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Correlation between Epworth Sleepiness Score and Polysomnographic Indices in Sleep Related Breathing Disorders

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ABSTRACT

Background: *Sleep disordered breathing is a common disorder affecting the general population carrying significant functional and physiological consequences. Excessive daytime sleepiness (EDS) is a cardinal symptom of Obstructive sleep apnea (OSA) and in many; it is the presenting symptom also. Although many objective scales are used to assess EDS, Epworth sleepiness scale (ESS) is the most popular method to quantify daytime hypersomnolence.This study is undertaken to find out the correlation between ESS Score and the polysomnographic indices and to evaluate the scientific basis in the prediction of OSA.*

Materials and methods: *A total of 85 subjects were included in the study. Symptoms suggestive of OSA were sought in a structured interview. They were asked to fill up the ESS questionnaire in the presence of their partner. A complete physical examination and anthropometry followed by overnight polysomnography (OPS) were done in all patients. ESS score of more than 10 was taken as significant. OSA was diagnosed based on American Academy of Sleep Medicine (AASM) criteria.Statstical analysis was done using EPI INFO statistical software.*

Results: *ESS score showed positive correlation with all three major polysomnograhic indices namely Apnea-Hypopnea Index (AHI), Desaturation Index (DI) and Snore Index (SI).Linear regression showed that ESS is independently predicted by both AHI and SI.*

Conclusions: *We may conclude that both Apnea –Hyponea index and Snore index can independently predict ESS.Hence a positive ESS score cannot differentiate between Obstructive sleep apnea and Primary snoring. ESS should not be used as a sole screening parameter for sleep apnea but we have to look into other clinical predictors also.*

Keywords: *Obstructive sleep apnea, Excessive day* time sleepiness, Epworth sleepiness score, Apnea-Hypopnea index, Desaturation index, Snore index

INTRODUCTION

Sleep related breathing disorders have emerged as a major global public health burden with an estimated prevalence of 2-6% in middle aged adults[1]. Today, it is well recognized that undiagnosed and untreated Obstructive sleep apnea [OSA] can cause significant medical and psychosocial complications. The cardiovascular complications include Hypertension [often refractory to standard treatment], Coronary artery disease, Congestive heart failure, Myocardial infarction, stroke and Pulmonary Hypertension. More important is the psychosocial complications which include increased propensity for accidents during driving and at work place, excessive day time somnolence, cognitive dysfunction, memory impairment and male sexual dysfunction. But it has to be noted that obstructive sleep apnea is essentially a treatable condition. Treatment with Continuous positive airway pressure [CPAP] device effectively eliminates apneas, restores quality of life and prevents the complications of OSA [2,3 and 4]. Thus, there is substantial medical, social and economic consequences are there for untreated OSA and there is high likely hood of successful treatment also. But it is found that OSA usually remains undiagnosed and untreated in primary practice. One of the main reasons behind this is limited availability of Overnight Polysomnography which is the gold standard investigation to diagnose OSA. All these factors strongly recommend screening for this common disease. Screening assumes much more significance in a resource poor country like India which is having a high patient turnover rate also.

Epworth Sleepiness Scale

This is the most commonly used screening method for OSA. This is a simple questionnaire examining 'excessive day time sleepiness' which is a cardinal symptom of OSA. It was put forwarded and validated by Dr. M.W. Johns, Epworth hospital, Melbourne, Australia in the year 1991[5].It is very popular worldwide as a screening tool for OSA because of its simplicity, high reliability, internal consistency and apparent lack of influence of language and cultural background .It is well validated in other languages also like French, German, Greek, Italian etc. The questionnaire is shown in illustration 1.

Polysomnographic Determinants of Positive Epworth Sleepiness Score

In the original study, Dr. M W Johns concluded that the average ESS score of the normal subjects differed significantly from that of patients with sleep disorders. ESS score can also significantly distinguish between primary snoring and obstructive sleep apnea. Also, it was found that in patients with OSA, ESS was most closely related to Respiratory disturbance Index [RDI] and lowest nocturnal saturation. He proposed that a value of ESS>10 can be taken as significant and can define excessive daytime sleepiness in a patient [5,6].

But subsequent studies from different parts of the world failed to show consistent results. Studies by Gottlieb et al in Boston university school of medicine have shown that ESS is independently predicted by R D I and snoring frequency [7]. A similar study by Osman et al in UK concluded that ESS score failed to show significant correlation with AHI [8]. At present, there is limited data regarding the applicability of ESS score in Indian population and also regarding the polysomnographic determinants of positive ESS. This study is conducted in this context to assess the validity of ESS in predicting OSA in our population and to assess the correlation between ESS and major polysomnographic indices namely 1.Apnea-Hypopnea Index 2.Snore Index and 3.Desaturation index.

Illustration 1. The Epworth Sleepiness Scale [ESS]

How likely are you to doze off or fall asleep in the following situations, in contrast to feeling just tired? This refers to your usual way of life in recent times. Even if you have not done some of these things recently, try to work out how they would have affected you. Use the following scale to choose the most appropriate number for each situation:

0 = would never doze

1 = slight chance of dozing

2 = moderate chance of dozing

3 = high chance of dozing

Situations

Chance of dozing:

1. Sitting and reading
2. Watching TV
3. Sitting inactive in a public place(e.g. . a theatre or a meeting)
4. as a passenger in a car for an hour without a break
5. Lying down to rest in the afternoon when circumstances permit
6. Sitting and talking to someone
7. Sitting quietly after a lunch without alcohol
8. in a car, while stopped for a few minutes in the traffic

MATERIALS AND METHODS

The present study was carried out at Government medical college, Calicut, Kerala, India. Study period was from June 2005 to may 2006. The subjects were taken on the basis of inclusion and exclusion criteria as described below.

Inclusion Criteria:

All patients with loud habitual snoring with at least one other symptom suggestive of OSA which included nocturnal awakenings, witnessed apneas, excessive daytime sleepiness, early morning headache and daytime fatigability.

Exclusion Criteria:

Patients were excluded from the study if they did not consent to the study, or if any technical failure occurred during the procedure or if they could not sleep during the procedure.

Study Design

Symptoms suggestive of OSA were sought through a detailed interview. The patient was asked to fill up the Epworth sleepiness questionnaire in the presence of their partner. A score >10 was taken as significant and suggestive of OSA.A thorough history followed by complete physical examination including anthropometry [neck circumference and BMI] is done. Overnight polysomnograqphy was arranged for all patients .The study included the following recordings :electroencephalogram, chin electromyography, electrooculography, chest and abdominal movements and body position measured by inductance

plethysmography, airflow and snore detected via nasal pressure sensors, oxygen saturation by pulse oximeter and heart rate monitoring by ECG electodes. Results were analyzed by software and also scored manually. Apnea was defined as complete cessation of airflow >10sec.Hypopnea was defined as reduction of >50% in one of the three respiratory signals-airflow signal or either respiratory or abdominal signals of inductance plethysmography, with an associated fall of >3% in oxygen saturation with or without an arousal. OSA was diagnosed if a patient with had a cumulative apnea hypopnea index [AHI] of >5.Those with OSA were further grouped based on AHI into three classes of severity as mild OSA [AHI 5 to 15], moderate OSA [AHI 15-30] and severe OSA[AHI>30]. Desaturation index was defined as the average number of desaturation events in an hour. Snore index was defined as average number of snore events in an hour. Correlation between ESS and the following parameters were calculated by correlation studies. It included age, BMI, Apnea-Hypopnea index [AHI], Desaturation index [DI] and Snore Index [SI]. Linear regression was done thereafter to find out the most independent predictors of ESS. Statstical analysis was done using EPI INFO statistical software version 3.3.

RESULTS

A total of 89 patients were initially enrolled into study of which 4 patients were excluded. The age and sex distribution of the study group is shown in the table 1.The average age of the study group was 49 years with majority of study group distributed between 51 to 60 years. On applying Epworth sleepiness scale, a significant ESS score >10 was shown by 36[42.4%] patients. The average ESS score of the study group was 10.31.The distribution based on ESS is shown in table 2.On doing overnight polysomnography, OSA was diagnosed in 71 [83`5%] of the study group. Their distribution based on severity is shown in table 3.The various co morbidities in the study cohort are shown in table 4.

Table 1. Distribution of study population based on age group

OSA	Age group in years					
	20-30	31-40	41-50	51-60	61-70	71-80
Yes	3	10	18	30	7	3
No	1	3	4	4	2	0
Total (Number%)	4 (4.7%)	13 (15.2%)	22 (22.8%)	34 (40%)	9 (10.5%)	3 (3.5%)

Table 2. Distribution of study population based on ESS

OSA	ESS		
	<10 (Number%)	>10 (Number%)	Total (Number%)
Yes (Number%)	41	30	71 (83.5%)
No (Number%)	8	6	14 (16.5%)
Total (Number%)	49 (57.6%)	36 (42.4%)	85 (100%)

Table 3. Distribution based on severity of OSA

Severity	Number	Percentage
Mild	18	25.4%
Moderate	18	25.4%
Severe	35	49.3%

Table 4. Co-morbidities in the study group

Disease	OSA	No OSA	Total
Systemic Hypertension	33	6	39(45.8%)
GERD	14	6	20(23.5%)
Asthma	9	2	11(12.9%)
Diabetes mellitus	10	4	14(16.4%)
Coronary artery disease	8	2	10(11.7%)
Pulmonary artery hypertension	6	1	7(8.2%)
Chronic obstructive airway disease	7	3	10(11.7%)
Hypothyroidism	4	0	4(4.7%)
Cerebrovascular accident	3	0	3(3.5%)
Pickwickian syndrome	3	0	3(3.5%)
Xeroderma pigmntosa	1	0	1(1.1%)
Pierrie Robin syndrome	1	0	1(1.1%)

Correlation studies were carried out to see the correlation between ESS with age, BMI, AHI, SI and DI.This is shown in illustration 2. ESS was not found to have statistically significant correlation between age and BMI as evidenced by the p value. But statistically significant linear positive correlation was found between ESS and all the three polysomnographic indices namely AHI, DI and SI.In order to find out the most independent predictors of ESS, linear regression was carried out. This is shown in illustration 3. It is observed that ESS is most independently predicted by AHI and Snore index.

Illustration 2. Correlation between ESS and AGE,BMI,AHI,DI and SI

		AGE	ESS
AGE	Pearson correlation	1.000	-.107
	Sig.(2-tailed)	.	.330
	N	85	85
ESS	Pearson correlation	-.107	1.000
	Sig.(2-tailed)	.330	.
	N	85	85

		ESS	BMI
ESS	Pearson correlation	1.000	-.064
	Sig.(2-tailed)	.	.559
	N	85	85
BMI	Pearson correlation	-.064	1.000
	Sig.(2-tailed)	.559	.
	N	85	85

		ESS	AHI
ESS	Pearson correlation	1.000	.236*
	Sig.(2-tailed)	.	.030
	N	85	85
AHI	Pearson correlation	.236*	1.000
	Sig.(2-tailed)	.030	.
	N	85	85

*Correlation is significant at the 0.05 level (2-tailed)

		ESS	DI
ESS	Pearson correlation	1.000	.256*
	Sig.(2-tailed)	.	.018
DI	Pearson correlation	.256*	1.000
	Sig.(2-tailed)	.018	.

*Correlation is significant at the 0.05 level (2-tailed)

		ESS	SI
ESS	Pearson correlation	1.000	.291**
	Sig.(2-tailed)	.	.007
	N	85	85
SI	Pearson correlation	.291**	1.000
	Sig.(2-tailed)	.007	.
	N	85	85

**Correlation is significant at the 0.01 level

DISCUSSION

The present study was aimed mainly to look into the correlation between major polysomnographic indices and ESS score in patients with sleep related breathing disoders.The polysomnographic indices studied were apnea hypopnea index [AHI], desaturation index [DI] and snore index [SI].

In this study a statistically significant positive correlation was found between ESS score and all the three major polysomnographic indices. It suggests that frequency of apneas, the frequency of desaturations as well as frequency of snoring can influence day time sleepiness as perceived by ESS score. It is not influenced by age or BMI as per the present study. On doing linear regression the most independent predictors of positive ESS score in a snorer is AHI and snore index [SI].This observation carries significance as it is in contrary to the observation in the original study. The present study suggests that both primary snoring and OSA can lead to EDS independent of each other. And a positive ESS scorer in a snorer cannot distinguish between the two. These results are in concordance with results of Gottlieb et al and Osman et al as mentioned above.

Illustration 3.Linear regression

Model Summary

Model	R square
2	0.152

Coefficients a

Model		Unstandardised coefficients
		B
2	(Constant)	6.658
	SI	1.942E-02
	AHI	4.893E-02

a. Dependent variable: ESS

This study is the first kind of it in our country which looked into the applicability of ESS in our population. We conclude that ESS is a useful tool to quantify morbidity due to sleep related breathing disorder but less useful as a screening tool for OSA. This is because ESS measures EDS but neglects other predictors of OSA.

CONCLUSIONS

1. ESS shows positive correlation between all three major polysomnographic indices namely AHI, DI and SI.
2. ESS is most independently predicted by AHI and SI
3. Primary snoring can also lead on to excessive daytime sleepiness irrespective of AHI.

4. Postive ESS score can not differentiate between OSA and primary snoring.

5. Epworth sleepiness score cannot be taken as the sole screening process for prioritizing patients for polysomnography. We have to look into other clinical predictors also.

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