Journal of Otolaryngology and Rhinology Research
Received 11 Aug 2023 | Revised 21 Aug 2023 | Accepted 01 Sep 2023 | Published Online 09 Oct 2023

DOI: https://doi.org/10.52845/JORR/2023/4.4.1

JORR 04 (04), 172–180 (2023)

ISSN (O) 2693-9282

ORIGINAL-RESEARCH-ARTICLE

Correlation between Desaturation Event Index and Apnea Hypopnea Index for Diagnosis of Obstructive Sleep Apnea

Rahul Alapati, BS [1*] | Amanda Salvatore, BS [1,] | Jamie Tsao, BS [1] | Maria Armache, MD [2] | Zhanna Fast, MD [3] | Colin Huntley, MD [2]

1. Sidney Kimmel Medical College, Thomas Jefferson University, Philadelphia, PA, USA
2. Department of Otolaryngology-Head & Neck Surgery, Thomas Jefferson University, Philadelphia, PA, USA
3. Department of Sleep Medicine, Thomas Jefferson University, Philadelphia, PA, USA

Abstract

Objective: To determine if there is a correlation between desaturation-event index (DEI) and apnea-hypopnea index (AHI) which may potentially facilitate screening and earlier diagnosis of obstructive sleep apnea (OSA).

Methods: A retrospective chart review was conducted to compare patients who underwent high-resolution pulse oximetry (HRPO) during in a sleep medicine consult while inpatient, followed by outpatient polysomnography (PSG) after their discharge over a 2-year period at a tertiary care academic center.Demographic data, DEI, AHI, and oxygen nadir levels were collected.

Results: Sixty-six patients (46 males, 20 females; mean age of 59.1 years) with suspected OSA underwent inpatient HRPO during their hospital stay, followed by a PSG in the outpatient setting. The strength of association between DEI and AHI was determined using a Spearman's rank correlation coefficient, which showed a statistically significant, moderately weak positive association between DEI and AHI (ρ=0.317, p=0.009). Multivariable analysis demonstrated a predictive value of 0.270 between AHI and DEI, when adjusted for age, sex, body mass index (BMI), ethnicity, reason of admission, medical comorbidities, and usage of supplemental oxygen (p=0.040). HRPO nadir oxygen saturation (NOS) also correlated with PSG NOS with a Spearman's Rho correlation coefficient of 0.320 (p=0.013). Multivariable analysis showed a predictive value beta of 0.316 (p=0.033).

Conclusion: DEI calculated through HRPO may be correlated with AHI. Although there is a correlation, HRPO should not replace PSG. Instead, HRPO should be used for screening purposes to help identify people in need of further workup.

Key words: high-resolution pulse oximetry, desaturation-event index, apnea-hypopnea index, obstructive sleep apnea

1 | INTRODUCTION

Obstructive sleep apnea (OSA) is characterized by decreased muscle tone in the upper airway, leading to recurrent episodes of partial or complte airway collapse during sleep with an associated decrease in oxygen saturation or arousal from sleep.[1] It is becoming an increasingly prevalent condition within the United States population, seen in up to 30% of men and 17% of women.[2] This condition is linked with multiple risk factors including obesity,

male sex, age, alcohol and tobacco use, and structural factors like retrognathia.[1] Patients who fall into the category of moderate-to-severe OSA have been shown to be at an increased likelihood of developing sequelae, such as hypertension, diabetes, myocardial infarction, cerebrovascular accidents, and depression.[1], [3], [4]

Polysomnogram (PSG) is regarded as the gold standard for OSA diagnosis. This in-laboratory study measures multiple variables, including electroencephalography, electromyography, electrocardiography, airflow,respiratory effort, and oxygen saturation.[5] Several high-sensitivity outpatient screening tools for moderate-to-severe OSA exist, the most prevalent being the eight-question STOP-BANG questionnaire.[6], [7],[8] However, their utilization in the inpatient setting remains minimal. Some institutions employ high-resolution pulse oximetry (HRPO) to monitor oxygen desaturations during patient's hospital stay.[9], [10] HRPO, because of its increased sampling rate and bit depth, yields precise oxygen saturation measurements by monitoring infrared light absorption by red blood cells. The enhanced bit depth detects minute SpO2 variations, while the heightened sampling rate aids in apnea detection, enabling a more accurate calculation of a desaturation event index (DEI).[11] Despite assessing nocturnal desaturations, DEI alone is insufficient for OSA diagnosis. Instead, these tools may be useful in screening for potential OSA.

The inpatient setting poses barriers to PSG administration, including infrastructural constraints, scheduling issues, and insurance-related hurdles. Further, the stressful inpatient environment may disrupt patient sleep patterns, potentially confounding PSG measurements. Considering these challenges, the need arises for an alternative, reliable measure to screen for OSA in overnight-stay patients.

In our study, we aimed to explore the possible correlation between DEI and Apnea-Hypopnea Index (AHI), and to delineate its clinical potential in facilitating an early OSA diagnosis. We additionally sought to discuss its role in OSA screening as well as how these screening outcomes can inform decisions regarding the initiation of OSA empirical therapy. We hypothesize that there will be a positive correlation between DEI and AHI, suggesting that HRPO can aid in identifying patients necessitating further sleep-disordered breathing workup.

2 | MATERIALS AND METHODS

Following approval from Thomas Jefferson University's Institutional Review Board, we conducted a retrospective chart review of 115 patients admitted to a tertiary care academic medical center between 2018 and 2020. Each patient underwent sleep medicine consultation and HRPO during their inpatient stay. Because this study was retrospective in nature, formal consent was not required. We adhered to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.

We identified patients via a query of inpatient consultations performed by the sleep medicine department within the aforementioned period. The inclusion criteria entailed undergoing HRPO during inpatient hospitalization and outpatient PSG post-discharge, in either home or laboratory environments. Exclusion criteria included absence of HRPO data, failure to complete outpatient PSG after inpatient stay, or the presence of a non-capped tracheostomy during testing. Data was extracted from EMR review by two authors (RA and JT) and disagreements were discussed until consensus was reached.

Demographic data, including race, sex, body mass index (BMI), reason for admission, and medical comorbidities, was collected. Likewise, data was collected on chronic intermittent oxygen use, DEI, supplemental oxygen usage during HRPO, HRPO oxygen nadir, HRPO continuous time with oxygen saturation <88%, and tracheostomy presence through electronic medical record (EMR) review. We also recorded data on time to obtain PSG post-discharge, PSG/Home Sleep Test (HST) AHI/ respiratory event index (REI), and PSG/HST oxygen nadir levels. HRPO data, including DEI, pulse oximetry nadir, and longest continuous time <88% saturation, were derived from sleep medicine inpatient consult notes. The HRPO data, scored by an automatic algorithm, was not manually checked to exclude artifact periods. PSG

Supplementary information The online version of this article (https://doi.org/10.52845/JORR/2023/4.4.1) contains supplementary material, which is available to authorized users.

Corresponding Author: *Rahul Alapati, BS, Department of Otolaryngology-Head & Neck Surgery, Thomas Jefferson University 925 Chestnut Street, Floor 6, Philadelphia, PA, 19107, USA Tel: 408-478-5681 E-mail: ralapati98@gmail.com*

data was obtained from the patient's sleep study scanned into their EMR and was reported by a board-certified sleep medicine physician. AHI and DEI were defined as events causing a decrease of at least 4% oxygen saturation.

Statistical Analysis

In our statistical analysis, we employed Spearman's correlation to assess the correlation between AHI and DEI, and HRPO and PSG nadir oxygen saturation (NOS). We preferred this over Pearson's coefficient due to the non-normal data distribution, as confirmed by the Shapiro-Wilk test. The Mann-Whitney test was utilized to compare the means between groups. Similarly, a multivariable analysis was used to examine the significance between AHI and DEI, controlling for potential confounders like age, sex, BMI, medical comorbidities, reason for admission, and supplemental oxygen use. A subsequent multivariable analysis was used to determine the significance between HRPO and PSG NOS, with the same confounders controlled for. Statistical significance was set at $p<0.05$. The Statistical Package for the Social Sciences 28.0 (IBM Corp.; Armonk, NY, USA) software was used for analysis.

3 | RESULTS

Of the 115 patients who underwent inpatient HRPO, 66 met our inclusion criteria.

Demographic Profile

The sample comprised predominantly males (n=46) with a mean age of 59.1 ± 13.2 years. Racial distribution included a majority of African Americans (n=38) and Caucasians (n=23). Hypertension (n=38), congestive heart failure (n=34), and obstructive sleep apnea (n=18) were the predominant medical comorbidities. Approximately a third of the patients (n=25) used supplemental oxygen during HRPO testing. The average Body Mass Index (BMI) was 36.7 ± 11.2 kg/m2. The mean AHI and DEI were 46.0 events/hour and 40.1 events/hour, respectively. The average duration to obtain a PSG post-discharge was 97 ± 162 days (**Table 1**).

Table 1. *Demographics and Sleep Data*

Demographic Variables	N (%)	Mean (Std deviation)
Age (years)		59.17 (13.2)
BMI (kg/m^2)		36.72 (11.2)
Sex		
Male	46 (69.7)	
Female	20 (30.3)	
Ethnicity		
African American	38 (69.7)	
Caucasian	20 (30.3)	
Asian	3 (4.5)	
Hispanic	2 (3.0)	
Medical Comorbidities		
Hypertension	38 (57.6)	
Congestive Heart Failure	34 (51.5)	
Cardiomyopathy	6 (9.1)	
Type 1 Diabetes	2 (3.0)	
Type 2 Diabetes	13 (19.7)	
Coronary Artery Disease	9 (13.6)	
Pulmonary Hypertension	9 (13.6)	
Chronic Obstructive Pulmonary Disease	9 (13.6)	
Obstructive Sleep Apnea		
Interstitial Lung Disease	18 (27.3)	
Cardiomyopathy	2 (3.0)	
DVT/Pulmonary Embolism	5 (7.6)	
Respiratory Failure	5 (7.6)	
Chronic Kidney Disease	2 (3.0)	
Hyperlipidemia	6 (9.1)	
Peripheral Vascular Disease	6 (9.1)	
	3 (4.5)	
Reason for Admission		
Heart Failure	25 (37.9)	
Atrial Flutter/Fibrillation	3 (4.5)	
Hypertension Emergency	1 (1.5)	
Cardiomyopathy	1 (1.5)	
NSTEMI	4 (6.1)	
Respiratory Failure	5 (7.6)	
Shortness of Breath	2 (3.0)	
COPD Exacerbation	2 (3.0)	
Pneumonia	3 (4.5)	
PE	1 (1.5)	
Other	19 (28.7)	
Use of Supplemental Oxygen	25 (37.9)	
AHI (events/hr)		46.01 (37.08)
DEI (events/hr)		40.1 (29.49)
Time to PSG (days)		97 (162)

AHI & DEI Correlation

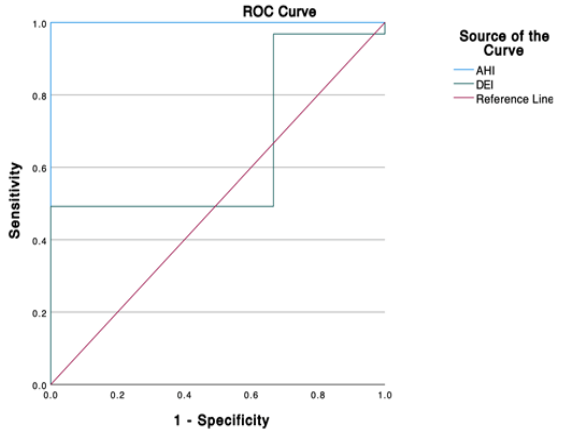
Among the 66 patients with available AHI and DEI data, AHI demonstrated no significant relationship with age (p=0.374) or BMI (p=0.105). However, a significantly higher AHI was observed in males compared to females (p=0.002). The majority of the patients exhibited a DEI ≥ 15 events/hour (n=53) or an AHI ≥ 15 events/hour (n=42). Spearman's rank correlation coefficient revealed a statistically significant but weak positive association between DEI and AHI (ρ=0.317, p=0.009). Multivariable analysis, adjusting for age, sex, BMI, ethnicity, medical comorbidities, reason for admission, and supplemental oxygen use during HRPO, revealed a similar weak but positive statistically significant predictive value of 0.270 (p=0.040, **Table 2**).

Table 2. *Correlations between PSG and HRPO Parameters*

Correlation Test for AHI and DEI	Value
Spearman's Rho	ρ=0.317, p=0.009
Multivariable[a]	0.270; p=0.040
Test utilized for PSG and HRPO NOS	**Value**
Spearman's Rho	ρ=0.320, p=0.013
Multivariable[a]	0.316; p=0.033

[a]Multivariable model adjusts for age, sex, BMI, race, medical comorbidities, reason for admission, and supplemental HRPO oxygen use

The ROC curve showed that the area under the curve (AUC) for DEI and AHI was 0.651, demonstrating diagnostic accuracy in screening for OSA. Based on the Youden-Index, a DEI score ≥ 4.15 was deemed the optimal threshold for OSA screening, while an AHI score ≥ 4 was optimal for OSA diagnosis (Figure 1). In our cohort, the DEI demonstrated a sensitivity of 96.8%, specificity of 33.3%, positive predictive value (PPV) of 96.8%, and negative predictive value (NPV) of 33.3% (Table 3). For patients on supplemental oxygen, the DEI-AHI ROC curve yielded an AUC of 0.674 (Figure 2), with similar sensitivities and a DEI cut-off of 4.15 based on the Youden-Index (Table 3).

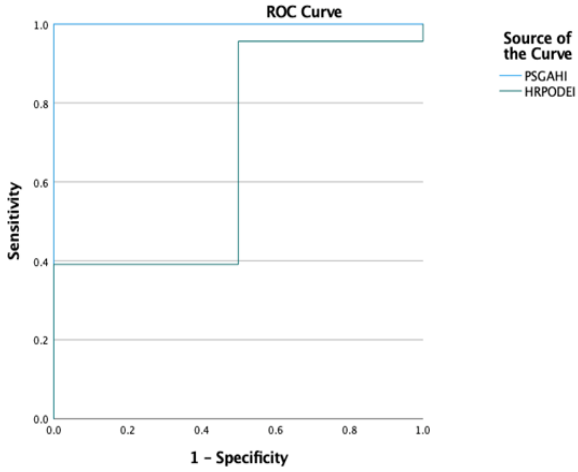


Area Under the Curve

Test Result Variable(s)	Area
AHI	1.000
DEI	.651

Figure 1. *Receiver Operating Characteristic Curve of Apnea-Hypopnea Index and Desaturation Event Index*

Receiver operating characteristic (ROC) curve showing comparing the accuracy of high-resolution pulse oximetry (HRPO) desaturation event index (DEI) to the gold standard polysomnography (PSG) apnea-hypopnea index (AHI)



Area Under the Curve

Test Result Variable(s)	Area
PSGAHI	1.000
HRPODEI	.674

Figure 2. *Receiver Operating Characteristic Curve of patients with supplemental oxygen*

Receiver operating characteristic (ROC) curve showing comparing the accuracy of high-resolution pulse oximetry (HRPO) desaturation event index (DEI) to the gold standard polysomnography (PSG) apnea-hypopnea index (AHI) in patients with oxygen use during HRPO

Table 3. *Sensitivity, Specificity, Positive Predictive Value, and Negative Predictive Value of HRPO*

Statistic Tests	Percentage (%) for HRPO Overall	Percentage (%) for Supplemental Supplemental Oxygen HRPO
Sensitivity	96.8%	95.7%
Specificity	33.3%	50.0%
Positive Predictive Value	96.8%	95.7%
Negative Predictive Value	33.3%	100.0%

NOS Analysis

Sixty patients had recorded pulse oxygen NOS data. The HRPO NOS displayed a weak yet statistically significant positive correlation with polysomnography NOS (ρ=0.320, p=0.013). Multivariable analysis, after adjusting for age, sex, BMI, race, medical comorbidities, reason for admission, and supplemental HRPO oxygen use, noted a weak and positive predictive value of 0.316 (p=0.033, **Table 2**).

4 | DISCUSSION

This study identified a correlation between HRPO's DEI and PSG's AHI to determine if DEI could be used to screen for OSA. We found that a DEI and AHI had a similar cut-off score for identifying OSA. The diagnostic accuracy of HRPO in identifying patients with OSA was moderately acceptable. After controlling for covariates, there was a moderately weak, positive correlation between DEI and AHI, suggesting there may be utility for DEI to be used for OSA screening and initiation of empiric CPAP therapy.

With the advent of increasingly precise technologies for recording appropriate desaturations in oxygen levels, a shift toward using overnight oximetry in the inpatient setting can become a vital step in screening for OSA. There are multiple benefits of streamlining an inpatient work-up of OSA without having the need to perform a PSG, which could be confounded by multiple variables affecting sleep quality in the inpatient setting.

Pulse oximetry utilizes an electronic processor and a pair of small light-emitting diodes (LED), one red (660nm) and one infrared (940nm), which alternate at approximately 30 times per second (Hz) to measure light transmission through a translucent part of the body, usually the fingertip. Deoxygenated hemoglobin absorbs more red light and permits the passage of infrared light, while oxygenated hemoglobin absorbs more infrared light and permits the passage of red light. The amount of light that is transmitted, not absorbed, is measured. The ratio of the red-light measurement to the infrared-light measurement is calculated by the processors within the pulse oximeter, which represents the ratio of oxygenated hemoglobin to deoxygenated hemoglobin, which is then converted to SpO2.[12]

In contrast, HRPO offers enhanced signal resolution, averaging time, and sampling rate. Signal resolution refers to the ability of a pulse oximeter to accurately measure and distinguish small changes in the photoplethysmography (PPG) signals that represent the arterial blood oxygen saturation. It is determined by two main factors: sampling rate and bit depth. Sampling rate is the frequency at which the PPG signal is acquired, with higher rates allowing the oximeter to capture more detailed information about changes in blood oxygen saturation and heart rate. A high sampling rate, usually greater than 1 per second, increases the detection of apneas.

Meanwhile, lower sampling rates can underestimate apneic events due to a decreased threshold of detection, causing an artificially decreased oxygen desaturation index.[13] Bit depth is the number of bits used to represent each sample in the digital PPG signal, with a higher bit depth allowing the oximeter to distinguish smaller changes in the signal, leading to more accurate SpO2 measurements.[14] Furthermore, a signal resolution of 0.1% SpO2 on high-resolution pulse oximetry, compared to the 1% SpO2 in regular pulse oximetry, results in a better detection of apneas and hypopneas. HRPOs also have a shorter averaging time, which is the process of averaging data across specific time intervals during the test. A longer averaging time may cause underestimation of the frequency of desaturation events.[13]

Studies since the 1990s have highlighted the potential of overnight pulse oximetry as an alternative to in-lab sleep studies[15],[16],[17],[18] Similarly, Magalang et al. discovered that oxygen desaturation indices could improve the accuracy of AHI and offer an alternative diagnostic tool for OSA.[19] Recently, Varghese et al. noted a strong correlation between oxygen desaturation index (ODI) and AHI.[20] This stronger correlation can be attributed to simultaneous acquisition of both metrics on the same day. In our study, we assessed DEI in patients primarily admitted for cardiopulmonary exacerbations, and then compared it with a PSG completed approximately 100 days after discharge. These differences may explain the weaker correlation in our findings. However, the diagnostic accuracy of ODI/DEI remained consistent. Another study stated ODI and AHI correlations ranging from 0.4 to 0.7.[21] Like the previous study, these stronger correlations likely stem from concurrent evaluations during outpatient PSG studies.

The ROC curves for both HRPO and PSG yielded a Youden-Index cut-off score of 4 within our analysis. Considering the widely accepted PSG cut-off for diagnosing OSA is an AHI of 5, the cut-off of 4 derived from our cohort suggests a comparable diagnostic threshold when utilizing the DEI from HRPO. This cut-off score is substantiated by the high sensitivity of HRPO and a similar sensitivity in the subgroup of patients receiving supplemental

oxygen. The high sensitivity of HRPO effectively minimizes false negatives, thereby making it a reliable screening tool for ruling out OSA. However, it is paramount to interpret these findings within the broader clinical context, considering other clinical markers and symptoms, to ensure a comprehensive evaluation of the patient's OSA risk profile.

Prior literature acknowledges that darker skin tones may contribute to an overestimation of actual oxygen values, thereby decreasing the likelihood of detecting occult hypoxemia. This characteristic of HRPO can introduce potential bias and should be considered when interpreting HRPO results in patients with darker skin tones.[22] However, our analysis revealed that ethnicity, a surrogate marker for skin tone in this context, did not significantly affect the correlation within our cohort. Nonetheless, this potential limitation of HRPO underscores the importance of comprehensive clinical evaluation and decision-making.

The integration of HRPO as a preliminary screening tool holds potential in streamlining the diagnostic process for OSA. Utilizing HRPO screening can hasten the detection of at-risk individuals, enabling initiation of empiric CPAP therapy during the hospital admission. Such proactive management may mitigate the consequences of untreated OSA[23] Additionally, this strategy could optimize hospital resource allocation, as the immediate initiation of therapy can contribute to an increased patient turnaround, thereby reducing hospitalization periods. Normally, patients would require an outpatient sleep referral unless the hospital has dedicated lab equipment for overnight sleep testing. Interestingly, a prior study noted that using inpatient home sleep tests to initiate PAP therapy could be a cost-effective strategy to reduce length of stay.[24] This perspective builds upon Kelly and colleagues' observation that patients who need home durable medical equipment experience increased costs and extended length of stay due to delays in discharge.[25] For hospitals lacking sleep-testing resources, overnight HRPO with subsequent referral to a sleep center could serve as a cost-effective alternative.[24]

A prior clinical trial done at our institution found that HRPO is a simple and cost-effective screening tool for sleep disordered breathing in patients with congestive heart failure.[26] Compared to our results, this study revealed a greater diagnostic accuracy of HRPO and indicated consistent results between HRPO and portable sleep monitoring systems. Other studies corroborate similar conclusions that HRPO can be used to screen for OSA in hospitalized patients.[27], [28] Though some discrepancies might stem from post-discharge PSG delays, our findings underscore a similar viability of HRPO as a sleep apnea screening instrument. However, further research is essential to confirm this potential and to determine how we can integrate HRPO into current sleep apnea diagnostic pathways.

Limitations

Our study, while yielding promising results, acknowledges certain limitations that could influence the interpretation of the findings. The retrospective nature of this study and limited sample size are inherent biases that limit our conclusions. The primary limitation stemmed from conducting HRPO studies on an inpatient cohort seeking sleep consultation, wherein new or aggravated cardiopulmonary conditions might have affected the oxygen saturation levels and hence, HRPO results. To mitigate this, we controlled for the confounding factor of patients being on supplemental oxygen during the HRPO study in our statistical analysis. Moreover, a temporal gap in conducting the PSG post-discharge introduced another potential bias. In some cases, PSG was performed up to a year following the inpatient consultation, leading to a discrepancy in the timeline of capturing DEI during the inpatient stay and AHI in the outpatient setting. Variations in factors influencing OSA over this extended period may have confounded the observed correlation.

Additionally, the unique environment of the inpatient setting could have altered sleep apnea measurements. Acute illness or deconditioning in hospitalized patients could potentially distort the representation of their typical OSA characteristics, affecting the external validity of the correlation drawn between DEI and AHI. Lastly, a noteworthy source of potential bias might be the presence of artifacts within HRPO data, which could have influenced our results and subsequent statistical analysis. Future studies need to address these limitations through careful experimental design and additional analytical controls, to enhance the reliability and applicability of our findings.

4 | CONCLUSION

From our findings, we conclude that DEI obtained from HRPO is weakly correlated with AHI. While HRPO may serve as a valuable tool in screening for OSA, it should not be used in isolation. Rather, its role should be primarily to augment the process of risk stratification, considering additional clinical factors such as symptoms, physical examination findings, and other co-existing conditions. The efficacy of HRPO as a screening tool, as demonstrated in our study, is significant. However, acknowledging and understanding its limitations ensures its judicious application in clinical practice. Further research is needed to validate these findings and potentially refine the use of HRPO, especially in populations with diverse ethnic backgrounds.

Conflict of Interest: Dr. Colin Huntley receives research support from Inspire and Nyxoah. He is also a consultant for Inspire. All other authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants,; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

REFERENCES

1. Slowik JM, Sankari A, Collen JF. Obstructive Sleep Apnea. StatPearls. Treasure Island (FL): StatPearls Publishing Copyright ©2023, Statpearls Publishing LLC.; 2023.
2. Peppard PE, Young T, Barnet JH, Palta M, Hagen EW, Hla KM. Increased prevalence of sleep-disordered breathing in adults. Am J Epidemiol. 2013;177(9):1006-14. Epub 20130414. doi: 10.1093/aje/kws342. PubMed PMID: 23589584; PMCID: PMC3639722.
3. Vasu TS, Grewal R, Doghramji K. Obstructive sleep apnea syndrome and perioperative complications: a systematic review of the literature. J Clin Sleep Med. 2012;8(2):199-207. Epub 20120415. doi: 10.5664/jcsm.1784. PubMed PMID: 22505868; PMCID: PMC3311420.
4. Stansbury RC, Strollo PJ. Clinical manifestations of sleep apnea. J Thorac Dis. 2015;7(9):E298-310. doi: 10.3978/j.issn.2072-1439.2015.09.13. PubMed PMID: 26543619; PMCID: PMC4598518.
5. Malhotra RK, Kirsch DB, Kristo DA, Olson EJ, Aurora RN, Carden KA, Chervin RD, Martin JL, Ramar K, Rosen CL, Rowley JA, Rosen IM. Polysomnography for Obstructive Sleep Apnea Should Include Arousal-Based Scoring: An American Academy of Sleep Medicine Position Statement. J Clin Sleep Med. 2018;14(7):1245-7. Epub 20180715. doi: 10.5664/jcsm.7234. PubMed PMID: 29991439; PMCID: PMC6040795.
6. Jin J. Screening for Obstructive Sleep Apnea. JAMA. 2022;328(19):1988-. doi: 10.1001/jama.2022.20142.
7. Amra B, Rahmati B, Soltaninejad F, Feizi A. Screening Questionnaires for Obstructive Sleep Apnea: An Updated Systematic Review. Oman Med J.2018;33(3):184-92. doi: 10.5001/omj.2018.36. PubMed PMID: 29896325; PMCID: PMC5971053.
8. Oktay Arslan B, Uçar Hoşgör ZZ, Orman MN. Which Screening Questionnaire is Best for Predicting Obstructive Sleep Apnea in the Sleep Clinic Population Considering Age, Gender, and Comorbidities? Turk Thorac J. 2020;21(6):383-9. Epub 20201101. doi: 10.5152/TurkThoracJ.2019.19024. PubMed PMID: 33352093; PMCID: PMC7752116.
9. Stansbury R, Abdelfattah M, Chan J, Mittal A, Alqahtani F, Sharma S. Hospital screening for obstructive sleep apnea in patients admitted to a rural, tertiary care academic hospital with heart failure. Hosp Pract (1995). 2020;48(5):266-71. Epub 20200804. doi:10.1080/21548331.2020.1799601. PubMed PMID:32715796; PMCID: PMC7725971.
10. Collop NA, Anderson WM, Boehlecke B, Claman D, Goldberg R, Gottlieb DJ, Hudgel D, Sateia M, Schwab R. Clinical guidelines for the use of unattended portable monitors in the diagnosis of obstructive sleep apnea in adult patients. Portable Monitoring Task Force of the American Academy of Sleep Medicine. J Clin Sleep Med. 2007;3(7):737-47. PubMed PMID: 18198809; PMCID: PMC2556918.
11. Metz JE, Attarian HP, Harrison MC, Blank JE, Takacs CM, Smith DL, Gozal D. High-Resolution Pulse Oximetry and Titration ofa Mandibular Advancement Device for Obstructive Sleep Apnea.

Front Neurol. 2019;10:757. Epub 20190717. doi: 10.3389/fneur.2019.00757. PubMed PMID: 31379712; PMCID: PMC6650535.

12. ubran A. Pulse oximetry. Crit Care.2015;19(1):272. Epub 20150716. doi: 10.1186/s13054-015-0984-8. PubMed PMID: 26179876; PMCID: PMC4504215.
13. Cross TJ, Keller-Ross M, Issa A, Wentz R, Taylor B, Johnson B. The Impact of Averaging Window Length on the"Desaturation Indexes during Overnight Pulse Oximetry at High-Altitude". Sleep. 2015;38(8):1331-4. Epub 20150801. doi: 10.5665/sleep.4920. PubMed PMID: 25581919; PMCID: PMC4507739.
14. Böhning N, Schultheiss B, Eilers S, Penzel T, Böhning W, Schmittendorf E. Comparability of pulse oximeters used in sleep medicine for the screening of OSA. Physiol Meas. 2010;31(7):875-88. Epub 20100526. doi: 10.1088/0967-3334/31/7/001. PubMed PMID: 20505219.
15. Kunisaki KM, Bohn OA, Wetherbee EE, Rector TS. High-resolution wrist-worn overnight oximetry has high positive predictive value for obstructive sleep apnea in a sleep study referral population. Sleep Breath. 2016;20(2):583-7. Epub 20150909. doi: 10.1007/s11325-015-1251-6. PubMed PMID: 26354105.
16. Chiner E, Signes-Costa J, Arriero JM, Marco J, Fuentes I, Sergado A. Nocturnal oximetry for the diagnosis of the sleep apnoea hypopnoea syndrome: a method to reduce the number of polysomnographies? Thorax. 1999;54(11):968-71. doi: 10.1136/thx.54.11.968. PubMed PMID: 10525553; PMCID: PMC1745404.
17. Sériès F, Marc I, Cormier Y, La Forge J. Utility of nocturnal home oximetry for case finding in patients with suspected sleep apnea hypopnea syndrome. Ann Intern Med. 1993;119(6):449-53. doi: 10.7326/0003-4819-119-6-199309150-00001. PubMed PMID: 8357109.
18. Lévy P, Pépin JL, Deschaux-Blanc C, Paramelle B, Brambilla C. Accuracy of oximetry for detection of respiratory disturbances in sleep apnea syndrome. Chest. 1996;109(2):395-9. doi: 10.1378/chest.109.2.395. PubMed PMID: 8620711.
19. Magalang UJ, Dmochowski J, Veeramachaneni S, Draw A, Mador MJ, El-Solh A, Grant BJ. Prediction of the apnea-hypopnea index from overnight pulse oximetry. Chest. 2003;124(5):1694-701. doi: 10.1378/chest.124.5.1694. PubMed PMID: 14605037.
20. Varghese L, Rebekah G, N P, Oliver A, Kurien R. Oxygen desaturation index as alternative parameter in screening patients with severe obstructive sleep apnea. Sleep Sci. 2022;15(Spec 1):224-8. doi: 10.5935/1984-0063.20200119. PubMed PMID: 35273770; PMCID: PMC8889990.
21. Temirbekov D, Güneş S, Yazıcı ZM, Sayın İ. The Ignored Parameter in the Diagnosis of Obstructive Sleep Apnea Syndrome: The Oxygen Desaturation Index. Turk Arch Otorhinolaryngol. 2018;56(1):1-6. Epub 20180301. doi: 10.5152/tao.2018.3025. PubMed PMID: 29988275; PMCID: PMC6017211.
22. Cabanas AM, Fuentes-Guajardo M, Latorre K, León D, Martín-Escudero P. Skin Pigmentation Influence on Pulse Oximetry Accuracy: A Systematic Review and Bibliometric Analysis. Sensors (Basel). 2022;22(9). Epub 20220429. doi: 10.3390/s22093402. PubMed PMID: 35591092; PMCID: PMC9102088.
23. Motamedi KK, McClary AC, Amedee RG. Obstructive sleep apnea: a growing problem. Ochsner J. 2009;9(3):149-53. PubMed PMID: 21603432; PMCID: PMC3096276.
24. Khalid A, Mukundan TH, Khalid R, Pusalavidyasagar S, Khan A. Management of Obstructive Sleep Apnea in Hospitalized Patients. Applied Sciences. 2023;13(4):2108. PubMed PMID: doi:10.3390/app13042108.
25. Kelly A, Chavez Jr R, RS JS, Butler C. Characterization of Hospitalized Patients with Residual Disability: Does Home Durable Medical Equipment Setup Requirements Represent a Barrier to Discharge. Adv Clin Med Res. 2020;1:1-9.
26. Sharma S, Mather PJ, Chowdhury A, Gupta S, Mukhtar U, Willes L, Whellan DJ, Malhotra A, Quan SF. Sleep Overnight Monitoring for Apnea in Patients Hospitalized with Heart Failure (SOMA-HF Study). J Clin Sleep Med. 2017;13(10):1185-90. Epub 20171015. doi: 10.5664/jcsm.6768. PubMed PMID: 28859720; PMCID: PMC5612634.
27. Sharma S, Mather P, Efird JT, Kahn D, Cheema M, Rubin S, Reeves G, Bonita R, Malloy R, Whellan DJ. Photoplethysmographic Signal to Screen Sleep-Disordered Breathing in Hospitalized Heart Failure Patients: Feasibility of a Prospective Clinical Pathway. JACC Heart Fail. 2015;3(9):725-31. doi: 10.1016/j.jchf.2015.04.015. PubMed PMID: 26362449.
27. Sharma S, Mather PJ, Efird JT, Kahn D, Shiue KY, Cheema M, Malloy R, Quan SF. Obstructive Sleep Apnea in Obese Hospitalized Patients: A Single Center Experience. J Clin Sleep Med.2015;11(7):7

717-23. Epub 20150715. doi: 10.5664/jcsm.4842. PubMed PMID: 25766715; PMCID: PMC4481054.

How to cite this article: Rahul Alapati, BS et al. Correlation between Desaturation Event Index and Apnea Hypopnea Index for Diagnosis of Obstructive Sleep Apnea, Journal of Otolaryngology and Rhinology Research. 2023;172-180. https://doi.org/10.52845/JORR/2023/4.4.1