DOI: 10.69605/ijlbpr_14.2.2025.132

ORIGINAL RESEARCH

Oxygen desaturation index (ODI) as alternative parameter in screening patients with obstructive sleep apnoea (OSA) in comparison to OSA screening questionnaires

[1]Dr. Ashish Ranjan, [2]Dr. Anjana Singh, [3]Dr. Pulkit Gupta, [4]Dr. Ved Prakash, [5]Dr. Ashutosh Singh, [6]Dr. Ravi kant Pandey, [7]Dr. Anushka Verma, [8]Dr. Sachin Kumar, [9]Dr.Anurag Tripathi, [10]Dr. Deepak Sharma

[1]Senior Resident, Department of Pulmonary & Critical Care Medicine, King George's Medical University (KGMU), Lucknow, India
[2]Assistant Professor, Department of Biochemistry, Era Medical University, Lucknow, India
[3]Assistant Professor, Department of Pulmonary Medicine, RMLIMS, Lucknow, India
[4]Professor & Head of Department, [5,6,7,9,10]Senior Resident, [8]Assistant Professor, Department of Pulmonary & Critical Care Medicine, King George's Medical University(KGMU), Lucknow, India

Corresponding Author
Dr. Ved Prakash
Professor & Head of Department, Pulmonary & Critical Care Medicine, King George's Medical University (KGMU), Lucknow, India
Email: drvedprakash.07@gmail.com

Received: 26 January, 2025 Accepted: 14 February, 2025 Published: 25 February, 2025

ABSTRACT

Introduction- Obstructive Sleep Apnoea (OSA) is a prevalent but frequently underdiagnosed disorder that can lead to significant medical repercussions if not identified promptly. This circumstance has necessitated the development of a preliminary, alternative diagnostic instrument for the early detection and severity evaluation of OSA.The objective of this study was to ascertain the correlation and concordance between the other screening questionnaire (like AHI, ESS and STOP bang) and the Oxygen Desaturation Index (ODI) in evaluating the severity of obstructive sleep apnoea (OSA). **Material and methods**- The present cross-sectional study was conducted for among patients of Obstructive sleep apnoea for a period of one year at a tertiary care centre. Through convenience sampling technique a total of 200 patients diagnosed with OSA through polysomnography (PSG) were taken for the study. Assessments of subjective sleepiness as determined sleep study metrics including the AHI, ESS and STOP bang and Oxygen Desaturation Index. **Results-** The patients BMI varied from 18.8 to 44.3, with a mean of 27.3±2.1. Forty six patients (23%) were classified as normal weight, whereas 116 patients (58%) were overweight, and 38 patients (19%) were categorised as obese.The study group exhibited an ESS ranging from 0 to 24, with a mean of 11.23±2.7. The average lowest SpO2 value was 73.5±3.6. The mean SpO2 value during PSG averaged 89.20±4.2.The Apnea-Hypopnea Index (AHI) ranged from 6 to 97, with a mean of 41.33±3.6. The mean Oxygen Desaturation Index (ODI) for the study group was 40.41±2.7, with values ranging from 4.8 to 96.2.In a Cohen's weighted Kappa analysis, the Kappa and the proportional agreement observed between AHI and ODI in classifying severity of OSA was 0.66 and 87.12%. ODI>15 exhibited 100% sensitivity, 54.7% specificity, a positive predictive value (PPV) of 78%, and a negative predictive value (NPV) of 100%. The sensitivity for identifying patients with severe obstructive sleep apnoea (OSA) was 96.7% at an oxygen desaturation index (ODI) of 20 and 88.9% at an ODI of 25.There was a statistically significant relationship between ESS and mean SpO2, minimum SpO2, AH%SPT, ODI, and AHI.The sensitivity of ODI in detecting patients with severe OSA in relation to the STOP bang questionnaire was 100%, 96.9%, and 88.7%, respectively. **Conclusion-** A significant association between AHI , ESS, STOP bang and ODI renders nocturnal oximetry a cost-effective method for reliably screening patients with severe OSA.

Keywords -Apnea Hypopnea Index; Oxygen Desaturation Index; Obstructive Sleep Apnea

 Online ISSN: 2250-3137
Print ISSN: 2977-0122

DOI: 10.69605/ijlbpr_14.2.2025.132

INTRODUCTION

Obstructive sleep apnoea (OSA) is a sleep-associated respiratory disorder marked by recurrent partial or total blockage of the upper airway, frequently leading to diminished arterial oxygen saturation and awakenings from sleep [1,2]. OSA is the most common type of breathing disorder, constituting 90 - 95% of cases and affecting 6% of men and 4% of women in the general population causing associated excessive daytime sleepiness. It is correlated with cardiovascular and metabolic repercussions and is also associated with heightened total mortality. [3] At now, overnight polysomnography (PSG) is the definitive standard for identifying the existence and severity of obstructive sleep apnoea (OSA). Nonetheless, its considerable cost, relative inaccessibility, and time demands may hinder or obstruct the diagnosis and treatment of individuals with OSA, particularly in regions with constrained healthcare resources [4]. Moreover, the rising incidence of patients suspected of having obstructive sleep apnoea (OSA) and the absence of systematic patient interviews contribute to the escalating referrals to sleep clinics. Consequently, straightforward screening tools for identifying patients at elevated risk for obstructive sleep apnoea (OSA) have gained significance.

Several instruments have been developed over the years for identifying OSA. Intermittent desaturations significantly contribute to the progression of difficulties associated with obstructive sleep apnoea (OSA); thus, the oxygen desaturation index (ODI) can be utilised asa metric to assess the severity of OSA. ODI is the average frequency of desaturation episodes per hour, with desaturation episodes characterised as a reduction in mean oxygen saturation of ≥3% (during the preceding 120 seconds) lasting a minimum of 10 seconds.[5] The ODI quantifies the severity of oxygen desaturation, a critical component of OSA, as well as its extensive systemic ramifications [6]. Prior research indicates that ODI may function as a dependable measure of OSA severity; however, extensive comparisons between ODI and other screening questionnaire are few [7,5].

The objective of this study was to ascertain the correlation and concordance between the other screening questionnaire (like AHI, ESS and STOP bang) and the Oxygen Desaturation Index (ODI) in evaluating the severity of obstructive sleep apnoea (OSA), and to assess the reliability of ODI as a viable alternative for screening patients with severe OSA.

MATERIAL AND METHODS

The present cross-sectional study was conducted for among patients of Obstructive sleep apnoea for a period of one year at Department of pulmonary and critical care medicine, king George's medical university, Lucknow. Ethical clearance for conducting the research was taken from institutional ethics committee and patients were asked to sign an informed consent form after explaining them the complete procedure.

Through convenience sampling technique a total of 200 patients diagnosed with OSA through polysomnography (PSG) were taken for the study on the basis of inclusion and exclusion criteria.

Inclusion criteria

- Patients underwent polysomnography (PSG) over a period of one years, done in department of pulmonary and critical care medicine, king George's medical university , Lucknow.
- Patients with an AHI of >5 events/h, with >50% apneic events being obstructive were considered to have obstructive apnea.

Exclusion criteria

- Patients with predominant central apnoea.
- Patients less than 18 years.

The collected data encompassed demographic information (age, gender, and comorbidities), anthropometric measurements (body mass index and neck circumference), and clinical assessments of subjective sleepiness as determined sleep study metrics including the Apnea-Hypopnea Index, Oxygen Desaturation Index, percentage of sleep period time spent in apnea-hypopnea, and minimum oxygen saturation levels and average SpO2. Comprehensive nocturnal polysomnography captured information from the electrocardiogram (ECG), electromyogram (EMG), electrooculogram (EOG), electroencephalogram (EEG), as well as from abdominal and chest leads, and nasal airflow. A Masimo LNCS DCI adult reusable clip pulse oximeter was utilised to measure oxygen saturation, with a maximum sampling rate of 2,000 Hz and a storage rate of 3 Hz.

Patients were classified into mild, moderate, and severe obstructive sleep apnoea (OSA) according to apnea-hypopnea index (AHI) values of 5-15, 15-30, and ≥30 episodes per hour, respectively. Desaturation episodes were characterised by a reduction in mean oxygen saturation of ≥3% lasting over 10 seconds, and the Oxygen Desaturation Index (ODI) was computed based on the frequency of desaturation episodes per hour. Obstructive Sleep Apnoea (OSA) was classified into three categories: mild (5-15), moderate (15-30), and severe (≥30). Patients with an ODI less than 5 were classified as exhibiting no oxygen desaturation.

Epworth sleepiness score (ESS) of >10 was considered as clinically significant sleepiness.

Four items from the STOP questionnaire—snoring, fatigue, obstructive apnoeas, and hypertension—as well as four demographic questions—BMI >35 kg/m2, age >50, neck circumference >40 cm, and male gender—make up the STOP-Bang questionnaire. Each question receives a score of 1 for a "yes" response and a score of 0 for a "no." A cumulative

DOI: 10.69605/ijlbpr_14.2.2025.132

score of ≥3 points, out of a possible 8 points, indicates a high likelihood of OSA.

Results were analyzed using SPSS version 25.0. Descriptive statistics were employed to present the demographic, anthropometric, and summary data from the PSG. Categorical data were presented as frequencies with percentages. The mean ± standard deviation was employed for continuous data with a normal distribution. The association between AHI and ODIwas examined utilising Pearson's correlation coefficient. The severity of obstructive sleep apnoea (OSA), characterised by oxygen desaturation index (ODI) and apnea-hypopnea index (AHI), ESS and STOP bang was cross-tabulated, and distributional differences were analysed using the $\chi 2$-test.

RESULTS

The meane age of the patients was 42.34±4.6 year, with a male to female ratio of 3:1. Hypertension was the predominant comorbidity observed (120 patients, 60%), followed by dyslipidaemia (50 patients, 25%), diabetes mellitus (20 patients, 10%), and hypothyroidism (10 patients, 5%). The patients BMI varied from 18.8 to 44.3, with a mean of 27.3±2.1. Forty six patients (23%) were classified as normal weight, whereas 116 patients (58%) were overweight, and 38 patients (19%) were categorised as obese. The neck circumference (NC) of the patients varied from 31 to 49 cm, with a mean of 39.05±2.3 cm. The study group exhibited an ESS ranging from 0 to 24, with a mean of 11.23±2.7. The average lowest SpO2 value was 73.5±3.6. The mean SpO2 value during PSG averaged 89.20±4.2.

Table: 1. Demographic data & clinical parameter of patients

Demographic data and clinical parameter		Values
Mean age		42.34 ± 4.6
Male: female		3:1
Comorbidity	Hypertension	120 (60)
	Dyslipidaemia	50 (25)
	Diabetes mellitus	20 (10)
	Hypothyroidism	10 (5)
Mean BMI		27.3±2.1
Weight	Normal weight	46 (23)
	Overweight	116 (58)
	Obese	38 (19)
Mean neck circumference (cm)		39.05±2.3
Mean ESS		11.23±2.7
Mean Spo2		89.20±4.2
Minimum SpO2		73.5±3.6

The Apnea-Hypopnea Index (AHI) ranged from 6 to 97, with a mean of 41.33±3.6. According to AHI classifications, 93 patients (46.5%) exhibited severe obstructive sleep apnoea (OSA), while 39 patients (19.5%) had mild OSA and 68 patients (34%) had moderate OSA. The mean Oxygen Desaturation Index (ODI) for the study group was 40.41±2.7, with values ranging from 4.8 to 96.2. Based on ODI classifications, 45 patients (22.5%) were categorised with mild OSA, whereas 58 patients (29%) and 97 patients (48.5%) were classified with moderate and severe OSA, respectively. In a Cohen's weighted Kappa analysis, the Kappa and the proportional agreement observed between AHI and ODI in classifying severity of OSA was 0.66 and 87.12%, respectively as shown in table 2.

Table: 2. AHI and ODI correlation according to the OSA grades

AHI	ODI			Total	Correlation coefficient	Agreement	Kappa	P value
	Mild OSA	Moderate OSA	Severe OSA					
Mild OSA	10	12	17	39	0.918	87.12%	0.66	<0.001
Moderate OSA	19	23	26	68				
Severe OSA	16	23	54	93				
Total	45	58	97	200				

ODI>15 exhibited 100% sensitivity, 54.7% specificity, a positive predictive value (PPV) of 78%, and a negative predictive value (NPV) of 100%. The sensitivity for identifying patients with severe obstructive sleep apnoea (OSA) was 96.7% at an oxygen desaturation index (ODI) of 20 and 88.9% at an ODI of 25 as shown in table 3.

Table: 3 Predictive value of different ODI cutoffs for severe OSA with respect to AHI

AHI>30 hr	Sensitivity (%)	Specificity (%)	PPV (5)	NPV (%)
ODI>15	100	54.7	78	100
ODI>20	96.7	70.4	84.2	93.2
ODI >25	88.9	79.3	86.9	83.5

The relationship between the several elements that contribute to tiredness was examined. There was a statistically significant relationship between ESS and mean SpO2, minimum SpO2, AH%SPT, ODI, and AHI. Even when examined as groups, ESS<10 and >10 also showed consistency as shown in table 4.

Table: 4. Correlation of different parameters to ESS.

Variable		ESS Mean ±SD/ n(%)		p-value
		<10	>10	
Sex	Male	78 (52)	72 (48)	0.301
	Female	30 (60)	20 (40)	
BMI	<25	18(39.1)	28(60.8)	0.313
	25-30	50 (43.1)	66(50)	
	>30	28(73.6)	10(26.4)	
NC		34.63+3.22	41.54	0.095
AHI	Mild	20(51.2)	19(48.7)	0.008
	Moderate	48(70.5)	20(29.4)	
	Severe	38(40.8)	55(59.1)	
ODI	Mild	35(77.7)	10(22.2)	0.004
	Moderate	38(65.5)	20(34.4)	
	Severe	22(22.6)	75(77.3)	
AH%SPT		21.21+13.92	31.03+18.40	<0.01
Mean SpO2		89.94+2.99	85.32+5.06	<0.01
Minimum SpO2		77.33+9.10	70.04+12.24	<0.01

ODI>15 exhibited 100% sensitivity, 55.6% specificity, a positive predictive value (PPV) of 77%, and a negative predictive value (NPV) of 100%. The sensitivity for identifying patients with severe obstructive sleep apnoea (OSA) was 96.9% at an oxygen desaturation index (ODI) of 20 and 88.7% at an ODI of 25 as shown in table 5.

Table: 5. Predictive value of different ODI cutoffs for severe OSA with respect to STOP bang

STOP-Bang≥3	Sensitivity (%)	Specificity (%)	PPV (5)	NPV (%)
ODI>15	100	55.6	77	100
ODI>20	96.9	70.2	84.1	92.3
ODI >25	88.7	79.5	86.2	83.4

DISCUSSION

Obstructive Sleep Apnoea (OSA) is a common but frequently undiagnosed respiratory disorder characterised by recurrent instances of partial or total obstruction of the upper airway during sleep [8].Obstructive Sleep Apnoea (OSA) is generally diagnosed through polysomnography conducted at sleep centres, which measures the average frequency of apneic and hypopneic episodes per hour of sleep. The AHI score derived from this procedure is employed to evaluate the severity of OSA. Polysomnography is a resource-intensive procedure necessitating professionally trained personnel; hence, this technology is impractical in areas with restricted resources or access.[9-12]

The ODI, which measures the incidence of substantial declines in blood oxygen levels during sleep, is emerging as a viable alternative.[6] The current study sought to address this gap by systematically comparing the outcomes of ODI and AHI to ascertain if ODI can be effectively utilised as an independent or adjunctive instrument in the diagnosis of OSA and the assessment of its severity.

This study established a substantial relationship between the AHI and ODI, evidenced by a robust correlation coefficient (r=0.918, p<0.001), suggesting that ODI is a reliable metric for evaluating OSA severity. ODI is far less intrusive than traditional measurements like AHI, which is usually obtained using polysomnography [13]. Given that ODI may be assessed using more portable and cost-effective instruments, this creates an opportunity to enhance OSA screening and promote early diagnosis, especially in contexts where the resources of comprehensive sleep study centres may be constrained.

Cohen's weighted Kappa analysis in our study demonstrated a substantial level of concordance (k=0.66) and proportional agreement (87.12%) between AHI and ODI in assessing the severity of

DOI: 10.69605/ijlbpr_14.2.2025.132

OSA. The results align with a research by Temirbekov et al, which reported a concordance of 72.3% between AHI and ODI. [5] Likewise, Hang et al determined that overnight pulse oximetry is effective in diagnosing severe obstructive sleep apnoea (OSA).[14]According to our research, at ODI levels of 15, 20, and 25, the sensitivity of ODI in detecting patients with severe OSA in relation to the STOP bang questionnaire was 100%, 96.9%, and 88.7%, respectively. Therefore, we can rule out the presence of severe OSA in patients with an ODI of less than 15. Choosing a threshold of ODI more than 20 would be optimal, since it can identify nearly all patients with severe obstructive sleep apnoea while maintaining adequate specificity.The investigation by Varghese L et al. emphasised the effectiveness of ODI in detecting severe OSA, indicating that an ODI threshold of around 20 was strongly predictive of severe OSA, with a sensitivity of 96.6% and specificity of 69.6% [15].

One well-known side effect of obstructive sleep apnoea (OSA) is excessive daytime sleepiness (EDS).[16] Although the maintenance of wakefulness test and the multiple sleep latency test are objective indicators of sleepiness, their usage is difficult and expensive. Since ESS has a small but statistically significant link with mean sleep delay, it was used to measure EDS in our study. The objective respiratory measures AHI, ODI, AH%SPT, mean SpO2, and minimum SpO2, as evaluated during PSG, showed a statistically significant connection with the subjective self-assessment of daytime drowsiness on the standardised ESS questionnaire. While some research in the literature have offered evidence against the positive connection between AHI and ESS, others have found evidence in favour of it.[17-19]

According to our research, at ODI levels of 15, 20, and 25, the sensitivity of ODI in detecting patients with severe OSA in relation to the STOP bang questionnaire was 100%, 96.9%, and 88.7%, respectively. A score system similar to the STOP-Bang questionnaire may be taken into consideration based on the findings of our investigation. A similar strategy was proposed by Coutinho Costa et al., who ranked patients according to their score. Patients with a score of 0–5 are considered to have a low likelihood of OSA, especially moderate to severe OSA; those with a score of ≥7 are considered probable OSA; and those with a score of ≥12 are considered to have a high risk of OSA, especially moderate to severe OSA.[20]

Patients with sleep-related breathing disorders necessitate frequent evaluations of the severity of obstructive sleep apnoea, particularly while undergoing conservative interventions such as weight loss and oropharyngeal exercises. This applies equally to individuals who have undergone surgical procedures and necessitate ongoing follow-up. Despite PSG being the benchmark, financial constraints and the restricted availability of time slots for routine overnight polysomnography hinder its frequent application. [21] AASM recommends the utilisation of type III portable home devices, which are scarce in developing nations. In this context, nocturnal oximetry utilising ODI, as demonstrated in this work, may serve as a useful alternative metric for assessing the severity of OSA. Only individuals with moderate to severe obstructive sleep apnoea, as determined by the oxygen desaturation index, are eligible for routine polysomnography.

The limitations of our study include a limited number of subjects with mild OSA and the exclusion of patients with an AHI of less than 5. Our study underscores the efficacy of ODI as a user-friendly, cost-effective instrument for reliably screening patients who do not necessitate an extensive PSG. Only patients with an ODI exceeding 20 require additional examination. This would enhance the efficiency of sleep study appointments and alleviate the financial strain on patients.

CONCLUSION

This study established a robust significant between the AHI, ESS, STOP bang and the ODI, hence confirming ODI as a less invasive alternative for diagnosing OSA. The strong association and efficacy of an ODI in precisely detecting severe OSA with few false positives underscore its promise, especially in resource-constrained environments. Integrating ODI into standard clinical evaluations may streamline diagnosis, promote early intervention, and improve patient management. Incorporating ODI into OSA diagnosis methods in conjunction with AHI could markedly enhance patient care and avert consequences arising from untreated OSA.

REFERENCES

1. American Academy of Sleep Medicine Task Force. Sleep related breathing disorders in adults: recommendations for syndrome definition and measurement techniques in clinical research. The Report of an American Academy of Sleep Medicine Task Force. Sleep.1999; 22:667–689.
2. Berry RB, Brooks R, Gamaldo C, Harding SM, Lloyd RM, Quan SF, Troester MT, Vaughn BV.AASM scoring manual up dates for 2017 (version 2.4). J Clin Sleep Med.2017; 13:665–666.
3. Muraja-Murro A, Kulkas A, Hiltunen M, Kupari S, Hukkanen T, Tiihonen P, Mervaala E, Töyräs J. The severity of individual obstruction events is related to increased mortality rate in severe obstructive sleep apnea. J Sleep Res.2013; 22:663–669.
4. Flemons WW,Douglas NJ, Kuna ST, Rodenstein DO, Wheatley J. Access to diagnosis and treatment of patients with suspected sleep apnea. Am J Respir Crit Care Med.2004; 169:668–672.
5. Temirbekov D, Güneş S, Yazıcı ZM, Sayıni I. The ignored parameter in the diagnosis of obstructive sleep apnea syndrome: the oxygen desaturation index. Turk Arch Otorhinolaryngol. 2018 Mar;56(1):1-6.
6. Levendowski DJ, Hamilton GS, St. Louis EK, Penzel T, Dawson D, Westbrook PR. A comparison between auto-scored apnea-hypopnea index and oxygen

DOI: 10.69605/ijlbpr_14.2.2025.132

desaturation index in the characterization of positional obstructive sleep apnea. Nat Sci Sleep. 2019;11:69-78.

7. Rashid N, Zaghi S, Scapuccin M, Camacho M, Certal V, Capasso R. The value of oxygen desaturation index for diagnosing obstructive sleep apnea: A systematic review. Laryngoscope. 2021;131(2):440-47.
8. Franklin KA, Lindberg E. Obstructive sleep apnea is a common disorder in the population-A review on the epidemiology of sleep apnea. J Thorac Dis. 2015;7(8):1311-22.
9. Dong JY, Zhang YH, Qin LQ. Obstructive sleep apnea and cardiovascular risk: Meta-analysis of prospective cohort studies. Atherosclerosis. 2013;229(2):489 95.
10. Loke YK, Brown JW, Kwok CS, Niruban A, Myint PK. Association of obstructive sleep apnea with risk of serious cardiovascular events: A systematic review and meta-analysis. Circ Cardiovasc Qual Outcomes. 2012;5(5):720-28.
11. Xie C, Zhu R, Tian Y, Wang K. Association of obstructive sleep apnoea with the risk of vascular outcomes and all-cause mortality: A meta-analysis. BMJ Open. 2017;7(12):e013983.
12. Orrù G, Storari M, Scano A, Piras V, Taibi R, Viscuso D. Obstructive sleep apnea, oxidative stress, inflammation, and endothelial dysfunction-An overview of predictive laboratory biomarkers. Eur Rev Med Pharmacol Sci. 2020;24(12):6939-48.
13. Chen L, Tang W, Wang C, Chen D, Gao Y, Ma W, et al. Diagnostic accuracy of oxygen desaturation index for sleep-disordered breathing in patients with diabetes. Front Endocrinol (Lausanne). 2021;12:598470.
14. Hang LW, Wang HL, Chen JH, Hsu JC, Lin HH, Chung WS, et al. Validation of overnight oximetry to diagnose patients with moderate to severe obstructive sleep apnea. BMC Pulm Med. 2015 Mar;15:24
15. Varghese L, Rebekah G, Priya N, Oliver A, Kurien R. Oxygen desaturation index as an alternative parameter in screening patients with severe obstructive sleep apnea. Sleep Sci. 2022;15(Spec 1):224-28.
16. Seneviratne U, Puvanendran K. Excessive daytime sleepiness in obstructive sleep apnea: prevalence, severity, and predictors. Sleep Med. 2004 Jul;5(4):339-43.
17. Bausmer U, Gouveris H, Selivanova O, Goepel B, Mann W. Correlation of the Epworth sleepiness scale with respiratory sleep parameters in patients with sleep-related breathing disorders and upper airway pathology. Eur Arch Otorhinolaryngol. 2010 Oct;267(10):1645-8.
18. Guilleminault C, Do Kim Y, Chowdhuri S, Horita M, Ohayon M, Kushida C. Sleep and daytime sleepiness in upper airway resistance syndrome compared to obstructive sleep apnoea syndrome. Eur Respir J. 2001 May;17(5):838-47.
19. Kapur VK, Baldwin CM, Resnick HE, Gottlieb DJ, Nieto FJ. Sleepiness in patients with moderate to severe sleep disordered breathing. Sleep. 2005 Apr;28(4):472-7.
20. Coutinho Costa J, Rebelo-Marques A, Machado JN, Gama JMR, Santos C, Teixeira F, Moita J. Validation of NoSAS (neck, obesity, snoring, age, sex) score as a screening tool for obstructive sleep apnea: analysis in a sleep clinic. Pulmonology.2019; 25:263–270.
21. Chung F, Liao P, Elsaid H, Islam S, Shapiro CM, Sun Y. Oxygen desaturation index from nocturnal oximetry: a sensitive and specific tool to detect sleep-disordered breathing in surgical patients. AnesthAnalg. 2012 May;114(5):993-1000.