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Oxygen Saturation Index: The Non-Invasive Surrogate of the Oxygenation Index for Continuous Monitoring of Hypoxemia in Ventilated Neonates

S. Mohanapriya[1], P. Sakthi Seethalakshmi[2], P. Deepika[3], R. Nivetha[4], K.S. Kumaravel[5]

[1]Department of Pediatrics, Govt Karur Medical College, Karur, Tamil Nadu, India
[2,3,4,5]Department of Pediatrics, Govt Mohan Kumaramangalam Medical College, Salem, Tamil Nadu, India.

Corresponding Author: Dr. K.S. Kumaravel

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ABSTRACT

Background: The Oxygenation Index (OI) is widely used to assess lung injury and hypoxic respiratory failure (HRF). The Oxygen Saturation Index (OSI) has recently been proposed as a non-invasive alternative to OI. This study aims to analyse the correlation between OI and OSI in ventilated neonates and to determine a cut-off value of OSI that correlates with an OI of 15 (mild HRF).
Methods: This prospective observational study was conducted in a tertiary care hospital for 1 year and included all ventilated neonates on the first day of life. A Pearson correlation analysis was performed to determine the relationship strength between OI and OSI. Receiver Operating Characteristic (ROC) curves were constructed, and a cut-off value of OSI that will correlate with an OI of 15 (mild HRF) was determined.
Results: The mean birth weight of the neonates (n=100) was 1.9 ±0.7 kg. The most common indication for ventilation among neonates was respiratory distress syndrome (61%). The Pearson correlation showed a strong correlation between OI and OSI (r=0.601) among the study group. On ROC curve analysis, at a cut-off OSI value of 4.95, the area under the curve was 0.837, sensitivity was 78.9%, and specificity was 75% (P <0.001).
Conclusion: The study demonstrates a strong correlation between OSI and OI. Its high sensitivity and specificity, combined with its non-invasive nature, make OSI a valuable tool for continuous monitoring of HRF, bridging the gaps between intermittent OI assessments.

Keywords: Neonate, oxygen, distress, monitoring, preterm.

INTRODUCTION

Respiratory failure is a leading cause of neonatal mortality, particularly among ventilated neonates (1). Managing severe respiratory failure in neonatal intensive care units (NICUs) is often challenging because of complex treatment, high costs, and increased mortality risk (2). Survivors of prolonged respiratory failure may also develop neurological complications (3). The Oxygenation Index (OI) is widely used to assess lung injury and hypoxic respiratory failure (HRF), guiding interventions such as high-frequency ventilation, inhaled nitric oxide therapy, or extracorporeal membrane oxygenation (4). Additionally, OI predicts neonatal mortality.

The OI is calculated as OI = (MAP × FiO_2 × 100) / PaO_2, where MAP is the mean airway pressure, FiO_2 is the fraction of inspired oxygen, and PaO_2 is the partial pressure of arterial oxygen (5). OI has been classified as mild (OI ≤15), moderate (OI 16 to 25), severe (OI 26 to 40) and very severe (OI ≥41) HRF. However, obtaining PaO_2 requires arterial blood sampling, an invasive procedure with risks such as hematoma, arterial thrombosis, and anemia, particularly in neonates requiring prolonged mechanical ventilation. To overcome these limitations, the Oxygen Saturation Index (OSI) was proposed as a non-invasive alternative, replacing PaO_2 with SpO_2 in the equation: OSI = (MAP × FiO_2 × 100) / SpO_2 (5). Since pulse oximeters are widely available in NICUs, OSI may offer continuous non-invasive oxygenation monitoring without the risks associated with arterial blood sampling (6). Effective management of respiratory distress in NICUs requires reliable indices to guide treatment and predict outcomes. Understanding the correlation between OSI and OI could validate OSI as a surrogate for OI, improving neonatal respiratory management in resource-limited settings where arterial blood gas analysis is not routinely available. However, despite their clinical significance, the correlation between OSI and OI in ventilated neonates remains underexplored (7,8). This study aims to analyse the correlation between OI and OSI in ventilated neonates and to determine a cut-off value of OSI that will correlate with an OI of 15 (mild HRF).

MATERIALS AND METHODS

This prospective observational study was conducted in the NICU at a tertiary care hospital from July 2025 to October 2025. It included neonates admitted for ventilator support on the first day of life. All neonates, term and preterm, inborn and outborn, requiring invasive ventilatory support within the first day of life were included. Non-invasively ventilated neonates, neonates with congenital heart disease, apnea of prematurity or congenital anomalies and those whose parents did not provide consent were excluded. Institutional Human Ethics Committee approval was obtained, and consent was obtained from the parents.

A structured proforma was used to collect clinical and demographic data. About 0.5 mL of blood was taken from a postductal artery under aseptic precautions by standard technique. SpO2 was analysed using the Masimo® pulse oximeter machine. PaO2 was analysed using the OPTI CCA-TS Blood Gas and Electrolyte Analyzer®. OI and OSI were estimated at the same time, within 24 hours after birth.

The sample size was estimated to be 63 using the formula for Fisher's z-transformation, assuming a power of 0.8, α of 0.05 and an r of 0.35. However, we included all the neonates who met the inclusion criteria. Data entry was performed using MS Excel, and statistical analysis was conducted using SPSS software version 21. Continuous variables were expressed as mean and standard deviations, while categorical variables were expressed as frequencies and percentages. After assessing the normality of distribution using the Shapiro-Wilk test, Pearson correlation was performed to find out the strength of the relationship between OI and OSI. Receiver Operating Characteristic (ROC) curves were constructed, and a cut-off value of OSI that correlates with an OI of 15 (mild HRF) was determined. A p-value of less than 0.05 was considered statistically significant.

RESULTS

The baseline characteristics of the study population (n=100) are shown in Table 1. Among the neonates, 61% were male, 36% were born at term, 60% were inborn, 64% were delivered by caesarean section, and 64% were low birth weight. The mean birth weight was 1.9 ± 0.7kg. Respiratory distress syndrome (61%) and birth asphyxia (25%) were the common morbidities. On analysis of oxygen saturation levels, 56% of participants had normal SpO_2, while 44% exhibited abnormal Spo_2. The mean FiO_2 was 65.8% ± 23.1. The mean PaO_2 was 87.1 ± 41.4 mmHg.

The mean OI and OSI were 8.73 (±6.6) and 7.1 (±4), respectively.

Table 1: Baseline characteristics of the neonates (n=100)

Parameter	**No**
Gender	
Male	61%
Female	39%
Place of birth	
Inborn	60%
Outborn	40%
Mode of delivery	
Cesarean section	64%
Labour natural	36%
Birth weight	
≤2500 gms	64%
>2500 gms	36%
Mean birth weight	1.9 ±0.7 kgs
Gestational age	
Term	36%
Extreme Preterm	13%
Early preterm	18%
Moderate preterm	4%
Late preterm	29%
Diagnosis	
Respiratory distress syndrome	61%
Birth asphyxia	25%
Meconium aspiration syndrome	6%
Others	8%
Mean Airway Pressure	9.18 ±1.61 cm H2O
Mean FiO2	65.8±23.1%
Mean PaO2	87.19±41.40 mm Hg
Oxygenation Index	
≤15.0	89%
15.1-25	7%
≥25.1	4%
Mean OI	8.73±6.60
Oxygen Saturation Index	
≤5.0	35%
5.1-12.5	53%
≥12.6	12%
Mean OSI	7.10±4.00

Mean values are presented as mean ± standard deviation.

Table 2 and Figure 1 illustrate the correlation between OI and OSI. There was a statistically significant correlation between OI and OSI among the overall study population (r=0.602). The analysis also revealed a positive correlation between OI and OSI across all gestational age groups, except early and moderate preterm, which may be due to the small sample size in those subgroups. Figure 2 illustrates the ROC curve analysis of the OSI for predicting an OI of 15. At a cut-off OSI value of 4.95, the area under the curve was 0.837 (95% CI = 0.748 – 0.926), the sensitivity was 78.9%, and the specificity was 75% ($P < 0.001$).

Table 2: Pearson Correlation between Oxygenation index and Oxygen saturation index

Gestational age	No	r value	P value
Extreme Preterm	13	0.767	0.002
Early Preterm	18	0.411	0.090
Moderate Preterm	4	0.591	0.409
Late Preterm	29	0.584	<0.001
Term	36	0.582	<0.001
Overall	100	0.601	<0.001

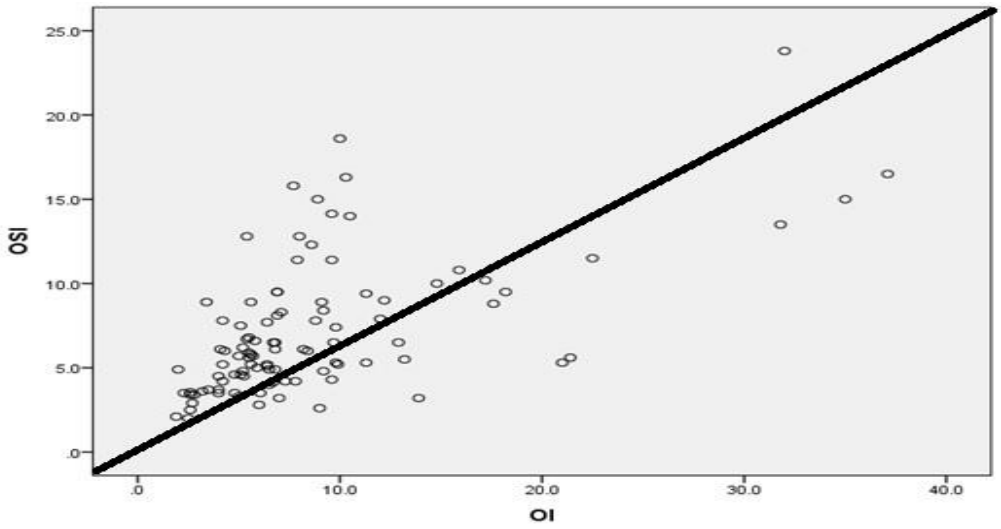

Figure 1: Scatter plot for correlation between OI and OSI

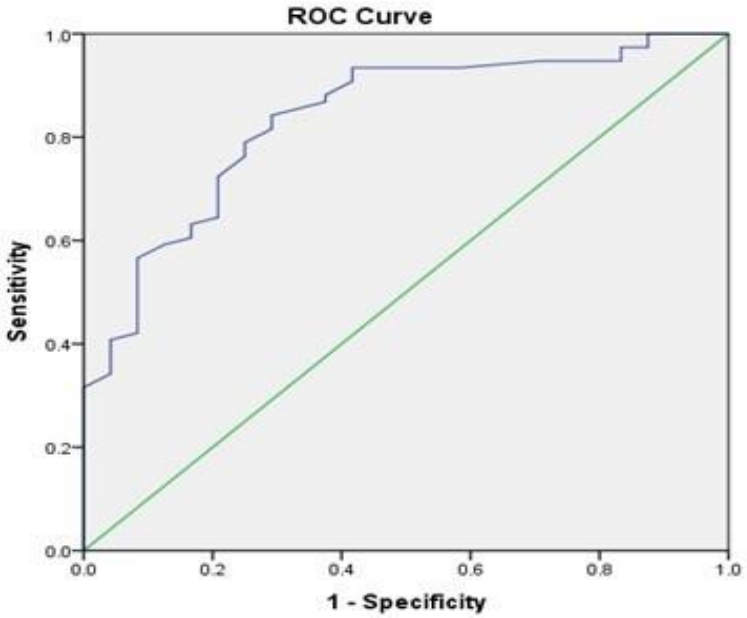

Figure 2: ROC curve analysis at an OSI value of 4.95

The area under the curve was 0.837, sensitivity was 78.9%, and specificity was 75% ($P < 0.001$).

DISCUSSION

The findings of this study highlight the significant correlation between the OSI and OI in ventilated neonates, suggesting that the OSI can serve as a reliable non-invasive alternative for assessing respiratory function. The strong positive correlation ($r = 0.602$, $p < 0.001$) between OSI and OI underscores the potential of OSI to replace OI in clinical settings, where minimising invasive

procedures can reduce the risk of complications such as hematoma, arterial spasm, and anemia (9,10). Additionally, because SpO2 is continuously available at the bedside, OSI offers real-time feedback, allowing for more agile clinical interventions compared to intermittent OI values.

The ROC curve analysis for OSI demonstrated an area under the curve (AUC) of 0.837, with a sensitivity of 78.9% and specificity of 75% at a cutoff value of 4.95. This indicates that OSI has good diagnostic performance in identifying neonates with HRF. The high sensitivity and specificity of OSI make it a valuable tool for continuous monitoring of respiratory function, allowing for timely interventions and adjustments in ventilatory support. This is particularly important in preterm neonates, who are at higher risk of respiratory complications due to underdeveloped lungs and immature pulmonary vasculature (11,12).

The findings of this study are consistent with previous studies that have demonstrated a strong correlation between OSI and OI in neonates with hypoxemic respiratory failure (13,14,15). Sunil et al. (2021) reported a correlation coefficient of 0.727 between OSI and OI, with an AUC of 0.912 for OSI in predicting HRF severity (14). Similarly, Bui-Binh-Bao et al. (2024) found a strong agreement between OSI and OI, with an agreement rate of 94.3% within the 95% bounds of agreement (15). These studies collectively support the use of OSI as a non-invasive alternative to OI in clinical practice.

Despite its advantages, OSI has limitations. Factors such as poor peripheral perfusion, motion artefacts, and skin pigmentation can impact SpO2 readings, particularly in critically ill neonates (16,17,18). Furthermore, the sigmoidal nature of the oxygen dissociation curve means that OSI may be less accurate at extreme ends of oxygenation (19,20). For instance, in hyperoxia (SpO2 > 95%), PaO2 can vary significantly despite stable SpO2, potentially underestimating oxygenation deficits. Therefore, OSI may complement, but not completely replace, traditional indices until further validation is achieved. The limitations of the study include it being a single-centre study, and cut-off values of OSI for different OI levels were not determined because of the limited sample size. Further multi-centre studies with larger sample sizes and across different gestational age groups are warranted to establish gestation age-specific OSI thresholds and guidelines for clinical implementation.

CONCLUSION

The study demonstrates a strong correlation between OSI and OI, indicating that OSI is a reliable, non-invasive surrogate for assessing respiratory function in ventilated neonates. Its high sensitivity and specificity, combined with its non-invasive nature, make OSI a valuable tool for continuous monitoring of HRF, helping to bridge the gaps between intermittent OI assessments.

Declaration by Authors

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REFERENCES

1. Wang H, Dong Y, Sun B, Chinese Collaborative Study Group for Neonatal Respiratory Diseases. Admission volume is associated with mortality of neonatal respiratory failure in emerging neonatal intensive care units. The Journal of Maternal-Fetal & Neonatal Medicine. 2019 Jul 3;32(13):2233-40.
2. Sharma D, Murki S. Making neonatal intensive care: cost effective. The Journal of Maternal-Fetal & Neonatal Medicine. 2021 Jul 18;34(14):2375-83.
3. Mehta A, Ibsen LM. Neurologic complications and neurodevelopmental outcome with extracorporeal life support. World journal of critical care medicine. 2013 Nov 4;2(4):40.
4. Muniraman HK, Song AY, Ramanathan R, Fletcher KL, Kibe R, Ding L, Lakshmanan A, Biniwale M. Evaluation of oxygen saturation index compared with oxygenation index in neonates with hypoxemic

respiratory failure. JAMA network open. 2019 Mar 1;2(3):e191179-.
5. Ashwini KH, Badiger S, Tadakanahalli S. Utility of the Oxygen Saturation Index Over the Oxygenation Index in Monitoring Neonates with Respiratory Diseases. Apollo Medicine. 2024:09760016241291656.
6. Sauthier M, Tuli G, Jouvet PA, Brownstein JS, Randolph AG. Estimated Pao2: A continuous and noninvasive method to estimate Pao2 and oxygenation index. Critical care explorations. 2021 Oct 1;3(10):e0546.
7. Subramanyam TV, Lakshmi V. Correlation Between Oxygenation Index and Oxygen Saturation Index for Identifying the Hypoxemic Respiratory Failure in Ventilated Neonates. Journal of Neonatology. 2025:09732179251322563.
8. Maneenil G, Premprat N, Janjindamai W, Dissaneevate S, Phatigomet M, Thatrimontrichai A. Correlation and prediction of oxygen index from oxygen saturation index in neonates with acute respiratory failure. American journal of perinatology. 2024 Jan;41(02):180-6.
9. Arnts IJ. Managing the complications of intravenous devices in the neonatal intensive care unit: A contribution to patient safety. Sl: sn; 2015.
10. Ramasethu J. Complications of vascular catheters in the neonatal intensive care unit. Clinics in perinatology. 2008 Mar 1;35(1):199-222.
11. Bogdan RD, Bohiltea RE, Toma AI. Respiratory follow up of the premature neonates—rationale and practical issues. Journal of Clinical Medicine. 2022 Mar 21;11(6):1746.
12. Natile M, Ventura ML, Colombo M, Bernasconi D, Locatelli A, Plevani C, Valsecchi MG, Tagliabue P. Short-term respiratory outcomes in late preterm infants. Italian journal of pediatrics. 2014 Dec; 40:1-0.
13. Rawat M, Chandrasekharan PK, Williams A, Gugino S, Koenigsknecht C, Swartz D, Ma CX, Mathew B, Nair J, Lakshminrusimha S. Oxygen saturation index and severity of hypoxic respiratory failure. Neonatology. 2015 Mar 1;107(3):161-6.
14. Sunil B, Nithya E. Correlation of Oxygen Saturation Index and Oxygenation Index in Hypoxemic Respiratory Failure among Neonates. Journal of Clinical & Diagnostic Research. 2021 Aug 1;15(8).
15. Bui-Binh-Bao S, Nguyen Thi D, Hoang Mai L, Do Ho Tinh T, Nguyen TT. Assessing hypoxic respiratory failure in mechanically ventilated neonates: A comparative study of oxygen saturation index and oxygenation index. Plos one. 2024 May 30;19(5):e0304278.
16. Sharma M, Brown AW, Powell NM, Rajaram N, Tong L, Mourani PM, Schootman M. Racial and skin color mediated disparities in pulse oximetry in infants and young children. Paediatric Respiratory Reviews. 2024 Jun 1;50:62-72.
17. Poets CF. Noninvasive monitoring and assessment of oxygenation in infants. Clinics in Perinatology. 2019 Sep 1;46(3):417-33.
18. Al-Halawani R, Charlton PH, Qassem M, Kyriacou PA. A review of the effect of skin pigmentation on pulse oximeter accuracy. Physiological measurement. 2023 Jun 1;44(5):05TR01.
19. Collins JA, Rudenski A, Gibson J, Howard L, O'Driscoll R. Relating oxygen partial pressure, saturation and content: the haemoglobin–oxygen dissociation curve. Breathe. 2015 Sep 1;11(3):194-201.
20. DesPrez K, McNeil JB, Wang C, Bastarache JA, Shaver CM, Ware LB. Oxygenation saturation index predicts clinical outcomes in ARDS. Chest. 2017 Dec 1;152(6):1151-8.

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