Section: Pediatrics

JAMP

Original Research Article

GROWTH AND NEURODEVELOPMENTAL OUTCOME OF EXTREMELY LOW BIRTH WEIGHT BABIES UP TO 1 YEAR OF CORRECTED AGE DISCHARGED FROM TERTIARY HOSPITAL

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Received : 09/04/2025
Received in revised form : 03/06/2025
Accepted : 28/06/2025

Keywords:
Extremely Low Birth Weight (ELBW), Neurodevelopmental Outcome, Growth Pattern, Developmental Delay, NICU Follow-up, Birth Weight and Development, Amiel-Tison Score, Denver Developmental Screening Test (DDST), Retinopathy of Prematurity (ROP, BERA (Brainstem Evoked Response Audiometry).

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DOI: 10.47009/jamp.2025.7.4.19

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2025; 7 (4); 90-99

ABSTRACT

Background: Extremely low birth weight (ELBW) infants, defined as those weighing less than 1000 grams, are at increased risk for neonatal mortality, growth failure, and long-term neurodevelopmental impairments. While neonatal care has improved survival, challenges remain regarding developmental outcomes, particularly in resource-constrained settings. This study was undertaken to evaluate the growth and neurodevelopmental outcomes of ELBW infants up to one year of corrected age in a tertiary care center in South India. **Objectives:** To assess the postnatal growth pattern and neurodevelopmental outcomes in ELBW infants discharged from a tertiary care NICU and followed up to one year of corrected age. **Material and Methods:** This was a hospital-based prospective observational study conducted over 18 months (July 2022 – January 2024) at the Level-3 NICU of Niloufer Hospital, Hyderabad. A total of 57 ELBW infants admitted to the NICU were included. Among these, 14 survived the neonatal period, and 12 were followed up for one year. Data on maternal and neonatal characteristics, growth parameters, and neurodevelopmental assessments were collected using a structured proforma. Growth was assessed using WHO and Fenton charts, and neurodevelopment was evaluated using the Amiel-Tison tone assessment and Denver Developmental Screening Test (DDST-II). Data were analyzed using SPSS v20, with $p < 0.05$ considered statistically significant. **Result:** Of the 57 ELBW infants, 43 (75.4%) died during NICU stay, and 2 died after discharge. The 12 surviving infants were monitored longitudinally. Mean gestational age was 28.3 ± 2.6 weeks, and mean birth weight was 854.6 ± 93.3 grams. Growth monitoring showed substantial catch-up across weight, length, and head circumference by 12 months of corrected age. At 3 months, 97% had weight <3rd percentile, which improved to 8% by 12 months. Developmental delay was seen in 9 of 12 infants (75%) based on Amiel-Tison and DDST-II scores. There was a statistically significant association between lower birth weight and developmental delay ($p < 0.05$), but not with gestational age. Tone abnormalities were present in 59% at 3 months, reducing to 41% by 12 months. Abnormal hearing (as assessed by BERA) was also significantly associated with developmental delay ($p = 0.024$). Three infants had retinopathy of prematurity (ROP), with one requiring cryotherapy. **Conclusion:** The study revealed high mortality and morbidity among ELBW infants, with a majority of survivors demonstrating delayed neurodevelopmental outcomes despite some catch-up in growth. Lower birth weight was significantly associated with developmental delay. Early identification, structured follow-up, and timely interventions, particularly in the domains of nutrition, tone abnormalities, and hearing, are essential to improve long-term outcomes in ELBW infants.

INTRODUCTION

Extremely low birth weight infants, defined as those weighing less than 1000 grams, are among the most premature newborns, typically born after 22 to 23 weeks of gestation.[1,3] Prematurity significantly increases the risk of perinatal mortality and morbidity.[2] These infants are prone to long-term complications such as cerebral palsy, cognitive impairment, blindness, and hearing loss, among others, which can be mitigated with timely interventions such as laser photocoagulation for retinopathy of prematurity and hearing aids for hearing impairment.

Common issues include thermoregulation challenges, respiratory distress, patent ductus arteriosus (PDA), intra ventricular hemorrhage (IVH), renal problems, electrolyte imbalances, impaired glucose tolerance, infections, bronchopulmonary dysplasia (BPD), retinopathy of prematurity (ROP), anemia of prematurity (AOP), metabolic bone disease etc during neonatal period.

Infants with very low birth weight are particularly susceptible to growth failure and poor neurodevelopmental outcomes.[1] While neonatal intensive care has improved survival rates, it also increases the likelihood of long-term complications.[3] Growth failure in these infants can result from intrauterine growth restriction, inadequate nutrition, and complications like BPD.[4] Although premature infants often experience catch-up growth after the neonatal stage, many do not fully recover. By the age of 2 to 3 years, a significant proportion of very low birth weight infants remain below average weight ranges.[5]

Understanding the postnatal growth patterns of extremely low birth weight infants is crucial due to their unique nutritional requirements and susceptibility to long-term complications. Regular monitoring of weight, length, and head circumference is essential to assess nutritional status and ensure adequate feeding. Daily monitoring of weight and weekly monitoring of head circumference and length in the first weeks of life are recommended to track physiological weight loss and detect dehydration or sepsis promptly.

Neurodevelopmental impairments remain common among extremely low birth weight infants, with intraventricular hemorrhage and periventricular leukomalacia being the most frequent forms of brain injury.[6] These conditions can lead to significant morbidity and mortality, impacting cognitive and behavioral outcomes.

Research indicates that growth failure contributes to suboptimal brain development, exacerbated by dietary deficiencies and abnormal body composition. Addressing these factors early can potentially improve long-term outcomes for these vulnerable infants. Therefore, further studies are needed to evaluate growth and neurodevelopmental outcomes in extremely low birth weight infants, aiming to guide effective interventions that promote their future well-being.[7]

There are not many studies in survival and outcome of ELBW babies from south India, ours being tertiary care neonatal centre we have taken up this study for growth and neurodevelopmental outcome of these babies at 1 yr of corrected age.

MATERIALS AND METHODS

Study Design

This was a hospital-based, prospective observational study.

Study Setting

The study was conducted in the Level-3 Neonatal Intensive Care Unit (NICU) at Niloufer Hospital, Hyderabad, Telangana, a tertiary care referral center for neonates.

Study Period

The study was carried out over a period of 18 months, from July 2022 to January 2024.

Study Population

The study population comprised randomly selected neonates with a birth weight of less than 1000 grams, admitted to the NICU during the study period.

Sample Size

A total of 57 extremely low birth weight (ELBW) neonates were included in the study, selected using a consecutive non-probability sampling method.

Inclusion Criteria

- Neonates born to mothers who had crossed the threshold of viability
- Birth weight less than 1000 grams
- Willingness of the parents or guardians to participate in the study

Exclusion Criteria

- Neonates with major congenital anomalies, particularly thoracic and cardiac malformations
- Parents or guardians unwilling to provide informed consent

Data Collection

Data was collected using a structured questionnaire, adapted with necessary modifications based on variables identified in previous research. A pre-designed proforma was used to record prenatal, natal, and postnatal history of each infant.

Study Procedure

Out of 57 ELBW neonates admitted during the study period, 14 infants survived and were discharged. Among them, 2 died during follow-up due to recurrent infections.

The study was ultimately conducted on 12 surviving ELBW infants who underwent serial assessments both during hospitalization and at follow-up visits corresponding to 3, 6, 9, and 12 months of corrected age.

Initial assessments included the following parameters

- Nutritional evaluation, including breastfeeding, infant formula, and complementary feeding practices

- Immunization status review
- Growth monitoring using Fenton and WHO growth charts
- Hearing assessment and ROP screening
- Neuromotor evaluation using the Amiel-Tison scale
- Neurodevelopmental screening using the Denver Developmental Screening Tool (DDST-II)

Morbidity and mortality data were recorded during hospitalization and follow-up. Infants received oxygen support via CPAP, nasal prongs, or mechanical ventilation as needed during NICUstay.

Kangaroo Mother Care (KMC) was initiated once babies achieved hemodynamic stability and continued until they reached an additional 2 kg weight gain from baseline. The average duration of NICU stay for each infant ranged between 2 to 3 months. Post-discharge, infants were followed biweekly and provided with nutritional supplements and nursing care. Complementary feeding was introduced at 6 months of corrected age.

Data Analysis

Data were entered using MS Excel 2016 and analyzed with SPSS software version 20. Descriptive statistics were used to calculate frequencies and percentages, and findings were presented using tables, bar diagrams, and pie charts. Bivariate analysis was conducted using the Chi-square test, and a p-value < 0.05 was considered statistically significant.

Reference Citing

References were cited using the Vancouver system, where sources are numbered consecutively in the order of their appearance in the text.

Ethical Considerations

The study was conducted after obtaining ethical clearance from the Institutional Ethics Committee. Informed consent was obtained from all participants' guardians, with assurance of privacy, confidentiality, and voluntary participation.

Aims & Objectives

Aim

To determine growth and neurodevelopmental outcome in extremely low birth weight babies at 1 year of corrected age.

Objectives

1. To determine the growth pattern.
2. To assess neurodevelopmental outcomes.
3. To assess morbidity pattern and mortality rate
4. To conduct audiological evaluations.
5. To perform visual assessments

RESULTS

A total of 57 extremely low birth weight (ELBW) infants were enrolled in the study. Among them, 43 (75.4%) died during NICU stay, 2 (3.5%) died after discharge, and 12 (21%) were followed up for growth and neurodevelopmental assessment up to one year of corrected age. The majority of the mothers were aged between 21 to 30 years and belonged to the lower and middle socioeconomic classes. Most of them were illiterate and homemakers. The mean gestational age of the ELBW infants was 28.3 ± 2.6 weeks, and the mean birth weight was 854.6 ± 93.3 grams. Most deliveries were conducted via normal vaginal route (66.7%). Growth monitoring showed progressive catch-up in weight, head circumference, and length by 12 months. Developmental assessments using the Amiel-Tison score and DDST revealed tone abnormalities and developmental delays in a significant number of infants. A strong correlation was observed between lower birth weight and developmental delay, while gestational age was not statistically significant. Morbidity patterns included respiratory distress syndrome, IVH, and HIE. Nearly all infants required CPAP, and 41.6% needed mechanical ventilation. Hearing screening revealed a statistically significant association between abnormal BERA results and developmental delay. The findings reflect the critical need for targeted neonatal follow-up and early interventions to mitigate long-term complications in ELBW infants.

Table 1: Mortality Distribution of ELBW Infants

Consequences	Frequency (n=57)	Percentage (%)
Death during NICU stay	43	75.4%
Death after discharge	2	3.5%
Alive and followed-up	12	21.0%

Table 1 presents the distribution of outcomes among the 57 extremely low birth weight infants included in the study. A majority, 43 infants (75.4%), died during NICU stay. Among the 14 initially discharged, 2 infants (3.5%) died during follow-up. The remaining 12 infants (21%) survived and were available for assessment of growth and neurodevelopment outcomes.

Table 2: Age-wise Distribution of Mothers

Age Group (Years)	Frequency (n=12)	Percentage (%)
15–20	1	8.3%
21–25	5	41.7%
26–30	5	41.7%
31–35	1	8.3%
Total	12	100.0%

Table 2 depicts the age distribution of mothers whose infants were included in the final cohort of the study. The majority of mothers (83.4%) were in the 21–30 years age group, with 5 mothers (41.7%) each in both the 21–25

ISSN (O): 2687-5365; ISSN (P): 2753-6556

and 26–30 years categories. Only one mother each (8.3%) belonged to the younger (15–20 years) and older (31–35 years) age brackets.

Table 3: Socioeconomic Status of Mothers (Kuppuswamy Classification)

S. No	Class	Type	Frequency (n=12)	Percentage (%)
1	Class I	Upper class	1	8.3%
2	Class II	Upper middle class	3	25.0%
3	Class III	Lower middle class	4	33.3%
4	Class IV	Upper lower class	3	25.0%
5	Class V	Lower class	1	8.3%
Total			12	100.0%

Table 3 illustrates the socioeconomic classification of mothers using the Kuppuswamy scale. The largest proportion of mothers, 4 out of 12 (33.3%), were from the Lower Middle class (Class III), followed by 3 mothers (25%) each from the Upper Middle (Class II) and Upper Lower (Class IV) classes. One mother each (8.3%) belonged to the Upper class (Class I) and Lower class (Class V).

Table 4: Educational Status of Mothers

Education Level	Frequency (n=12)	Percentage (%)
Illiterate	8	66.7%
Primary	3	25.0%
Secondary	1	8.3%
Total	12	100.0%

Table 4 presents the distribution of mothers based on their educational background. A majority of the mothers, 8 out of 12 (66.7%), were illiterate. Only 3 mothers (25%) had completed primary education, and just 1 mother (8.3%) had secondary level education. None of the mothers had higher education.

Table 5: Occupational Status of Mothers

Occupation	Frequency (n=12)	Percentage (%)
Unemployed/Home Maker	10	83.3%
Employed	2	16.7%
Total	12	100.0%

Table 5 shows the occupational distribution of mothers in the study. The vast majority, 10 out of 12 mothers (83.3%), were homemakers or unemployed. Only 2 mothers (16.7%) were employed in semi-skilled or skilled occupations.

Table 6: Type of Delivery Among Mothers

Type of Delivery	Frequency (n=12)	Percentage (%)
Normal	8	66.7%
Instrumental	2	16.7%
LSCS	2	16.7%
Total	12	100.0%

Table 6 highlights the mode of delivery in the study participants. The majority of deliveries, 8 out of 12 (66.7%), were conducted by normal vaginal delivery. Instrumental and lower segment cesarean section (LSCS) deliveries were reported in 2 cases each (16.7%).

Table 7: Gender Distribution of ELBW Infants

Gender	Frequency (n=12)	Percentage (%)
Male	4	33.3%
Female	8	66.7%
Total	12	100.0%

Table 7 presents the gender-wise distribution of the extremely low birth weight infants included in the study. A higher proportion of the infants were females, accounting for 8 out of 12 (66.7%) cases, while males constituted 4 cases (33.3%).

Table 8: Gestational Age of ELBW Infants

Gestational Age (Weeks)	Value
Mean ± SD	28.3 ± 2.6
Minimum	26
Maximum	36

Table 8 summarizes the gestational age distribution of the infants enrolled in the study. The mean gestational age was 28.3 ± 2.6 weeks. The earliest gestation recorded was 26 weeks, while the maximum gestational age observed was 36 weeks.

Table 9: Birth Weight of ELBW Infants

Birth Weight (Grams)	Value
Mean ± SD	854.6 ± 93.3
Minimum	650
Maximum	990

Table 9 displays the birth weight characteristics of the infants included in the study. The mean birth weight was 854.6 ± 93.3 grams. The lowest recorded weight was 650 grams, while the highest was 990 grams.

Table 10: Morbidity Pattern Among ELBW Infants During NICU Stay

Condition	Frequency (n=12)	Percentage (%)
RDS and Sepsis	6	75.0%
IVH and Hyperbilirubinemia	3	25.0%
HIE	3	25.0%

Table 10 illustrates the distribution of major morbidities experienced by the ELBW infants during their NICU admission. The most common condition observed was respiratory distress syndrome (RDS) along with sepsis in 6 infants (75%). Intraventricular hemorrhage (IVH) and hyperbilirubinemia affected 3 infants (25%), and hypoxic ischemic encephalopathy (HIE) was also seen in 3 infants (25%).

Table 11: Need for Ventilatory Support Among ELBW Infants

Type of Ventilation	Frequency	Percentage (%)
Mechanical Ventilation	5	41.6%
CPAP	12	100.0%

Table 11 outlines the need for respiratory support in the ELBW infants. All 12 infants (100%) required Continuous Positive Airway Pressure (CPAP), while 5 infants (41.6%) required mechanical ventilation due to severe respiratory distress.

Table 12: Growth Parameters of Surviving ELBW Infants at Corrected Ages

Parameters	3 Months	6 Months	9 Months	12 Months
Weight < 3rd percentile	97%	58%	14%	8%
HC < 3rd percentile	96%	68%	22%	10%
Length < 3rd percentile	98.5%	59%	19%	17%

Table 12 shows the trend in growth parameters of the surviving extremely low birth weight infants at different corrected ages—3, 6, 9, and 12 months. There was a consistent pattern of catch-up growth over time across all domains. At 3 months, nearly all infants were below the 3rd percentile for weight (97%), head circumference (96%), and length (98.5%). By 12 months, these proportions significantly declined to 8%, 10%, and 17%, respectively, indicating substantial improvement.

Table 13: Growth Parameters (Z-scores) of Surviving ELBW Infants at Corrected Ages

Parameters	3 Months	6 Months	9 Months	12 Months
WAZ (Weight-for-Age)	-5.69	-3.20	-1.41	-0.52
LAZ (Length-for-Age)	-8.34	-5.93	-2.43	-0.34
WLZ (Weight-for-Length)	-3.21	-0.23	-0.19	-1.10

Table 13 displays the Z-scores for weight-for-age (WAZ), length-for-age (LAZ), and weight-for-length (WLZ) across different corrected ages. A marked improvement in growth was observed over time. At 3 months, the WAZ was as low as -5.69, indicating severe underweight, which improved to -0.52 by 12 months. Similarly, LAZ and WLZ scores showed progressive normalization of growth trends by the end of the first year.

Table 14: Comparison of Growth Parameters Between Normal Outcome and Developmental Delay

Parameters	Normal Outcome (n=3)	%	Developmental Delay (n=9)	%	P-value
Weight < 3rd percentile	1	33.3%	8	88.9%	0.021*
HC < 3rd percentile	0	0.0%	7	77.8%	0.018*
Length < 3rd percentile	1	33.3%	5	55.6%	0.505

****Significant at p < 0.05***

Table 14 compares the growth indicators among infants with normal neurodevelopmental outcomes and those with developmental delay. A significant association was found between developmental delay and both weight <3rd percentile (p=0.021) and head circumference (HC) <3rd percentile (p=0.018). However, no statistically significant association was noted between developmental delay and length <3rd percentile (p=0.505).

Table 15: Comparison of Mean Birth Weight Between Outcome Groups

Outcome Group	Mean Birth Weight (grams) ± SD	P-value
Normal Outcome	865.9 ± 13.3	
Developmental Delay	757.0 ± 10.1	0.000*

****Significant at p < 0.05***

Table 15 shows the comparison of mean birth weights between infants with normal neurodevelopmental outcomes and those with developmental delay. The mean birth weight of infants with a normal outcome was significantly higher (865.9 ± 13.3 grams) compared to those with developmental delay (757.0 ± 10.1 grams), with a statistically significant p-value of 0.000.

Table 16: Amiel-Tison Score for Tone Abnormalities at Different Corrected Ages

Corrected Age	Tone Result	Frequency (n=12)	Percentage (%)
At 40 weeks	Normal	5	41%
	Abnormal	7	59%
At 3 months	Normal	5	41%
	Abnormal	7	59%
At 6 months	Normal	6	50%
	Abnormal	6	50%
At 9 months	Normal	7	59%
	Abnormal	5	41%
At 12 months	Normal	7	59%
	Abnormal	5	41%

Table 16 presents the results of primary neurological assessment using the Amiel-Tison scale for tone abnormalities across multiple corrected ages. At both 40 weeks and 3 months, 7 out of 12 infants (59%) showed tone abnormalities. At 6 months, normal and abnormal tone were equally distributed (50% each). Improvement was noted at 9 and 12 months, where 59% had normal tone and 41% remained abnormal.

Table 17: Developmental Outcomes Using Denver Developmental Screening Test (DDST)

Age of Assessment	Result	Frequency (n=12)	Percentage (%)
At 3 Months	Normal	6	50%
	Abnormal	6	50%
At 6 Months	Normal	5	41%
	Abnormal	7	59%
At 9 Months	Normal	6	50%
	Abnormal	6	50%
At 12 Months	Normal	7	59%
	Abnormal	5	41%

Table 17 presents the findings from the Denver Developmental Screening Test (DDST), which assessed infants in four domains: gross motor, fine motor, language, and social development. At 3 and 9 months of corrected age, developmental delays were present in 6 out of 12 infants (50%). At 6 months, delays were noted in 7 infants (59%). By 12 months, improvement was observed, with 7 infants (59%) achieving normal developmental outcomes and 5 infants (41%) still showing developmental concerns.

Table 18: Association Between Amiel-Tison Score and DDST at 1 Year of Corrected Age

S. No	Birth Weight (g)	Gestational Age (Weeks)	Amiel-Tison Score (1 Year)	DDST (1 Year)
1	900	36	Normal	Normal
2	800	28	Abnormal	Abnormal
3	900	27	Abnormal	Abnormal
4	841	28	Normal	Normal
5	850	34	Normal	Normal
6	800	30	Abnormal	Abnormal
7	980	28	Normal	Normal
8	990	28	Normal	Normal
9	650	30	Abnormal	Abnormal
10	895	30	Normal	Normal
11	800	27	Abnormal	Abnormal
12	800	28	Normal	Normal

Table 18 presents individual-level data comparing Amiel-Tison scores and Denver Developmental Screening Test (DDST) outcomes at 1 year of corrected age in relation to birth weight and gestational age. Among the 12 surviving ELBW infants, 6 exhibited both abnormal Amiel-Tison scores and DDST results, suggesting consistent findings across both neurodevelopmental assessments. The other 6 infants had normal scores in both assessments, showing agreement between motor tone evaluation and global developmental status.

Table 19: Association Between Amiel-Tison Score and Mean Birth Weight and Gestational Age

Variable	Amiel-Tison Score	Mean ± SD	P-value
Birth Weight (g)	Normal (n=7)	893.7 ± 70.98	
	Abnormal (n=5)	790 ± 89.44	0.049*
Gestational Age	Normal (n=7)	30.29 ± 3.35	
(weeks)	Abnormal (n=5)	28.40 ± 1.51	0.272

****Significant at p < 0.05***

Table 19 compares the mean birth weight and gestational age among infants with normal and abnormal Amiel-Tison scores. Infants with normal tone at 1 year had significantly higher mean birth weight (893.7 ± 70.98 g) compared to those with abnormal tone (790 ± 89.44 g), with a statistically significant p-value of 0.049. The difference in gestational age was not statistically significant (p = 0.272).

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Table 20: Association Between DDST Outcome and Mean Birth Weight and Gestational Age

Variable	DDST Outcome	Mean ± SD	P-value
Birth Weight (g)	Normal (n=7)	893.7 ± 70.98	
	Abnormal (n=5)	790 ± 89.44	0.049*
Gestational Age	Normal (n=7)	30.29 ± 3.35	
(weeks)	Abnormal (n=5)	28.40 ± 1.51	0.272

****Significant at p < 0.05***

Table 20 examines the relationship between DDST outcomes and birth-related variables. Similar to Amiel-Tison scoring, infants with normal DDST at 1 year had significantly higher mean birth weight (893.7 ± 70.98 g) than those with developmental delay (790 ± 89.44 g), with p = 0.049. No significant difference was observed in gestational age between the two groups (p = 0.272).

Table 21: Severity of Developmental Delay Compared with Amiel-Tison Score

Category	Gender Distribution	Birth Weight (Mean ± SD, g)	Gestational Age (Mean ± SD, weeks)	P-value (Gender)	P-value (Weight)	P-value (Gestation)
Intermediate	Male – 1 Female – 1	800 ± 0.0	28 ± 0.01	0.540	0.000*	0.150
Abnormal	Male – 2 Female – 4	801 ± 81.9	28.1 ± 1.94	0.778	0.018*	0.230

****Significant at p < 0.05***

Table 21 evaluates the association between developmental delay severity and Amiel-Tison scores, analyzing gender, birth weight, and gestational age. It was observed that birth weight was significantly lower in babies categorized as having abnormal tone (801 ± 81.9 grams; p = 0.018), while no significant difference was noted in gestational age (p = 0.230) or gender distribution (p > 0.05).

When the severity of Developmental delay was compared with normal Amieltiscon scores it was observed that, birth weight was significantly lower (p<0.05) in babies categorized as abnormal (801 ± 81.9 gms). However gender and gestational age did not differ significantly (p>0.05).

Table 23: Association Between OAE (BERA) and Developmental Outcome

BERA Result	Normal Outcome (n=3)	Percentage (%)	Developmental Delay (n=9)	Percentage (%)
Abnormal	1	33.3%	8	88.9%
Normal	2	66.7%	1	11.1%

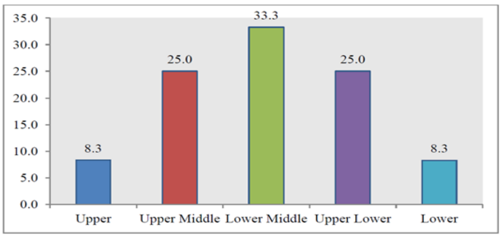
Chi-square = 5.10, p = 0.024 (p < 0.05, significant)*

Table 23 examines the correlation between hearing assessment results using OAE/BERA and neurodevelopmental outcomes. Among infants with developmental delay, 8 out of 9 (88.9%) had abnormal BERA results, whereas only 1 out of 3 (33.3%) in the normal outcome group had abnormal BERA findings. The association was statistically significant with a chi-square value of 5.10 and a p-value of 0.024.

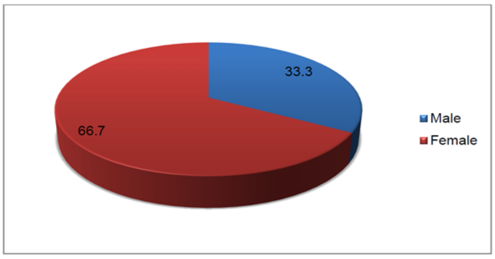
Table 1 revealed that mortality was significantly high, with 75.4% of the ELBW infants dying during the NICU stay. **Table 2** showed that the majority of mothers belonged to the 21–30 years age group. **Table 3** illustrated that most participants came from lower and middle socioeconomic classes. **Table 4** highlighted that a large proportion of mothers were illiterate. **Table 5** indicated that 83.3% of mothers were homemakers. **Table 6** showed normal vaginal delivery as the predominant delivery mode. **Table 7** indicated a higher proportion of female babies (66.7%). **Table 8** presented the mean gestational age as 28.3 ± 2.6 weeks, and **Table 9** reported the mean birth weight as 854.6 ± 93.3 grams. **Table 10** identified RDS, IVH, and HIE as major morbidities. **Table 11** confirmed that all infants required CPAP, and 41.6% needed mechanical ventilation. **Table 12** showed a progressive decline in growth failure parameters across all time points. **Table 13** displayed consistent improvement in Z-scores for weight, length, and weight-for-length over 12 months. **Table 14** showed that weight and head circumference <3rd percentile were significantly associated with developmental delay. **Table 15** demonstrated a statistically significant association between lower birth weight and developmental delay. **Table 16** reflected that tone abnormalities were highest at 3 months and improved by 12 months. **Table 17** showed persistent developmental delays as per DDST across 3, 6, 9, and 12 months. **Table 18** correlated Amiel-Tison and DDST scores, showing close agreement in developmental classification. **Table 19** reported significantly lower birth weight in infants with abnormal Amiel-Tison scores. **Table 20** demonstrated similar findings with DDST scores. **Table 21** further confirmed that abnormal Amiel-Tison scores were significantly associated with lower birth weight, though not with gender or gestational age. **Table 22** summarized ROP outcomes, with one case requiring cryotherapy. **Table 23** highlighted a statistically significant relationship between abnormal BERA findings and developmental delay.

Graph No. 1: Socioeconomic Status

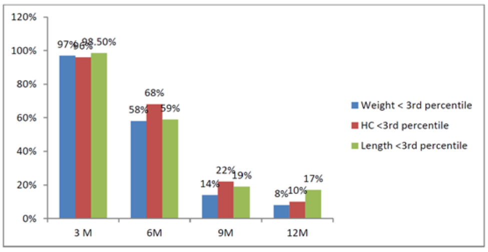
(All figures in percentages)



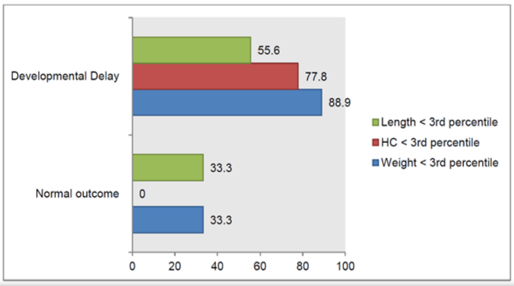
Graph No. 2: Gender (%)



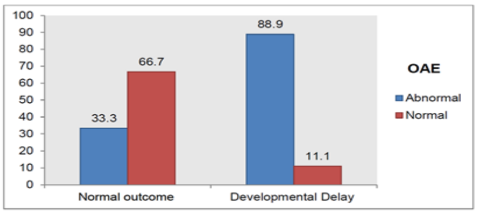
Graph No. 3: Frequency of growth parameters at different months (%)



Graph No. 5: Comparison of Growth Parameters and Development delay



Graph No. 7: Comparison of hearing examination and Development delay (%)



ROP screening:

Among 12 pre-term infants 3 had ROP and 1 among them had plus signs and needed cryotherapy.

DISCUSSION

This prospective observational study was conducted at Niloufer Hospital, Hyderabad, Telangana, and involved 57 extremely low birth weight (ELBW) infants admitted to the Level-3 NICU. Out of these, 14 infants survived the neonatal period, while 2 succumbed post-discharge. The remaining 12 infants were followed longitudinally for growth and neurodevelopmental outcomes over a 12-month corrected age period.[8] The study aimed to evaluate key predictors of morbidity, mortality, and developmental trajectories in this vulnerable population.

Growth Parameters

In the present cohort, female infants comprised the majority (66.7%), and the mean gestational age and birth weight were 28.3 ± 2.6 weeks and 854.6 ± 93.3 grams, respectively. These findings are consistent with broader trends observed in ELBW infants, who are often delivered prematurely with significantly reduced birth weights, increasing their susceptibility to postnatal complications.[9,10]

Over the course of the study, catch-up growth was observed across multiple parameters. At 3 months, 97% of infants were below the 3rd percentile for weight, which improved to only 8% by 12 months. Similar patterns were seen in head circumference and length.[11] These findings indicate a gradual normalization of growth parameters with adequate neonatal care and nutritional interventions. Several earlier studies have also confirmed that ELBW infants typically experience intrauterine growth restriction, followed by postnatal catch-up growth, especially when supported by structured feeding regimens and clinical follow-up.[12,13]

Other studies have emphasized the high proportion of ELBW infants born small for gestational age (SGA), and factors such as socioeconomic status, perinatal morbidities, and ethnicity have been linked to these growth outcomes. The improvement in weight-for-age (WAZ) and length-for-age (LAZ) scores over time further reinforces the effectiveness of nutritional rehabilitation and specialized neonatal interventions.[14]

Neurodevelopmental Outcomes

Neurodevelopmental delay is a major concern in ELBW survivors. In this study, developmental delay was significantly associated with weight <3rd percentile (88.9%) and head circumference <3rd percentile (77.8%), while no significant association was found with length <3rd percentile. These findings suggest that poor weight gain and inadequate head growth are critical markers of developmental impairment in this population.[16]

Tone abnormalities were evaluated using the Amiel-Tison score, and neurodevelopmental status was assessed using the Denver Developmental Screening Test (DDST). At 40 weeks and 3 months of corrected age, 59% of infants showed abnormal tone, which gradually reduced to 41% by 12 months. This

ISSN (O): 2687-5365; ISSN (P): 2753-6556

improvement indicates some degree of neuroplasticity and postnatal recovery, though nearly half of the infants continued to demonstrate delays.[17]
A significant association was found between abnormal Amiel-Tison or DDST scores and lower birth weights. However, gestational age did not emerge as a statistically significant factor in this association. These findings support the role of low birth weight as a stronger predictor of developmental outcome than gestational age alone.[18]
Other studies using similar screening tools have highlighted high sensitivity and predictive value of early assessments for long-term outcomes. Although our study used only Amiel-Tison and DDST-II, the observed correlations suggest their utility in early risk identification.[19]
Some earlier studies have also pointed out that intrauterine growth restriction, abnormal head growth trajectories, and the presence of early morbidities such as intraventricular hemorrhage (IVH) and bronchopulmonary dysplasia (BPD) significantly influence developmental outcomes. While our study did not include MRI or advanced imaging, the significant associations between head circumference and developmental outcome are in line with this hypothesis.[20,21]

Morbidity and Mortality Outcomes

The mortality rate among ELBW infants in this study was 75.4%. Among the survivors, acute morbidities like respiratory distress syndrome (RDS), intraventricular hemorrhage (IVH), hyperbilirubinemia, and hypoxic-ischemic encephalopathy (HIE) were observed. At long-term follow-up, 59% of the infants showed signs of developmental delay and tone abnormalities. This high morbidity burden underscores the need for enhanced perinatal care and robust follow-up programs.[22,23]
Other neonatal studies have reported similar patterns, with higher mortality in ELBW infants compared to very low birth weight (VLBW) infants, especially those in the 500–749 g range. Morbidities such as RDS, shock, hypoglycemia, and HIE are commonly seen and are often more severe in the ELBW population.[24,25]

Hearing and ROP Screening

In this study, hearing evaluation using OAE and BERA showed that 88.9% of infants with developmental delay had abnormal auditory responses, compared to 33.3% in those with normal development. This significant association highlights the importance of early hearing assessment in this high-risk group.[26]
Retinopathy of prematurity (ROP) was identified in 3 of the 12 infants, with one requiring cryotherapy. These findings reinforce the critical need for routine ROP screening and timely intervention in ELBW infants.[27]

Limitations

The study was conducted at a single tertiary care center with a limited sample size, which may restrict generalizability. Furthermore, the absence of advanced neurodevelopmental tools like MRI or Bayley Scales limits the depth of developmental assessment. A multi-center study with a larger cohort and more comprehensive screening methods would allow for stronger conclusions.

CONCLUSION

The study revealed that ELBW (extremely low birth weight) infants exhibited impaired growth and significant developmental abnormalities. Proper nutritional and follow-up strategies should be put in place to ensure that these vulnerable infants achieve optimal growth and development. These findings can be used to enhance the understanding of infant development and to guide interventions for improved neonatal and infant care. Further research and targeted interventions in areas such as expertise hands during hospital stay, nutritional aspects, developmental delay, tone abnormalities, and hearing assessments could contribute to better outcomes for infants.

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