

Original Research Article

Growth and developmental pattern of early and late preterm at three months of age delivered in tertiary care hospital

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ABSTRACT

Background: Preterm birth is a global health concern affecting 5-18% of births, with India experiencing around 3.5 million preterm births annually. This study aims to examine the growth, development and morbidity patterns of early and late preterm infants at 3 months of age in a tertiary care hospital.

Methods: This prospective observational study conducted at Jawaharlal Nehru Medical College and Hospital (JNMCH), Aligarh Muslim University, Uttar Pradesh over 2 years period included 264 preterm infants (29% early preterm, 71% late preterm). Growth and development were assessed at scheduled visits up to 3 months using Fenton's growth chart for preterm infants and the Denver 2 developmental screening test.

Results: This study investigated the growth and development of 264 preterm infants (77 early preterm, 187 late preterm) at a tertiary care hospital in India. The findings revealed statistically significant differences in weight, length, and head circumference between the two groups, with early preterm infants showing slower growth rate. Early preterm infants also experienced more developmental delays in gross motor and fine motor skills.

Conclusions: Preterm infants especially those born early, face significant growth and developmental delays and are at higher risk for health problems. Early interventions and ongoing support, including counseling at discharge and regular follow-up are critical for improving their neurodevelopmental outcomes.

Keywords: Preterm, Growth, Development, Risk factors, Morbidity, Mortality

INTRODUCTION

According to World Health Organization (WHO), prematurity is defined as a birth that occurs before 37 completed weeks (less than 259 days) of gestation.¹ Globally the prevalence of preterm birth ranges between 5% to 18%. India is the biggest contributor to world's prematurity burden. In India, out of 27 million births, around 3.5 million are preterm births.² Prematurity is the major cause of morbidity in neonates. Babies who are born preterm have a higher chance of not achieving their growth and development milestones compared to term babies.

In the last decade, the number of high-quality neonatal growth charts has increased greatly. These include the Olsen, Bertino, CDC growth charts, WHO growth charts

and Fenton growth charts, which use advanced mathematical modelling approaches such as the lambda-mu-sigma method (LMS) that allow the calculation of precise Z-scores and centiles. Development is a multidimensional complex structured process. Development denotes capacity and ability of an individual to integrate task performance, coordination, language, social and behavioural adjustment. Mostly growth and development go hand in hand in an organised sequential and predictable manner. Any change in development is associated with delay and disability in later life. Developmental delay may include either all 5 domains of development i.e. gross motor, visuospatial, language, social and adaptive or a particular domain. It is essential to perform the developmental assessment of all infants for

early identification and timely intervention to prevent adverse outcomes.

Most premature babies develop as expected and have healthy childhoods. But there is a higher chance of premature babies developing developmental delay or disability compared with babies born at full-term. And preterm babies have significant morbidities in neonatal period which increases the risk of developmental delay in childhood. Proper growth and developmental surveillance, timely follow-up and proper counselling are very important for this vulnerable population. Evaluating the burden of problem as well as estimating the morbidities are also expected to help in strategic planning regarding management of preterm infants. Hence, this study will help to identify the risk factors contributing to the morbidity and mortality in preterm babies admitted in neonatal intensive care unit (NICU) and also suggest recommendations for preventing the adverse outcomes in preterm neonates.

METHODS

This is a hospital based Prospective observational study was carried out at Jawaharlal Nehru Medical College and Hospital (JNMCH), Aligarh Muslim University, Uttar Pradesh, Aligarh from July 2022 to July 2024 in the neonatal section of Department of Paediatrics, JN Medical College, Aligarh, India. Two hundred and sixty-four (264) preterm babies formed the study group. Ethical clearance was taken from Ethical Research Committee, JNMCH, Aligarh.

Inclusion criteria

Inclusion criterion for current study was all preterm babies born in hospital (JNMCH) with gestational age between of 34 and 37 weeks and whose parents give consent for the study will be included in this study (gestational age will be calculated on basis of LMP or ultrasonography (USG) done in the first trimester). If both are unavailable, the New Ballard scoring will be done for the evaluation of gestational age.

Exclusion criteria

Exclusion criterion for current study were preterm babies born outside hospital (JNMCH), babies with major congenital malformation.

Procedure

The details of the baby at birth, anthropometry and clinical course in the hospital were included in the predesigned proforma. The details of the baby at birth, anthropometry, clinical course in the hospital and details of mother regarding her particulars and diagnosis were entered in the predesigned proforma. Babies were weighed naked on an electronic weighing machine (NBY-30 PHOENIX) with an accuracy of ± 10 grams. Supine length was measured

using an infant-meter. Head circumference was measured with a non-stretchable tape with an accuracy of 0.1 cm in a crisscross manner from occipital protuberance to the supraorbital ridges. Chest circumference was measured at the level of the nipples with a non-stretchable tape. Follow up of these babies was done during regular visits to well-baby clinic on monthly basis up to 3 months of life. Growth and developmental outcomes were recorded as per standard growth charts (Fenton preterm growth chart) and developmental scales (Denver developmental scale II). All the observations in this study were evaluated statistically. Quantitative data was expressed as mean $\pm$ SD and qualitative data as frequency and percentage. Variables with a p value < 0.05 were considered as statistically significant and odds ratio with 95% confidence interval was used to measure the strength of association.

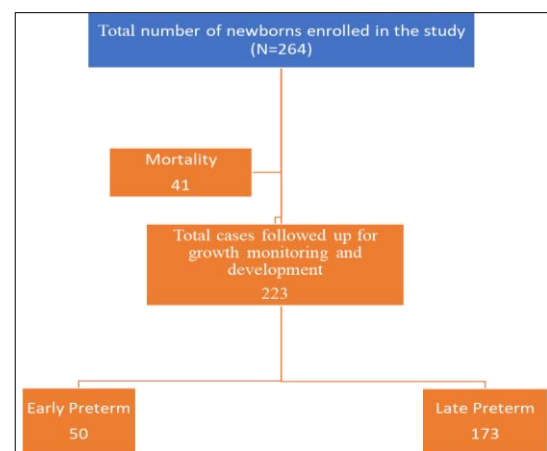


Figure 1: Patients enrolled in the study.

RESULTS

The study demonstrated a clear and statistically significant difference in weight between early preterm and late preterm infants. Early preterm infants started with a lower mean birth weight (1.39 kg) compared to late preterm infants (2.05 kg). This disparity in weight continued throughout the first three months of life. At 6 weeks of age, the mean weight for early preterm infants was 2.1 ± 0.36 kg, while late preterm infants weighed 2.75 ± 0.25 kg. This pattern persisted at 10 weeks, with early preterm infants averaging 2.73 ± 0.43 kg and late preterm infants at 3.49 ± 0.31 kg. By 3 months, the mean weight for early preterm infants was 3.44 ± 0.56 kg, and for late preterm infants, it was 4.26 ± 0.38 kg. These statistically significant differences in weight throughout the first three months of life highlight the slower growth trajectory of early preterm infants compared to their late preterm counterparts (Table 1).

Similar to weight, the study found a statistically significant difference in length between early preterm and late preterm infants. Early preterm infants had a lower mean length at birth (42.4 cm) compared to late preterm infants (46.54 cm). This length disparity was consistent across the

first three months of life. At 6 weeks of age, the mean length for early preterm infants was 47.62 cm, while late preterm infants measured 50.36 cm. This trend continued at 10 weeks, with early preterm infants averaging 50.51 cm and late preterm infants measuring 53.19 cm. By 14 weeks, the mean length for early preterm infants was 53.33 cm, and for late preterm infants, it was 56.01 cm. These statistically significant differences in length highlight the slower growth pattern of early preterm infants compared to their late preterm counterparts, supporting the overall observation that early preterm infants exhibit a slower growth trajectory across various measurements (Table 2).

Table 1: Comparison of change in weight of the baby in early and late preterm groups (n=264).

Interval	Mean (SD)		P value
	Early preterm	Late preterm	
Birth	1.39 (0.35)	2.05 (0.27)	<0.001
6 weeks	2.1 (0.36)	2.75 (0.25)	<0.001
10 weeks	2.73 (0.43)	3.49 (0.31)	<0.001
14 weeks	3.44 (0.56)	4.26 (0.38)	<0.001
P value (intra-group)	<0.001	<0.001	

Table 2: Comparison of change in length of the baby in early and late preterm groups (n=264).

Interval	Mean (SD)		P value
	Early preterm	Late preterm	
Birth	42.4 (4.36)	46.54 (2.51)	<0.001
6 weeks	47.62 (4.25)	50.36 (2.63)	<0.001
10 weeks	50.51 (4.34)	53.19 (2.7)	<0.001
14 weeks	53.33 (4.33)	56.01 (2.78)	<0.001
P value (intra-group)	<0.001	<0.001	

Table 3 demonstrates a higher rate of gross motor developmental delay in early preterm infants compared to late preterm infants. At 10 weeks: 7.79% of early preterm infants had a delay in lifting their head when prone, compared to only 1.06% of late preterm infants. At 14 weeks: 10.38% of early preterm infants had a delay in pulling to sit and head control, compared to 1.06% of late preterm infants. This data suggests that early preterm infants may experience more challenges with achieving these gross motor milestones. By 14 weeks, the differences in fine motor development became more pronounced. Both groups demonstrated delays in grasping objects, bringing their hands together, and following an object through 180 degrees. However, the rate of delay was likely higher in the early preterm group compared to the late preterm group. This statistically significant difference suggests that early preterm infants may face more challenges with these specific fine motor skills, which are crucial for hand-eye coordination and object manipulation. At 6 weeks (smiles

spontaneously) no social developmental delay was seen. But social developmental milestones assessed and delay was found in 4 (7.4%) infants in early preterm group and 3 (1.6%) in late preterm group noted at 10 weeks (looks at face and smiles spontaneously) and 14 weeks (hand regard). Language development assessed at 6 weeks (responding to stimuli) and 10 and 14 weeks (cooing and responding to sounds) showed no delay in both the groups.

Table 3: Distribution of cases according to developmental milestones in early and late preterm groups (n=223).

Milestones and weeks	Early preterm (%)	Late preterm (%)	P value
Gross motor			
6 weeks			
Apt for age	54 (100)	187 (100)	-
Not apt for age	0 (0)	0 (0)	
10 weeks			
Apt for age	48 (88.88)	185 (98.93)	<0.001
Not apt for age	6 (11.11)	2 (1.06)	
14 weeks			
Apt for age	46 (85.18)	185 (98.93)	<0.001
Not apt for age	8 (14.81)	2 (1.06)	
Fine motor			
6 weeks			
Apt for age	54 (100)	186 (99.46)	0.590
Not apt for age	0 (0)	1 (0.53)	
10 weeks			
Apt for age	47 (87.03)	183 (97.86)	<0.001
Not apt for age	7 (12.96)	4 (2.13)	
14 weeks			
Apt for age	46 (85.18)	183 (97.86)	<0.001
Not apt for age	7 (12.96)	4 (2.13)	
Social			
6 weeks			
Apt for age	54 (100)	187 (100)	-
Not apt for age	0 (0)	0 (0)	
10 weeks			
Apt for age	50 (92.59)	184 (98.39)	0.025
Not apt for age	4 (7.4)	3 (1.6)	
14 weeks			
Apt for age	50 (92.59)	184 (98.39)	0.025
Not apt for age	4 (7.4)	3 (1.6)	
Language			
6 weeks			
Apt for age	54 (100)	187 (100)	-
Not apt for age	0 (0)	0 (0)	
10 weeks			
Apt for age	54 (100)	187 (100)	-
Not apt for age	0 (0)	0 (0)	
14 weeks			
Apt for age	53 (98.14)	187 (100)	0.062
Not apt for age	1 (1.85)	0 (0)	

Table 4 shows that according to our study there is no significant risk factor for comparison in early and late preterm birth. Majority of patients in both the groups had no risk factor i.e. 72.7% in early preterm group and 68.9% in late preterm group. One of the major risk factors that presented in all the preterm birth in both the groups was PPROM about 20.7% in early preterm group and 14.9% in the late preterm group.

Table 4: Comparison of risk factors in early and late preterm groups (n=264).

Risk factors	Early preterm (%)	Late preterm (%)	Total (%)	P value
Oligohydramnios	1 (1.29)	2 (1.06)	3 (1.13)	0.873
Polyhydramnios	2 (2.59)	7 (3.74)	9 (3.4)	0.641
PPROM	16 (20.77)	28 (14.97)	44 (16.66)	0.250
Previous LSCS	0 (0)	9 (4.81)	9 (3.4)	0.050
Twin gestation	1 (1.29)	12 (6.41)	13 (4.92)	0.081
Previous preterm	1 (1.29)	0 (0)	1 (0.37)	0.118
No risk factor	56 (72.7)	129 (68.9)	185 (75.2)	

Table 5: Morbidity pattern in late preterm.

Morbidities	No. of early preterm (%) Total=77	No. of late preterm (%) Total=187	P value
Jaundice	19 (24.6)	32 (17.1)	>0.05
Respiratory distress syndrome	8 (10.3)	20 (10.6)	>0.05
Congenital pneumonia	1 (1.2)	3 (1.6)	>0.05
Sepsis	18 (23.3)	18 (9.6)	<0.05
Apnea	6 (7.7)	2 (1.06)	<0.05
Birth asphyxia	6 (7.7)	15 (8.1)	>0.05
Hypoglycemia	3 (3.8)	0	<0.05
NEC	6 (7.7)	10 (5.3)	>0.05
Polycythemia	5 (6.4)	12 (6.4)	>.05
Hemolytic diseases of newborn	2 (2.5)	0	<0.05
Congenital heart disease	4 (5.1)	8 (4.2)	>0.05
No morbidity	0	67 (35.8)	<0.05

Figure 2 shows out of the 264 preterm children enrolled in the study 223 patients were discharged after birth. 41

(15.2%) of patients died 223 (84.5%) patients survived and were followed up. Of the 41, 27 (65.8%) were early preterm group and 14 (34.2%) patients were late preterm. In the early preterm group 50 patients survived out of 77 and had a mortality of 35.06% during NICU stay. In late preterm group 173 patients survived out of 187 and had a mortality of 6.95% during NICU stay.

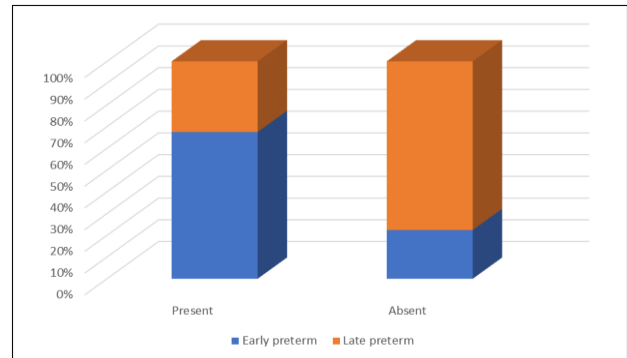


Figure 2: Comparison of mortality of the baby in early and late preterm groups.

DISCUSSION

In present study 264 neonates were enrolled who were born at less than 37 completed gestational age. It comprised of 77 (29%) early preterm born between 32 weeks to 33 weeks and 6 days and 187 (71%) late preterm born between 34 weeks to 36 weeks and 6 days period of gestation. Out of the 264 neonates 41 (15.2%) of patients died 223 (84.5%) patients survived and were followed up. Out of the 264 patients enrolled 46.5% were male babies and 53.4% patients were female babies. The distribution of both genders among the early and late preterm groups was also almost equal. A higher proportion of preterm delivery reflected the poor maternal health, antenatal check-up and socioeconomic status of the rural society as our hospital catered people from rural areas and from low socioeconomic groups. In our study 20.79% had preterm premature rupture of membranes followed by polyhydramnios 2.6% and 2.6% had twin pregnancy which shows similar to other studies in India. Hassan et al reported that the type of gestation, mothers' age, presence of complications during pregnancy, bad obstetric history, and family and medical history of diseases were the most common risk factors of prematurity.

Akshara et al reported the assessment of physical growth and motor development.³ A prospective study was conducted on 159 preterm babies of gestational age 32 to 36 weeks reported, preterm babies 95.5% infants born as preterm had a length of more than 58 cm (-3SD) and weight 5.6 kg at 1 year and 50% infants had a head circumference of more than 39 cm (-3SD). In our study 54% early preterm had a length of 53.33 cm (4.33) and late preterm 56.0 cm (2.78) at 14 weeks of corrected age. Weight at 14 weeks in early and preterm infants is 3.4 kg and 4.26 kg respectively which is a proportional weight

gain pattern and head circumference at early preterm and late preterm is i.e. 37.87 cm and 39.79 cm respectively among early preterm and late preterm. Early preterm 30% infant had a head circumference less than -3SD. Early preterm at 14 weeks, 14.8% were found to have gross motor delay, fine motor delay in 12.96% and social delay in 1.85%. Significant individual positive correlations of length and head circumference at birth and of height and head circumference at follow-up were detected. Early preterm infants (born before 32 weeks) have slower growth rates compared to late preterm infants (born between 32 and 37 weeks), even though they show better weight gain up to 12 months. This study by Sudhir et al highlights significant differences in growth patterns even within the late preterm group, with late preterm infants showing better growth outcomes overall.⁴ Early preterm infants exhibited a consistently lower weight gain pattern than late preterm infants up to 3 months of age. Santos et al study focused on relation between the late preterm and growth faltering in early childhood reported that complex relationship between late preterm birth and growth in early babies.⁵ Late preterm infants initially grow quickly, but they may still be at risk for long term growth issues. This could not be assessed in our study due to the shorter follow up duration.

Murki et al reported that low birth weight is at jeopardy because of their shortened gestation period and growth restriction.⁶ Early preterm infants were at higher risk of adverse neuromotor cognitive behavioral and scholastic achievement compared to late term infants. Early preterm infants (born before 32 weeks) have higher rates of developmental delays in all areas compared to late preterm infants (born between 32 and 37 weeks). Early preterm infants also experience higher rates of morbidities like jaundice, sepsis, and apnea. Ryan et al found that early preterm infants have significant developmental delays in eye-hand coordination, personal/social/emotional development, gross motor skills, general development, and foundations of learning. Further research is needed to explore the effectiveness of early sensory-based interventions to support the development of preterm infants. This is similar to study of Sangamam et al conducted in Kozhikode, Kerala which stated that the most common morbidity in preterm/LBW neonates is hyperbilirubinemia (16.77%) followed by hypoglycemia (14.99%) and hyaline membrane disease (14.99%).⁷ It also states that preterm babies are at higher risk of birth asphyxia, hypoglycemia, hyperbilirubinemia, and neonatal ICU admissions.

Ali et al conducted in the same institution on LBW neonates suggested that RDS was the major morbidity 35% followed by sepsis 27.8%, jaundice 24%.⁸ In our study there is 100% NICU admission for early preterm neonates whereas only 68% of late preterm were admitted.⁸

Sridhar et al conducted a retrospective study at NICU, Madya Institute Medical Science, Karnataka over a period

of 1 year including a total of 1487 neonates.⁹ The major causes of morbidity were neonatal sepsis (28.8%), RDS (23.85%), birth asphyxia (17.72%), neonatal jaundice (7.02%), and meconium aspiration syndrome (5.47%). Our spectrum of morbidities is similar to some Indian studies. Early preterm had 5 times more risk of mortality than late preterm as suggested in our study.

This mortality profile is similar to the study by Sangamam et al which was conducted in KMCT, Kerala but the perinatal mortality in our study is comparatively very high i.e. 155 in 1000 preterm births. They stated a perinatal mortality among LBW as 127.4 in 1000 LBW births. Gupta et al from MGMSC, Jaipur conducted a prospective observational study including 200 LBW babies out of 957 babies born over a period of 1 year.¹⁰ Incidence of LBW babies was 20.9%. Hyperbilirubinemia (30.5%) was the commonest morbidity followed by respiratory distress (28.5%) and sepsis (23.5%).

Limitations

The study did not fully assess maternal risk factors during early pregnancy. The use of Fenton growth charts, developed for the US population, might not be completely suitable for Asian populations. The study's follow-up period of 3 months may not be sufficient to fully understand long-term growth patterns. The study did not account for potential confounding factors that might have influenced the findings. Developmental assessment was based on a screening tool, which may not be as comprehensive as a full developmental evaluation. Further research is needed to address these limitations and provide a more complete picture of preterm infant development in the Indian context.

CONCLUSION

This study highlights significant differences in growth, development, and health outcomes between early and late preterm infants. Early preterm infants demonstrate slower progress and face a higher risk of developmental delays and health complications. Personalized care, early interventions, and ongoing support are crucial to maximize their potential and minimize long-term challenges. The study underscores the importance of specialized care for all preterm infants, emphasizing the need for quality prenatal programs to reduce preterm births and improve outcomes for these vulnerable babies.

Recommendations

Further research is needed to better understand the growth and development of extremely preterm and very preterm infants. Multicentric studies can help address regional variations in preterm infant outcomes. Long-term prospective cohort studies are essential for establishing growth curves specifically for Indian preterm neonates. Improved prenatal care and monitoring can significantly

reduce preterm births and contribute to lower perinatal and neonatal mortality rates.

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Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. World Health Organization. Preterm birth. Available at: <https://www.who.int/news-room/fact-sheets/detail/preterm-birth>. Accessed on 17 August 2024.
2. World Health Organization. The Global Action Report on Preterm Birth Born Too Soon. Available at: <https://www.who.int/publications/i/item/9789241503433>. Accessed on 17 August 2024.
3. Akshara ES, Gohiya P, Shrivastav J. Assessment of Physical Growth and Motor Development of Preterm Babies Based on Developmental Assessment Scale For Indian Infants (DASII). J Neonatol. 2020;34(1-2):11-4.
4. Sudhir U, Ghanghoriya P, Barman M, Joshi T. Growth and Neurodevelopmental Outcome of High-Risk Premature Neonates at 1 Year in a Tertiary Level NICU of Central India. Int J Contemp Pediatr. 2017;4(5):1787.
5. Santos IS, Matijasevich A, Domingues MR, Barros AJ, Victora CG, Barros FC. Late preterm birth is a risk factor for growth faltering in early childhood: a cohort study. BMC Pediatr. 2009;9:1-8.
6. Murki S, Kallem VR, Gururaj J, Bashir T, Oleti TP, Kiran S. Growth and neurodevelopmental outcomes at 12 to 18 months of corrected age in preterm infants born small for gestational age. Indian Pediatr. 2020;57:301-4.
7. Sangamam R. Perinatal mortality and morbidity among low-birth-weight babies. Int J Comm Med Public Health. 2017;2(1):51-8.
8. Nazira K, Ali S, Firdaus U. Morbidity profile and short-term outcomes of low birth weight neonates delivered in a tertiary care centre: a prospective observational study. Int J Contemp Pediatr. 2022;9(8):740.
9. Thammanna PS, Sridhar PV, Sandeep M. Morbidity pattern and hospital outcome of neonates admitted in a tertiary care teaching hospital, Mandya. Int J Sci Study. 2015;3(6):126-9.
10. Gupta MK, Kakkar M, Sethi C, Malhotra AK. Pattern of morbidity and mortality in LBW neonates: a study from Jaipur. J Evol Med Dent Sci. 2014;3(6):1339-45.

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