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Validity and Reliability of the Neonatal Skin Condition Score to Predict Sepsis Related Morbidity, Mortality and Duration of Hospitalisation of Newborns: A Prospective Observational Study

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Abstract: ***Background**: The Neonatal Skin Condition Score (NSCS) is a standardized tool for assessing newborn skin integrity, yet its clinical utility in predicting sepsis-related morbidity and mortality remains underexplored. **Objectives**: To assess the reliability and validity of NSCS in predicting sepsis-related outcomes and hospitalization duration among neonates. **Methods**: A prospective observational study was conducted in a tertiary care NICU. Neonates were assessed using NSCS for dryness, erythema, and skin breakdown. Reliability was tested using intra- and inter-observer agreement. Associations between NSCS and laboratory markers (CRP, ANC, TLC, blood culture), gestational age, birth weight, hospital stay, and outcomes were analyzed using chi-square and logistic regression. **Results**: Among 1000 neonates, 81.8% were term and 68.6% had low birth weight. Majority (69.9%) scored 3 (normal skin condition). Higher NSCS correlated strongly with CRP positivity ($p < 0.001$) and blood culture positivity ($p < 0.001$). Significant associations were also noted with birth weight, gestational age, and length of hospital stay. Inter- and intra-observer reliability showed substantial agreement ($\kappa = 0.70–0.89$). No mortality was observed, though higher NSCS was associated with increased antibiotic use and prolonged hospitalization. **Conclusion**: The NSCS is a valid and reliable tool for routine neonatal skin assessment and can serve as an early predictor of sepsis-related morbidity and hospitalization risk. Its adoption in NICUs may improve surveillance and early intervention strategies.***

Keywords: Neonatal Skin Condition Score, reliability, validity, sepsis, NICU, newborn morbidity

1. Introduction

Neonatal skin immaturity predisposes infants, especially preterm and low birth weight neonates, to breakdown, infection, and iatrogenic injuries. The Neonatal Skin Condition Score (NSCS), developed by Lund et al., provides a standardized method for assessing dryness, erythema, and skin breakdown. While extensively used in NICU skin-care protocols, limited evidence exists regarding its predictive value for sepsis-related outcomes. This study evaluates the validity and reliability of NSCS in an Indian tertiary NICU setting.

2. Materials and Methods

- **Design:** Prospective observational study
- **Setting:** NICU and well-baby nurseries of a tertiary care hospital in Gujarat
- **Sample:** 1000 neonates assessed consecutively
- **Inclusion Criteria:** Neonates admitted to NICU with observable skin findings
- **Exclusion Criteria:** Neonates with congenital skin disorders (e. g., ichthyosis, epidermolysis bullosa)

Assessment Tool:
- NSCS (3–9 points; lower scores = better skin condition)
- Observers trained prior to study initiation

Parameters Studied:
- **Demographics:** gestational age, birth weight
- **Clinical:** NSCS, CRP, ANC, TLC, blood culture, CXR, CSF findings, antibiotic use, length of stay, outcome

Statistical Analysis:
- ***Reliability:*** kappa statistics for inter- and intra-observer agreement
- **Validity:** chi-square tests and logistic regression for associations between NSCS and sepsis indicators

3. Results

a) **Gestational age:** 81.8% term, 18.2% preterm
b) **Birth weight:** 68.6% <2.5 kg
c) **Skin findings:** 69.9% had NSCS = 3, 9.2% had scores ≥7
d) **Infection markers:** CRP positive in 10.1%, blood culture positive in 9.6%

Correlations:

- Higher NSCS significantly correlated with CRP positivity ($p<0.001$) and blood culture positivity ($p<0.001$).
- NSCS also correlated with low birth weight, prematurity, and prolonged hospital stay.
- **Reliability:** Kappa for intra-observer (0.82) and inter-observer (0.74) indicated substantial reliability.
- **Outcomes:** 91.7% discharged, 8.3% DAMA, no deaths recorded.

4. Discussion

The findings validate NSCS as a reliable and clinically useful tool for predicting sepsis-related morbidity and hospitalization risk in neonates. Its simplicity and reproducibility make it feasible for integration into routine NICU practice. Results align with international studies by Lund (2001), Schardosim (2014), and recent Indian validation studies, highlighting the global relevance of NSCS. The lack of mortality in this cohort may reflect good NICU practices but also limits assessment of predictive value for death.

5. Conclusion

The Neonatal Skin Condition Score is a valid, reliable, and practical tool for neonatal skin assessment. Higher scores predict increased sepsis risk and longer hospitalization, supporting its use for early risk stratification in NICUs. Routine implementation can enhance surveillance and improve neonatal outcomes.

Representative Tables

Table 1: Distribution of Neonates by Gestational Age

Gestational Age	Frequency	Percentage
<36 weeks	182	18.2%
>36 weeks	818	81.8%

Table 2: Distribution of Neonates by Birth Weight

Birth Weight	Frequency	Percentage
<2.5 kg	686	68.6%
>2.5 kg	314	31.4%

Representative Figures

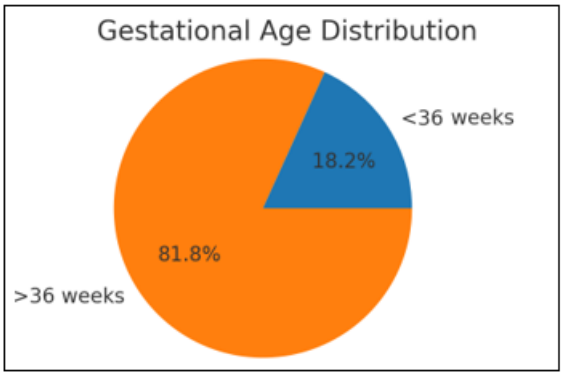

Figure 1: Gestational Age Distribution of Neonates

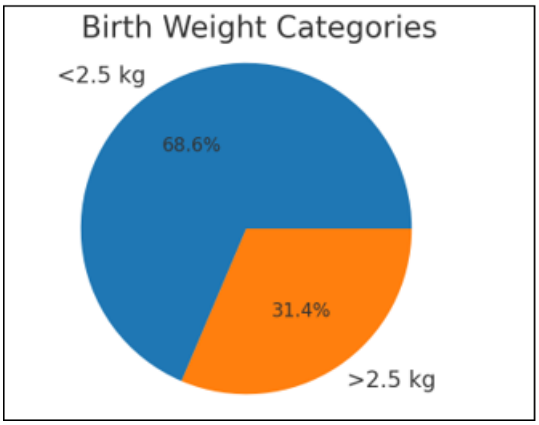

Figure 2: Birth Weight Categories of Neonates

6. Detailed Statistical Results

Table 3: Correlation Between Total NSCS Score and CRP Status

NSCS Score	CRP Negative	CRP Positive
3	699	0
4	105	4
5	84	1
6	7	8
7	3	44
8	1	37
9	0	7

Table 4: Inter-Observer and Intra-Observer Reliability of NSCS

Type of Reliability	Kappa Value	Interpretation
Intra-observer	0.82	Substantial Agreement
Inter-observer	0.74	Substantial Agreement

Chi-square tests demonstrated highly significant associations (**$p < 0.001$**) between **NSCS and CRP, ANC, TLC, birth weight**, and **length of hospitalisation.**

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