ORIGINAL ARTICLE

Obstructive sleep apnoea (OSA) in octroi employees of Mumbai: Evaluation of waist circumference, diabetes mellitus, metabolic syndrome as risk factors

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Indian J Sleep Med 2009; 4.3, 100-105

Abstract

Background: Obstructive sleep apnea (OSA), a complex disease is a growing health concern globally. Various global epidemiological studies have demonstrated prevalence of obstructive sleep apnea to vary from 0.3% to 5.1 %. Clinical scores (CS) are useful to estimate individuals at risk for OSA and predict prevalence of OSA in community based studies. Waist circumference, diabetes mellitus and metabolic syndrome are emerging as important risk factors for OSA. During a preventive health check Octroi employees were found to have sedentary habits and were hence assessed for OSA and its risk factors.

Aims and objective: The aims of the study were i) study the overall health status ii) estimate individuals at risk for OSA using the CS and iii) study waist circumference, diabetes mellitus and metabolic syndrome as a risk factor for OSA.

Methods: 262 Octroi employees, who received preventive health check up at the tertiary care hospital in Mumbai, were invited to participate in the study. A questionnaire was used to assess their demographic characteristics, diet, life styles, and medical history. Body mass index (BMI) was calculated as (weight in kg) / (height in meter) ^{2}. Waist circumference measurements were made directly above the iliac crest with minimal respiration. Laboratory investigations included complete haemogram, blood sugar estimation, and lipid profile and thyroid function tests. CS included the following parameters 1) loud, habitual snoring 2) interrupted breathing, both reported to the patient by spouse or family members 3) excessive day time sleepiness as evidenced by napping in company or while driving, and/or difficulty in staying awake in quiet surroundings 4) obesity, defined as BMI $\geq$25kg/m^2 5) essential hypertension, identified by the use of hypotensive medications or a BP $\geq$/= 140/90 mm of Hg on more than two separate occasions. Each feature was assigned a score of 1 with a possible maximum score of 5. A score of more than 3 was used to predict individuals at risk for presence of OSA. Metabolic syndrome was diagnosed if 3 out of 5 following variables were present 1) hypertension (BP $\geq$130/$\geq$85mm of Hg), 2) insulin resistance or glucose intolerance BS$\geq$110 mg%), 3) Low HDL cholesterol <40mg% (men), <50mg% (women), 4) elevated triglycerides (>150mg%), 5) abdominal obesity – waist circumference >35inches. Statistical analysis was employed to estimate the association of significant CS with waist circumference, diabetes mellitus and metabolic syndrome.

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Results: CS >3 indicating at risk for OSA was present in 12 (4.58%) employees. Ten (83.33%) patients with CS >3, had waist circumference ≥35 inches. The association of waist circumference was superior to body mass index (table 1). Metabolic syndrome (p 0.0000353), waist circumference (p 0.0015) but not diabetes mellitus (p 0.6374) showed statistically significant correlation with CS. (table 2)

Conclusion: The risk for OSA using CS was thus 4.58% in the study population. Waist circumference and metabolic syndrome were independent risk factors for OSA.

Keywords: Clinical score, waist circumference, metabolic syndrome

Introduction

Obstructive sleep apnea (OSA) is a complex disease and growing health concern globally. The condition is characterized by excessive daytime sleepiness, disruptive snoring, repeated episodes of upper airway obstruction during sleep and nocturnal hypoxemia. Population-based epidemiologic studies have consistently found that even mild obstructive sleep apnea is associated with significant morbidity.[1] Untreated OSA can cause daytime somnolence, cognitive impairment, loss in work productivity, and increased risk of automobile crashes.[2-4] It is well known that its occurrence is determined by an array of demographic characteristics, life style factors, diet and genetic susceptibility. The estimated prevalence of obstructive sleep apnea syndrome in the United States is 2% in women and 4% in men.[5] Epidemiological studies from other parts of the world have demonstrated prevalence of OSA to vary from 0.3% to 5.1%.[6-16] Although polysomnography is considered the gold standard for the diagnosis of OSA, subjective instruments or clinical prediction scores have been used in population studies for the identification of individuals at higher risk of developing the disease [17]. William et al[18] described a simple clinical score (CS) based on snoring, interrupted breathing, excessive day time sleepiness, obesity, essential hypertension and found that clinical scores were significantly different for those with OSA (apnea index >10) than without OSA. We used this simple clinical score for estimating risk of OSA in octroi employees of Mumbai during a preventive health check up. We also evaluated waist circumference, diabetes mellitus and metabolic syndrome as these are important emerging risk factors for OSA. The high prevalence of sedentary habits in the population led us to assess for OSA and its risk factors.

Methods

Octroi workers, who received preventive health check up at the tertiary care hospital in Mumbai, were invited to participate in the study. A questionnaire was used to assess their demographic characteristics, diet, life styles, and medical history. Height and weight were measured by calibrated stadiometer and calibrated digital scale respectively. Spirometry and electrocardiogram (ECG) was performed in all. Body mass index (BMI) was calculated as (weight in kg) / (height in meter) ^{2} and BMI>25kg/m^2 was considered as obesity. Waist circumference measurements were made directly above the iliac crest with minimal respiration. Laboratory investigations included complete haemogram, blood sugar estimation, lipid profile and thyroid function tests. Two-dimensional echocardiography was done in those with ECG abnormalities and significant lung disease and all snorers. Clinical score (CS)[18] included the following parameters 1) loud, habitual snoring 2) interrupted breathing, both reported to the patient by spouse or family members 3) excessive day time sleepiness as evidenced by napping in company or while driving, and/or difficulty in staying awake in quiet surroundings 4) obesity, defined as BMI ≥25kg/m2 5) essential hypertension, identified by the use of hypotensive medications or a BP ≥ 140/90 mm of Hg on more than two separate occasions. Each feature was assigned a score of 1 with a possible maximum score of 5. A score of more than 3 in an individual was considered at risk for OSA. Metabolic syndrome was diagnosed if 3 out of 5 following variables were present 1) hypertension (BP ≥130/≥85mm of Hg),2) insulin resistance or glucose intolerance (FBS≥110 mg%), 3) Low HDL cholesterol <40mg% (men), <50mg% (women), 4) elevated triglycerides (>150mg%), 5) abdominal obesity – waist circumference >35inches (men). Statistical analysis was employed to estimate the association of significant CS with waist circumference, DM and metabolic syndrome.

Statistical Analysis

Data was recorded on SPSS statistical software. Cross tabulation of various parameters such as waist circumference (>35 inches), diabetes mellitus and metabolic syndrome by significant CS (>3) was done. Statistical significance was found with test of independence using Chi-squared with Yates' correction. P value less than 0.05 suggested statistically significant relationship of these variables with CS. Binary logistic regression analysis was performed to assess the predictive status of two independent variables i.e. BMI and waist circumference with the dependent variable i.e. CS.

Results

A total of 262 employees, all men age range 29-58 years, mean age 45.29 years who attended preventive health check up at our hospital, were included in the study. Body mass index ranged from 14.9 - 33.24 kg/m^2 (mean 22.2 kg/m^2) and waist circumference 24 - 45.5 inches. Using BMI as the criteria 4.20% of the employees were underweight, while 33.97% were overweight and 5.73% were obese. Anemia was present in 5%, hypertension in 9.92 %, diabetes mellitus in 17.56%, coronary artery disease in 0.76%, hypothyroidism in 0.76 %, metabolic syndrome in 7.25% of the participants. Respiratory disorders found were allergic rhinitis in 12.21%, bronchial asthma in 4.6% and COPD in 0.38%. Other disorders noted were leprosy in 0.38%, dermatitis in 0.76%, psoriasis in 0.38%, gastro esophageal reflux disease in 8.08% and hepatitis in 1.14%.

Twenty six subjects (9.92%) had snoring while excessive daytime sleepiness was present in 3.05% and witnessed apneas in 3.82%. Twelve subjects (4.58%) had CS >3. The risk for OSA using CS was thus 4.58% in the study population. The age range of this group was 32-57 years with BMI ranging from 24.3-33.24 kg/m2. Waist circumference ≥35 inches was found in 10, 83.33% of patients with CS>3. Waist circumference showed statistically significant relationship with CS (p 0.0015) and was superior to body mass index (Table1).

Table 1: Comparison of waist circumference with body mass index (BMI) as risk factor for Obstructive Sleep apnoea (OSA)

Likelihood Ratio Tests

Factor	Chi-Squared	Df	P-Value
Waist circumference (>35inches)	5.17412	1	0.0229*
Body Mass Index (>25 (kg/ m^2)	2.62135	1	0.1054

* significant p value < 0.05

Diabetes was seen only in 1, 8.33% individual with CS>3 and was not statistically significant (p 0.6374). However, metabolic syndrome was present in 5, 41.67% with CS>3 and showed a statistically significant correlation (p 0.0000353) (Table2).

Table 2: Relationship between Risk factors & Complications of Obstructive Sleep Apnoea (OSA) with Clinical Score (CS)

Risk Factors	OSA(CS>3) Yes (n=12,%)	No OSA(CS <3) No (n=250,%)	P Value
Diabetes Mellitus	(1),8.33%	(45),18%	0.6374
Metabolic Syndrome	(5),41.67%	(14),5.60%	0.0000353*
Waist circumference	(10),83.33%	(85),34%	0.0015*

* significant p value <0.05

Discussion

As polysomnography, the standard diagnostic test for sleep apnea is a limited resource; epidemiologic studies have been performed to evaluate prevalence of OSA using overnight pulse oximetry[18], Epworth Sleepiness Scale (ESS) [19] and clinical predictors[20-25]. Several sleep apnea clinical prediction rules[26-33] have been developed, most incorporate anthropomorphic variables such as BMI, waist circumference, and/or neck circumference, and some type of abnormal respiration during sleep (snoring, apneas, choking and/or gasping) witnessed by a bed partner.[34] One of these clinical prediction score was developed by William et al[18] and uses snoring, interrupted breathing, excessive day time sleepiness, obesity and essential hypertension. A clinical score of 3 or greater correlates well with apnea index >10. We therefore used this easy to use clinical scoring system for estimating prevalence of OSA in our study population. The results of prevalence study are influenced by the characteristic of study population. Because the prevalence found in the study group can only be generalized to population with similar characteristics, the study group must be representative of the total population. The mean BMI of our study population was 24.2 which show no statistical difference from study in an adult population from various sections of society in Mumbai where BMI mean was found to be 23.9+3.8[35]. As BMI is an important predictor of OSA; our population would be fairly representative of adult urban Indian males. Our estimated prevalence of individuals at risk for OSA using a simple CS score of 4.58% is thus comparable to previous prevalence studies from India[6-10].

Waist circumference is reliable for predicting the risk of sleep disordered breathing[36-38]. Our study showed significant relationship between waist circumference >35 inches and CS >3. The association of waist circumference was superior to body mass index (table1). Various studies have shown better correlation of waist circumference to OSA than BMI.[39,40] Waist circumference is a good measure of obesity and its co-morbidities[38] as it measures abdominal obesity and visceral adipose tissue, which are more closely related to cardiovascular risk[41-45] The 'Asian Indian Phenotype' is characterized "metabolic obesity" by less of generalized obesity as measured by BMI but greater central body obesity as shown by greater waist circumference and waist-to-hip ratios.[46] The prevalence of the OSA is similar in Asian countries when compared to their Western counterparts despite overall lower BMI in the studies from Asia. This may be partly explained by the higher "metabolic" or "truncal" obesity in the Asian population.

The most significant medical associations of OSA include hypertension,[47,48] coronary vascular disease,[49] congestive heart failure,[50]cerebrovascular disease,[51] glucose intolerance[52] and impotence.[53] A number of studies have shown association between diabetes and OSA.[54,55]The effects of elevated sympathetic activity, alteration in glucocorticoid regulation induced by sleep loss and recurrent intermittent hypoxemia associated with OSA facilitate the development of glucose intolerance and insulin resistance. In the present study the correlation of DM and CS>3 was not statistically significant, however metabolic syndrome showed significant relationship with CS>3. Clustering of sleep apnea with other components of the metabolic syndrome was first proposed by Wilcox et al.[56] Recently this relationship has been reiterated by others.[57-63]It appears that obstructive sleep apnea and metabolic syndrome are characterized by the same pathophysiologic environment, which increases the risk for the development of cardiovascular disease. The increased amount of visceral fat and the accompanying insulin resistance seem to be the main characteristics responsible for the development of OSA and metabolic syndrome.

To conclude, the risk for OSA using clinical scoring system in our study was 4.58% and was comparable to previous prevalence estimates in adult Indian men. Waist circumference and metabolic syndrome were independent risk factor for prediction of OSA. Waist circumference was superior to BMI and may be used as more useful marker for prediction of OSA. As metabolic syndrome is a significant co morbidity associated with OSA, all patients with metabolic syndrome should be assessed for OSA.

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