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Neurodevelopmental Outcome of High-Risk Neonates At 24 Months of Age, With Respect to General Movements of Prechettl at Term or Within 3 Months of Age

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ABSTRACT

Background: Advances in secondary and tertiary level neonatal care in India and the state of Kerala have resulted in better survival and reduction of mortality of high risk neonates. So it is essential to have follow up of these babies more frequently and start early interventions to prevent or reduce the severity of developmental delay. Various non- invasive, cost effective methods are being tried to detect or predict early the developmental delay, one among these methods is general movements of Prechettl, since only a small percentage of neonates with risk factors are developing significant developmental delay later.

Methods: Neonates 25 weeks and above, but less than 42 weeks, admitted with risk factors and discharged, presenting for follow up within 3 months of age were enrolled for the study. Those babies having visible birth defects (VBD), chromosomal or other genetic disorders, and dysmorphic or syndromic features were excluded from the study. Neonates at term or their first visit within 3 months were observed for general movements of Prechettl when the baby is remaining alert without crying and noted as normal or absent/abnormal. These high risk babies (N=375) in this prospective observational analytic study were followed up to their completed or corrected 24 months of age. Neurodevelopmental assessment done in domains- cognitive, communication, motor, and social-emotional at 24 months using Bayley scales of infant and toddler development edition-3 (BSID-III). The study was conducted over a period of 6 years from 2017 in south of middle Kerala, India.

Results: Out of total 375 high risk babies, 53 babies were having abnormal/absent general movements pattern of Prechettl and 322 had normal general movements pattern. High risk babies with absent/abnormal general movements cohort babies were having significantly lower total and domain-wise (cognitive, language, motor and social-emotional) developmental scores compared to high risk babies with normal general movements pattern cohort at their corrected/completed 24 months of age, using BSID-III indicating higher chance for babies with absent/abnormal general movements to have moderate to severe developmental delay and cerebral palsy at 24 months of age.

Conclusion: Abnormal or absent general movements pattern at term or within 3 months of age of high risk infants are associated with high chance of moderate to severe developmental delay and cerebral palsy at their corrected/completed 24 months of age, compared to high risk infants with normal general movements pattern, at term or within 3 months of age.

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Introduction

Survival of high risk neonates is more now in India and the state of Kerala due to advances in the neonatal care after the introduction of national health mission (NHM) especially in the public sector. Common high risk factors in neonates include prematurity, respiratory distress syndrome (RDS), meconium aspiration syndrome (MAS), sepsis, pneumonia, intrauterine growth restriction (IUGR), hypoglycemia, perinatal asphyxia, necrotizing enterocolitis (NEC), intraventricular hemorrhage (IVH)

and persistent pulmonary hypertension of the newborn (PPHN). There is a need to understand the impact of many antenatal, perinatal and neonatal factors on the neurodevelopmental outcome of these groups of babies [1-3].

High risk neonates admitted and discharged from NICU/SNCU are having more chance of insults to developing brain due to hypoxia, ischemia, hypoglycaemia and electrolyte imbalance and are at risk of more chance for developmental delay. They need more frequent follow up and early interventions, if indicated. Many early predictors of developmental delay such as hypoxic ischemic encephalopathy (HIE) stage –II, III; abnormal brain imaging, abnormal Amiel-Tison tone, absent or abnormal general

movements pattern, microcephaly/macrocephaly have been tested [4-8].

The objective of the present study was to find out whether there is any association between general movements pattern at term or within 3 months of age and developmental delay and cerebral palsy. Normally developing babies are generally having non purposive, spontaneous, ‘writhing’ pattern of motor activity (preterm to 8 weeks post term) followed by ‘fidgety’ movements pattern (9 -20 weeks) within the initial months of life, when the babies are remaining alert without crying. These types of movements, usually referred to as general movements of Prechettl, are well observed at term or within 3 months of age. In normally developing babies these initial movements are replaced by purposive voluntary movements with increasing age (4 months and beyond). Abnormal ‘writhing’ movements which are rigid, cramped synchronous or absent fidgety movements, at term or within 3 months of age are considered abnormal. All high risk babies were initially examined at term or within 3 months of age for assessment of general movements pattern and noted [9].

All babies were followed up to their completed or corrected 24 months of age and assessed for their development of domains cognitive, language, motor, and social-emotional using Bayley scales of infant and toddler development edition-3 (BSID-III).

Various insults to brain due to risk factors may affect the general movements pattern of babies and abnormal general movements may be a predictor of developmental delay. So the current study try to find out the association between general movements pattern and moderate to severe developmental delay and cerebral palsy of high risk newborn. Many studies point towards the usefulness of this cost-effective, non-invasive method as a screening test for predicting developmental delay and cerebral palsy [10,11].

Materials and Methods

Research Design

This is a community level prospective observational analytic study done over a period of 6 years from 2017, among high risk neonates admitted and discharged from SNCU/NICU of Kottayam district, coming for follow up within 3 months of age. The neonates belonged to 5 districts of south of middle Kerala, India. After

initial random enrollment at term or within 3 months of age, general movements pattern assessment done in all 375 neonates. They were followed up to their completed/corrected 24 months of age for final assessment of neurodevelopment using BSID-III.

Methodology

Neurodevelopmental assessment of all babies done at 24 months of age using Bayley scales of infant and toddler development edition -3 (BSID-3). Domains cognitive, language, and motor were assessed by the principal investigator and the domain of social-emotional was done using the questionnaire English/Malayalam version with the help of parents [12].

Inclusion Criteria

- Gestational age of babies more than 24 weeks and less than 42 weeks of gestation
- Babies with discharge summary of SNCU/NICU of Kottayam district
- Those babies brought for follow up within 3 months of age
- Babies brought for assessment at completed/corrected 24 months of age

Exclusion Criteria

- Babies having visible birth defects (VBD), chromosomal anomalies, other genetic disorders, dysmorphic or syndromic features were excluded
- Gestational age less than 25 weeks and 42 or above weeks
- Babies of parents not providing consent

Statistical Analysis

- Descriptive statistics of mean, median, standard deviation (SD), coefficient of kurtosis, coefficient of skewness
- Inferential statistics, parametric test- independent t test

Results

Table 1 shows that Prechettl’s general movements absent/abnormal at term or within 3 months of age group babies are having significantly lower mean values of total neurodevelopmental status scores at their completed/corrected 24 months of age compared to Prechettl’s general movements normal group babies.

Table 1: Mean Values, Standard Deviations and t Values of Total Neurodevelopmental Status Scores of Children at Completed/Corrected 24 Months of Age, with Respect to Their General Movements Status at Term or Less Than 3 Months of Age

General Movements of Prechettl	Number	Total Neurodevelopment Score		t	p
		Mean	SD		
Normal	322	361.53	33.52	13.97	0.000
Abnormal or Absent	53	302.87	27.39		

Table 2 shows that Prechettl’s general movements absent/abnormal at term or within 3 months of age group babies are having significantly lower mean values of cognitive scores at their completed/corrected 24 months of age compared to Prechettl’s general movements normal group babies.

Table 2: Mean Values, Standard Deviations and t Values of Cognitive Scores of Children at Completed/Corrected 24 Months of Age with Respect to their General Movements Status at Term or Less Than 3 Months of Age

General Movement of Prechettl	Number	Cognitive Score		t	p
		Mean	SD		
Normal	322	87.14	8.10	10.31	0.000
Abnormal or Absent	53	74.81	7.84		

Table 3 Prechettl’s general movements absent/abnormal at term or within 3 months of age group babies are having significantly lower mean value of language scores at their completed/corrected 24 months of age, compared to Prechettl’s general movements normal group babies.

Table 3: Mean Values, Standard Deviations and t Values of Language Scores of Children at Completed/Corrected 24 Months of Age with Respect to their General Movements Status at Term or Less Than 3 Months of Age

General Movements of Prechettl	Number	Language Score		t	p
		Mean	SD		
Normal	322	94.32	10.11	8.58	0.000
Abnormal or Absent	53	81.64	9.02		

Table 4 Prechettl’s general movements absent/abnormal at term or within 3 months of age group babies are having significantly lower mean value of motor scores at their completed/corrected 24 months of age, compared to Prechettl’s general movements normal group babies.

Table 4: Mean Values, Standard Deviations and t Values of Motor Scores of Children at Completed/Corrected 24 Months of Age, with Respect to their General Movements Status at Term or Less Than 3 Months of Age

General Movements of Prechettl	Number	Motor Scores		t	p
		Mean	SD		
Normal	322	91.15	9.75	14.25	0.000
Abnormal or Absent	53	70.57	9.72		

Table 5 Prechettl’s general movements absent/abnormal at term or within 3 months of age group babies are having significantly lower mean value of social-emotional scores at their completed/corrected 24 months of age, comparedto Prechettl’s general movements normal group babies.

Table 5: Mean Values, Standard Deviations and t Values of Social-Emotional Scores of Children at Completed/Corrected 24 Months of Age, with Respect to their General Movements Status at Term or Less Than 3 Months of Age

General Movements of Prechettl	Number	Social- Emotional Scores		t	p
		Mean	SD		
Normal	322	88.93	10.61	11.21	0.000
Abnormal or Absent	53	75.85	7.32		

Discussion

Identification early predictors developmental delay is a matter of concern for researchers in neurodevelopment of high risk newborn. Hypoxic ischemic encephalopathy grading, cranial ultrasound and other brain imaging, Amiel-Tison tone, Prechettl’s general movements, and serial head circumference measurements are tested for predicting developmental delay in various studies [12-14].

Clinical conditions of high risk neonates included prematurity, respiratory distress syndrome (RDS), meconium aspiration syndrome (MAS), perinatal asphyxia, neonatal sepsis, hypoglycaemia, necrotizing enterocolitis (NEC), intraventricular hemorrhage (IVH), and persistent pulmonary hypertension of the newborn (PPHN). Insults occurring to the developing brain due to the high risk conditions may lead to developmental delay in these babies [15,16].

In majority of high risk babies likely to have developmental delay later may be prevented or reduce its severity by identifying these babies early and starting appropriate focused interventions early with the full support of parents.

Present study specifically look for the association of moderate to severe developmental delay to general movements pattern of babies at term or within 3 months of age. A total of 375 high risk infants were examined for Prechettl’s general movements pattern at

term or within 3 months of age and classified as normal or absent/ abnormal. 322 babies were having normal general movements pattern and 53 babies were having absent or abnormal general movements of Prechettl. These babies were followed up to their completed/corrected 24 months of age and neurodevelopmental assessment done using Bayley scales of infant and toddler development edition-3 (BSID-III). Absent/abnormal general movements group babies were having significantly lower total and domain-wise - cognitive, language, motor, and social-emotional-developmental mean status scores at their completed/corrected 24 months of age, compared to normal general movements group babies. This shows that absent/abnormal general movements of Prechettl in high risk neonates at term or within 3 months of age are strongly associated with moderate to severe developmental delay and cerebral palsy [16,17].

Glass et al., (2021) in this prospective cohort study, 7 out the 58 high risk children developed cerebral palsy (12%). Abnormal general movement assessment and abnormal MRI at 3 months of age have found to be highly specific for early identification of moderate and severe neurodevelopmental impairment (NDI) and cerebral palsy [18].

Barnes, Graham, Loganathan & Nair (2021) in a fiveyear observational study 137 very low birth weight babies had their general movements assessment done at 3 months post term and found that absent fidgety movements at 3 months post term had

high specificity for cerebral palsy. They conclude that general movements assessment at 3 months of age in high risk very low birth weight babies is a good screening tool for early identification of neurodevelopmental impairment /cerebral palsy [19,20].

Conclusion

Abnormal writhing movement or absent fidgety movement at term or within 3 months of age in high risk neonates were found to be associated with moderate to severe developmental delay and cerebral palsy. General movements assessment at term or within 3 months of age is a cost effective and non invasive screening test for developmental delay and cerebral palsy in high risk neonates. Abnormal or absent general movements pattern may be considered as predictor of developmental delay and cerebral palsy among high risk neonates and can start early specific psychomotor interventions to prevent or reduce the impact of high risk factors in these babies by facilitated neuroplasticity of the developing brain.

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Ethical Approval

Approval for the study given by the institutional ethics committee, School of Behavioural Sciences, Mahatma Gandhi University, Priyadarsini Hills, Kottayam, Kerala, India dated 22-09-2017.

Contribution of Authors

Research concept- PR Jayakumar
Research design- PR Jayakumar
Supervision-PS Sukumaran
Materials- PR Jayakumar
Data collection- PR Jayakumar
Data analysis and Interpretation- PS Sukumaran, PR Jayakumar
Literature review- PR Jayakumar
Writing article- PR Jayakumar
Critical review- PS Sukumaran, PR Jayakumar
Article editing- PS Sukumaran
Final approval- PS Sukumaran

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