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Identification of Risk for Obstructive Sleep Apnea by Berlin Questionnaire

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ABSTRACT

Obstructive sleep apnea (OSA) is a disabling condition characterized by excessive daytime sleepiness, snoring and repeated episodes of airway obstruction during sleep and nocturnal hypoxemia which may leads to adverse health outcome. The aim of the study was to test the utility of Berlin questionnaire for identification and risk categorization of OSA in Indian setting. This study was conducted on 122 subjects, who underwent an overnight polysomnography (PSG) study and each patient received a Berlin questionnaire. Among 122 subjects 94 and 88 were OSA patients as per PSG and Berlin questionnaire respectively. Questionnaire addressed the presence of frequency of snoring, wake time sleepiness, fatigue, obesity and hypertension. Subjects with persistent and frequent symptoms in any two of these three domains were considered in high risk category for obstructive sleep apnea. Overnight polysomnograhy was performed to measure apnoea hypopnoea index (AHI). Berlin questionnaire score correlated positively and significantly with AHI (p<0.01), oxygen saturation (p<0.01) and oxygen de-saturation (p <0.05) in high risk patients. Findings suggest that sleep disordered breathing causes OSA which is an independent risk factor for cardiac and neurologic morbidities.. An immediate treatment option like nasal continuous positive airway pressure (n- CPAP) must be weighed. The study concluded that administration of Berlin questionnaire provides a means of identifying patients who are likely to have sleep apnea and can identify high risk subjects and can avoid unnecessary PSG studies especially in resource limited areas.

Key words: Berlin questionnaire, Obstructive sleep apnea, Apnea hypopnea index, Polysomnography.

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INTRODUCTION

Obstructive sleep apnea (OSA) is a breathing or sleeping disorder that has implications beyond disrupted sleep. It is recognized as an independent risk factor for cardiac and neurologic morbidities. Yet this disorder remains undiagnosed in a substantial portion of our population [1]. OSA has been found to have an independent association with hypertension, cardiovascular disease, stroke, type 2 diabetes, metabolic syndrome, and an overall deterioration of an individual's quality of life and working capacity [2, 3]. Obstructive sleep apnea with manifest clinical symptoms is estimated to be prevalent in 2-4% of the population, while the prevalence of an apnea hypopnea index (AHI) values greater than 5 is reported as 25% for men and 9% for women [4, 5]. Patients with Obstructive sleep apnea have increased circulating levels of C-reactive protein, triglycerides, Intracellular adhesion molecule-I, lipoproteins, TNF- alpha, Interleukins, and leptin [6].

The standardized diagnosis of OSA is overnight polysomnography (PSG) but the prohibitive cost of the test and long waiting lists limit its widespread access. Although symptom questionnaires have been developed to predict presence of OSA, their overall reliability and utility have not been established. The Berlin questionnaire is an instrument validated to use in the western population to determine the occurrence of risk factors for OSA namely snoring behavior, wake-time sleepiness or fatigue and the presence of obesity or hypertension. The questions were selected from literature to elicit factors or behaviors that, consistently predicted the presence of sleep-disordered breathing. The questionnaire had symptoms about snoring, excessive daytime sleepiness (EDS), obesity and hypertension. The Berlin questionnaire has been evaluated in the population of Ohio with a sensitivity of 86% and specificity of 77% [7, 8].

This study used the Berlin questionnaire for risk categorization of OSA. After the risk categorization an immediate treatment option like nasal continuous positive airway pressure (n- CPAP) must be weighed. One of the studies in Japanese patients confirmed the usefulness of nasal CPAP on the quality of life with OSA [9]. The purpose of the study was to determine whether OSA increases the risk of cerebro-vascular and cardiovascular causes and the risk of study population were categorized based on Berlin questionnaire.

MATERIAL AND METHODS

Patient Distribution

This study was conducted at Kovai Medical Centre and hospital, Coimbatore, India. Subjects of the study selected from the patients who underwent an overnight PSG (n=122) and each patient received a Berlin questionnaire. Patients who were critically ill and unable to fill the questionnaire were excluded from the study.

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Body Measurement & Sleep study

Body Measurements like weight was recorded in all patients, in erect position. Height was measured and body mass index (BMI) was calculated as body weight/height^2 (kg/m^2).

Overnight polysomnography was performed by using recording system and standard electrodes and sensors. Various parameters monitored included electroencephalogram (EEG), electro-oculogram (EOG), electrocardiogram (ECG), chin and leg electromyogram (EMG), nasal airflow, tracheal breath sounds, thoracic wall and abdominal movements, transcutaneous oxygen saturation and body position. All subjects underwent PSG for at least 6 h. The sleep data recorded by the computer were scored for sleep stages, apneas, and hypopneas. The apnea was defined as cessation of oro-nasal airflowfor >10 sec. Obstructive apneas were scored when airflow was absent but respiratory efforts were present. Hypopnea was defined as the reduction in respiratory airflow during a preceding period of normal breathing for >10 sec accompanied by a decrease of 4 per cent or more in oxy-haemoglobin saturation during sleep. Apnea-hypopnea index (AHI) was calculated based on the following formula: AHI = (total no. of obstructive apneas + total no. of hypopneas)/total sleep time in hours [7].

Risk Categorization of Berlin Questionnaire

The Berlin questionnaire was an outcome of the Conference on Sleep in Primary Care, which involved 120 US and German pulmonary and primary care physicians and was held in April 1996 in Berlin, Germany.[7] Questions were selected from the literature to elicit factors or behaviors that, across studies, consistently predicted the presence of sleep disordered breathing. By consensus, the instrument focused on a limited set of known risk factors for sleep apnea. One introductory question and four follow-up questions concern snoring, three questions address daytime sleepiness and one question concerns history of high blood pressure. Pre determination of high risk and lower risk for sleep apnea was based on responses in three symptom categories. In category1, high risk was defined as persistent symptoms (3 to 4 times/wk) in two or more questions about their snoring. In category 2, high risk was defined as persistent (3 to 4 times/wk) wake time sleepiness, drowsy driving, or both. In category 3, high risk was defined as a history of high blood pressure or a body mass index more than 30 kg/m^2. To be considered at high risk for sleep apnea, a patient had to qualify for at least two symptom categories. Those who denied having persistent symptoms or who qualified for only one symptom category were placed in the lower risk group.

Statistical Analysis

The quantitative distribution of questionnaires, individual patient variables and results of sleep study monitoring are expressed by descriptive statistics (frequencies, mean ± SD).The Pearson correlation test and level of significance were used to compare questionnaire responses and AHI risk groupings. SPSS version 16.0 for windows was used for the statistical analysis. The values of $p<0.05$ and $p<0.01$ were statistically significant.

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RESULTS

Among 122 patients, 94 were diagnosed with obstructive sleep apnea (77.05%). Based on AHI, distribution of patients evaluated as no risk, mild, moderate and severe obstructive sleep apnea syndrome was established as 22.95%, 18.03%, 16.39% and 42.62% respectively. There is strong association between the AHI and presence of symptoms. Properly filled questionnaire showed that 72.13% of patients are at high risk and 27.86% of patients are at low risk. While comparing Polysomnographic report (AHI) and Questionnaire result, low risk showed by 22.95% and 27.86% then high risk showed by 77.05% and 72.13% of patients respectively. The Berlin questionnaire provides as a tool for identifying patients those who are likely to have obstructive sleep apnea. Comparison of AHI and Berlin questionnaire were presented in Table 1

Table 1 Comparison of AHI and Berlin questionnaire

Category	Percentage of patients (n=122)
AHI (low)	22.95 (28)
Ques (low)	27.86(34)
AHI(high)	77.05(94)
Ques (high)	72.13(88)

Out of 94 obstructive sleep apnea patients 74 (78.72%) were males and 20 were females (21.27%). In these study males were comparatively higher than females. Approximately 9% of females and 24% of male experience sleep apnea. Based on the BMI, distribution of patients considered as normal, overweight and obese was established as 10.67%, 59.57% and 29.78% respectively. Obesity (BMI) Sex and age are all important risk factors for OSA. Not only increased body weight but also the fat distribution plays a major role in OSA.

Table 2 The mean and standard deviation of polysomnographic variables

Variables	Total OSA Patients (n=94) { Male 74 & Female 20 }
Age	51.25±13.06
BMI	27.73 ±3.09
Sleep Efficiency	49.74 ±28.58
AHI	36.17 ±22.79
Sleep Onset	24.91 ±22.41
Total Sleep Time	226.1 ±121.5
Oxygen Desaturation	24.50 ±36.22
Oxygen Saturation	91.58 ±6.09
No. of Snoring	52.46 ±24.11

Among 94 OSA patients the mean BMI, AHI, oxygen desaturation, oxygen saturation were found to be 27.73 ± 3.09, 36.17 ± 22.79, 24.50 ± 36.22 and 91.58 ± 6.09 respectively. PSG variables OSA patients were presented in Table 2. In order to analyze correlation among variables, Pearson correlation test was used. Out of 94 OSA patients correlation value of AHI with each variable shows significance for BMI (p<0.05), Oxygen saturation (p<0.01), Oxygen desaturation (p<0.01) and number of snoring (p<0.05). Then AHI with variables sleep efficiency and sleep onset doesn't show significance. There was no correlation between Berlin

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questionnaire with BMI, sleep efficiency, sleep onset and number of snoring. Questionnaire shows significance with AHI (p<0.01), oxygen saturation (p<0.01) and oxygen desaturation (p<0.05). Out of 122 patients we found that Berlin questionnaire score correlated positively and significantly with apnea hypopnea index (p<0.01) in high risk patients. We also found that Berlin questionnaire score correlated positively and significantly with apnea hypopnea index (p<0.01) in low risk patients. Correlation coefficients of clinical variables are shown in Table 3.

Table 3 Pearson Correlation of each variable between AHI and Questionnaire

Variables	AHI	Berlin Questionnaire
	p value	p value
AHI	-	0.000**
BMI	0.021*	0.165
Sleep Efficiency	0.572	0.482
Sleep Onset	0.840	0.083
Oxygen Saturation	0.006**	0.002**
Oxygen De-saturation	0.000**	0.029*
No. of Snoring	0.018*	0.078
Questionnaire	0.000**	-

DISCUSSION

Clusters of epidemiological studies related to sleep apnea have been performed all over the world to determine the prevalence of OSA. Unfortunately data related to sleep breathing disorders among some countries are sparse. It is a prerequisite to have a symptoms questionnaire to screen the patients at risk for OSA before a PSG is done, due to its high cost and non-availability at all centers in developing countries like India where resources are limited. Having a symptom-based questionnaire with good predictive ability will avoid unnecessary sleep studies in the subjects who are not at high risk for having OSA. Therefore, this questionnaire was used to identify the patients at risk for OSA in the Indian population. This could be attributed to the simple questions in the questionnaire and filling by the subjects in the presence of a qualified sleep lab technician. Based on responses to questionnaire, we calculated snoring, choking, alcohol, smoking indices of which choking and snoring indices were found to be independent predictors of mild to moderate OSA (AHI > 5-15/h) and moderate to severe OSA (AHI > 30/h) respectively. We used gold standard diagnostic study (overnight PSG) for our study population. The definition of OSA is arbitrary, and it has been suggested that an AHI >5/h is a low cut-off value, especially for older people.

In this study we examine the AHI through polysomnography. Here is strong association between the AHI and presence of symptoms. The risk of Obstructive sleep apnea is increased in people with obesity; hypertension and abnormalities in craniofacial anatomy [10]. Previous investigations have observed that apnea hypopnea index was significant determinant of C-reactive protein [11]. Based on the BMI, distribution of patients considered as normal, overweight and obese. Obesity is strongly associated with sleep apnea [8]. In obese patients fatty cells clogs the throat tissue, which indicates that they narrow the airways. The more obese a person with sleep apnea is, the higher the pressure on the airway and therefore greater the

obstruction of the airway. Sleep and weight gain are closely related, and weight gain is one of the common effects of lack of sleep. Obesity and sleep apnea occur together frequently, lack of sleep has multiple effects that can result in excess weight. Lack of sleep lowers the level of leptin, a protein that regulates and controls appetite. Low leptin levels may increase appetite, leading to weight gain. Although leptin is a circulating signal that reduces appetite, in general, obese people have an unusually high circulating concentration of leptin. These people are resistant to the effect of leptin. Previous investigators have observed that the ability of the questionnaire to predict an elevated AHI was similar to that of PSG.

We conclude that the Berlin questionnaire will detect important symptoms of OSA and permit risk grouping clearly. Berlin questionnaire provides as a tool for identifying patients those who are likely to have sleep apnea. So the patients should be screened carefully with Berlin questionnaire before referring them to investigations such as PSG. The ability of questionnaire to predict an elevated AHI was similar to that of PSG. So we can find out the severity of OSA through questionnaire and can avoid unnecessary PSG studies in people who are not at the risk of OSA. In further studies validation of Berlin questionnaire need to be done in different areas of the country.

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