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Original Article -A study of sleep disordered breathing in obese patients

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Abstract
Introduction: As the modern life style is dominantly accepted by our society along with sedentary life style our society is getting obesity as a gift, a gift that is costing human species a lots of health problems and one of them is sleep disturbances and sleep disorders specially obstructive sleep apnoea (OSA). OSA itself leads to hypertention and other systemic manifestations. so we decide to study obese patients and related sleep disorder specialy OSA.
Aims/Objectives: 1 to analyze SDB in obese patients. To analyze severity of hypertension in obese patients. 2 To analyze whether SDB is a risk factor for hypertension in obese individuals.
3 To correlate how many obese hypertensive have correctable SDB.
Material and Methods: This cross sectional study was conducted in the, department of pulmonology of People's College of Medical Sciences and Research centre, Bhopal m.p. The duration of the study was 1 and half years. Total of 100 patients were included in this study.
Results and Conclusion: Obesity has a very high and proportionate correlation to sleep disordered breathing. Obstructive sleep apnea is the predominant sleep disordered breathing in our study population. Moderate obstructive sleep apnea correlates very highly for predicting hypertension and maybe considered as a risk factor for the same. Sleep disordered breathing is very much correctable in obese hypertensive population by weight reduction and risk factor control.

Keywords: Obesity, Sleep Disorders, Obstructive Sleep Apnoea.

Introduction
Obstructive sleep apnea (OSA) is a condition characterized by repeated episodes of upper airway closure during sleep. It is associated with a constellation of symptoms and objective findings which include loud snoring, motor restlessness, unrefreshing sleep and excessive daytime sleepiness (EDS) [1]. OSA is associated with significant morbidity and mortality, both from vascular complications and from road traffic and industrial accidents [2]. The Epworth sleepiness scale (ESS) score is a simple tool to determine the degree of EDS in patients with OSA [3]. The diagnostic test for OSA is an overnight polysomnography (PSG) [4]. Respiratory distress index (RDI), which is the average number of respiratory disturbances per hour of sleep, of more than 5 is considered to be diagnostic of OSA [5, 6]. However, these diagnostic tools are costly, time-consuming and of limited availability, particularly in developing countries. OSA has been diagnosed in previous studies using a sleep questionnaire designed to assess the specific symptoms associated with sleep-related breathing disorders with higher predictive ability, with additional data on body mass index (BMI) [7]. This is of special relevance to our country where the initial diagnosis of OSA can be made using a questionnaire and then the patients can be subjected to PSG for confirmation and assessment of severity. Obesity is strongly linked with respiratory symptoms and diseases, including exertional dyspnea, obstructive sleep apnea syndrome (OSAS), obesity hypoventilation syndrome (OHS), chronic obstructive pulmonary disease (COPD), asthma, pulmonary embolism, and aspiration pneumonia [8-10]. The risk of developing OSA increases considerably at a higher BMI. In a morbidly obese (BMI>40 kg/m2) individual, the risk of developing OSA lies between 55% and 90% [11]. Moderate OSA (AHI>15 events per hour) and severe OSA (AHI>30 events per hour) are associated with an increased mortality. Reducing disease severity to an AHI of <15 events per hour (i.e. mild OSA) through weight loss can help in achieving improved outcomes in OSA patients [12].

Aims/Objectives: To analyze SDB in obese patients. To analyze severity of hypertension in obese patients. To analyze whether SDB is a risk factor for hypertension in obese individuals. To correlate how many obese hypertensive have correctable SDB.

Material and Methods: This cross sectional study was conducted in the Department of, department of pulmonology of People's College of Medical Sciences and Research Bhopal m.p. The duration of study was one and half years (Dec 2013 to May-2015.)
Simple random sampling technique was used for selection of desired samples according to inclusion-exclusion criterion. Clinical History was taken, general Examination, Bio-Chemical Parameter, Respiratory function, and Overnight sleep study (Overnight Polysomnograph analysis) was done.

Inclusion Criteria
Age group, 17-80 year.
Informed and willing patients who have consented for data recording.
Cases admitted to the study center.

Exclusion Criteria
Patients who showed unwillingness for study.
Non consenting patients.
Patient not tolerating sleep study.
Other co-morbid conditions like bronchial asthma, coronary artery disease, chronic obstructive airway disease.
Patients with pure central sleep apnea.

Methodology: The obese patients who visited study center for bariatric surgery and further met the inclusion criteria selected as subjects during specified schedule. A total of 100 obese patients were randomly chosen from the outpatient department of pulmonology of People's College of Medical Sciences and Research Bhopal m.p selected as subjects for the study. The patients were explained clearly about the study and their willingness to participate in the study was recorded in a consent form, duly signed by them. A total of 100 such subjects were available for the study. Berlin's questionnaire and the Epworth sleepiness scale score (ESSS) were used to assess the sleep disordered breathing (SDB). The questionnaire was handed to patient at the time of history recording and collected when the analysis was performed. Polysomnograph analysis, body mass index (BMI), neck circumference, pulmonary function test and clinical history were carried out in assistance of nursing staff and sleep study technician. Asian classification of obesity suggested by World Health Organization was used for assessment of BMI. Bio-chemical parameters of subjects were identified.

Statistical Technique: The responses of frequencies were calculated and analyzed by using the raw data of 100 subjects. The raw data were entered into the computer database. Statistical software, SPSS version 17.0 was used for analysis. Prevalence of an outcome variable along with 95% confidence limits was calculated. Both, descriptive and inferential statistics were used to study the sleep disordered breathing in obese patients. Descriptive statistical analysis has used to depict the main features and characteristic of the collected samples. Results on continuous measurements are presented on Mean±SD (Min-Max) and results on categorical measurements are presented in numbers (%). A parametric test, unpaired t-test was used to identify the significance of difference in body mass index, neck circumference, blood pressure, ratio (FEV1/FVC), thyroid stimulating hormone, Hb1AC and apnea hypopnea index between male and female obese patients. A non-parametric test, Pearson's Chi-Square test had been for qualitative data to observe the association of obesity, hypertension, diabetic status and sleep apnea among obese patients with age, sex and other parameters. The Karl Pearson's coefficient of correlation had been used to identify the degree and direction of relationship of obesity, hypertension, sleep apnea and diabetic status of obese patients with blood pressure, biochemical and other parameters. Binary logistic regression used to predict the hypertension and the risk factors found to be significant in the univariate analysis used to model the prediction of hypertension among obese patients using obesity grades, severity of apnea, age, sex and diabetic status of obese patients. The probability value, $p>0.05$ was considered as statistically insignificant but the probability value from $p<0.05$ to $p<0.1$ was considered as suggestively or poorly significant. The probability value from $p<0.05$ to $p<0.01$ was considered as statistically significant while from $p<0.009$ to $p<0.001$ was considered as statistically highly/strongly significant. Following are the notations used to present the significance of observed probability value.

Observations and Results: The present study entitled "A study of sleep disordered breathing in obese patients" is carried out in the department of pulmonology of People's College of Medical Sciences and Research Bhopal m.p. A total of 100 subjects randomly selected for study. Out of them 58 subjects were male and 42 were female. The age of all subjects were obtained in the ranges from 17 to 80 years. The mean spread of age of male (N=58) subjects were identified in the ranges of 44.90±13.14 years while 46.67±12.18 years recorded for female (N=32) subjects. The mean spread of age for total selected subjects (N=100) was 45.64±12.75 years. The following tables are showing the analyzed results with interpretations.

Table 1: Demographic Characteristic

Age (years)	Male (N=58)		Female (N=42)	
	N	%	N	%
15-35	12	20.68	10	23.80
35-55	30	51.72	18	42.85
55-75	15	25.86	13	30.95
≥75	1	1.72	1	2.38

Table 1 showed that most of the male (51.72%) and female (42.85%) obese patients were belonged to age group of 35-55 years. The age group ranges from 55-75 years involved 25.86 % and 30.95 % male and female subjects respectively. 20.68% and 23.80% male and female chosen from age group of 15-35 years. One male and female was only identified in the elder age group of ≥75 years.

Table 2: Distribution of Body Mass Index with Grading Of Obesity

Body Mass Index (N=100)			Obesity Grading (N=100)		
BMI (kg/m^2)	Frequency	%	Grading	Frequency	%
<40	18	18.0	Grade I	1	1.0
40-50	49	49.0			
50-60	25	25.0	Grade II	99	99.0
≥60	8	8.0			

Table 2 projected that the body mass index (BMI) between 40 and 50 kg/m^2 in 49.0% obese patient was more frequent followed by 25.0% who had BMI in the ranges of 50-60 kg/m^2. 8.0% obese patients had BMI more than or equal to 60 kg/m^2 while <40 kg/m^2 was measured in 18.0% obese patients. Approximately all (99.0%) obese patients were measured in grade II while only one was identified in grade I.

Table 3: Distribution of Neck Circumference

Neck Circumference (Inch)	Frequency (N=100)	Percentage (%)
14-16	31	31.0
16-18	46	46.0
18-20	20	20.0
≥20	3	3.0

Approximately half (46.0%) of subjects had neck circumference (NC) in the range of 16-18 inch followed by 14-16 inch measured in 31.0% which can be seen easily in table 3. 20.0% subjects had NC in the ranges of 18-20 inch. NC of ≥20 inch was observed in few (3.0%) subjects.

Table 4: Distribution of Addiction among Obese Patients

Type/Material	Yes/Used	No/Non-used
Addiction	62 (62.0)	38 (38.0)
Alcohol	54.0(54.0)	46(46.0)
Tobacco	52 (52.0)	48 (48.0)
Alcohol and Tobacco	43 (43.0)	57(57.0)
Cigarette	43 (43.0)	57 (57.0)
Beedi	3(3.0)	97 (97.0)
Chewable	24 (24.0) *	76(76.0)

*The figures in parenthesis denote corresponding %.

Table 4 presented that most of the subjects (62.0%) subjects was found with addiction. 54.0% used alcohol but tobacco was used by 52% while both the material used by 43.0%. Chewable was consumed by 24.0% less as compared to cigarette was smoked by 43.0%. Beedi was identified as the least used (3.0%) material among all material.

Table 5: Polysomnograph Analysis for Sleep Apnea and Type of Sleep Apnea

Severity of apnea (N=100)			Predominant Apnea (N=100)		
Category	Frequency	%	Type	Frequency	%
Normal	1	1.0	Obstructive	70	70.0
Mild	7	7.0			
Moderate	50	25.0	Mix	30	30.0
Severe	67	67.0			

It was easily seen in the table 5 that the sleep disordered breathing (SDB) was present in most of the cases. Sleep apnea was severe in most (67.0%) of the obese patient. Moderate sleep apnea was found in 25.0%. 7.0% obese patient had mild sleep apnea while only one had normal. Major part of population (70.0%) had suffered from obstructive sleep apnea while rest (30.0%) had mix sleep apnea.

Table 6: Comorbid Status of Subjects

Parameter		Male		Female	
Disease status	Variable	N	%	N	%
Hypertension	Yes	46	79.31	32	76.19
	No	12	20.62	10	23.80
Thyroidism	Hyperthyroid	0	0.0	1	2.38
	Euthyroid	47	81.03	28	66.66
	Hypothyroid	11	18.97	13	30.95
Diabetes	Diabetic	36	62.06	18	42.85
	Non-Diabetic	22	37.93	20	57.14

Table 6 highlighted the comorbid status of subjects. Hypertension observed (79.31%) more in male as compared to female (76.19%). Euthyroid was also measured more frequent in (81.03%) male as compared to (66.66%) female while Hypothyroid was reported more frequent in (30.95%) female than (18.97%) male. Major part of population of male obese patients (62.06%) was identified with diabetes more as compared to female (57.14%) obese patients.

Table 7: Association of Age with Blood Pressure Grade

Age (year)	Blood Pressure Grading				Total
	Normal	Pre hypertensive	Stage I	Stage II	
15-35	5 50.0%	4 40.0%	8 13.12%	4 21.05%	21 21.0%
35-55	3 30%	3 30.0%	32 52.46%	9 47.37%	47 47.0%
55-75	1 10.0%	2 20.0%	21 34.42%	5 26.31%	29 29.0%
≥75	1 10.0%	1 10.0%	0 0.00%	1 5.27%	3 3.0%
Total	10 100.0%	10 100.0%	61 100.0%	19 100.0%	100 100.0%
$\chi_9^2 = 23.73^{\#}$ p<0.005 (Highly significant)					

$^{\#}$ The association is highly significant at 9 degrees of freedom at the 0.005 levels of significance.

Age of obese patient was reported with a very strong association (p<0.005) with blood pressure grading which can be easily seen in the table 9. Further, table revealed that 47.0% obese subjects belonged to age group of 35-55 years was identified as the most common age group in which 32 (52.46%) subjects measured with blood pressure of stage I followed by 21(34.42%) subjects who belonged to age group of 55-75 years. 8 (13.12%) and 4 (21.05%) subjects of younger age group of 15-35 years was reported with blood pressure of stage I and stage II respectively. Finally, it was projected on statistical ground that age is the significant strong factor that highly influenced the blood pressure grading among obese patients.

Table 08: Association of Age with Predominant Apnea

Age (year)	Predominant Apnea		Total
	Obstructive	Mixed	
15-35	17(24.29%)	5 (16.67%)	22 (22.0%)
35-55	34(48.57%)	15 (50.0%)	49(49.0%)
55-75	18 (25.71%)	10(33.33%)	28 (28.0%)
≥75	1 (1.43%)	0 (0.0%)	1 (1.0%)
Total	70 (100.0%)	30(100.0%)	100 (100.0%)
$\chi_3^2 = 1.72^{\otimes}$ p>0.05 (Insignificant)			

$^{\otimes}$ The association isn't significant (Insignificant) at 3 degrees of freedom at the 0.05 levels of significance.

No significant association (p>0.05) was evidenced on statistical ground between age of obese patient and predominant apnea, easily seen in the table 11. Approximately three-fourth (70.0%) of total population had obstructive predominant apnea in which 34(48.57%) subjects that was most common in the age group of 35-55 years among obese patients while 15(50.0%) subjects observed with mixed sleep apnea in the same age group. Moreover, it was inference that age of obese patient wasn't the factor which may impact the predominant apnea.

Table 9: Association of Age with Reversibility

Age (year)	Reversibility		Total
	No	Yes	
15-35	13 (20.31%)	7 (19.44%)	20 (20.0%)
35-55	35 (54.69%)	14 (38.89%)	49 (49.0%)
55-75	15 (23.44%)	15 (41.67%)	30(30.0%)
≥75	1 (1.56%)	0 (0%)	1(1.0%)
Total	64(100.0%)	36 (100.0%)	100 (100.0%)
$\chi_3^2 = 6.86^*$ p<0.08 (Poorly significant)			

*The association is poorly significant at 3 degrees of freedom at the 0.05 levels of significance.

Table 9 reported that the age of obese patient was poorly associated (p<0.08) at 92.0% confidence interval with reversibility of sleep apnea. Major part of (14, 38.89%) obese subjects were identified with reversibility of apnea in the age group of 35-55 years followed by 15 (41.67%) subjects who had reversibility of apnea in the age group of 55-75 years. None of the subject was identified with reversibility of apnea in the age of ≥75 years. Furthermore, it was found that age of obese patient may be impacted due to chance the reversibility of sleep apnea among obese patients.

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Table 10: Association of Age with Diabetic Status

Age (year)	Diabetic Status		Total
	Non-Diabetic	Diabetic	
15-35	15 (32.61%)	6 (11.11%)	21 (21.0%)
35-55	15 (32.61%)	31 (57.41%)	46 (46.0%)
55-75	16 (34.78%)	16 (29.63%)	32 (32.0%)
≥75	0 (0.0%)	1(1.85%)	1(1.0%)
Total	46 (100.0%)	54 (100.0%)	100 (100.0%)
$\chi_3^2 = 17.06^{\#}$ p<0.001 (Highly significant)			

The association is highly significant at 3 degrees of freedom at the 0.001 levels of significance.

Table 10 highlighted that age of obese patient had a very strong association (p<0.001) with diabetic status. 31 (57.41%) obese subjects belonged to age group of 35-55 years found with diabetes was identified as the most common age group followed by 16 (29.63%) subjects who belonged to age group of 55-75 years found with diabetes. 6(11.11%) subjects of younger age group of 15-35 years was reported with diabetes while 1 (1.85%) subjects who observed with diabetes was ≥75 years. Moreover, it was concreted statistically that age of obese patient is the most important and strong significant factor that highly impacted the diabetic status of obese patient.

Table 11: Association of Sex with Severity of Sleep Apnea

Sex	Severity Of Sleep Apnea				Total
	Normal	Mild	Moderate	Severe	
Male	0 0.0%	2 33.33%	12 46.15%	44 65.67%	58 58.0%
Female	1 100.0%	4 67.67%	14 53.85%	23 34.33%	42 42.0%
Total	1 100.0%	6 100.0%	26 100.0%	67 100.0%	100 100.0%
$\chi_3^2 = 10.71^{**}$ p<0.02 (Significant)					

** The association is significant at 3 degrees of freedom at the 0.02 levels of significance.

Table 11 reported that sex of obese patient was associated significantly (p<0.02) with severity of sleep apnea. Proportion of male (44, 65.67%) with sever sleep apnea was higher than female (23, 34.33%) obese subjects but noted opposite for moderate sleep apnea as the proportion of female (14, 53.85%) was higher than male (12, 46.15%) obese subjects. Overall, it was inference statistically that sex may be the significant factor which impacted the severity of sleep apnea among obese patients.

Table 12: Association of Sex with Thyroid Stimulating Hormone

Sex	Thyroid Stimulating Hormone			Total
	Hyperthyroid	Euthyroid	Hypothyroid	
Male	0 0.0%	46 61.33%	12 50.0%	58 58.0%
Female	1 100.0%	29 38.67%	12 50.0%	42 42.0%
Total	1 100.0%	75 100.0%	24 100.0%	100 100.0%
$\chi_6^2 = 4.83^*$ p<0.09 (Poorly significant)				

*The association is poorly significant at 3 degrees of freedom at the 0.05 levels of significance.

The sex of obese patient was poorly associated (p<0.08) at 91.0% confidence interval with thyroid stimulating hormone, easily seen in the table 18.

Euthyroid was seen most common in male (4, 61.33%) than female (29, 38.67%) obese subjects but Hypothyroid was observed equally in female n male (12, 50.0%) obese subjects. Furthermore, it was found that sex of subjects may be impacted the thyroid stimulating hormone due to chance among obese patients.

Table 13: Association of Sex with Diabetic Status

Sex	Diabetic Status		Total
	Non-Diabetic	Diabetic	
Male	22 (47.83%)	36(66.67%)	58 (58.0%)
Female	24 (52.17%)	18(33.33%)	42 (42.0%)
Total	46(100.0%)	54 (100.0%)	100 (100.0%)
$\chi_1^2 = 7.02^{\#}$ p<0.008 (Highly significant)			

#The association is highly significant at 1 degree of freedom at the 0.008 levels of significance.

Table 13 dealt with sex of obese patient that had a very strong association (p<0.008) with diabetic status. Diabetes was detected most common in male (36, 66.67%) as compared to female (18, 33%) obese subjects. Henceforth, it was rooted statistically that sex is the most important and strong significant factor that highly impacted the diabetic status of obese patient.

Table 14: Comparison of Difference between Male and Female for Various Parameters

Parameter	Sex	Range	95% CI of the Difference		t-value	LOS
		Mean±SD	LB	UB		
Body Mass Index (kg/m^2)	Male	47.76±7.84	-0.92	3.75	1.20	$p>0.05^{\otimes}$
	Female	46.35±8.79				
Neck Circumference (inch)	Male	17.10±1.31	1.28	1.96	9.34	$p<0.001^{\#}$
	Female	15.48±1.07				
Systolic Blood Pressure (mmHg)	Male	138.71±12.82	-1.68	5.29	1.02	$p>0.05^{\otimes}$
	Female	136.90±11.61				
Diastolic Blood Pressure (mmHg)	Male	89.40±7.72	-1.16	3.19	0.92	$p>0.05^{\otimes}$
	Female	88.38±7.63				
FEV1/FVC	Male	1.04±0.20	0.00	0.09	1.94	$p<0.06^{*}$
	Female	1.00±0.00				
TSH	Male	3.13±1.88	1.00	3.83	3.36	$p<0.001^{\#}$
	Female	5.54±7.41				
Hb1AC (mg/dl)	Male	7.06±1.99	-0.04	1.07	1.82	$p<0.08^{*}$
	Female	6.55±1.93				
Apnea Hypopnea Index	Male	42.84±17.95	4.42	14.17	3.76	$p<0.001^{\#}$
	Female	33.54±16.27				

$^{\otimes}$ The mean difference is not significant (insignificant) at the 0.05 level of significance. $^{\#}$ The mean difference is highly significant at the 0.001 level of significance. *The mean difference is poorly significant at the 0.06 and 0.08 level of significance. [Degrees of freedom is 198; CI-Confidence Interval; UB-Upper Bound; LB-Lower Bound; LOS-Level of Significance]

Table 14 highlighted that male obese patients had significantly different neck circumference, thyroid stimulate hormone and apnea hypopnea index as compared to female obese patients. No significant difference in mean body mass index was measured between male (47.76±7.84 kg/m^2) and female (46.35±8.79 kg/m^2) obese patients. The systolic blood pressure (mmHg) between male (138.71±12.82 mmHg) and female (136.90±11.61 mmHg) and diastolic blood pressure (mmHg) between male (89.40±7.72 mmHg) and female (88.38±7.63 mmHg) obese patients were not significantly differ ($p>0.05$) which further reflected that sex had not impacted the blood pressure in obese patients.The mean difference of neck circumference between male (17.10±1.31 inch) and female (15.48±1.07 inch) obese patients was absolutely different confirmed highly significant ($p<0.001$) on statistical ground. The mean thyroid stimulate hormone in male was (3.13±1.88) lower than female (5.54±7.741) but mean of apnea hypopnea index in male (42.84±17.95) was higher as compared to female (33.54±16.27) obese patients and these mean differences were measured statistically highly significant ($p<0.001$) between sexes. The mean differences in ratio (FEV1/FVC) and Hb1AC of male and female obese patients were poorly significant ($p<0.06$ & $p<0.08$) reflected that the observed lesser mean difference was due to chance between sexes Moreover, it was concreted statistically when sex was considered that neck circumference, thyroid stimulate hormone and apnea hypopnea index were the important and significant risk factors in obese patients with reference to sleeping disorder breathing.

Table 15: Correlation of Apnea Hypopnea Index with Neck Circumference and HbA1c among Male and Female

Category	Correlation parameter	Apnea Hypopnea Index	LOS p-value
		r	
Total Male	Neck Circumference	$0.164^{\otimes}$	$p>0.05^{\otimes}$
Total Female	Neck Circumference	$0.105^{\otimes}$	$p>0.05^{\otimes}$
Diabetic Male	Hb1AC	$-0.09^{\otimes}$	$p>0.05^{\otimes}$
Diabetic Female	Hb1AC	$-0.06^{\otimes}$	$p>0.05^{\otimes}$

$^{\otimes}$ Correlation isn't significant (insignificant) at the 0.05 level. [r– Pearson's coefficient of Correlation; LOS-Level of Significance]

Table 15 dealt with the correlation between neck circumference and apnea hypopnea index (AHI) of all obese male and female subjects and relation of diabetic male and female (Hb1AC) with AHI. The Karl Pearson coefficient of correlation (r) is treated as described previously. Neck circumference was deviated in positive direction with reference to apnea hypopnea index in both male and female obese patients but very poorly correlated with apnea hypopnea index that were measured insignificant ($p>0.05$) on statistical ground. Diabetic male and female whose Hb1AC was not related with AHI but the direction of relationship was in negative direction observed for both male and female diabetic obese patients that were conformed statistically insignificant ($p>0.05$).

Discussion: Our study population comprised of 100 randomly selected subjects, out of which 58 (58%) were males and 42 (42%) were females. The age of the subjects

ranged from 17 to 80 years. The mean spread of age for total selected subjects (N=100) was 45.64±12.75 years and for males (N=58) it was 44.90±13.14 years and for females (N=42) it was 46.67±12.18 years. Maximum male (51.72) as well as female (42.85%) obese patients belonged to age group of 35-55 years. After this the most number of male and female obese patients belonged to age group of 55-75 years with 25.86% and 30.95% respectively. In the age group of 15-35 years 20.68% were male and 23.8% were female obese patients. Whereas in the age group of $\geq$ 75 years there were only 1 male and 1 female obese patients. Maximum obese patients (49%) had the body mass index (BMI) between 40-50 kg/m^2, followed by 25.0% who had BMI between 50-60 kg/m^2. 18.0% of obese patients had BMI in the range of <40 kg/m^2, while only 8.0% of obese patients had BMI $\geq$ 60 kg/m^2. Approximately all (99.0%) obese patients were in Obese class II while only one obese patient (1.0%) was Obese class I according to their BMI. Approximately half (46.0%) of the subjects had neck circumference (NC) in the range of 16-18 inches, which was followed by 14-16 inches measured in 31.0%. 20.0% subjects had NC in the range of 18-20 inches. Whereas NC of ≥20 inch was observed in only few (3.0%) subjects. We found that maximum of our subjects (62%) were addict to some form of substance abuse. Alcohol being the commonest form of addiction in maximum subject (54.0%). Tobacco abuse was seen in 52%, whereas 43.0% of our patients were addict to both, i.e. alcohol as well tobacco. Most common form of tobacco consumption was in form of cigarette smoking which was seen in 43.0% of our subjects, which was followed by consumption of tobacco in chewable form that was either guthka or pure tobacco and it was consumed by 24.0% of our subjects. There were also few subjects (3%) who consumed tobacco in the form of beedi smoking. Systemic hypertension was the most common co-morbid condition and was observed in 78% of our obese subjects. Systemic hypertension prevailed more in male (79.31%) obese subjects as compared to female (76.19%) obese subjects. We found that 54.0% of our obese subjects suffering from diabetes, out of which, male (62.06%) obese patients suffering from diabetes were predominantly more, as compared to female (42.85%) obese patients. Hypothyroid was reported in 24 of obese subjects, and was more frequent in female (30.95%) than male (18.97%) obese subjects. Differences between systemic hypertensive and systemic non-hypertensive obese patients to predict the significant risk factors for hypertensive were analyzed by using a binary univariate logistic regression. Overall severity of sleep apnea was found the important significant risk factor ($p<0.05$) for predicting hypertension among obese patients. The most significant risk factor for predicting hypertension was moderate type sleep apnea ($p<0.005$) followed by age of the ($p<0.007$) obese patients that were confirmed strongly significant on statistical ground. Obesity grade II, sex and diabetic status was not found significant ($p>0.05$) risk factors for predicting hypertension among obese subjects. Neck circumference of obese subjects was found to be positively correlated with apnea hypopnea index (AHI) and the strength of correlation was poor that was confirmed statistically significant ($p<0.05$).In our study, the sleep disordered breathing (SDB) was present in approximately all the obese subjects (99.0%). Maximum subjects (67%) had severe form of sleep apnea, while 25% obese subjects had moderate sleep apnea. Mild sleep apnea was found in 7% of obese patients, while only 1 obese patient had a normal sleep study. The most common type of sleep apnea was obstructive type, which was present in 70% of the obese subjects. Mixed type of sleep apnea was found in 30% of obese patients. In a study done by Lopez *et al*. [13], of 290 obese subject population {comprising of 22% males and 278% females}, the prevalence of sleep disordered breathing was found to be 78%.In our study, the prevalence of systemic hypertension in the study population was 78%, with predominant male population (79.31%), then female population (76.19%).In a study done by Mandal *et al*. [14], of 300 subject population {comprising of 72.3% males and 27.7% females}, the prevalence of systemic hypertension in the obese population was 22.2%. In our study, the overall severity of sleep apnea was found to be the most important significant risk factor ($p<0.05$) for predicting systemic hypertension among obese patients, with moderate type of sleep apnea ($p<0.005$) being the most significant risk factor for predicting systemic hypertension. In a study done by Hoffstein *et al*. [15], of 1415 subject population {comprising of 72.5% males and 27.5% females}, revealed AHI to be an independent determinant of systemic hypertension. In a study done by Grunstein *et al*. [16], of 3035 subject population {comprising of 43.6% males and 56.4% females}, using multivariate analysis, it revealed that OSA was independently associated with blood pressure in men and women.

Conclusion

Obesity has a very high and proportionate correlation to sleep disordered breathing. Obstructive sleep apnea is the predominant sleep disordered breathing in our study population. Moderate obstructive sleep apnea correlates very highly for predicting hypertension and maybe considered as a risk factor for the same. Sleep disordered breathing is very much correctable in obese hypertensive population by weight reduction and risk factor control.

Limitations

Number of study subjects and study duration is very small for application to general population. Level 2 PSG analysis was done.

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