=63)

Parameter	Apnea-Hypopnea Index				Kruskal Wallis test P value
	Normal	Mild	Moderate	Severe	
Diabetic people					
FBS	197.50 (183,203.75)	200 (187.75, 236.25)	200.50 (183.75, 207.25)	190 (176, 205)	0.638
HBA1C	8.95 (8.15,9.07)	8.95 (8.57, 9.77)	8.90(8.22,9.02)	8.90(8,9.2)	0.863
Non- diabetic people					
FBS	111.50 (106, 111.50)	88 (79.50, 110.75)	85 (72.4, 127.50)	110 (99.50, 124.50)	0.391
HBA1C	5.7(5.5,5.7)	4.9(4.75,5.92)	5.3 (4.8, 6.42)	5.8 (5.12, 6.27)	0.403

Table-3: Comparison of median FBS, HBA1C with Apnea-Hypopnea Index in diabetic and non-diabetic people (N=63)

in FBS across the apnea hypopnea index was statistically not significant (P-value 0.391). The median HBA1C in normal AHI in non-diabetic people was 5.7, it was 4.9 in mild AHI, it was 5.3 in moderate AHI, it was 5.8 in severe AHI. The difference in HBA1C across the apnea hypopnea index was statistically not significant. (P-value 0.403) (Table 3)

DISCUSSION

Obstructive sleep apnoea (OSA) is a common chronic disorder characterized by repetitive episodes of the complete or partial collapse of the upper airway (mainly the oropharyngeal tract) during sleep, with a consequent cessation/reduction of the airflow.¹¹⁻¹³ The clinical features of OSA include tiredness after awake, less concentration, and daytime sleepiness. One of the most commonly associated comorbidities of OSA is metabolic syndrome.¹⁴ Insulin resistance is a precursor state of diabetes mellitus, and MS is also highly predictive of diabetes mellitus. If OSA does contribute causally to the severity of insulin resistance, it may also indirectly fuel other derangements attributable to insulin resistance, such as hypertension, hypertriglyceridemia, and visceral obesity, perpetuating the disturbances in MS and further add to its cardiovascular sequelae.¹⁵ OSA may be an independent risk factor for microvascular complications in type 2 DM as well, including diabetic retinopathy, neuropathy and foot ulcers,

and nephropathy, though much remains to be confirmed in large-scale studies.¹⁶⁻¹⁸

The mean age of the present study population was 50.9 ± 12.98 years and the majority of the participants were males (61.90%). A study by Parish, JM et al¹⁹, to correlate the Metabolic syndrome with age, gender and severity of OSA with total participants of 250 consecutive patients showed a Mean age of 63.2 ± 13.9 (15-89) years. Literature states that men have greater vulnerability than women toward developing obstructive sleep apnea.²

STOP-BANG questionnaire showed a low risk of OSA in 4.76%, intermediate risk of OSA in 23.81% and high risk of OSA in 73.02%. The mean ESS was 9.19 ± 4.44 and showed a moderate risk of OSA and 66.67% had a high risk of OSA as per the modified Berlin score. All participants had loud snoring, tired, fatigability or excessive daytime sleepiness. Observed apnea during sleep was observed in 61.90% of the participant.

The metabolism of glucose has shown to be affected by intermittent hypoxic conditions. Further OSA has been identified as an independent contributor in the development of glucose intolerance or insulin resistance.²⁰ The association of OSA and type II diabetes is bidirectional, and most often they coexist in subjects. In such situations, prompt diagnosis and management of both can decrease the risk of developing cardiovascular events.^{21, 22} The present study has

found subjects with obesity in greater percentage and can be considered as one of the common risk factors for developing OSA.

The present study of the difference in FBS, HbA1C between diabetes was statistically significant. and the difference in AHI value between diabetes was statistically not significant. However, the present study the difference between the FBS values and AHI index across different grades among the diabetics was statistically insignificant. Similarly, the median HbA1c values across the diabetics and their AHI index normal and mild AHI was 8.95, moderate and severe AHI was 8.90 with different grades shown no statistically significant results.

The median FBS in normal AHI in non-diabetic people was 111.50 mg/dl, it was 88 mg/dl in mild AHI, it was 85 mg/dl in moderate AHI, and it was 110 mg/dl in severe AHI. The difference in FBS across the apnea-hypopnea index was statistically not significant. The median HbA1C in the normal apnea-hypopnea index in non-diabetic people was 5.7, it was 4.9 in the mild apnea-hypopnea index, it was 5.3 in the moderate index, and it was 5.8 in a severe index. The difference in HbA1C across the apnea-hypopnea index was statistically not significant.

Studies especially randomized trials have attempted to study the association of OSA and glycemic control, with conflicting results. A positive association of apnea and glycemic control was shown by a pilot study Tatti P et al²³, were the respiratory cycles and night awareness could predict the variations in FBS among type II diabetics. Another study showed that glycemic control was worsened in subjects of both controlled and uncontrolled type II Diabetes in cases of nocturnal hypoxemia.²⁴ Hui P et al. in their study stated that a timely and daily glucose monitoring of diabetes patients with OSA showed increased levels of glucose along with blood oxygen desaturation.²⁵ A study among nondiabetic with OSA have also shown that impaired glucose metabolism to precede type II diabetes.²⁶ However, it is still unclear whether glucose levels have a direct or linear relationship with OSA. The present study has also shown no significant correlation of FBS, HbA1c among diabetics and non-diabetics with different grade of AHI. The limitation to the present was a smaller sample size. We recommend more that similar studies with a larger population should be conducted to put light on this subject.

CONCLUSION

Prior studies have shown a correlation among Fasting blood sugars, hbA1c and AHI values. In the present study, AHI severity did not correlate with FBS and HbA1c values in either of the groups However in the non-diabetic subgroup with severe AHI the fasting blood sugar levels were above the higher limit of normal.

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