CORRELATION OF SEVERITY OF APNOEA HYPOPNOEA INDEX (AHI) WITH FORCED EXPIRATORY VOLUME 1 (FEV1) IN OVERLAP SYNDROME

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ABSTRACT

BACKGROUND

Overlap syndrome was first described by David Flenley in 1980 refers to the coexistence of Chronic Obstructive Pulmonary Disease (COPD) and Obstructive Sleep Apnoea (OSA). The global prevalence of Overlap syndrome is 11-14% and 7.5% in India Overlap patients are at higher risk of developing Nocturnal desaturations, hypertension, congestive heart failure, stroke etc. resulting in greater mortality and morbidity. There are very few studies in India correlating factors like poor lung function, body mass index, high ESS score, MMRC dyspnea grading in COPD patients with OSA .Hence, this study was undertaken to correlate the association and severity of OSA using AHI with Forced Expiratory Volume in 1 sec (FEV1), Body Mass Index (BMI), Modified Medical Research Council dyspnea grade (MRC) and high Epworth Sleepiness Scale (ESS).

MATERIALS AND METHODS

A prospective observational study, done in 66 COPD patients in Department of Respiratory Medicine, CHRI, Chennai. The diagnosis of COPD was based upon GOLD guidelines 2016. The OSA was diagnosed based on the American Academy of Sleep Medicine guidelines (AASMA). All COPD patients were subjected to detailed clinical history, thorough physical examination, ENT examination to rule out Upper airway obstruction. All patients were asked to fill up the Epworth sleepiness questionnaire. BMI was recorded. Dyspnea grading was done using MMRC scale. Patient was also subjected to Spirometry and overnight Polysomnography,

RESULTS

In patients with overlap syndrome, no correlation of statistical significance between the AHI and FEV1. Though, the grade of AHI showed an increase as the FEV1 decreased. Significant positive correlation was observed between AHI and MMRC as well as AHI and ESS.

CONCLUSION

In COPD patients FEV1 did not correlate with AHI grade and hence lung function cannot be used as predictor of OSA in COPD. However, simple clinical parameters like ESS and MMRC which show a positive correlation with AHI grade may be utilized to assess the presence of OSA.

KEYWORDS

Overlap Syndrome, AHI, FEV1, BMI, MMRC, ESS.

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BACKGROUND

The term Overlap syndrome was first described by Pulmonologist David Flenley in 1980 which refer to the coexistence of Obstructive Sleep Apnoea and Chronic Obstructive Pulmonary Disease.[1] This entity is associated with poor prognosis as compared to COPD alone. Studies done in different parts of the world shows the prevalence of overlap syndrome to vary between 11-14%.[2] and 29%.[3]

The Indian data on the prevalence of OSA in COPD patients is limited. In one Indian study prevalence of

obstructive sleep apnoea was 7.5%, 4.5% in males and females respectively.[4] Overlap syndrome is considered a heterogeneous disease with unclear Pathophysiology. It is doubtful whether COPD predisposes to OSA or vice-versa.[5]

There are various mechanisms responsible for Overlap syndrome like skeletal muscle myopathy secondary to inhaled corticosteroids.[6] increased end expiratory lung volume, redistribution of oedema fluid in supine position which may contribute to OSA in COPD patients.[7]

The postulated risk factors for development of OSA in COPD patients includes high BMI, significant nocturnal desaturations, ESS score more than 10, poor lung function and presence of daytime hypoventilation.

The co-existence of COPD and OSA appears to increase morbidity and mortality which is mainly attributable to prolonged hypoxemia due to Alveolar Hypoventilation, ventilation- perfusion mismatch and increased End-Expiratory volumes. Moreover both COPD and OSA are associated with systemic inflammation mediators resulting in significant Cardiovascular mortality and morbidity.[8]

Though FEVI1 is used to grade severity of lung function in COPD (GOLD guidelines) it has not been shown to consistently correlate with the presence of OSA in COPD.[9] Hence the presence study was undertaken to study the correlation of FEV1 with AHI.

Correlation of AHI with other variables like BMI, ESS, MMRC were also evaluated.

Aim and Objectives

1. To Assess the Correlation of AHI with FEV1 in Overlap Syndrome.
2. To Assess the Correlation of AHI with BMI, MMRC and ESS.

MATERIALS AND METHODS

Study setting- Study Design- Prospective Observational Study.
Study Sample- 66 COPD patients.
Study Area- Department of Respiratory Medicine, Chettinad Hospital and Research Institute, Chennai.
Period of Study- June 2016- July 2017.

The diagnosis of COPD was based upon GOLD guidelines 2016.

The OSA was diagnosed based on the American Academy of Sleep Medicine guidelines (AASMA).

All COPD patients were subjected to detailed clinical history, thorough physical examination, ENT examination to rule out Upper airway obstruction. All patients were asked to fill up the Epworth sleepiness questionnaire. BMI was recorded. Dyspnea grading was done using MMRC scale,

Spirometry was done (using Easy one Pro spirometer) for confirmation and staging of COPD,

All patients underwent Polysomnography (Level 3 using BMC YH600 Polywatch) to diagnose OSA and Apnoea Hypopnoea Index (AHI). The AHI grading was done according to the American Academy of Sleep Medicine guidelines (AASMA). Correlation of degree of Obstructive Apnoea with COPD disease severity was assessed by clinical and Spirometric variables were done using SPSS software version 20.

Inclusion Criteria

Age > 35 yrs.
Patients diagnosed with COPD according to GOLD.

Exclusion Criteria

Age <35.
Pregnancy and/or lactation.
Any Acute Respiratory infections.
Co-morbidities like CAD, hypertension.

RESULTS

Gender	Frequency	Percent
Female	30	45.5
Male	36	54.5
Total	**66**	**100.0**

Table 1. Gender Distribution

54.5% of the study participants were males end 45.5% were female.

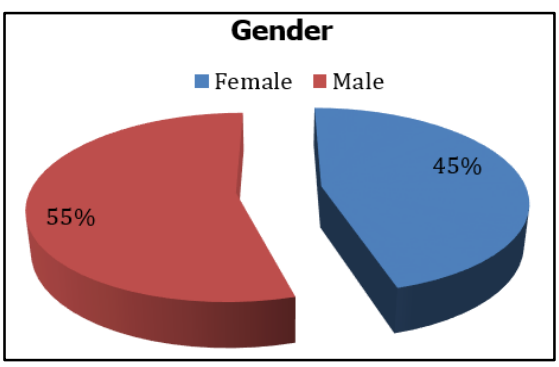

Chart 1. Gender

BMI	Frequency	Percent
Normal	19	28.8
Obese class 1	12	18.2
Obese class 2	11	16.7
Overweight	20	30.3
Underweight	4	6.1
Total	**66**	**100.0**

Table 2. BMI Distribution

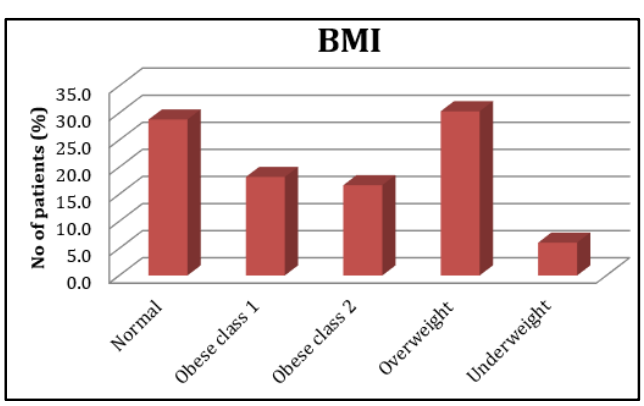

Chart 2. BMI

The BMI of 28.8% fell in the normal range, with 6.1% of patients had low BMI, with 30.3% of patients overweight.

Gold FEV1	Frequency	Percent
Mild	4	6.1
Moderate	30	45.5
Severe	18	27.3
Very severe	14	21.2
Total	**66**	**100.0**

Table 3. FEV1 Gold Grading

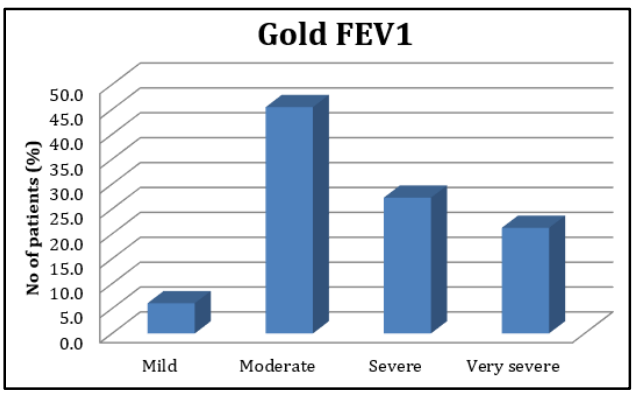

Chart 3. Gold FEV1

Majority of the patients (45.5%) in the study group had moderate airway obstruction. Severe and very severe airway obstruction was found in 27.3% and 21.2% respectively.

MMRC	Frequency	Percent
Grade 0	4	6.1
Grade 1	21	31.8
Grade 2	22	33.3
Grade 3	18	27.3
Grade 4	1	1.5
Total	**66**	**100.0**

Table 4. MMRC Dyspnea Grade

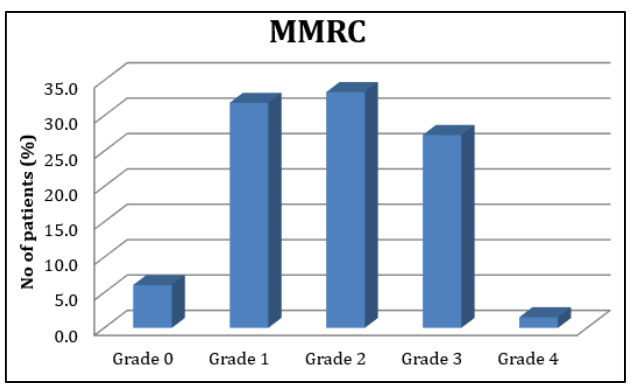

Chart 4. MMRC Dyspnea Grade

There was almost equal distribution of subjects with Grade 1 and Grade 2 dyspnea grading that is 31.8% and 33.3%, and 1.5% of subjects with Grade 4 dyspnea score.

AHI	Frequency	Percent
Mild	15	22.7
Moderate	8	12.1
Normal	31	47.0
Severe	12	18.2
Total	**66**	**100.0**

Table 5. AHI Grading

Majority of the patients, 47% had normal AHI, 22.7% had mild, 12.1% moderate and 18.2% subjects had severe AHI.

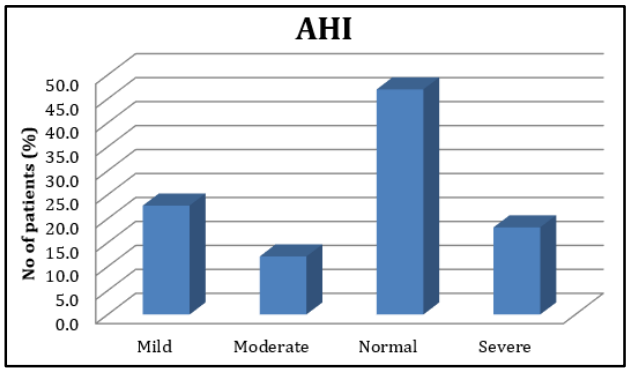

Chart 5. AHI Grading

ESS	Frequency	Percent
Higher normal	24	36.4
lower normal	18	27.3
Mild excessive	6	9.1
Moderate excessive	10	15.2
Severe excessive	8	12.1
Total	**66**	**100.0**

Table 6. ESS Grading

36.4% subjects had normal ESS and 12.1% subjects had excessive day time sleepiness on ESS score.

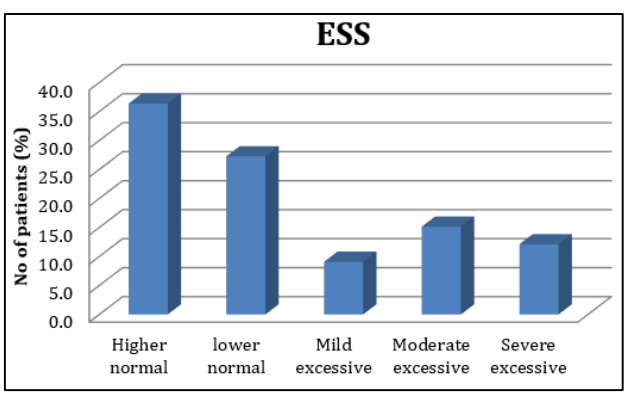

Chart 6. ESS Grading

	Mean	Std. Deviation
Age	55.79	11.056
Height	155.38	6.856
Weight	68.82	16.383
BMI1	28.14	6.821
FEV1	50.39	18.694
AHI	15.32	22.033
ESS	9.38	5.417

Table 7. Mean and Standard Deviation

			BMI			Total
			Underweight	Normal	Obese	
AHI		**Count**	**2**	**4**	**9**	**15**
		% within AHI	13.30%	26.70%	60.00%	100.00%
		Count	0	4	4	8
		% within AHI	0.00%	50.00%	50.00%	100.00%
		Count	0	7	24	31
		% within AHI	0.00%	22.60%	77.40%	100.00%
		Count	2	4	6	12
		% within AHI	16.70%	33.30%	50.00%	100.00%
Total		**Count**	**4**	**19**	**43**	**66**
		% within AHI	**6.10%**	**28.80%**	**65.20%**	**100.00%**

Table 7. Association between AHI and BMI Category in Study Population

Chi square Value- 9.15, Df - 6, P value -0.165.

Out of 15 cases of Mild AHI, most of the cases were Obese (9 cases) followed by normal BMI (4 cases) and Underweight (2 cases), Out of 8 cases of moderate AHI, most of the cases had normal BMI (4 cases) followed by Obese (4 Cases), Out of 12 cases of severe AHI, most of the cases were Obese (6 cases) followed by normal BMI (4 cases) and Underweight (2 cases). There was no statistically significant correlation between AHI and BMI.

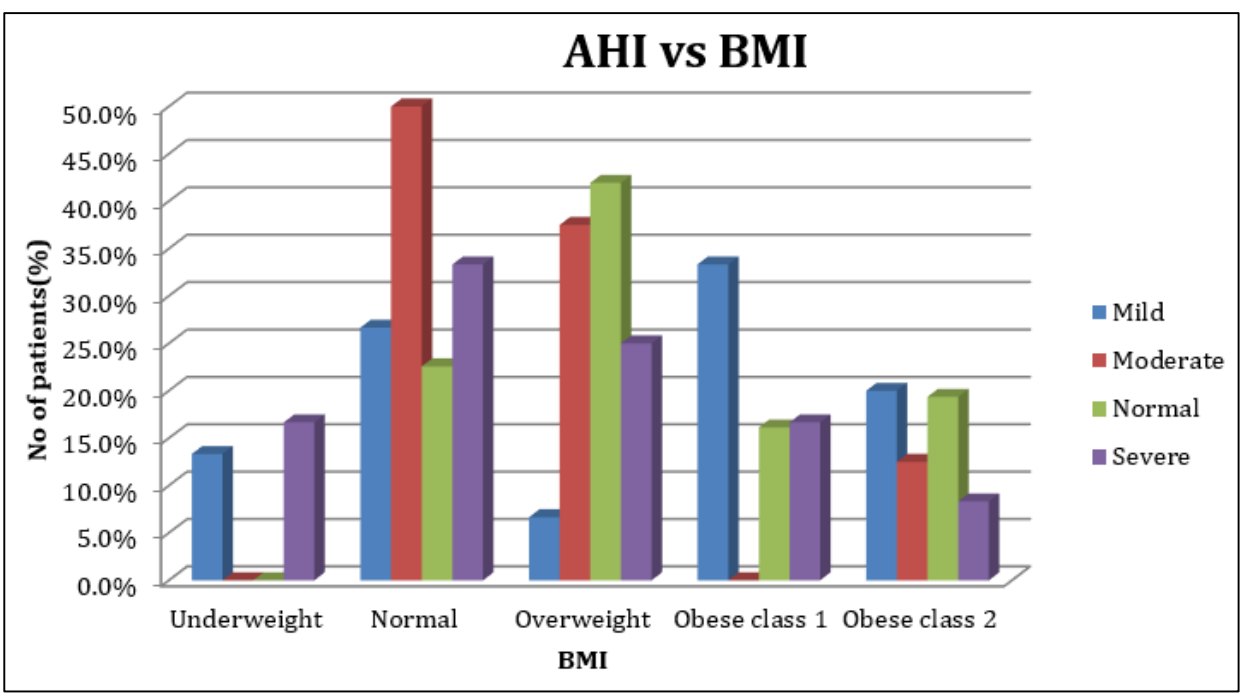

Chart 7. Association between AHI and BMI Category in Study Population

			FEV1				Total
			Mild	Moderate	Severe	Very severe	
AHI	Mild	Count	0	7	5	3	15
		% within AHI	0.0%	46.7%	33.3%	20.0%	100.0%
	Moderate	Count	2	4	0	2	8
		% within AHI	25.0%	50.0%	0.0%	25.0%	100.0%
	Normal	Count	1	17	9	4	31
		% within AHI	3.2%	54.8%	29.0%	12.9%	100.0%
	Severe	Count	1	2	4	5	12
		% within AHI	8.3%	16.7%	33.3%	41.7%	100.0%
Total		**Count**	**4**	**30**	**18**	**14**	**66**
		% within AHI	**6.1%**	**45.5%**	**27.3%**	**21.2%**	**100.0%**

Table 8. Association between AHI and FEV1 Category in Study Population

Chi square Value- 15, Df- 9, P value -0.91.

Out of 15 cases of Mild AHI, most of the cases had moderate FEV1 (7 cases) followed by severe FEV1 (5 cases) and very severe FEV1 (3 cases), Out of 8 cases of moderate AHI, most of the cases had moderate FEV1 (4 cases) followed by mild FEV1 (3 cases) and very severe FEV1 (3 cases), Out of 12 cases of severe AHI, most of the cases had very severe FEV1 (5 cases) followed by severe FEV1 (4 cases) and moderate FEV1 (2 cases). There was no statistically significant correlation between AHI and FEV1.

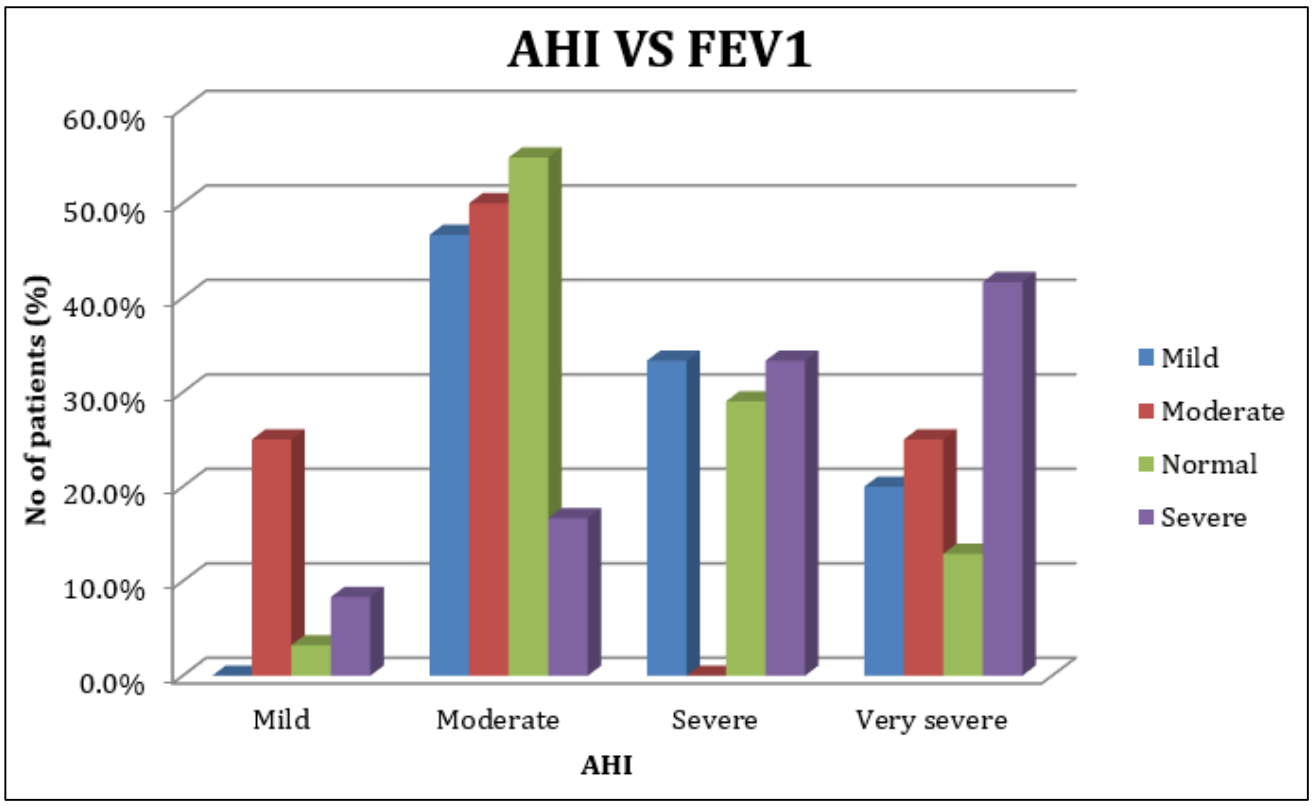

Chart 8. Association between AHI and FEV1 Category in Study Population

			MMRC					Total
			Grade 0	Grade 1	Grade 2	Grade 3	Grade 4	
AHI	Mild	Count	0	8	4	3	0	15
		% within AHI	0.0%	53.3%	26.7%	20.0%	0.0%	100.0%
	Moderate	Count	0	0	4	4	0	8
		% within AHI	0.0%	0.0%	50.0%	50.0%	0.0%	100.0%
	Normal	Count	4	12	11	4	0	31
		% within AHI	12.9%	38.7%	35.5%	12.9%	0.0%	100.0%
	Severe	Count	0	1	3	7	1	12
		% within AHI	0.0%	8.3%	25.0%	58.3%	8.3%	100.0%
Total		**Count**	**4**	**21**	**22**	**18**	**1**	**66**
		% within AHI	**6.1%**	**31.8%**	**33.3%**	**27.3%**	**1.5%**	**100.0%**

Table 9. Association between AHI and MMRC in Study Population (N=65)

Chi square Value- 25.84, Df- 12, P value -0.011.

Out of 15 cases of Mild AHI, most of the cases had grade 1 dyspnoea (8 cases) followed by grade 2 (4 cases) and grade 3 (3 cases), Out of 8 cases of moderate AHI, most of the cases had grade 2 dyspnoea (4 cases) and grade 3 (4 cases), Out of 12 cases of severe AHI, most of the cases had grade 3 dyspnoea (7 cases) followed by grade 2 (3 cases). There was statistically significant difference between AHI and MMRC.

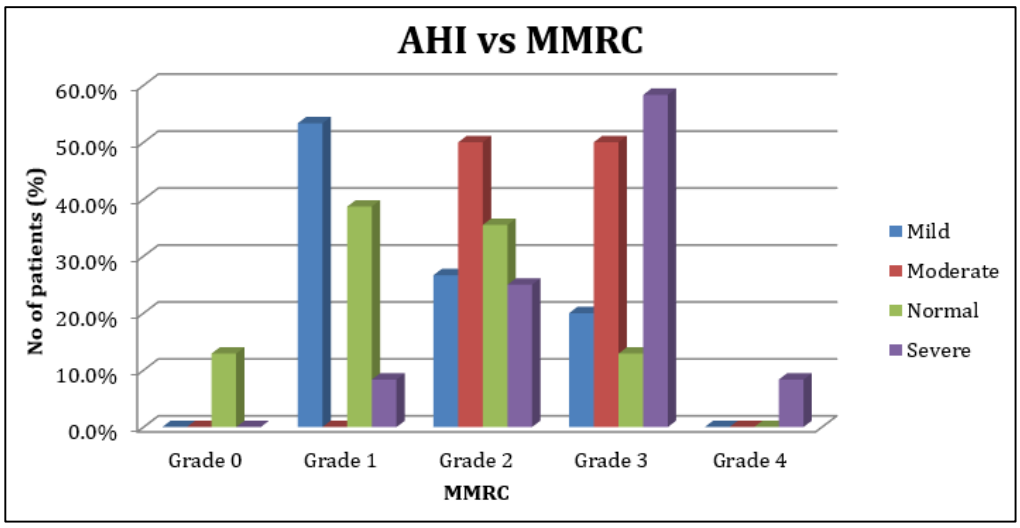

Chart 9. Association between AHI and MMRC in Study Population (N=65)

			ESS					Total
			Higher Normal	**Lower Normal**	**Mild Excessive**	**Moderate Excessive**	**Severe Excessive**	
AHI	Mild	Count	5	3	3	3	1	15
		% within AHI	33.3%	20.0%	20.0%	20.0%	6.7%	100.0%
	Moderate	Count	3	0	1	2	2	8
		% within AHI	37.5%	0.0%	12.5%	25.0%	25.0%	100.0%
	Normal	Count	15	13	1	2	0	31
		% within AHI	48.4%	41.9%	3.2%	6.5%	0.0%	100.0%
	Severe	Count	1	2	1	3	5	12
		% within AHI	8.3%	16.7%	8.3%	25.0%	41.7%	100.0%
Total		**Count**	**24**	**18**	**6**	**10**	**8**	**66**
		% within AHI	**36.4%**	**27.3%**	**9.1%**	**15.2%**	**12.1%**	**100.0%**

Table 10. Association between AHI and ESS Category in Study Population (N=45)

Chi square Value- 29.84, Df- 12, P value – 0.003.

Out of 15 cases of Mild AHI, most of the cases had Higher normal ESS (5 cases) followed by lower normal (3 cases), mild excessive (3 cases) and moderate excessive ESS (3 cases), Out of 8 cases of moderate AHI, most of the cases had Higher normal ESS (3 cases) followed by moderate excessive ESS (3 cases) and severe excessive ESS, Out of 12 cases of severe AHI, most of the cases had severe excessive ESS (5 cases) followed by moderate excessive ESS (3 cases) and lower normal ESS (2 cases) There was statistically significant correlation between AHI and ESS.

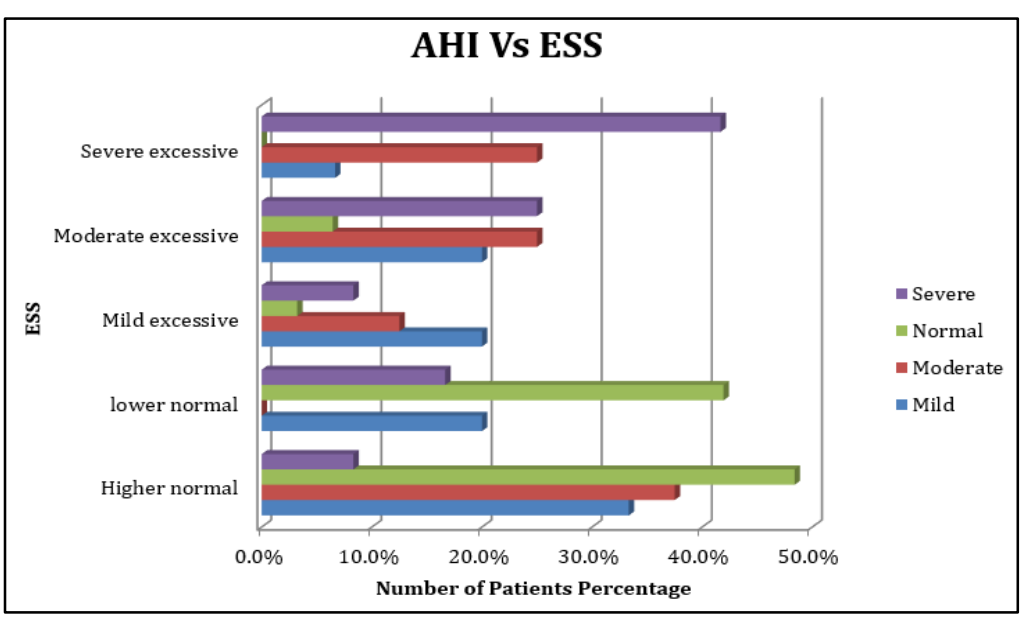

Chart 10. Association between AHI and ESS Category in Study Population (N=45)

		BMI	FEV1	MMRC	ESS
AHI	Pearson Correlation	-.150	-.245*	.424**	.526**
	Sig. (2-tailed)	.230	.047	.000	.000
	N	66	66	66	66

Table 10. Association between AHI and ESS Category in Study Population

As seen in the above table, there was significant positive correlation was observed between AHI, MMRC and ESS while significant negative correlation was observed between AHI and FEV1. There was no significant correlation was observed between AHI and BMI.

DISCUSSION

Overlap syndrome has been associated with greater mortality and morbidity as compared to OSA and COPD alone.[10] Studies to assess the association between reduced lung function as an independent risk factor for OSA have shown varied results. In our study the prevalence of overlap syndrome was 53%. However the global prevalence of overlap syndrome varies in different studies, which is estimated to be 10 to 15%.[11,12] in one old study done by C. Guilleminault et al. showed prevalence of 92%.

Our study showed a negative correlation between the AHI and FEV1. Majority of the patients with severe OSA had poor lung function. This was similar to studies done by Chaouat A et al[13] and another Indian study done by Shah et al.[14]

On the contrary some western studies done by Gajanan et al. and Sharma et al. did not shown any correlation between FEV1 and AHI.[15]

Obesity has been shown to be a risk factor for the development of OSA. Our study showed that 50% patients with severe OSA belonged to the obese category however no significant correlation was observed between AHI and BMI. This is in accordance with the study done by Venkateswaran et al[16] who also showed that BMI did not correlate with degree of AHI. However on the contrary, studies done by Peppard PE et al[17] and others.[18] demonstrated a positive correlation between the AHI and BMI. One of the western study done by Deegan PC et al. the prevalence of OSA correlated with BMI in male patients and more closely to neck circumference in female patients.[19]

MMRC is one of the most widely used dyspnea grading in Respiratory system. It quantifies the disability associated with breathlessness. In our study there was a positive correlation between with AHI and MMRC. Studies done by Venkateswaran S et al. and Aihara et al[20] also showed that MMRC dyspnea grading correlated with the AHI grade.

ESS is a validated questionnaire used to detect sleep disorders and recommend polysomnography but cannot qualify or quantify the disease. Our study showed that ESS score correlated positively with AHI. This is similar to studies done by John MW et al. and Chica-Urzola HLet al[21,22]

The prevalence of overlap syndrome is 53% in our study (AHI >5 events/hour) though AHI did not correlate with FEV1. Simple parameters like ESS score, MMRC dyspnea grading and BMI (in severe OSA) could be used as screening tools for diagnosing Overlap syndrome in COPD patients. Our study showed that poor lung function (FEV1) was associated with higher grade of OSA.

CONCLUSION

In COPD patients FEV1 did not correlate with AHI grade and hence lung function cannot be used as predictor of OSA in COPD. However, simple clinical parameters like ESS and MMRC which show a positive correlation with AHI grade may be utilized to assess the presence of OSA. So ESS, MMRC dyspnea grading and BMI can be used in resource limited setting as referral tools for predicting OSA in COPD patients for early referral to tertiary care centers to diagnose Overlap syndrome by polysomnography.

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