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To Analyze the Risk Factors That Have Contributed to The Neurobehavioral Profiles

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ABSTRACT

Background: The term ―neurobehavior is used broadly to reflect the idea that all human experiences have both psychosocial and biological contexts. Biological and behavioural systems dynamically influence each other and are dependent upon neural feedback for optimal synergistic functioning. Neurobehavior reflects the interface of behavior and physiology. Objective: To analyze the risk factors that have contributed to the neurobehavioral profiles.

Material and Methods: This is single center descriptive study with prospective data collection carried out at tertiary hospital, KIMS hospital Bengalore between December 2019 to June 2021.

Results:advanced maternal age has increased chances of delivery of SGA babies and also affects neurobehaviour pattern of newborn in SGA babies. AGA babies delivery is more with high maternal education status compared to SGA babies. Low maternal education was associated with abnormal neurobehaviour pattern of SGA babies. Lower socio economic status is associated with increased incidence of SGA babies.

Conclusion:NNNS scale offers us an insight into factors like demographic, medical as well as non medical variables affecting early newborn behaviour and developmental pathways thus allowing for early identification and management of neurobehavioural problems associated with these risk factors.

Keywords:NNNS scale, neurobehavioural problems, risk factors.

INTRODUCTION

Neonatal neurobehavioral assessments not only guide clinical decisions regarding care in the Neonatal Intensive Care Unit (NICU), but also help to determine which infants will need long-term support via targeted therapeutic interventions and the early involvement of specialist developmental services following hospital discharge.[1]

Newborn assessments typically have at least one of three primary objectives:

1. To identify high-risk infants with CNS and neurobehavioral disturbances in need of treatment and/or intervention,
2. To evaluate developmental progress in response to NICU interventions and family-centered therapies, and/or
3. To prognosticate longer-term neurodevelopmental outcomes.[2]

The behavioral organization of the premature infant is also predictive of later health and behavioral difficulties. In the same study with their sample of premature infants, it was

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observed that; premature birth and a profile of under arousal on the Neonatal Intensive Care Unit Network Neurobehavioral Scales predicted 26% of the variance in low motor performance on the Bayley Scales of Infant Development at 24 months. Also it was found that lower Neonatal Behavioral Assessment Scale scores for motor and state control in very-low-birthweight neonates could be used to correctly classify 50–75% of children showing high levels of behavioral problems in middle childhood (ages 7–8 years).[3]
A relative strength of the NNNS is its flexible administration that takes the arousal state of the infant into account. Also from an infantcentered perspective, the NBAS focuses on behavioral strengths and views the infant as an active participant who is capable of communicating through behavior. Among all the assessments, the NNNS is considered the most comprehensive as it integrates principals and components from the NBAS, NAPI, and APIB.[1,4]

MATERIAL &METHODS

This is single center descriptive study with prospective data collection carried out at tertiary hospital, KIMS hospital Bengalore between December 2019 to June 2021. Study was approved by research ethical committee of KIMS hospital. Informed consent from mother of term (>37weeks) newborns was taken. Gestational age was calculated from last menstrual date and confirmed by modified Ballard's scoring system.

Inclusion Criteria

All term (>37 weeks of gestational age) neonates in postnatal wards and NICU of KIMS hospital.

Exclusion Criteria

1.Preterm babies
2.Babies with major congenital anomalies which can affect neurobehaviour pattern

Study variables

1.Socio demographic variables: Age, education, occupation, income, and family structure, social support, consanguinity, married life (duration)
2.Maternal medical conditions like, infection, gestational diabetes, hypertension, thyroid related issues, Pre-pregnancy weight, weight gain during pregnancy.
3.Maternal non-medical conditions: Stress, anxiety and depression
4.Newborn: mode of delivery, sex, gestational age, APGAR score, anthropometry and examination findings were obtained
5.NNNS scale applied to study the neurobehavioural pattern in newborn.

- The neurobehavioral patterns was assessed using NNNS scale at 48 to 72hours of birth or at the time of discharge (mean 5 days) by the investigator in between the feeds.
- The examination was performed on infants who are medically stable, preferably in an open crib and in calm, dimly lit and warm room.
- NNNS scale was administered in a fixed sequence, that starts with a pre-examination observation, followed by the neurologic and behavioural components.
- The stress/abstinence scale is based on signs of stress observed throughout the examination and the order of administration is relatively invariant.
- NNNS scale is a scale that assesses neurological integrity, behavioural function and presence of signals of stress and abstinence in newborn. Reliability of NNNS was verified periodically in order to detect and correct possible discrepancies.

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- After assessment NNNS scale was divided into 13 summary scores: Habituation, Attention, Arousal, Regulation, Number of Handling Procedures, Quality of Movement, Excitability, Lethargy, Number of Nonoptimal Reflexes, Number of Asymmetric Reflexes, Hypertonicity, Hypotonicity, and Stress/Abstinence signs.
- Pre-examination was done before applying the NNNS scale. Initial state observations like sleep, asleep, covered or covered done
- Habituation was done by observing response decrement to light, response decrement to rattle, response decrement to bell
- After unwrapping and when newborn is in supine posture, skin color, skin texture, movement response decrement to tactile stimulation of the foot was observed.
- Lower extremity reflexes-following items were performed plantar grasp, babinski,ankle clonus, leg resistance, leg recoil, power of active leg movements, popliteal angle
- Upper extremities and facial reflexes were done by doing scarf sign, forearm resistance, forearm recoil, power of active arm movements, rooting, sucking, hand grasp, truncal tone and pull-to-sit
- Upright responses got by placing, stepping, ventral suspension and incurvation
- It was observed prone, crawling, stimulation needed, and head raise in prone
- After picking up infant cuddle in arm, or cuddle on shoulder
- When newborn is supine on examiner's laporientation (order not predetermined): animate visual and auditory, animate visual, animate auditory, inanimate visual and auditory, inanimate visual and inanimate auditory were observed.

RESULTS

In our study, total 160 term newborns were assessed and in that, 66 babies were SGA and 94 babies were AGA. NNNS scale was applied to assess neurobehaviour pattern of newborn babies at 48 hours to 72 hours of life. This scale has 13 summary score and these scores were assessed and compared between SGA and AGA newborns. Decreased mean value or increased mean value indicate abnormal neurobehaviour pattern.

Table 1: Maternal age distribution in study group.

Age (yrs)	SGA	AGA	Total
21 - 25	25	38	63
26 - 30	36	54	90
31 - 35	5	2	7
Total	66	94	160

Maternal age distribution in AGA, showing 21-25 years mothers are 40%, 26-30 years are 58% and 31 – 35 years are 2%.

It was found that advanced maternal age has increased chances of delivery of SGA babies and also affects neurobehaviour pattern of newborn in SGA babies like decreased habituation observed in 4 babies, regulation in 6 babies, handling 7 babies and increased hypotonia in 4 babies and stress abstinence in 6 babies. In AGA babies it was found that decreased habituation found in 4 babies, regulation in 3 babies and increased hypotonia in 5babies and stress/abstinence in 4 babies.

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Table 2: Maternal education

Education	SGA	AGA	Total
Primary	1	3	4
Secondary	2	4	6
High school	18	29	47
PUC	15	19	34
Diploma	4	8	12
Graduation	22	23	45
Post Graduation	3	8	11
Uneducated	1	0	1
Total	66	94	160

Maternal education in AGA group, showing delivery of AGA baby is more in mothers with good education status.

It has been observed that AGA babies delivery is more with high maternal education status compared to SGA babies. Low maternal education was associated with abnormal neurobehaviour pattern of SGA babies like decrease in habituation found in 3 babies, regulation in 6 babies, handling in 5 babies and stress abstinence in 4 babies. Increased hypotonia in 4 babies, lethargy in 2 babies and stree/abstinence in 3 babies.. AGA babies had shown decrease in attention, found in 2 babies, hypotonia in 2 babies and increase stress/abstinence in 2 babies.

Table 3: Maternal occupation

Occupation	SGA	AGA	Total
Managers, Senior officials and Legislators	0	0	0
Professionals	3	3	6
Technicians and Associate professionals	0	0	0
Clerks	2	11	13
Service and Sale workers	10	7	17
Skilled agricultural, fishery, forestry workers	0	0	0
Crafts and related trades workers	0	0	0
Plant and Machine operators and Assemblers	0	0	0
Elementary occupations	0	1	1
Armed forces occupation	0	0	0

Table 4: Distribution of socio-economic status in study group

Socio economic status	SGA	AGA	Total
	2	1	3
LOWER MIDDLE CLASS	40	55	95
UPPER MIDDLE CLASS	24	38	62
Total	66	94	160

Lower socioeconomic status is associated with increased incidence of SGA babies. SGA babies of low soio economic status had neurobehavioural abnormalities like decrease in habituation found in 10 babies , arousal in 6, attention in 6, regulation in 8, quality of movements in 6, excitability in 8 and non-optimal reflex in 8. Increased hypotonia in 6, lethargy in 6 and stree/abstinence in 8. In AGA babies decrease in attention in 6, hypotonia in 7 and increase stress/abstinence in 7 babies.

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Table 5: Maternal Significant Medical History

Significant medical history	SGA	AGA	Total
PIH	15	10	25
Anemia	20	12	32
GESTATIONAL DIABETES	10	8	18
HYPOTHYROIDISM	6	4	10
No Known medical condition	14	59	73
RHD	0	1	1
TYPE 1 DIABETES	1	0	1
Total	66	94	160

Medical conditions like PIH, GDM, Hypothyroidism and anemia had increased incidence of SGA baby delivery.

SGA babies of PIH mother showed decreased habituation in 4 babies, attention in 5, regulation in 3 and quality of movements in 2. And Increased lethargy in 2 babies, hypotonia 3 babies , Arousal 2 babies and stress/abstinence 3 babies. AGA babies showed abnormal Habituation 2 babies, excitability 3 babies, Regulation 2 babies and Quality of movements in 3 babies. In GDM it has been observed that decreased habituation in 3 babies, attention in 4, regulation in 4 and quality of movements in 4. And lethargy in 3 babies, hypotonia 2 babies, Arousal 2 babies and stress/abstinence 4 babies. AGA babies showed abnormal Habituation 4 babies, excitability 4 babies, Regulation 2 babies and Quality of movements in 4 babies. In hypothyroidism it has been observed that decreased habituation in 2 babies, attention in 4, regulation in 2 and quality of movements in 1 baby. And lethargy in 4 babies, hypotonia 2 babies, Arousal 2 babies and stress/abstinence 2 babies. AGA babies showed abnormal Habituation 2 babies, excitability 4 babies, Regulation 2 babies and Quality of movements in 2 babies Inanemia it has been found that decreased habituation in 2 babies, attention in 2, regulation in 3 and quality of movements in 2. And lethargy in 2 babies, hypotonia 2 babies, Arousal 3 babies and stress/abstinence 2 babies. AGA babies showed abnormal Habituation 4 babies, excitability 4 babies, Regulation 3 babies and Quality of movements in 3 babies.

DISCUSSION

In this study we examined detrimental effects of socio-demographic, maternal medical conditions, maternal non-medical conditions, maternal stress etc operating in utero and perinatal period on the neonatal behaviour of offspring.

In our study, total 160 term newborns were assessed in that 66 babies were SGA and 94 babies were AGA. Among SGA newborns 31 were female babies and 35 were male babies and in AGA 46 were female babies and 48 were male babies.

In this study we have used NNNS scale to assess neurobehaviour pattern of newborn babies. This scale has 13 summary score and these scores were assessed and compared between SGA and AGA newborns. Decreased mean value or increased mean value indicate abnormal neurobehaviour pattern.

In our study we have found that advanced maternal age has increased chances of delivery of SGA babies and also affects neurobehaviour pattern of newborn in SGA babies like decreased habituation observed in 4 babies, regulation in 6 babies, handling 7 babies and increased hypotonia in 4 babies and stress abstinence in 6 babies. In AGA babies it was found that decreased habituation was found in 4 babies, regulation in 3 babies and increased hypotonia in 5 babies and ress/abstinence in 4 babies. In a study by Peter Edward et.al onthe association between advanced maternal age and diagnosis of small for gestational age found

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that nulliparous women aged 30 years and older have higher risk of SGA < 10th and SGA < 5th percentiles compared with women aged 20 to 29 years. In contrast, both nulliparous and multiparous women age 40 years and older have an increased risk of SGA < 5th percentile compared with all women in the age group of 20 to 29 years.[5]

It has been observed that higher maternal education status had more AGA babies delivered among the study group. Low maternal education was associated with abnormal neurobehaviour pattern of SGA babies like decrease in habituation found in 3 babies, regulation in 6 babies, handling in 5 babies and stress abstinence in 4 babies. Increased hypotonia in 4 babies, lethargy in 2 babies and stree/abstinence in 3 babies. AGA babies had shown decrease in attention, found in 2 babies, hypotonia in 2 babies and increase stress/abstinence in 2 babies. Low maternal educational attainment was associated with a decrease in child birth weight for GA. Low maternal education attainment may lead to have many taboos which later influences on baby's weight as well as altered or abnormal neurobehaviour pattern.[6]

In our study mothers of SGA group belonged to lower cadre in occupation. Maternal occupations like teacher, nurses and textile supervisor had associated with more work related stress,had more chance of SGA babies delivey compared to other groups. We have found that lower socioeconomic status is associated with increased incidence of SGA babies. Small-for-gestational-age (SGA) status has negative health consequences in neonates and later life. In this study SGA babies of low soio economic status had neurobehavoural abnormalities like decrease in habituation found in 10 babies , arousal in 6, attention in 6, regulation in 8, quality of movements in 6, excitability in 8 and non-optimal reflex in 8. Increased hypotonia in 6, lethargy in 6 and stree/abstinence in 8. In AGA babies decrease in attention in 6, hypotonia in 7 and increase stress/abstinence in 7 babies. Low-SES infants showed higher inattention than their high-SES peers at all ages and were less likely to modulate their attention on the basis of stimulus complexity.[7]

In this study it was found that delivery of SGA babies was associated with maternal medical conditions like PIH, GDM, Hypothyroidism and anemia and showed abnormalities in neurobehaviour like in PIH, showed decreased habituation in 4 babies, attention in 5, regulation in 3 and quality of movements in 2. And increased lethargy in 2 babies, hypotonia 3 babies, Arousal 2 babies and stress/abstinence 3 babies. AGA babies showed abnormal Habituation 2 babies, excitability 3 babies, Regulation 2 babies and Quality movements in 3 babies. In GDM it has been observed that decreased habituation in 3 babies, attention in 4, regulation in 4 and quality of movements in 4. And lethargy in 3 babies, hypotonia 2 babies, Arousal 2 babies and stress/abstinence 4 babies. AGA babies showed abnormal habituation 4 babies, excitability 4 babies, regulation 2 babies and quality of movements in 4 babies. In hypothyroidism it has been observed that decreased habituation in 2 babies, attention in 4, regulation in 2 and quality of movements in 1 baby. And lethargy in 4 babies, hypotonia 2 babies, Arousal 2 babies and stress/abstinence 2 babies. AGA babies showed abnormal Habituation 2 babies, excitability 4 babies, Regulation 2 babies and Quality of movements in 2 babies Inanemia it has been found that decreased habituation in 2 babies, attention in 2, regulation in 3 and quality of movements in 2. And lethargy in 2 babies, hypotonia 2 babies, Arousal 3 babies and stress/abstinence 2 babies. AGA babies showed abnormal Habituation 4 babies, excitability 4 babies, Regulation 3 babies and Quality of movements in 3 babies.

In our study it was also found that maternal mindfulness, good family support, social support and less stress during antenatal period had positive influence on AGA babies delivered and near normal neurobehaviour pattern compare to SGA babies.

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CONCLUSION

NNNS scale with its more-complete analysis of neurobehavior, neurologic and stress responses, and regulatory capacities, and in its more-standardized format, has wide application to clinically normal and compromised infants of different gestational ages and offers us an insight into factors like demographic, medical as well as non medical variables affecting early newborn behaviour and developmental pathways thus allowing for early identification and management of neurobehavioural problems associated with these risk factors and also serve as vehicle for communication with parents about the status and care of their infant.

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