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# Silverman-Anderson Score and Downes Score for Assessing Respiratory Distress in Newborns

Abdul Salam Memon[1*], Muhammad Rafique[1], Amanullah Lail[1], Zainab Khalid[1], Kulsoom Abdul Sattar[1], Malik Sohail Danish[1]

[1]*Department of Paediatric, Dr Ruth Pfau Civil Hospital, Karachi, Sindh-Pakistan*
***Correspondence:*** *abdulsalammemon21@gmail.com*
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## ABSTRACT

**OBJECTIVE:** To compare the effectiveness of the Silverman-Anderson and Downes scoring systems in predicting respiratory distress in newborns admitted to pediatric nursery.
**METHODOLOGY:** A descriptive cross-sectional study was conducted in the neonatal nursery of Dr. Ruth K. M. Pfau Civil Hospital, Karachi, Pakistan, from July - December 2024, using non-probability consecutive sampling. The study included neonates within the first 24 hours of life of either gender and encompassed both term infants and preterm infants. Respiratory distress was defined by symptoms such as tachypnea, retractions, grunting, or cyanosis. The severity of respiratory distress was assessed using the Silverman-Anderson scoring system, which evaluated upper and lower thoracic depression, subxiphoid depression, nasal flaring, and expiratory grunting, and the Downes scoring system, which analyzed respiratory frequency, cyanosis, chest retractions, grunting, and lung sounds. Data were analyzed using SPSS version 24.
**RESULTS:** Of 255 patients, the diagnostic accuracy of the Silverman-Anderson Scale in predicting respiratory distress showed a sensitivity of 91.04%, specificity of 63.3%, positive predictive value (PPV) of 46.92%, negative predictive value (NPV) of 95.2 % and an overall accuracy of 70.59%. The Downes Scoring demonstrated higher sensitivity (94.03%), specificity (68.09%), PPV (51.22%), NPV (96.97%), and overall accuracy (74.09%). The area under the curve (AUC) for Silverman-Anderson Scoring was 0.831 (95% CI 0.78–0.89), whereas Downes Scoring achieved a higher AUC of 0.885 (95% CI 0.84–0.93), indicating slightly better performance in diagnosing respiratory distress.
**CONCLUSION:** While both systems demonstrated high diagnostic performance, the Downes score exhibited marginally superior diagnostic accuracy and predictive value.

**KEYWORDS:** Respiratory Distress, Silverman-Anderson Scale, Downes scoring systems, Newborns, Efficacy, Pakistan

## INTRODUCTION

Respiratory distress in the neonatal period poses a significant clinical challenge and demands a precise and efficient diagnostic approach for timely intervention.[1] Various studies have reported that many hospitalized neonates in pediatric nurseries reported clinical signs of respiratory distress within the first 24 hours of life.[2,3]

It is reported that the diagnosis of neonatal respiratory distress suffers a significant delay due to the late reporting of invasive blood gas tests, which the use of validated non-invasive scoring systems can improve.[4] The Silverman-Anderson and Downes scores are the two efficient scoring systems used to predict respiratory distress severity in neonates.[5,6] Both are based on specific clinical calculations to quantify the severity of respiratory distress.[7] The Silverman-Anderson system includes retractions, nasal flaring, grunting, chest movement, and respiratory rate. In contrast, the Downes system includes variables such as grunting, retractions, nasal flaring, chest movement, and skin color to predict respiratory distress in neonates.[8] other assessment methods have been explored, including the Respiratory Severity Score, which integrates oxygen requirement and respiratory support level, and the Clinical Respiratory Score, which is often used in pediatric populations, though less validated in neonates.[9,10] Furthermore, emerging tools such as lung ultrasound and pulse oximetry-based indices are gaining traction for their diagnostic accuracy and real-time application.[11] Despite the availability of multiple assessment modalities, the Silverman-Anderson and Downes scores remain the most practical and widely implemented tools for frontline evaluation. Nevertheless, comparative studies assessing their concurrent validity and reliability across diverse clinical settings are essential to determine their optimal applicability and integration into routine neonatal care.

The rationale of this study is that though these scoring systems are widely used in healthcare settings, their reliability may vary. A thorough literature search has revealed a dearth of studies from Pakistan, particularly from the pediatric nursery of Civil Hospital Karachi, Pakistan. As Civil Hospital Karachi is one of the largest public sector hospitals that cater to patients from almost all corners of the Sindh province and is overburdened with severe cases most of the time, identifying the most effective scoring system can lead to the optimization of diagnostic practices, ensuring timely and accurate assessments that are crucial for effective clinical decision-making.

## METHODOLOGY

This descriptive cross-sectional study was conducted over six months in the neonatal nursery of the Pediatric Department at Dr. Ruth K. M. Pfau Civil Hospital, Karachi, Pakistan, from July - December 2024. The approval of the research synopsis by the Institutional Review Board of Dow University of Health Sciences was obtained before the commencement of the study (IRB-3424/DUHS/Approval/2024/81).

Neonates within the first 24 hours of the life of both genders, including both term infants (≥37 weeks gestation) and preterm infants (28–34 weeks gestation), were included through a non-probability consecutive sampling method. Neonates with congenital anomalies affecting respiratory function, such as congenital heart disease or metabolic disorders, or those diagnosed with birth asphyxia, hypoxic-ischemic encephalopathy, or neuromuscular conditions, such as spinal muscular atrophy, were excluded. Additionally, neonates on mechanical ventilation at the time of assessment were not eligible for inclusion.

Epi Info sample size calculator is used to estimate the sample size. Taking a confidence interval of 95%, margin of error of 5%, and reported prevalence of respiratory distress in patients with higher Silverman-Anderson scores of 79%[12], the estimated sample size was 255.

Respiratory distress was defined as the presence of tachypnea (respiratory rate >60 breaths per minute), retractions (visible inward movements of the chest wall during inspiration), grunting (audible sounds during expiration), or cyanosis (bluish discoloration of the skin or mucous membranes). The Silverman-Anderson scoring system assessed respiratory distress using five criteria: upper thoracic depression, lower thoracic depression, subxiphoid depression, nasal flaring, and expiratory grunting, with each criterion scored 0, 1, or 2. The Downes scoring system evaluated respiratory distress based on five parameters: respiratory frequency, cyanosis, three concave signs, grunting, and lung sounds. It also scored on a 0–2 scale. Higher scores in both systems indicated greater severity of respiratory distress.

Data collection commenced after obtaining informed consent from parents or guardians of eligible neonates. A trained team comprising pediatric residents and neonatal nurses conducted data collection in rotational shifts to ensure round-the-clock coverage, including weekends and night hours. Baseline information such as the age of the neonate, gender, birth weight, mode of delivery, and gestational age was recorded at the time of admission. Both the Silverman-Anderson and Downes scoring systems were applied independently by two trained assessors to minimize inter-observer variability and ensure consistency. Scoring was conducted at predefined intervals during the initial 24 hours of life. All data were first documented on standardized paper-based forms and later entered into a secured Microsoft Excel database by a designated research assistant who maintained daily logs and ensured data quality through periodic cross-verification.

Statistical Package for Social Sciences (SPSS) version 24 was used for data analysis. Inferential statistics were explored using the Chi-Square test and independent t-test. The p-value was found to be significant at $<0.05$. The effectiveness of the scoring systems was evaluated using positive predictive value (PPV), negative predictive value (NPV), sensitivity, specificity, and overall diagnostic accuracy. The area under the receiver operating characteristic curve (AUC-ROC) was used to assess the overall diagnostic accuracy of each scoring system.

## RESULTS

Of 255 patients, the mean gestational age of the newborn was 36.09±2.79 weeks. There were 145(56.9%) males and 110(43.1%) females. The mean birth weight of the newborn was 2.49±0.68 kg. Vaginal delivery was reported by 106(41.6%) and cesarean section by 149(58.4%) newborns.

The score of the Silverman-Anderson Scale showed the mean score was 4.65±2.01, and Downes scoring was 4.29±2.21. There were 130(51%) newborns with 5-10 Silverman-Anderson scores and 132(51.8%) with 5-10 Downes scores.

Respiratory distress was observed in 67 (26.3%) newborns. A significant association of respiratory distress was observed with the mode of delivery (p-value 0.002) and need for respiratory support at 4 hours (p-value <0.001), at 12 months (p-value <0.001), and at 24 months (p <0.001). (**Table I**)

Diagnostic accuracy of the Silverman-Anderson Scale in predicting respiratory distress showed that the sensitivity was 91.04%, specificity 63.3%, PPV 46.92%, NPV 95.2%, and overall diagnostic accuracy 70.59%. The diagnostic accuracy of Downes scoring in predicting respiratory distress showed that the sensitivity was 94.03%, specificity 68.09%, PPV 51.22%, NPV 96.97%, and diagnostic accuracy 74.09%. (**Table II**)

The AUC of Silverman-Anderson Scoring in predicting respiratory distress was found to be 0.831 (95% CI 0.78 to 0.89), whereas Downes scored 0.885 (95% CI 0.84 to 0.93). (**Figure 1**)

**Table I: Comparison of respiratory distress, Silverman-Anderson Scale scoring, and Downes Scoring with general characteristics of the newborn (n=255)**

| Variables | Total | Respiratory Distress | | p-value | Silverman-Anderson scale | | p-value | Downes Score | | p-value |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Yes | No | | 0-4 | 5-10 | | 0-4 | 5-10 | |
| | | n=67 | n=188 | | n=125 | n=130 | | n=132 | n=123 | |
| **Gestational age, weeks** | 36.09 ±2.79 | 36.07 ±2.66 | 36.11 ±2.84 | 0.932 | 35.94±3.07 | 36.25 ±2.51 | 0.384 | 35.91±3.13 | 36.30 ±2.38 | 0.260 |
| **Birth Weight, kg** | 2.49 ±0.68 | 2.47 ±0.72 | 2.51 ±0.66 | 0.428 | 2.51±0.72 | 2.48 ±0.64 | 0.711 | 2.53±0.72 | 2.46 ±0.63 | 0.435 |
| **Gender** | | | | | | | | | | |
| Male | 145 (56.9) | 36 (24.8) | 109 (75.2) | 0.547 | 74 (51.0) | 71 (49.0) | 0.460 | 78 (53.8) | 67 (46.2) | 0.457 |
| Female | 110 (43.1) | 31 (28.2) | 79 (71.8) | | 51 (46.4) | 59 (53.6) | | 54 (49.1) | 56 (50.9) | |
| **Mode of Delivery** | | | | | | | | | | |
| C-Section | 106 (41.6) | 39 (36.8) | 67 (63.2) | 0.002 | 51 (48.1) | 55 (51.9) | 0.807 | 58 (54.7) | 48 (45.3) | 0.426 |
| Vaginal Delivery | 149 (58.4) | 28 (18.8) | 121 (81.2) | | 74 (49.7) | 75 (50.3) | | 74 (49.7) | 75 (50.3) | |
| **Need for Respiratory Support** | | | | | | | | | | |
| at 4 hours since birth | 16 (6.3) | 16 (100) | 0 (0) | <0.001 | 0 (0) | 16 (100) | <0.001 | 0 (0) | 16 (100) | <0.001 |
| 12 hours since birth | 36 (14.1) | 36 (100) | 0 (0) | <0.001 | 0 (0) | 36 (100) | <0.001 | 0 (0) | 36 (100) | <0.001 |
| 24 hours since birth | 67 (26.3) | 66 (98.5) | 1 (1.5) | <0.001 | 6 (9.0) | 61 (91.0) | <0.001 | 4 (6.0) | 63 (94.0) | <0.001 |

Independent t-test applied, Chi-Square test applied, p-value <0.05 considered as significant

**Table II: Diagnostic accuracy of Silverman-Anderson Scale and Downes Score in predicting respiratory distress (n=255)**

| | Respiratory Distress | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Yes** | **No** | **Se** | **Sp** | **PPV** | **NPV** | **Overall Diagnostic Accuracy** |
| **Silverman-Anderson Scale** | | | | | | | |
| 5-10 | 61 | 69 | 91.04% | 63.30% | 46.92% | 95.20% | 70.59% |
| 0-4 | 6 | 119 | | | | | |
| **Downes Score** | | | | | | | |
| 5-10 | 63 | 60 | 94.03% | 68.09% | 51.22% | 96.97% | 74.90% |
| 0-4 | 4 | 128 | | | | | |

Se: Sensitivity, Sp: Specificity, PPV: Positive Predicted Value, NPV: Negative Predicted Value

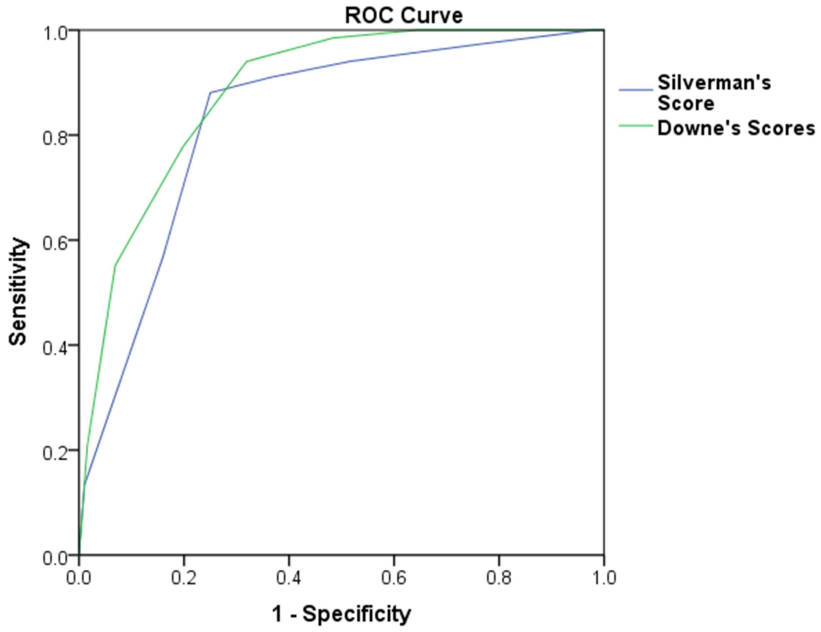


**Figure I: Receiver operating curve value in predicting respiratory distress for Silverman-Anderson Scoring and Downes Scoring**

## DISCUSSION

This study focused on comparing the predictive efficacy of the Silverman-Anderson and Downes scoring systems for assessing respiratory distress in neonates. The findings revealed that both scoring systems are effective, but the Downes scoring system demonstrated slightly better diagnostic accuracy, sensitivity, and specificity. In the current study, the Downes scoring system reported an overall diagnostic accuracy of 74.90% compared to 70.59% for the Silverman-Anderson scale and an AUC-ROC of 0.885 versus 0.831 for the Silverman-Anderson scale. Previous studies, such as those by **Kshirsagar et al. (2019)**[13] and **Shrestha et al. (2021)**[14], highlighted the effectiveness of non-invasive scoring systems like the Silverman-Anderson and Downes scales in diagnosing respiratory distress in neonates. Similar to the current findings, earlier studies noted that these scoring systems provide reliable and structured clinical assessments, reducing the need for invasive procedures. In a study by **Zhao et al.,** the author reported comparable sensitivities and specificities for the Silverman-Anderson and Downes scores.[15] However, they emphasized the importance of clinical context, such as shorter time for evaluation, in interpreting these scores. In another study, **Hedstrom et al.** reported that the Silverman-Anderson respiratory severity score has higher efficacy in preterm infants.[16] While Shashidhar et al. reported a higher efficacy of Downes score.[8] The present study aligns with these findings. Still, it provides additional insights by showing a statistically significant advantage of the Downes score regarding overall diagnostic accuracy and AUC-ROC values.

Consistent with prior research, such as the work of Baumert et al., this study found a significant association between the mode of delivery and respiratory distress.[17] Neonates delivered via cesarean section showed a higher incidence of respiratory distress, highlighting the need for careful monitoring in such cases. A study conducted by **Li et al.** in 2019 reported the risk of neonatal risk for respiratory distress as almost two times higher for individuals with elective cesarean and emergency cesarean section.[18] **Al-Bizri et al.** didn't find a considerable impact of cesarean section at 38 weeks; however, they observed a significant impact at 37 weeks of gestation.[19] **Nakhara et al**. reported that women who had a cesarean delivery and premature rupture of the membrane were found to be at higher risk for neonatal respiratory distress.[20] Whereas in a study by **Tsunoda et al.**, it was reported that women with singleton pregnancy among late preterm mothers who did not receive antenatal corticosteroids before cesarean delivery were found to be at the higher risk.[21] Similarly, neonatal respiratory distress risk was reported to be higher among women with cesarean section among late preterm in a study by **Rahmawati et al.** too.[22]

The current study has several strengths. Firstly, the current research has addressed a significant, prevalent issue in Pakistan.[23-25] Secondly, it provides a direct comparison of two established scoring systems, the Silverman-Anderson and Downes scales, offering valuable evidence for their diagnostic efficacy in assessing neonatal respiratory distress. Furthermore, the comprehensive analysis of diagnostic metrics, such as sensitivity, specificity, and AUC-ROC, thoroughly evaluates the scoring systems' performance. The findings suggest that while the Silverman-Anderson and Downes scores are valuable, the Downes scoring system may be preferable for routine clinical use due to its superior diagnostic accuracy. Moreover, the observed associations between mode of delivery and respiratory distress reported the significance of perinatal factors in predicting respiratory distress among neonates. However, the study also has limitations that warrant consideration. The single-center design limits the generalizability of the findings to other settings, particularly rural or under-resourced healthcare facilities. As a cross-

sectional study, it is inherently limited in establishing causation, and the observational nature introduces potential for inter-observer variability in scoring. The exclusion of neonates with congenital anomalies, birth asphyxia, or those on mechanical ventilation may have underestimated the performance of the scoring systems for the most severe cases of respiratory distress.

Furthermore, the study lacks longitudinal data, leaving the long-term predictive value of these scoring systems unexplored. While focusing on non-invasive tools is a strength, the absence of advanced diagnostic modalities, such as blood gas analysis, limits a more comprehensive assessment. Additionally, the findings are constrained by geographical and socioeconomic factors, making them less applicable to high-income settings with access to advanced neonatal care. The lack of external validation and the omission of correlations with biomarkers further restrict the scope of the study.

To address these limitations, it is recommended that multicenters be included in the future to improve generalizability and external validation. Studies should also evaluate inter- and intra-observer reliability to minimize bias and explore the integration of these scoring systems with advanced diagnostic tools. Expanding the inclusion criteria to cover more severe cases and assessing long-term outcomes would further enhance the understanding of the efficacy of these scoring systems.

## CONCLUSION

Although both systems were found to have a high diagnostic performance, the Downes score was found to have higher diagnostic accuracy and predictive value in our cohort of Civil Hospital Karachi.

**Ethical permission:** Dow University of Health Sciences, Karachi ERC letter No. IRB-3424/DUHS/Approval/2024/81.

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**Data Sharing Statement:** The corresponding author can provide the data proving the findings of this study on request. Privacy or ethical restrictions bound us from sharing the data publicly.

## AUTHOR CONTRIBUTION

Memon AS: Substantial contributions to the conception or design of the research
Rafique M: Substantial contributions to the conception or design of the research
Lail A: Acquisition, analysis or interpretation of data for the research, drafting
Khalid Z: Acquisition, analysis or interpretation of data for the research, drafting
Sattar KA: Acquisition, analysis or interpretation of data for the research, drafting
Danish MS: Acquisition, analysis or interpretation of data for the research, drafting

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