

Research Article

Neurobehavioral Assessment of Newborns Using the Modified Brazelton Neonatal Behavioral Assessment Scale: Relationship with Gestational Age and Birth Weight

Dr. Suresh¹, Dr. Manjusha C^{2*}, Dr. Ramprakash³

¹Professor, Department of Paediatrics, Sree Mookambika Institute of Medical Sciences, Kulasekaran, Kanyakumari.

^{2*}Junior Resident, Department of Paediatrics, Sree Mookambika Institute of Medical Sciences, Kulasekaran, Kanyakumari.

³Junior Resident, Department of Paediatrics, Sree Mookambika Institute of Medical Sciences, Kulasekaran, Kanyakumari.

Corresponding Author: Dr Manjusha C

Junior Resident, Department of Paediatrics, Sree Mookambika Institute of Medical Sciences, Kulasekaran, Kanyakumari.

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ABSTRACT

Background: The neonatal period represents a crucial stage of brain maturation during which newborns adapt rapidly to life outside the uterus. Assessment of neonatal neurobehavior provides valuable information regarding neurological integrity, behavioural organization, and developmental maturity. The Modified Brazelton Neonatal Behavioral Assessment Scale (MNBAS) is a standardized instrument that evaluates multiple domains of neonatal behaviour, including habituation, orientation, motor performance, behavioural state regulation, autonomic stability, and primitive reflexes. Since gestational age and birth weight are important determinants of neurological maturity, understanding their influence on neonatal neurobehavior may facilitate early identification of infants at risk for developmental impairment.

Objectives:

Primary Objectives

- To assess the neurobehavioral profile of newborns using the Modified Brazelton Neonatal Behavioral Assessment Scale.
- To evaluate the relationship between neurobehavioral performance and gestational age.
- To determine the association between birth weight and neurobehavioral assessment scores.

Secondary Objectives

- To compare neurobehavioral performance according to gender.
- To evaluate the influence of mode of delivery on neonatal neurobehavior.

Materials and Methods: A prospective hospital-based observational study was conducted over a one-year period in the Department of Paediatrics, Sree Mookambika Institute of Medical Sciences, Kulasekaram. Eighty eligible newborns were enrolled after obtaining informed parental consent. Neurobehavioral assessment was carried out within the first 72 hours after birth using the Modified Brazelton Neonatal Behavioral Assessment Scale under standardized environmental conditions. Maternal and neonatal clinical details, including gestational age, birth weight, gender, mode of delivery, Apgar score, and anthropometric measurements, were recorded. Data were analysed using appropriate descriptive and inferential statistical methods. A p-value less than 0.05 was considered statistically significant.

Results: Among the eighty newborns studied, term infants demonstrated significantly higher neurobehavioral scores than preterm infants. Newborns with normal birth weight performed better across most behavioural domains than low birth weight infants. Gestational age showed a significant positive correlation with the overall MNBAS score, while birth weight demonstrated a moderate positive correlation with neurobehavioral performance. No significant differences were observed with respect to gender or mode of delivery.

Conclusion: The Modified Brazelton Neonatal Behavioral Assessment Scale is a practical and reliable tool for evaluating neonatal neurobehavior in routine clinical practice. Increasing gestational age and birth weight are associated with improved neurobehavioral performance, emphasizing the

importance of early behavioural assessment in identifying newborns who may benefit from developmental surveillance and early intervention.

Keywords: Newborn, Neurobehavior, Modified Brazelton Neonatal Behavioral Assessment Scale, Gestational Age, Birth Weight, and Neurodevelopment.

INTRODUCTION

The neonatal period is a unique phase of human life characterized by rapid physiological and neurological adaptation following birth. During this time, the central nervous system undergoes significant functional maturation, enabling the newborn to respond appropriately to environmental stimuli. Assessment of neonatal neurobehavior serves as an important indicator of brain maturity and provides insight into the infant's ability to regulate behaviour, maintain physiological stability, and interact with the surrounding environment.

Conventional neurological examination primarily focuses on muscle tone, posture, and primitive reflexes. Although these assessments remain essential, they may not adequately evaluate behavioural competence or the functional integrity of the developing nervous system. Neurobehavioral assessment complements routine neurological examination by providing a broader understanding of behavioural organization, sensory responsiveness, autonomic regulation, motor performance, and state control during the neonatal period.

The Brazelton Neonatal Behavioral Assessment Scale (NBAS), introduced by T. Berry Brazelton, is widely recognized as one of the most comprehensive tools for evaluating neonatal behaviour. It assesses the infant's capacity to respond to visual, auditory, and tactile stimuli while simultaneously evaluating behavioural regulation and neurological maturity. The Modified Brazelton Neonatal Behavioral Assessment Scale (MNBAS) simplifies this assessment, making it more practical for routine clinical use without compromising its diagnostic value.

Gestational age is an important determinant of neonatal neurological development. As fetal maturation progresses, significant structural and functional changes occur within the brain, resulting in improved motor control, behavioural organization, sensory processing, and autonomic regulation. Consequently, term infants generally demonstrate superior neurobehavioral performance compared with preterm newborns.

Birth weight also plays an important role in determining neonatal neurodevelopment. Infants with low birth weight frequently exhibit

delayed neurological maturation due to incomplete intrauterine growth, reduced brain volume, and increased vulnerability to perinatal complications. These factors may adversely influence behavioural responses during the early neonatal period and increase the risk of long-term developmental impairment.

Early identification of neurobehavioral abnormalities is essential because many developmental disorders originate during the neonatal period but become clinically apparent only later in infancy. Systematic neurobehavioral assessment enables healthcare professionals to identify vulnerable newborns at an early stage, initiate developmental interventions, counsel parents, and establish appropriate follow-up programmes. Such early interventions have been shown to improve cognitive, motor, language, and behavioural outcomes among high-risk infants.

Although several international studies have evaluated neonatal neurobehavior using the Brazelton scale, published Indian data remain limited. Most available studies focus on neurological examination or developmental follow-up rather than comprehensive behavioural assessment during the immediate neonatal period. Furthermore, information regarding the relationship between gestational age, birth weight, and MNBAS scores in Indian newborns is scarce.

The present study was therefore undertaken to evaluate the neurobehavioral profile of newborns using the Modified Brazelton Neonatal Behavioral Assessment Scale and to examine its relationship with gestational age and birth weight in a tertiary care teaching hospital. The findings are expected to contribute to improved developmental surveillance and facilitate early identification of newborns requiring intervention.

MATERIALS AND METHODS

Study Design: A prospective hospital-based observational study was conducted.

Study Setting: The study was carried out in the Department of Paediatrics, Sree Mookambika Institute of Medical Sciences (SMIMS), Kulasekaram, Tamil Nadu, over a period of one year.

Study Population: The study included 80 newborns who fulfilled the eligibility criteria.

Inclusion Criteria:

- Live-born newborns examined within 72 hours of birth.
- Gestational age between 34 and 42 weeks.
- Parents willing to provide informed consent.

Exclusion Criteria:

- Major congenital anomalies.
- Chromosomal abnormalities.
- Severe birth asphyxia.
- Neonates with serious neurological illness or seizures.
- Critically ill newborns requiring prolonged ventilatory support.

Study Procedure:

After obtaining Institutional Ethics Committee approval and written informed consent, maternal and neonatal demographic details were recorded. Gestational age was assessed using obstetric history and the New Ballard Score where indicated. Birth weight was measured using a calibrated electronic weighing scale.

Neurobehavioral assessment was performed within the first 72 hours of life using the Modified Brazelton Neonatal Behavioral Assessment Scale (MNBAS) by a trained investigator under standardized conditions. The assessment included habituation, orientation, motor system, state organization, state regulation, autonomic stability, and primitive reflexes.

Statistical Analysis:

Data were entered into Microsoft Excel and analysed using SPSS version 26. Continuous variables were expressed as mean $\pm$ standard deviation, while categorical variables were expressed as frequency and percentage. Student's *t*-test, Chi-square test, ANOVA, and Pearson's correlation coefficient were used as appropriate. A *p*-value <0.05 was considered statistically significant.

RESULTS

A total of 80 newborns were included in the study. The mean gestational age was 37.8 ± 1.8 weeks, and the mean birth weight was 2.91 ± 0.49 kg. There were 44 (55%) males and 36 (45%) females. Most newborns were delivered by normal vaginal delivery (60%) and were born at term (77.5%).

Table 1. Baseline Characteristics of the Study Population (N = 80)

Variable	Value
Mean gestational age (weeks)	37.8 ± 1.8
Mean birth weight (kg)	2.91 ± 0.49
Male	44 (55%)
Female	36 (45%)
Normal vaginal delivery	48 (60%)
Caesarean section	32 (40%)

Table 2. Distribution According to Gestational Age and Birth Weight

Variable	Number (%)
Preterm (<37 weeks)	18 (22.5%)
Term (37–41 weeks)	62 (77.5%)
Low birth weight (<2.5 kg)	16 (20%)
Normal birth weight (≥ 2.5 kg)	64 (80%)

Table 3. Correlation between Gestational Age and Total MNBAS Score

Variable	Correlation (r)	p-value
Gestational age	0.62	<0.001

There was a strong positive correlation between gestational age and total neurobehavioral score, indicating improved neurobehavioral

performance with increasing gestational maturity.

Table 4. Correlation between Birth Weight and Total MNBAS Score

Variable	Correlation (R)	P-Value
Birth weight	0.54	<0.001

Birth weight showed a moderate positive correlation with neurobehavioral performance.

Newborns with higher birth weight had significantly better MNBAS scores.

Table 5. Association of Gender and Mode of Delivery with Neurobehavioral Score

Variable	Mean MNBAS Score	p-value
Male	31.9 ± 4.8	0.68
Female	31.7 ± 5.0	
Vaginal delivery	32.2 ± 4.7	0.32
Caesarean section	31.3 ± 5.1	

No statistically significant association was observed between neurobehavioral scores and gender or mode of delivery.

Summary of Results

- Term newborns had significantly higher neurobehavioral scores than preterm newborns.
- Birth weight showed a significant positive association with MNBAS scores.
- Gestational age demonstrated the strongest correlation with neonatal neurobehavior.
- Gender and mode of delivery did not significantly influence neurobehavioral performance

DISCUSSION

The present prospective hospital-based observational study evaluated the neurobehavioral characteristics of newborns using the Modified Brazelton Neonatal Behavioral Assessment Scale (MNBAS) and examined their association with gestational age and birth weight. The findings demonstrated that increasing gestational age and birth weight were associated with better neurobehavioral performance, indicating that these factors are important determinants of neonatal neurological maturity.

In the present study, term newborns achieved significantly higher MNBAS scores than preterm newborns across most behavioural domains, including orientation, motor performance, state regulation, and autonomic stability. This finding reflects the progressive maturation of the central nervous system during late gestation and is consistent with the established understanding that neurological and behavioural functions improve with advancing gestational age.

A significant positive correlation was observed between gestational age and overall neurobehavioral score, suggesting that infants born closer to term demonstrate greater behavioural organization and adaptive capacity. Similar observations have been reported in

previous studies using the Brazelton Neonatal Behavioral Assessment Scale, where preterm infants exhibited reduced behavioural competence compared with term infants.

Birth weight also showed a significant positive association with neurobehavioral performance. Newborns with normal birth weight demonstrated better behavioural responses than low birth weight infants. This may be attributed to improved intrauterine growth, better brain maturation, and reduced exposure to perinatal complications among infants with adequate birth weight.

The present study did not demonstrate a significant association between neurobehavioral performance and gender or mode of delivery. Male and female newborns showed comparable behavioural responses, while the mode of delivery did not appear to influence neurobehavioral outcomes during the early neonatal period. These findings are in agreement with several previous studies, suggesting that gestational maturity and birth weight have a greater influence on neonatal behaviour than demographic factors.

The Modified Brazelton Neonatal Behavioral Assessment Scale proved to be a practical bedside tool for assessing neonatal neurobehavior. Its comprehensive evaluation of behavioural organization, motor function, autonomic regulation, and reflexes allows early recognition of newborns who may require closer developmental surveillance. Incorporating standardized neurobehavioral assessment into routine neonatal practice may facilitate early intervention and improve long-term developmental outcomes.

CONCLUSION

The Modified Brazelton Neonatal Behavioral Assessment Scale is a reliable and clinically useful instrument for evaluating neonatal neurobehavior. Gestational age and birth weight were significantly associated with neurobehavioral performance, with term and normal birth weight newborns demonstrating better behavioural organization and

neurological maturity than preterm and low birth weight infants. Early neurobehavioral assessment may assist in identifying newborns at risk for developmental delay and facilitate timely intervention and structured developmental follow-up.

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