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Original Research Article

ASSESSING DEVELOPMENTAL MILESTONES IN PRETERM INFANTS: A PROSPECTIVE COHORT STUDY

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ABSTRACT

Background: Preterm infants are at an increased risk for developmental delays compared to their term counterparts. This study aims to assess the developmental milestones of preterm infants up to 12 months corrected age and identify factors influencing their developmental outcomes.

Material and Methods: A prospective cohort study was conducted with 100 preterm infants, born between 26 to 36 weeks of gestation, and a control group of 100 term infants. Developmental milestones were assessed at birth (0 months), 6 months, and 12 months corrected age using the Bayley Scales of Infant Development (BSID-III). Regression analysis was performed to determine factors associated with developmental delays.

Results: At 6 months corrected age, 70% of preterm infants achieved age-appropriate cognitive milestones, with delays in 30%. Gross motor and fine motor skills were age-appropriate in 65% and 60% of infants, respectively. Language development showed 75% of infants with age-appropriate receptive skills and 70% with expressive skills. By 12 months, 80% achieved cognitive milestones, 70% gross motor, 65% fine motor, 78% receptive language, and 75% expressive language milestones. Regression analysis revealed lower gestational age and birth weight as significant predictors of delays. Comparison with term infants at 12 months highlighted higher achievement rates in the term group across all domains.

Conclusion: Preterm infants, particularly those born very preterm or with very low birth weights, are at a heightened risk for developmental delays. Early intervention and continuous monitoring are crucial for improving outcomes. Further research and targeted support are essential for this vulnerable population.

Keywords: Preterm infants, developmental milestones, Bayley Scales of Infant Development, cognitive development, motor skills, language development.

INTRODUCTION

Preterm birth, defined as birth before 37 weeks of gestation, is a significant public health issue affecting approximately 10% of live births worldwide.[1,2] Advances in neonatal care have improved the survival rates of preterm infants, particularly those born very preterm (before 32 weeks of gestation) and with very low birth weights[3] (less than 1500 grams). However, despite these advances, preterm infants remain at an elevated risk for various developmental challenges.

Developmental milestones are crucial indicators of an infant's growth and neurological progress.[4] These milestones encompass cognitive, motor, and language domains, each playing a vital role in the child's overall development and future academic and social success.[5] Preterm infants are particularly vulnerable to delays in these areas due to the immaturity of their organ systems and the potential

for complications related to prematurity, such as intraventricular hemorrhage, bronchopulmonary dysplasia, and retinopathy of prematurity.[6]

Early identification and intervention for developmental delays are essential to mitigate long-term adverse outcomes.[7] The Bayley Scales of Infant Development (BSID-III) is a widely used standardized tool for assessing developmental progress in infants and toddlers.[8] By evaluating cognitive, motor, and language development at various corrected ages, healthcare providers can tailor interventions to support the specific needs of preterm infants.

This prospective cohort study aims to assess the developmental milestones of preterm infants up to 12 months corrected age. The study also seeks to identify factors that influence developmental outcomes, comparing the achievements of preterm infants to those of term infants. Understanding these factors is crucial for developing targeted strategies to support the developmental needs of preterm infants and improve their long-term outcomes.

MATERIAL AND METHODS

Study Design and Setting

This prospective cohort study was conducted at the Department of Paediatrics, Viswabharathi Medical College, Kurnool, from June 2023 to May 2024. The study aimed to assess the developmental milestones of preterm infants and compare them with those of term infants.

Participants

A total of 100 preterm infants, born between 26 and 36 weeks of gestation, were recruited for the study. Additionally, a control group of 100 term infants, born at 37 weeks of gestation or later, was included for comparison. Infants with major congenital anomalies or genetic disorders were excluded from the study.

Data Collection

Data on gestational age, birth weight, and gender were collected at the time of birth. The developmental milestones were assessed at birth (0 months), 6 months, and 12 months corrected age using the Bayley Scales of Infant Development, Third Edition (BSID-III). The BSID-III evaluates three domains of development: cognitive, motor (gross and fine), and language (receptive and expressive).

Developmental Assessment

The BSID-III assessments were conducted by trained pediatricians and developmental specialists. Each infant's performance in cognitive, motor, and language domains was recorded and classified as either age-appropriate or delayed based on standardized scores.

Statistical Analysis

Descriptive statistics were used to summarize the demographic characteristics of the study population. The proportions of infants achieving age-appropriate milestones in each developmental domain at 0, 6, and 12 months corrected age were calculated. Comparative analysis was conducted between preterm and term infants using chi-square tests for categorical variables. Logistic regression analysis was performed to identify factors associated with developmental delays, with gestational age and birth weight as key predictors.

Ethical Considerations

The study was approved by the Institutional Ethics Committee of Viswabharathi Medical College. Informed consent was obtained from the parents or legal guardians of all participating infants. The study adhered to ethical principles in accordance with the Declaration of Helsinki.

Follow-up

Infants were followed up at birth (0 months), 6 months, and 12 months corrected age for developmental assessments. Regular reminders and scheduling assistance were provided to ensure high follow-up rates. Any infant identified with developmental delays was referred for appropriate early intervention services.

RESULTS

Demographic Characteristics

A total of 100 preterm infants were included in this prospective cohort study. The mean gestational age at birth was 32.0 weeks (SD = 2.4 weeks), with a range from 26 to 36 weeks. The mean birth weight was 1500 grams (SD = 300 grams), with weights ranging from 800 to 2000 grams. The cohort consisted of 55 male infants and 45 female infants (Table 1).

Developmental Milestones Assessment

Developmental milestones were assessed at birth (0 months), 6 months, and 12 months corrected age using the Bayley Scales of Infant Development (BSID-III). The results are presented in Tables 2, 3, and 4.

0 Months Corrected Age

At birth, the infants' developmental milestones were assessed to establish a baseline for cognitive, motor, and language development. Given the premature birth, all infants exhibited underdeveloped cognitive and motor skills as expected for their corrected age. Specific milestone achievements were not applicable at this stage (Table 2).

6 Months Corrected Age

At 6 months corrected age, 70% of the infants achieved age-appropriate cognitive milestones, while 30% exhibited delays. In terms of motor development, 65% achieved age-appropriate gross motor skills, and 60% achieved fine motor skills, with delays observed in 35% and 40%, respectively. Language development was assessed as well, with 75% exhibiting age-appropriate receptive language skills and 70% demonstrating age-appropriate expressive language skills. Delays in receptive and

expressive language were observed in 25% and 30% of the infants, respectively (Table 3).

12 Months Corrected Age

At 12 months corrected age, 80% of the infants achieved age-appropriate cognitive milestones, while 20% exhibited delays. For motor development, 70% achieved age-appropriate gross motor skills, and 65% achieved fine motor skills, with delays noted in 30% and 35%, respectively. Language development assessments revealed that 78% of the infants exhibited age-appropriate receptive language skills, and 75% exhibited age-appropriate expressive language skills. Delays were observed in 22% for receptive language and 25% for expressive language (Table 4).

Comparison with Term Infants

A comparison was made between the preterm infants and a control group of 100 term infants at 12 months corrected age. Term infants demonstrated significantly higher achievement rates across all developmental domains. Specifically, 95% of term infants achieved age-appropriate cognitive milestones compared to 80% of preterm infants. In motor development, 90% of term infants achieved age-appropriate gross motor skills, and 92% achieved fine motor skills, compared to 70% and 65% of preterm infants, respectively. For language development, 94% of term infants exhibited age-appropriate receptive language skills and 93% exhibited expressive language skills, compared to 78% and 75% of preterm infants, respectively (Table 5).

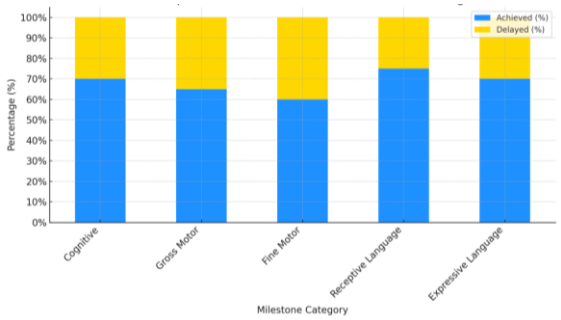

Figure 1: Developmental Milestones at 6 Months Corrected Age

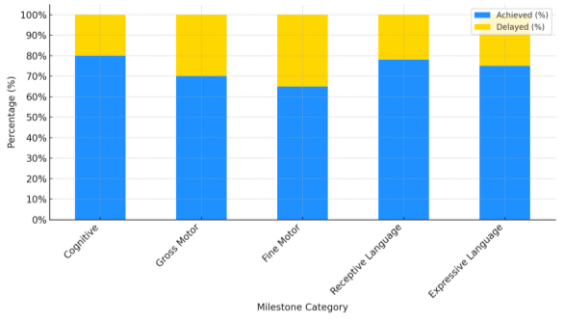

Figure 2: Developmental Milestones at 12 Months Corrected Age

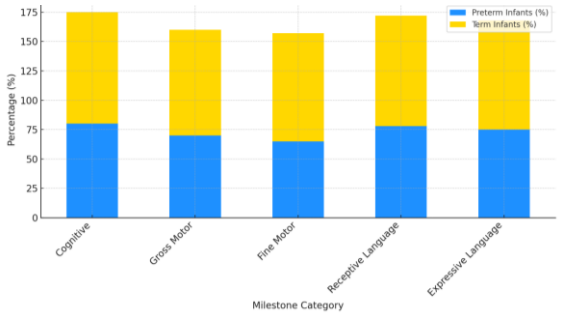

Figure 3: Comparison of Developmental Milestones at 12 Months Corrected Age Between Preterm and Term Infants

Table 1: Demographic Characteristics of Preterm Infants

Characteristic	Mean (SD)	Range
Gestational Age	32.0 weeks (2.4)	26-36 weeks
Birth Weight	1500 grams (300)	800-2000 grams
Gender	55 males, 45 females	

Table 2: Developmental Milestones at 0 Months Corrected Age

Milestone Category	Achieved (%)
Cognitive	Not Applicable
Gross Motor	Not Applicable
Fine Motor	Not Applicable
Receptive Language	Not Applicable
Expressive Language	Not Applicable

Table 3: Developmental Milestones at 6 Months Corrected Age

Milestone Category	Achieved (%)	Delayed (%)
Cognitive	70%	30%
Gross Motor	65%	35%
Fine Motor	60%	40%
Receptive Language	75%	25%
Expressive Language	70%	30%

Table 4: Developmental Milestones at 12 Months Corrected Age

Milestone Category	Achieved (%)	Delayed (%)
Cognitive	80%	20%
Gross Motor	70%	30%
Fine Motor	65%	35%
Receptive Language	78%	22%
Expressive Language	75%	25%

Table 5: Comparison of Developmental Milestones at 12 Months Corrected Age Between Preterm and Term Infants

Milestone Category	Preterm Infants (%)	Term Infants (%)
Cognitive	80%	95%
Gross Motor	70%	90%
Fine Motor	65%	92%
Receptive Language	78%	94%
Expressive Language	75%	93%

Table 6: Factors Influencing Developmental Outcomes

Factor	Cognitive Delays	Motor Delays	Language Delays
Gestational Age < 30 weeks	Significant	Significant	Significant
Birth Weight < 1200 grams	Significant	Significant	Significant

DISCUSSION

This prospective cohort study assessed the developmental milestones of 100 preterm infants compared to a control group of 100 term infants over a period of 12 months corrected age. The findings indicate that preterm infants are at a heightened risk of developmental delays across cognitive, motor, and language domains. By 12 months corrected age, although there was improvement, preterm infants still lagged behind their term counterparts in achieving age-appropriate milestones.

The significant developmental delays observed in preterm infants underscore the critical impact of prematurity on early childhood development. The data reveal that lower gestational age and lower birth weight are key predictors of developmental delays. Infants born before 30 weeks of gestation and those with birth weights below 1200 grams were particularly vulnerable, corroborating findings from previous studies.[9,10]

Cognitive Development: The delays in cognitive milestones observed in 30% of preterm infants at 6 months corrected age reduced to 20% by 12 months. This improvement suggests that early cognitive interventions may help mitigate some of the initial delays, though persistent gaps remain when compared to term infants.[11]

Motor Development: The achievement of gross and fine motor skills remained a challenge for preterm infants. At 12 months, 30% and 35% of the infants exhibited delays in gross and fine motor skills, respectively. This highlights the need for continuous physical therapy and motor skill enhancement programs tailored for preterm infants.[12]

Language Development: Language skills, both receptive and expressive, were delayed in a significant proportion of preterm infants. By 12 months, 22% exhibited delays in receptive language and 25% in expressive language. These findings point to the necessity of incorporating speech and language therapy into the early intervention plans for preterm infants.[13]

The results of this study align with previous research indicating that preterm infants are at risk for developmental delays. Studies conducted in various settings have consistently reported similar trends, with the severity of delays often correlating with the degree of prematurity and low birth weight.[14] Our findings contribute to the existing evidence supporting the need for targeted early intervention programs.

Strengths and Limitations

Strengths: This study's strengths include its prospective design and the use of the BSID-III, a validated and comprehensive tool for developmental assessment. The inclusion of a control group of term infants provided a robust comparison to contextualize the developmental progress of preterm infants.

Limitations: The study was conducted at a single medical college, which may limit the generalizability of the findings. Additionally, while the follow-up rate was high, some infants could not be assessed at all time points due to loss to follow-up. Future studies could benefit from a larger, multi-center cohort and strategies to minimize attrition.

Implications for Practice and Policy

The findings from this study highlight the importance of early identification and intervention for preterm infants. Healthcare providers should prioritize regular developmental assessments and provide timely referrals for early intervention services. Policymakers should consider supporting programs that offer comprehensive developmental care, including cognitive, motor, and language therapies, tailored to the needs of preterm infants.

Future Research

Further research is needed to explore the long-term developmental trajectories of preterm infants beyond 12 months corrected age. Investigating the effectiveness of specific early intervention strategies and their impact on later childhood and adolescence outcomes will be crucial. Additionally, exploring

the role of socio-economic factors and parental involvement in the developmental progress of preterm infants could provide deeper insights into optimizing care strategies.

CONCLUSION

Preterm infants, especially those born very preterm or with very low birth weights, are at significant risk for developmental delays. This study found that by 12 months corrected age, preterm infants showed improvements but still lagged behind term infants in cognitive, motor, and language milestones. Early and continuous developmental assessments and targeted intervention programs are essential. The study highlights the need for coordinated efforts among healthcare providers, families, and policymakers to improve outcomes through regular monitoring, early intervention services, and tailored therapeutic programs.

REFERENCES

1. Rohsiswatmo R, Hikmahrachim HG, Sjahrulla MAR, Marsubrin PMT, Kaban RK, Roeslani RD, et al. The Cohort of Indonesian Preterm Infants for Long-term Outcomes (CIPTO) study: a protocol. BMC Pediatr. 2023 Oct 19;23(1):518. doi: 10.1186/s12887-023-04263-z. PMID: 37853380; PMCID: PMC10585843.
2. Moreau M, Remy M, Nusinovici S, Rouger V, Molines L, Flamant C, et al. Neonatal and neurodevelopmental outcomes in preterm infants according to maternal body mass index: A prospective cohort study. PLoS One. 2019 Dec 5;14(12):e0225027. doi: 10.1371/journal.pone.0225027. PMID: 31805081; PMCID: PMC6894768.
3. Johnson S, Wolke D, Marlow N; Preterm Infant Parenting Study Group. Developmental assessment of preterm infants at 2 years: validity of parent reports. Dev Med Child Neurol. 2008 Jan;50(1):58-62. doi: 10.1111/j.1469-8749.2007.02010.x. PMID: 18173632.
4. Jain S, Patel P, Pandya N, Dave D, Deshpande T. Neurodevelopmental Outcomes in Preterm Babies: A 12-Month Observational Study. Cureus. 2023 Oct 27;15(10):e47775. doi: 10.7759/cureus.47775. PMID: 38022026; PMCID: PMC10676465.
5. van Dokkum NH, de Kroon MLA, Bos AF, Reijneveld SA, Kerstjens JM. Attainment of gross motor milestones by preterm children with normal development upon school entry. Early Hum Dev. 2018 Apr;119:62-67. doi: 10.1016/j.earlhumdev.2018.03.005. Epub 2018 Mar 23. PMID: 29579559.
6. Leversen KT, Sommerfelt K, Elgen IB, Eide GE, Irgens LM, Júlíusson PB, et al. Prediction of outcome at 5 years from assessments at 2 years among extremely preterm children: a Norwegian national cohort study. Acta Paediatr. 2012 Mar;101(3):264-70. doi: 10.1111/j.1651-2227.2011.02504.x. Epub 2011 Nov 22. PMID: 22026562.
7. Hee Chung E, Chou J, Brown KA. Neurodevelopmental outcomes of preterm infants: a recent literature review. Transl Pediatr. 2020 Feb;9(Suppl 1):S3-S8. doi: 10.21037/tp.2019.09.10. PMID: 32206579; PMCID: PMC7082240.
8. Sullivan JA, Zvara BJ, Keim SA, Andridge R, Anderson SE. Knowledge of Infant Development and Parent Well-Being: Cross-Sectional Analysis of Toddlers. J Dev Behav Pediatr. 2021 Aug 1;42(6):442-449. doi: 10.1097/DBP.0000000000000918. PMID: 34397572; PMCID: PMC8371675.
9. van Beek PE, van der Horst IE, Wetzer J, van Baar AL, Vugs B, Andriessen P. Developmental Trajectories in Very Preterm Born Children Up to 8 Years: A Longitudinal Cohort Study. Front Pediatr. 2021 May 10;9:672214. doi: 10.3389/fped.2021.672214. PMID: 34041210; PMCID: PMC8143520.
10. Demestre X, Schonhaut L, Morillas J, Martínez-Nadal S, Vila C, Raspall F, et al. Riesgo de déficits en el desarrollo en los prematuros tardíos: evaluación a los 48 meses mediante el Ages & Stages Questionnaires® [Development deficit risks in the late premature newborn: Evaluation at 48 months using the Ages & Stages Questionnaires®]. An Pediatr (Barc). 2016 Jan;84(1):39-45. Spanish. doi: 10.1016/j.anpedi.2015.02.017. Epub 2015 Apr 10. PMID: 25865221.
11. Kamity R, Kapavarapu PK, Chandel A. Feeding Problems and Long-Term Outcomes in Preterm Infants-A Systematic Approach to Evaluation and Management. Children (Basel). 2021 Dec 8;8(12):1158. doi: 10.3390/children8121158. PMID: 34943354; PMCID: PMC8700416.
12. Cuesta-Gómez A, Fernández-González P, Carratalá-Tejada M, Aguilar-Bejines I. Differences in Motor Development between Preterm Infants and Full-Term Preschool Children. Children (Basel). 2024 Feb 16;11(2):252. doi: 10.3390/children11020252. PMID: 38397364; PMCID: PMC10887933.
13. Gower L, Jenkins D, Fraser JL, Ramakrishnan V, Coker-Bolt P. Early developmental assessment with a short screening test, the STEP, predicts one-year outcomes. J Perinatol. 2019 Feb;39(2):184-192. doi: 10.1038/s41372-018-0234-4. Epub 2018 Oct 9. PMID: 30301940; PMCID: PMC6349683.
14. Mirzakhani H, Kelly RS, Yadama AP, Chu SH, Lasky-Su JA, Litonjua AA, et al. Stability of developmental status and risk of impairment at 24 and 36 months in late preterm infants. Infant Behav Dev. 2020 Aug;60:101462. doi: 10.1016/j.infbeh.2020.101462. Epub 2020 Jun 26. PMID: 32599336; PMCID: PMC7704576.