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CEREBRAL PALSY AND NEURODEVELOPMENTAL DISABILITIES AND ACCURACY OF GENERAL MOVEMENTS IN PRETERM SUBJECTS AND TIME OF FIDGETY MOVEMENT IN PRETERM BABIES

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ABSTRACT

Background: Prior to being released from the Neonatal Intensive Care Unit (NICU), it is imperative that patients have a neurological evaluation. This will enable prompt assessment and focused management aimed at reducing the likelihood and severity of neurodevelopmental disabilities and cerebral palsy.

Aim: In order to predict cerebral palsy and neurodevelopmental disabilities in preterm babies of gestational age < 32 weeks at the corrected gestational age of 18–24 months, the current study evaluated the accuracy of general movements in preterm subjects and time of fidgety movement.

Methods: General movements were examined in a preterm period of 31-36 weeks after the post-conception age, and fidgety movements were assessed in 8-18 weeks post-term in 85 extremely preterm newborns with a mean birth weight of 1213±224 grammes and gestational age of 29.6±1.34 weeks. Griffiths Mental Developmental Scales were used to assess the Neurodevelopmental outcomes in 64 child subjects.

Results: In five of the kid participants, neurodevelopmental impairment was seen. Four patients exhibited global developmental delays, and one person had cerebral palsy. The relative risk of neurodevelopmental impairment was observed to be 1.44 (0.33-6.87) at 95% CI and 6.05 (0.95-38.07) with fidgety movements and preterm movements. During the fidgety movement phase, the specificity and sensitivity values were 93% and 100%, respectively, whereas in the preterm period, they were 63% and 50%.

Conclusion: The current study reveals that in the latter phases of neurodevelopmental impairment and cerebral palsy prediction in preterm babies, poorer specificity and sensitivity were seen in the preterm movements compared to the fidgety movements.

Keywords: Cerebral palsy, developmental delay, fidgety movement, neurodevelopmental disorder

INTRODUCTION

Recently, there have been improvements in the rates of neurodevelopmental outcomes among infants born preterm and with extremely low birth weight. These newborns continue have challenges with learning, attention, sensory, perceptual, visual, linguistic, and cognitive domains, and they remain at high risk of developing cerebral palsy. Correct diagnosis and

early detection of these issues can reduce subsequent complications, enhance carer well-being, and remove the possibility of unfavourable developmental and motor outcomes.1

General motions are those that occur spontaneously in the early stages of foetal development and are simple to identify. Up to four or five months after the term, these motions are visible. General Movements Assessment, or GMA, has a strong predictive power for neurodevelopmental impairment, especially when it comes to cerebral palsy in term and preterm children who meet the risk categories.2

Preterm movements, writhing movements, and fidgety movements are the three categories into which these general motions are divided: those that occur 28 to 36–38 weeks after conception, 36–38 to 46–52 weeks after conception, and 46–52 to 54–58 weeks after conception, respectively.3

Adverse neurological outcomes in babies are typically linked to the absence of the key features, which include complexity, appropriate variety, and the fluency of proper general motions. Comparable to magnetic resonance imaging (MRI), the general movement evaluation has a strong prediction power that surpasses other assessment procedures such as neurological assessment and cranial ultrasonography.4 The motions that exhibit the best specificity and sensitivity for cerebral palsy prediction are writhing and fidgety movements. On the other hand, unfavourable outcomes unrelated to cerebral palsy show lesser accuracy. The literature has limited information about evaluating general movements prior to the term, with research on preterm movements demonstrating low specificity values.5

Poor follow-up rates are observed for newborns at high risk in the Indian situation. This is explained by a number of obstacles in low- and middle-income nations, including as the cost of perceived wellbeing and baby transportation problems. When it is not practical to get costly modalities like neuroimaging in areas with limited resources, GMA (General Movement Assessment) might be a helpful technique for evaluating neurological health.6

The purpose of this study was to evaluate the preterm movement's specificity and sensitivity in predicting cerebral palsy and neurodevelopmental disabilities in extremely preterm newborns. This was contrasted with the fidgety movements' specificity and sensitivity in predicting cerebral palsy and neurodevelopmental disabilities in those extremely preterm newborns. Neurodevelopmental impairment was evaluated using a standardised developmental evaluation at 18–24 months of corrected gestational age. Prechtl norms were also adhered to when documenting premature and fidgety movements on camera.7

MATERIALS AND METHODS

With a corrected gestational age of 18–24 months, the current prospective cohort clinical study aims to assess the predictive accuracy of general movements in preterm subjects and period of fidgety movement in the diagnosis of cerebral palsy and neurodevelopmental disability in preterm infants of gestational age ≤ 32 weeks. Before participating in the study, each individual gave their informed permission verbally and in writing.

Subjects with major congenital anomalies, subjects whose parents were unwilling to participate or show up for follow-up, subjects with anomalies incompatible with survival, and subjects under sedated or on a ventilator were all excluded from the study due to technical reasons. Following the ultimate enrollment of the research participants, the newborn's particulars, the mother's prenatal and perinatal medical histories, and the institutional records' preexisting data were documented.

Following the John HB et al. in 2022, neurodevelopmental evaluation, fidgety movement assessment, and preterm movement assessment were performed on all enrolled babies between the ages of 18 and 24 months.The primary examiner, an expert in his profession, rated eight broad motions as either abnormal or normal.

Before being released from the NICU, every baby was scheduled for early intervention. Up until the corrected gestational age of 18 months, a follow-up appointment was scheduled every three months for high-risk babies, during which a neurodevelopmental evaluation was conducted. An expert performed a neurodevelopmental evaluation using the GMDS (Griffiths Mental Development Scale, Second Edition) at the corrected gestational ages of 18 months and 24 months.9 The neurodevelopmental assessmentist was not aware of the study's procedure. The General Mental Development Scale (GMDS) has five domains: performance, locomotor, hearing and language, performance, and personal and social abilities. A sub-quotient was evaluated in each area, and the general quotient (Q)—which represented a child's overall development—was calculated by averaging the sub-quotients.

A cut-off score of ≤ 76 with a standard deviation of <-2 was used to identify neurodevelopmental impairment; the mean normal GQ had a mean of 100 with a standard deviation of 12. The normative GQ in babies between 16 and 24 months of age had a mean and standard deviation of 109±9.4.10 A skilled paediatrician who was unaware of the GMA results diagnosed children with aberrant tone and posture as having cerebral palsy, using the Gross Motor Function Classification System (GMFCS).

The collected data were statistically examined using the chi-square, Fisher's exact, and t-tests in SPSS software version 21.0. The specificity, sensitivity, and positive and negative predictive values were evaluated using the Medcalc programme. The significance level was kept at a p-value of <0.05.

RESULTS

In order to predict cerebral palsy and neurodevelopmental disabilities in preterm infants of gestational age ≤ 32 weeks at corrected gestational age of 18–24 months, the current prospective cohort clinical study set out to assess the accuracy of general movements in the preterm subjects and period of fidgety movement. The study findings demonstrated that, when comparing the demographics, aberrant general movements, and neonatal morbidities of the 64 participants who finished the trial to the 21 participants who did not show up for the follow-up, no discernible differences were found. The research individuals' mean birth weight was 1213±224 grammes, and their mean gestational age was 29.6±1.34 years.

When fidgety movements were assessed, the mean post-conceptional age was 11.7±2.3 years, and when preterm movement was assessed, it was 34.2±1.2 weeks post-term. Regarding the complications and neurodevelopmental outcomes, it was observed that 5 patients had an aberrant outcome and 59 subjects had a normal neurodevelopmental outcome. Necrotizing enterocolitis affected one subject with normal neurodevelopmental outcomes; septicemia affected 8.47% of subjects (n=5); invasive ventilation was required in 16.94% of subjects (n=10); bronchopulmonary dysplasia affected 15.25% of subjects (n=9); pneumonia affected 5.08% of subjects (n=3); perinatal asphyxia affected 3.38% of subjects (n=2); head circumference affected 6.77% of subjects (n=4); length affected 11.86% of subjects (n=7); and birth weight affected one (1) with a score less than -2SD were all observed in subjects with abnormal neurodevelopmental outcomes (Table 1).

In comparison to 50.84% (n=20) of participants with normal neurodevelopmental results, 80% (n=4) of subjects with bad neurodevelopmental outcomes had hyaline membrane disease. 20% (n=1) and 13.55% (n=8) of the participants with aberrant and normal neurodevelopmental outcomes did not receive any antepartum steroids. Of the cases with aberrant neurodevelopmental outcomes, 40% (n = 2) and 27.11% (n = 16) showed signs of PIPH, respectively. Sixty percent (n = 3) and thirty-five percent (n = 18) of the participants with impaired and normal neurodevelopmental outcomes, respectively, had multifetal pregnancy. In 40% of participants (n = 2) and 33.89% of subjects (n = 20) with impaired and normal neurodevelopmental outcomes, respectively, normal delivery was performed. The individuals with aberrant and normal neurodevelopmental outcomes had birth weights of 1155±177 and 1217±±227 grammes, and gestational ages of 29.36±1.65 and 29.7±1.27 weeks, respectively.

In groups with impaired and normal neurodevelopmental outcomes, there were 40% (n = 2) and 40.67% (n = 24) females, respectively (Table 1). The relative risk of neurodevelopmental impairment was found to be 6.05 (0.95-38.07) and 1.44 (0.33-6.87) at 95% with fidgety movements and preterm movements, respectively.CI. In the fidgety movement phase, specificity and sensitivity values were 93% and 100%, while in the preterm period, 63% and 50%, respectively. Table 2 lists the sensitivity specificity, negative predictive value, and positive predictive values of the general and fidgety motions.

DISCUSSION

Regarding aberrant general movements, newborn morbidities, and demographic factors, there was no discernible difference between the 64 study participants who finished the trial and the 21 study participants who did not show up for the follow-up. The research individuals had a mean gestational age of 29.6±1.34 years and a mean birth weight of 1213±224 grammes. When fidgety movements were assessed, the mean post-conceptional age was 11.7±2.3 years, and when preterm movement was assessed, it was 34.2±1.2 weeks post-term. These findings were consistent with research conducted by Spittle AJ et al. 11 in 2008 and Noble Y et al. 12 in 2012, whose authors evaluated participants using demographic information similar to that of the current study. According to the study's findings, 59 individuals had normal neurodevelopmental outcomes and 5 had aberrant outcomes in terms of complications and neurodevelopmental outcomes.

Necrotizing enterocolitis was diagnosed in one subject with normal neurodevelopmental outcomes, septicemia in 8.47% of cases, invasive ventilation was required in 16.94% of cases, bronchopulmonary dysplasia in 15.25% of cases, pneumonia in 5.08% of cases, perinatal asphyxia in 3.38% of cases, head circumference in 6.77% of cases, length in 11.86% of cases, and birth weight in 1.69% of cases. These complications were not observed in any subject with abnormal neurodevelopmental outcomes. These findings aligned with earlier research by Kwong AKL et al. 13 in 2018 and Groen SE et al. 14 in 2005, whose authors reported comparable neurodevelopmental outcomes and problems in their study participants.

Additionally, it was shown that 50.84% (n=20) of participants with good neurodevelopmental results and 80% (n=4) of those with bad neurodevelopmental outcomes had hyaline membrane disorder. 20% (n=1) and 13.55% (n=8) of the participants with aberrant and normal neurodevelopmental outcomes did not receive any antepartum steroids. Of the cases with aberrant neurodevelopmental outcomes, 40% (n = 2) and 27.11% (n = 16) showed signs of PIPH, respectively. Sixty percent (n = 3) and thirty-five percent (n = 18) of the participants with impaired and normal neurodevelopmental outcomes, respectively, had multifetal pregnancy. In 40% of participants (n = 2) and 33.89% of subjects (n = 20) with impaired and normal neurodevelopmental outcomes, respectively, normal delivery was performed. The individuals with aberrant and normal neurodevelopmental outcomes had birth weights of 1155±177 and 1217±±227 grammes, and gestational ages of 29.36±1.65 and 29.7±1.27 weeks, respectively.

In the groups with aberrant and normal neurodevelopmental outcomes, there were forty percent (n = 2) and forty-six percent (n = 24) females, respectively. These outcomes corroborated the findings of studies conducted in 2008 by Bruggink JL et al. and in 2011 by Zahed-Chiekh M et al., who found that the prevalence of neurovascular problems in their individuals was similar to that of the current investigation.

The study's findings also indicated that, at 95% confidence interval, the relative risks of neurodevelopmental impairment were 1.44 (0.33-6.87) and 6.05 (0.95-38.07) for fidgety and premature movements, respectively. During the fidgety movement phase, the specificity and sensitivity values were 93% and 100%, respectively, whereas in the preterm period, they were 63% and 50%.

The general and fidgety motions' sensitivity, specificity, negative predictive value, and positive predictive value these findings were consistent with research by Kodric J et al. 17 in 2010 and John HB et al. 18 in 2022, where the authors reported preterm movements and fidgety movements comparable to those of the current investigation.

CONCLUSION

The current study comes to the conclusion that in terms of predicting neurodevelopmental impairment and cerebral palsy in the later phases in preterm babies, poorer specificity and sensitivity were seen in the preterm movements compared to the fidgety movements. There were a few drawbacks to the study: it was conducted at a single institute, and only one examiner made the recordings.

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TABLES

S. No	Complications	Neurodevelopmental outcomes	
		Abnormal n=5 (%)	**Normal n=59 (%)**
1.	**Necrotizing enterocolitis**	0	1 (1.69)
2.	**Septicemia**	0	5 (8.47)
3.	**Invasive ventilation**	0	10 (16.94)
4.	**Hyaline membrane disease**	4 (80)	20 (50.84)
5.	**Bronchopulmonary dysplasia**	0	9 (15.25)
6.	**Pneumonia**	0	3 (5.08)
7.	**Perinatal asphyxia**	0	2 (3.38)
8.	**No antepartum steroids**	1 (20)	8 (13.55)
9.	**PIPH**	2 (40)	16 (27.11)
10.	**Multifetal pregnancy**	3 (60)	18 (30.50)
11.	**Normal delivery**	2 (40)	20 (33.89)
12.	**Head circumference score <-2SD**	0	4 (6.77)
13.	**Length score <-2SD**	0	7 (11.86)
14.	**Birth weight score <-2SD**	0	1 (1.69)
15.	**Birth weight (grams)**	1155±177	1217±±227

16.	**Gestational age (weeks)**	29.36±1.65	29.7±1.27
17.	**Female**	2 (40)	24 (40.67)

Table 1: Association of neurodevelopmental outcomes with neonatal and antenatal complications

S. No	Parameter	Fidgety movements (n=59)	Preterm general movements (n=68)
1.	**Cerebral palsy**		
a)	Negative predictive value	100	99.06 (96.42-99.75)
b)	Positive predictive value	16.04 (9.22-26.44)	1.62 (0.42-6.22)
c)	Specificity	93.77 (88.56-97.14)	63.67 (55.95-70.94)
d)	Sensitivity	100 (15.83-100)	50 (1.28-98.76)
2.	**Neurodevelopmental disability**		
a)	Negative predictive value	99.95 (92.57-96.57)	93.62 (90.05-95.92)
b)	Positive predictive value	18.53 (5.42-47.27)	5.85 (2.35-13.88)
c)	Specificity	92.75 (86.19-96.83)	64.43(55.05-73.02)
d)	Sensitivity	25.02 (3.17-65.07)	33.35 (7.47-70.09)

Table 2: Accuracy of Fidgety movement age and general movement age in the prediction of cerebral palsy and neurodevelopmental disability