Original Article

Comparing four standard Sleep Questionnaires to Polysomnography to predict possibility of Obstructive Sleep Apnea and its severity

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Keywords: Obstructive Sleep Apnea, Questionnaire, Polysomnography, Sensitivity, Specificity

Abstract

Background and Aims:

Obstructed Sleep Apnea (OSA) is emerging as a significant problem in South East Asia with the rise of Obesity. Polysomnography (PSG) being expensive in Nepal, is usually deferred. The commonly used screening tools are cornerstone to evaluate clinical possibility and effects of OSA without having to rely on the PSG at the onset in Nepal. In this study, we proposed the use of four sleep related questionnaires separate as well as in combination to clinically predict OSA and its severity. And to do that we have compared these scores with Apnea Hypo-apnea Index (AHI) derived from the gold standard level one PSG.

Method

This was a prospective randomized trial comparing level one polysomnography with individual scores from Epworth Sleepiness Score, STOP BANG score, Pittsburg Sleep Quality Index and Functional Outcome of Sleep Quality-10 and the composite sleep score derived from all the four.

Results

120 patients with clinical suspicion of OSA underwent PSG after filling all four questionnaires. The mean AHI of the study population was 37.65 ± 23.66. STOP BANG had the highest sensitivity for all three groups of AHI (≥5, ≥15 and ≥30), at 92.5%, 93.4%, and 95.2% respectively when compared with ESS, PSQI and FOSQ-10. PSQI showed negative correlation with AHI. The proposed composite score showed no correlation with AHI.

Conclusion

STOP BANG score and AHI showed good correlation. STOP BANG score had the highest sensitivity for all levels of AHI. ESS showed good PPV and NPV to predict OSA. PSQI had the highest NPV to predict AHI. And FOSQ-10 had the highest specificity, good PPV and good NPV.

Introduction

Obstructed Sleep Apnea (OSA) poses peculiar difficulty in South East Asian context, as one part of the population is struggling with malnutrition, the other with obesity. This is highlighted in the multiple studies of prevalence and severity of OSA in South East Asian Region (SEAR)[1-3].

Polysomnography (PSG) is something that Nepalese population is getting introduced to, with sleep physicians trying to catch up with the rest of the world. There are three or four level one sleep laboratories in the country, most focusing OSA [4-7].

PSGs are expensive investigations with average cost ranging from NPR 8000 to NPR 16,000 depending upon the level of sleep study performed. Many potential study subjects tend to refuse the study due to potential financial burden imposed by the same.

The commonly used screening tools; Epworth Sleepiness Scale

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(ESS) [8], STOP BANG questionnaire [9], Pittsburgh Sleep Quality Index (PSQI) [10], Berlin Questionnaire [11], and Functional Outcome of sleep quality [12] have been the cornerstone to evaluate clinical possibility and effects of OSA in SEAR. Functional Outcome of Sleep Quality-10 (FOSQ-10) is a shorter version of FOSQ, with 10 questions and captures the content of the original FOSQ, robust and easy to use in clinical setting [13]. Correlation between theses screening tools and PSG still needs exploration in Nepal, since larger portion of data are available from Europe, America and the western world only.

A good and significant correlation between these individual scores from the respective questionnaire to polysomnography (PSG) represents an important opportunity to the sleep clinicians to predict possibility of OSA without having to rely on the PSG at the onset. Level one PSG serves the role of being gold standard investigation for sleep disordered breathing (SDB) and the scores from the questionnaire can give clinicians the clinical head start.

In this study, we proposed the use of all the four scores (ESS, STOP BANG, PSQI, FOSQ-10) separate as well as combined to clinically predict OSA and its severity. And to do that we have compared the scores with the gold standard level one PSG.

3.METHODOLOGY:

This was a prospective randomized trial comparing polysomnography (level one) with individual scores from ESS, STOP BANG, PSQI and FOSQ-10 and the composite sleep score derived from all the four.

Study Participants:

Subjects who presented to the respiratory clinic with clinically suggestive history of OSA or SBD were included in the study. A total of 188 patients underwent PSG during the study time interval (2017 to 2020) with 180 diagnosed of OSA. Total of 121 subjects were enrolled randomly into the study. All four standard sleep scoring questionnaires were filled by expert sleep clinicians and technicians. The mandatory permission from original researchers were taken before initiation of the study (PSQI, FOSQ-10, ESS). The individual scores and composite sleep scores were calculated. Patients were then subjected to overnight level one PSG recording with subjects with significant AHI proceeding to CPAP titration protocol.

Demographic variables, sleep time variables, arousal variables, respiratory and cardiac variables were collected during PSG. PSG scores were done by respiratory and sleep technicians followed by expert sleep clinicians. Informed consents were obtained from all participants included in the study.

Study Instruments:

The PSQI is a 19-item questionnaire, and its permission to use was obtained and calculator provided by the original researcher were used for global PSQI score. PSQI is a self-rated questionnaire with 19 set of questions, over the past one-month time, which generated a seven component scores, the total of which gave the global score of PSQI [10]. The global PSQI score were then divided into normal (total PSQI score<5) and abnormal (total PSQI score≥5) as per standard recommendations [10].

ESS is measurement of subject's general level of daytime sleepiness assessed with eight different situations commonly encountered in daily life [8]. For ESS total score was manually calculated, then divided categorically into normal sleepiness (ESS total score<7), average sleepiness (ESS total score 7-8) and abnormal "Probably pathological" sleepiness (ESS total Score ≥9)

STOP BANG consists of eight yes or no questions with score ranging from 0 to 8 [14]. The total STOP-BANG score was assessed and then categorically divided into low risk of OSA (STOP-BANG total score ≤2), intermediate risk of OSA (STOP-BANG total score 3-4) and high risk of OSA (STOP-BANG Total score ≥5) [8].

FOSQ-10 is a shorter version of FOSQ and is used to measure impact of daytime sleepiness on activities of daily living [13]. FOSQ-10 scores were calculated by the calculator provided by the original researcher. Scores were categorized into poor (FOSQ<18) and good (FOSQ>18) sleep quality [13].

AHI from PSG was categorized as normal (AHI<5), mild (AHI 5-14), moderate (AHI 15-29), and severe (AHI ≥ 30) [15].

Data Analysis:

Initial tabulations were done in Microsoft Excel and data analysis was done in SPSS version 20. Normalcy of the data were verified using histogram and Shapiro-Wilk test. Data were identified to be non-normal in distribution. Hence, non-parametric tests were performed for the analysis of the data.

Statistical correlation was done with non-parametric tests with Spearman Rho between ESS, STOP BANG, PSQI, FOSQ-10 to AHI. Statistical correlation was also done between AHI and composite sleep score of totals of all four questionnaires. Categorical data from AHI and all four questionnaires were also analyzed with Spearman Rho correlation. Confidence interval was set at 95% with p value being <0.05. Sensitivity, specificity, positive and negative predictive values were calculated as well.

4.RESULTS:

The data of 121 patients who underwent PSG and all four questionnaires were included in the study. Of the final 180 participants, 92 were male and 27 were female. The mean age and BMI of subjects were 47.33+12.56 years and 30.53+6.1 kg/m2 respectively. All 121 subjects had OSA with AHI more than or equal to 5, with majority of them having severe OSA (n=72, 60%). PSG study readings of the study population are listed in table 1.

Table 1: PSG study average reading of the participants:

	Mean ± SD
Total recorded time in minutes (TRT), minutes	426.81± 60.01
Total Sleep Time (TST), minutes	371.05 ± 64.62
Sleep Efficiency, %	86.63 ± 6.75
Sleep Onset, minutes	24.31 ± 22.45
REM Latency, minutes	127.98 ± 68.39
N1%	26.04 ±12.64
N2%	37.98 ± 10.98
N3%	25.89 ± 16.31
REM	12.13 ± 8.35
Total Arousals	147.94 ± 96.39
Arousal Index, arousals/hour	30.3 ± 19.99
Snoring time, minutes	40.89 ± 18.22
Total Apnea and Hypopnea	179.26 ± 106.14
AHI	37.65 ± 23.66
REM AHI	39.04 ± 31.45
NREM AHI	37.03 ±
Longest respiratory event, seconds	53.21 ± 15.11
Average oxygen saturation, %	90.26 ± 4.96
Minimum Oxygen Saturation, %	75.01 ± 12.36

Our study showed a weak and clinically insignificant correlation between ESS and AHI (r=0.006, p= 0.9 CI [-0.23, -0.24]. Upon comparing the categorical value of ESS and AHI, there was still a weak correlation, with r=0.115, p=0.341, CI [-0.12, 0.34]. The Sensitivity of ESS was better than FOSQ-10 and PSQI but not as sensitive as STOP BANG score. The specificity for ESS was poor for all three levels of AHI. The PPV and NPV of ESS was highest when lowest cut-off was taken for AHI>=5 (PPV=95.35%, NPV=96.3%). NPV of ESS was 96.3% which appears to be the highest among all the questionnaires. We looked into relation between ESS and PSQI as well, which showed no correlation between them (correlation coefficient 0.002). (table 2 and 3)

STOP BANG:

There was significant positive correlation for STOP BANG with AHI (r=0.319, p<0.05). Upon comparing the categorical value for STOP BANG with categorical value of AHI, there was significant positive correlation with r=0.336 and p value <0.005. While evaluating sensitivity among the various questionnaires, STOP BANG had the highest sensitivity for all three groups of AHI (≥5, ≥15 and ≥30), at 92.5%, 93.4%, and 95.2% respectively. Specificity was lowest however compared to rest of the questionnaires. STOP BANG scored PPV of 96.88%, 89.06% and 62.5%, similarly NPV of 83.33%, 66.67% and 33.33% for AHI ≥ 5, 15 and 30 respectively. (table 2 and 3)

PSQI:

PSQI showed significant with AHI (median 4.5, Interquartile range = 3, r=-0.262, p=0.028). There was also significant but weak correlation when categorical values of PSQI and AHI were compared (r=-0.274, p<0.05). Sensitivity of PSQI for AHI more than 5, 15 and 30 were low. Specificity was highest among the questionnaires for AHI ≥5 at 66.7%. PPV was highest for PSQI in AHI≥5 group. Similarly, it was 82.86% and 45.75% for AHI≥15 and 30 respectively. NPV of PSQI was good (94.2%, 91.43% and 74.71% for AHI≥5, 15 and 30 respectively). (table 2 and 3)

FOSQ-10:

FOSQ-10 showed no correlation with AHI (r=0.077, p=0.5). Categorical value of FOSQ-10 and AHI had no correlation as well (r=0.031, p=0.799). Sensitivity was least compared to other questionnaires for all 3 groups of AHI. Specificity was highest among the questionnaires. FOSQ-10 had good PPV and NPV for AHI>5 and AHI>15. (table 2 and 3)

Composite Score:

The combined score of ESS and STOP BANG was also evaluated against AHI. For the composite score ESS, STOP BANG and PSQI were added, and FOSQ-10 was subtracted (higher score of FOSQ-10 represents normal outcome, contrary to other scores). The composite score was compared with the AHI. The results of these calculations are tabulated in the table 4. All 3 composite scores didn't have any correlation with AHI.

Table 2. Sensitivity and Specificity for all four questionnaires for 3 cut-off values of AHI

Questionnaire	AHI ≥ 5		AHI ≥ 15		AHI ≥ 30	
	Sensitivity	Specificity	Sensitivity	Specificity	Sensitivity	Specificity
PSQI	50.7	66.7	47.5	33.3	38.1	32.1
ESS	61.2	33.3	62.3	44.4	64.3	42.9
STOP BANG	92.5	33.3	93.4	22.2	95.2	14.3
FOSQ-10	32.8	66.7	34.4	77.8	33.3	67.9

Table 3. Positive predictive value (PPV) and Negative predictive value (NPV) for all four questionnaires for 3 cut-off values of AHI

Questionnaire	AHI ≥ 5		AHI ≥ 15		AHI ≥ 30	
	PPV	NPV	PPV	NPV	PPV	NPV
PSQI	97.14	94.29	82.86	91.43	45.7	74.71
ESS	95.35	96.3	88.33	85.19	88.37	85.18
STOP BANG	96.88	83.33	89.06	66.67	62.5	33.33
FOS-10	95.65	95.74	91.3	85.1	60.8	59.57

Table 4. Individual score of the four questionnaires and different combinations of composite scores are compared with AHI

	Median	Interquartile range	R	P	CI
PSQI	4.50	3	-0.262	0.028	[-0.47, -0.02]
ESS	8.00	23	0.006	0.963	[-0.23, -0.24]
STOP BANG	5.00	2	0.319	0.008	[0.08, 0.52]
FOSQ-10	16.33	4.17	0.077	0.526	[-0.16, 0.31]
ESS+STOP	14	8	0.082	0.5	[-0.16, 0.31]
ESS+STOP+PSQ-FOSQ	2.8	10.5	-0.051	0.676	[-0.28, 0.19]
ESS+STOP-FOSQ	-2.33	9.42	0.006	0.959	[-0.23, 0.24]

5.DISCUSSION:

At AHI of more than equals to five events per hour, overall population prevalence of OSA ranges from 9%-38% [16], with 10% women and 20% men [17]. OSA is associated with significant morbidity and is a matter of public health interest. OSA is associated with higher mortality, coronary artery disease, stroke, chronic kidney disease [18], depression [19], and cardiac arrhythmia like complex ventricular arrhythmia and atrial fibrillation/flutter [20].

A study done in Nepal almost 15 years back showed higher occurrence of milder forms of OSA with hypertension, cardiac disease and COPD occurring as co-morbid conditions [3]. Hence, OSA, though largely ignored in Nepal, has significant prevalence and morbidity. Prevalence of OSA in Nepal has not been evaluated thoroughly and needs further evaluation.

In this study we have analyzed occurrence of OSA in our respiratory practice and its around 4.73% of our OPD visits. Hence, we can derive that prevalence of OSA in our clinic is similar to the rest of the world.

ESS

ESS has been a cornerstone to assess daytime sleepiness since its development in 1990 [8] and subsequent modification in 1997 [21]. Our study included ESS in its 1997 modified version with standard interpretation as proposed by the original researcher. ESS has been extensively evaluated for its use in reference range, interpretation, psychometric properties and external criterion validity [22, 23]. In our study, ESS showed poor sensitivity and specificity to predict OSA but good PPV and NPV through all categories of AHI. Relationship between ESS with OSA and severity of OSA has been previously evaluated. ESS and AHI were found to have poor correlation with r2 of 0.011 in a study done in 2015 [24]. ESS had poor performance to predict OSA across multiple studies [25-27]. Specificity of ESS was found to be better than STOP BANG (Specificity of 67% for ESS versus 12.7% for STOP BANG) [26]. In other study STOP BANG had superior predictive value compared with ESS but specificity was still poor [25] in a 2014 study.

STOP BANG

STOP BANG tool is a validated screening tool for OSA. It identifies the probability of being OSA as mild, moderate and high risk [14]. STOP BANG questionnaire has been evaluated in conjugation with ESS and Berlin questionnaire. STOP BANG and Berlin questionnaires were found to be more reliable to predict OSA [28]. Higher the

STOP BANG score, higher can be the probability of OSA. This has been identified in a large clinical group of patients by the original researcher of STOP BANG score. The score of 5 to 8 was identified as high probability of Moderate to severe OSA [29]. Our study STOP-BANG showed significant correlation with OSA and AHI. OSA did correspond with grades of severity of AHI (R=0.336, p=0.004, CI [0.1, 0.53]). In our study higher STOP BANG scores correlated with higher AHI (R=0.319, P=0.008, CI [0.08,0.52]). The pre-test probability of OSA by STOP BANG score in PSG lab has been identified as score of four or more as having good sensitivity and specificity to predict AHI >15 [30]. In our study, STOP BANG when compared to rest of the questionnaire had the highest sensitivity for all three groups of AHI (92.5%, 93.4%, 95.2%) and a good PPV, though specificity and NPV was poor.

PSQI:

Sleep quality and sleep disturbance over the past one month is assessed by PSQI score; classifying patients as good and poor sleepers [10]. PSQI is a better indicator of sleep quality among OSA patients, as compared to its use as a screening tool to identify pretest probability of OSA. Studies directed towards the utility of PSQI in sleep labs have identified that OSA patients with higher AHI had higher global PSQI score; meaning they were poor sleepers [31].

Our study showed negative correlation of PSQI with AHI. The PPV was the highest for PSQI when AHI cut off was > 5 (97.14%), as compared to rest of the questionnaires.

Criterion validity of ESS and PSQI was also analyzed by Nishiyama et. al., to identify whether these two scores can screen or diagnose OSA, periodic limb movement disorder (PLMD), rapid eye movement sleep behavior disorder (RBD), and narcolepsy. It was identified that ESS had limitations in screening of OSA and PSQI was not adequately accurate to predict all four diseases [23]. Hence the authors advised against their use in screening tool for sleep disorders. Similarly, another study found PSQI to be a poor predictor for OSA, with correlation with AHI being very weak and clinically insignificant [32]. Our study has also showed clinically significant, but weak correlation of PSQI with AHI. Same study had sensitivities of ESS and PSQI at around 70% and 38% respectively, though ESS was weakly but significantly correlated with AHI (R=0.3) [32]. There is a limited relationship/association between PSQI and ESS. It has been seen that abnormal ESS increases chances of abnormal PSQI. However, ESS and PSQI assesses different dimensions of sleep architecture and outcome [33]. Our study showed poor sensitivity and specificity but the highest NPV of PSQI to predict AHI.

FOSQ-10

FOSQ-10 is a shorter version of original FOSQ, evaluated and published in 2009 by Chasens et. al. with comparable performance to its predecessor and is valid and reliable [13]. This evaluates functional impact of sleep on subjects' daily activities. Significant correlation has been identified between AHI and FOSQ-10 [34]. Lower values of FOSQ-10 were observed in patients with higher AHI (p=0.003). This study also proved internal validity and construct validity of FOSQ-10 Spanish version in OSA [34]. In our study, there was a weak positive correlation between FOSQ-10 and AHI. Our study identified that FOSQ-10 had the highest specificity, good PPV, NPV but very poor sensitivity to predict AHI.

Composite score

In our study composite score of ESS + PSQI + STOP BANG - FSOQ10 showed weak negative correlation with the AHI. ESS and STOP BANG together showed very weak and insignificant positive correlation. ESS, STOP BANG and FOSQ-10 together didn't show any significant correlation as well.

6.CONCLUSION:

Our study showed good correlation between STOP BANG score and AHI. STOP BANG score when compared to rest of the questionnaire had the highest sensitivity for all levels of AHI. ESS showed good PPV and NPV but poor sensitivity and specificity to predict OSA. Our study also showed that PSQI had the highest NPV to predict AHI but poor sensitivity and specificity. And FOSQ-10 had the highest specificity, good PPV, NPV but very poor sensitivity to predict AHI.

REFERENCES:

1. Agrawal S, Gupta R, Lahan V, Mustafa G, Kaur UJSjoa. Prevalence of obstructive sleep apnea in surgical patients presenting to a tertiary care teaching hospital in India: A preliminary study. 2013: 7(2): 155.
2. Kirsch DBJCLLiN. Obstructive sleep apnea. 2020: 26(4): 908-928.
3. Chokhani R, Pathak V, Kanth RJNMCjN. Sleep apnoea syndrome in Nepal. 2005: 7(1): 32-35.
4. Mediciti N. Nepal Mediciti for a healthy and prosperous nation. 2020 [cited; Available from: https://www.nepalmediciti.com/
5. Hospital H. Welcome to HAMS Hospital. 2020.
6. College KM. Kathmandu Medical College 2020.
7. Hospital D. Dhulikhel Hospital Kathmandu University Hospital. 2020.
8. Johns MWJs. A new method for measuring daytime sleepiness: the Epworth sleepiness scale. 1991: 14(6): 540-545.
9. Chung F, Yegneswaran B, Liao P, Chung SA, Vairavanathan S, Islam S, Khajehdehi A, Shapiro CMJATJotASoA. Stop questionnairea tool to screen patients for obstructive sleep apnea. 2008: 108(5): 812-821.
10. Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJJPr. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. 1989: 28(2): 193-213.
11. Netzer NC, Stoohs RA, Netzer CM, Clark K, Strohl KPJAoim. Using the Berlin Questionnaire to identify patients at risk for the sleep apnea syndrome. 1999: 131(7): 485-491.
12. Weaver TE, Laizner AM, Evans LK, Maislin G, Chugh DK, Lyon K, Smith PL, Schwartz AR, Redline S, Pack AIJS. An instrument to measure functional status outcomes for disorders of excessive sleepiness. 1997: 20(10): 835-843.
13. Chasens ER, Ratcliffe SJ, Weaver TEJS. Development of the FOSQ-10: a short version of the Functional Outcomes of Sleep Questionnaire. 2009: 32(7): 915-919.
14. Chung F, Abdullah HR, Liao PJC. STOP-Bang questionnaire: a practical approach to screen for obstructive sleep apnea. 2016: 149(3): 631-638.
15. Hudgel DWJS. Sleep apnea severity classification—revisited. 2016: 39(5): 1165-1166.
16. Senaratna CV, Perret JL, Lodge CJ, Lowe AJ, Campbell BE, Matheson MC, Hamilton GS, Dharmage SCJSmr. Prevalence of obstructive sleep apnea in the general population: a systematic review. 2017: 34: 70-81.
17. Jordan AS, McSharry DG, Malhotra AJTL. Adult obstructive sleep apnoea. 2014: 383(9918): 736-747.
18. Molnar MZ, Mucsi I, Novak M, Szabo Z, Freire AX, Huch KM, Arah OA, Ma JZ, Lu JL, Sim JJJT. Association of incident obstructive sleep apnoea with outcomes in a large cohort of US veterans. 2015: 70(9): 888-895.
19. Peppard PE, Szklo-Coxe M, Hla KM, Young TJAoim. Longitudinal association of sleep-related breathing disorder and depression. 2006: 166(16): 1709-1715.
20. Mehra R, Stone KL, Varosy PD, Hoffman AR, Marcus GM, Blackwell T, Ibrahim OA, Salem R, Redline SJAoim. Nocturnal arrhythmias across a spectrum of obstructive and central sleep-disordered breathing in older men: outcomes of sleep disorders in older men (MrOS sleep) study. 2009: 169(12): 1147-1155.

21. Johns M. The official website of the Epworth sleepiness scale (ESS) and the Epworth sleepiness scale for children and adolescents (ESS-CHAD). 2019.
22. Spira AP, Beaudreau SA, Stone KL, Kezirian EJ, Lui L-Y, Redline S, Ancoli-Israel S, Ensrud K, Stewart AJJoGSABS, Sciences M. Reliability and validity of the Pittsburgh Sleep Quality Index and the Epworth Sleepiness Scale in older men. 2012: 67(4): 433-439.
23. Nishiyama T, Mizuno T, Kojima M, Suzuki S, Kitajima T, Ando KB, Kuriyama S, Nakayama MJSm. Criterion validity of the Pittsburgh Sleep Quality Index and Epworth Sleepiness Scale for the diagnosis of sleep disorders. 2014: 15(4): 422-429.
24. Laub RR, Mikkelsen KL, Tønnesen P. Evaluation of the significance of Epworth sleepiness scale among 687 patients with suspected sleep apnea. Eur Respiratory Soc, 2015.
25. Jinmei L, Rong H, Xu Z, Yi X, Jiong ZJCmj. STOP-Bang questionnaire is superior to Epworth sleepiness scales, Berlin questionnaire, and STOP questionnaire in screening obstructive sleep apnea hypopnea syndrome patients. 2014: 127(17): 3065-3070.
26. Pataka A, Daskalopoulou E, Kalamaras G, Passa KF, Argyropoulou PJSm. Evaluation of five different questionnaires for assessing sleep apnea syndrome in a sleep clinic. 2014: 15(7): 776-781.
27. El-Sayed IHJEJoCD, Tuberculosis. Comparison of four sleep questionnaires for screening obstructive sleep apnea. 2012: 61(4): 433-441.
28. Mahmoud HAM, Sallama SSA, Ahmad AM. Validation of the Epworth sleepiness scale, Berlin, STOPBANG questionnaires and American Society of Anesthesiologists checklist as screening tools for obstructive sleep apnea in patients with chronic obstructive pulmonary disease, asthma and cardiovascular diseases. Eur Respiratory Soc, 2013.
29. Chung F, Subramanyam R, Liao P, Sasaki E, Shapiro C, Sun YJBjoa. High STOP-Bang score indicates a high probability of obstructive sleep apnoea. 2012: 108(5): 768-775.
30. Suseelan H, Islam J, Kodali L, Weingarten JA. The predictive value of the STOP-BANG questionnaire among patients referred for nocturnal polysomnography: implications for generalized screening. D82-A SLEEP DISORDERED BREATHING: DIAGNOSIS. American Thoracic Society, 2012; pp. A6442-A6442.
31. Kalcina LL, Valic M, Pecotic R, Dodig IP, Dogas ZJNS. Good and poor sleepers among OSA patients: sleep quality and overnight polysomnography findings. 2017: 38(7): 1299-1306.
32. Scarlata S, Pedone C, Curcio G, Cortese L, Chiurco D, Fontana D, Calabrese M, Fusiello R, Abbruzzese G, Santangelo SJJoms. Pre-polysomnographic assessment using the Pittsburgh Sleep Quality Index questionnaire is not useful in identifying people at higher risk for obstructive sleep apnea. 2013: 20(4): 220-226.
33. Mondal P, Gjevre JA, Taylor-Gjevre RM, Lim HJJN, sleep so. Relationship between the Pittsburgh Sleep Quality Index and the Epworth Sleepiness Scale in a sleep laboratory referral population. 2013: 5: 15.
34. Rey de Castro J, Rosales-Mayor E, Weaver TEJJoCSM. Reliability and validity of the Functional Outcomes of Sleep Questionnaire–Spanish short version (FOSQ-10SV) in Peruvian patients with obstructive sleep apnea. 2018: 14(4): 615-621.