e-ISSN: 0975-9506, p-ISSN: 2961-6093

Available online on www.ijpqa.com doi: 10.25258/ijpqa.16.7.49

International Journal of Pharmaceutical Quality Assurance 2025; 16(7); 305-310

Original Research Article

Evaluating the Impact of Maternal Health on Growth Outcomes of Very Low Birth Weight Infants

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Received: 10-05-2025 / Revised: 19-06-2025 / Accepted: 25-07-2025
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Conflict of interest: Nil

Abstract:

Background: Low Birth Weight and Very Low Birth Weight (<1500 g) remain significant public health challenges globally, particularly in developing countries like India. VLBW infants face increased risks of mortality, morbidity, growth delays, and long-term neurodevelopmental issues. Understanding their growth patterns and addressing challenges in neonatal care, particularly the differences between Small for Gestational Age also Appropriate for Gestational Age infants, is crucial for improving outcomes.

Aim: To evaluate the somatic growth trajectories of VLBW (Very Low Birth Weight) infants, focusing on growth outcomes at hospital discharge and 40 weeks postmenstrual age, with a comparative analysis of SGA and AGA groups.

Methodology: A prospective observational study was conducted over a year at JLNMCH, Bhagalpur, India. The study included 80 VLBW infants admitted within 72 hours of life. Anthropometric parameters (length, weight, head circumference) were measured at birth, discharge, also 40 weeks PMA. SPSS version 27 was used to evaluate the data, and feeding procedures and follow-ups were put into place.

Results: Of 80 neonates, 12.5% were SGA, 45% AGA, and 42.5% unclassified. At 40 weeks PMA, all infants showed significant gains in weight (mean increase 0.5–0.6 kg), length (4.5–5 cm), and head circumference (1–1.5 cm). However, SGA infants had persistently lower growth metrics than AGA counterparts. Complications included PDA (13.75%) and chronic lung disease (6.25%). No late-onset sepsis was reported.

Conclusion: SGA VLBW infants demonstrate slower postnatal growth, highlighting the need for targeted nutritional and clinical interventions. Maternal nutrition, antenatal care, and birth setting significantly influence outcomes in this vulnerable population.

Keywords: Anthropometric Measurements, Neonatal Care, Neonatal Growth, Small For Gestational Age, Postmenstrual Age, Very Low Birth Weight.

Introduction

Globally and in emerging nations like India, LBW (low birth weight) has become a major public health problem. The growth and survival of a newborn are significantly influenced by LBW, which is defined as a birth weight of less than 2500 grams. Numerous "negative consequences have been linked to it, such as stunted growth, elevated mortality and morbidity risks, delayed brain development, and an increased vulnerability to chronic illnesses in later life [1]. An infant's birth weight is mostly determined by the mother's health and nutritional state both before and throughout pregnancy.

Infants born with a weight below 1.5 kg are put in the category of VBW (Very Low Birth Weight) which places them in an even greater risk. The newborns are prone to deficiencies in growth due to a variety of factors, including challenging development in the womb or complications out of it, an unfavorable environment in the womb, and any suboptimal dietary methods that would not support their specific needs to the utmost. The infancy period tolerates the VLBW child at this stage with significant gaps in development, although advancements in neonatal care have resulted in reaching higher survival rates and understanding of neonate physiology [2].

The postnatal growth trajectories of VLBW infants have highlighted the extent to which development deficiencies are persistent in the neonatal and early childhood stages. This slow recovery underlines the importance of understanding and treating young babies to rehabilitate their course of development, although most VLBW infants respond to catch-up growth during childhood or adolescence development times, typically between the ages of 8 to 20 Years [3]. Moreover, it has been shown that adverse long-term physical and neurodevelopmental outcomes are below optimal in cases of poor postnatal growth and this major need we must study specifically and devise measures to mitigate the probable risks [4-5]. Despite the absence of information on underdeveloped countries such as India, survey done in industrialized countries has enlightened the world of outcomes of the growth on low birth weight babies. A large Indian study of the topic emphasized the vulnerability of LBW infants by indicating that their levels of impairment far outnumbered that of normal-weight controls [6]. There is not much knowledge related to the growth patterns and consequences of VLBW children in such environments particularly in regard to differences between the infants who are small in relation to gestational age (SGA), in relation to those who are appropriate in respect to gestational age (AGA). These types of research ensure the guidance of newborn care advancements as well as the maximization of long-term health outcomes of the high-risk populations.

This gap will be filled by the current prospective observational study, which will assess the somatic development of a cohort of VLBW newborns in an Indian context. With an emphasis on contrasting the development trends of SGA and AGA newborns, we specifically evaluated their growth at discharge and 40 weeks postmenstrual age [7]. This study aims to describe these outcomes in order to influence efforts for improving neonatal and postnatal care practices and to establish useful standards for the care given in neonatal intensive care units (NICUs).

The report recognizes the difficulties neonatologists encounter in controlling the growth of children born with VLBW. These difficulties result from a lack of knowledge about the physiological pressures they experience both during and after NICU hospitalization, as well as their particular dietary requirements. This study aims to close a significant gap in the literature by examining the growth trajectories of these infants and to help provide evidence-based recommendations for their treatment. This study examines how maternal health affects very low birth weight infants' growth outcomes.

Methodology

Study Design: This prospective study was conducted over a period of one year in the Department of Pediatrics, JLNMCH, Bhagalpur, Bihar, India. The objective of the study was to evaluate the use of the paperless partogram as a bedside tool for labor management.

Sample Size: The study included a total of 80 Very Low Birth Weight (VLBW) babies (<1500 g) admitted within 72 hours of life and discharged alive.

Inclusion and Exclusion Criteria

Inclusion Criteria:

- Very Low Birth Weight infants (weight <1500 g) hospitalized within 72 hours of life.
- Babies released alive and monitored until 40 weeks postmenstrual age.

Exclusion Criteria:

- Babies with major congenital malformations, such as major cardiac malformations, anencephaly, obstructive uropathy, congenital diaphragmatic hernia, and intestinal atresia.
- Syndromic babies.

Procedure: The study followed a prospective design, tracking VLBW babies until 40 weeks postmenstrual age, with baseline data collected before hospital discharge. At birth, discharge, and 40 weeks after menstruation, anthropometric measures such as weight, length, and head circumference (HC) were taken. Weight was measured without clothing using a conventional electronic scale with a ±5 g inaccuracy. The newborn was placed supine with both legs completely extended and feet put on a moveable footpiece in order to measure length using an infantometer. A non-stretchable fiberglass tape was used to measure HC at the occipitofrontal diameter. According to Fenton's growth charts, babies were categorized as Short for Gestational Age (SGA) if their birth weight fell below the 10th centile.

Feeding protocols were implemented based on birth weight. Minimal enteral nutrition (MEN) was initiated if the baby was hemodynamically stable with no increased oxygen requirement. For babies weighing less than 600 g, 1 ml of feed (expressed breast milk) was started every 6 hours at 24 hours of age, with an increment of 1 ml/day after every 48 hours. For babies between 600–999 g, 1 ml of feed was started every 4 hours at 24 hours of age, increasing by 1 ml/day every 48 hours. Babies between 1000–1399 g received 2 ml of feed every 4 hours starting at 12 hours of age, increasing by 3 ml/day every 36 hours. For babies weighing more than 1400 g, 2 ml of feed was started every 2 hours at 12 hours of age, with an increment of 4 ml/day every 24 hours. Target feed volume of 200 ml/kg/day was achieved by enteral & intravenous fluid. Intravenous fluid was gradually tapered & stopped once enteral feed volume reached around 150 to 180 ml/kg/day. Spoon feeding was introduced by 33 weeks postmenstrual age or earlier if the baby showed readiness.

Follow-up procedures included monitoring maximum weight loss, the time taken to regain birth weight, and anthropometric data at discharge and subsequent follow-ups. Permanent and present addresses, along with phone numbers, were recorded to ensure a high follow-up rate. Parents of babies who missed follow-ups were contacted by the principal investigator. Feeding adjustments were made based on feed tolerance, monitored through abdominal girth, aspirates, and overall hemodynamic stability. Feeds were withheld temporarily or for up to 72 hours in cases of bilious or bloody aspirates or suspected necrotizing enterocolitis. At discharge, mothers were instructed to continue breastfeeding or preterm formula feeding, depending on the feeding practices in the NICU.

Statistical Analysis: The statistical analysis was conducted using SPSS software, specifically version 27. The results were interpreted to assess the effectiveness of the partogram in managing labor. The Chi-square test was used to analyze categorical data. The P-value below 0.05 was indicated the statistical significance of result.

Result

Table 1 shows that 46.25% of participants were male and 53.75% were female, indicating a relatively balanced gender distribution. The average birth weight was 1199 ± 215.7 g, with 12.5% of babies classified as extremely low birth weight (ELBW). The average gestational age was 30 ± 2.5 weeks, with 45% being appropriate for gestational age (AGA), 12.5% small for gestational age (SGA), and 42.5% not categorized — possibly including large for gestational age (LGA) or unclassified entries. Of the neonates, 41.25% were inborn and 58.75% were outborn, indicating a higher proportion of deliveries outside the facility. Complete antenatal steroid coverage was observed in 21.25% of cases, while 13.75% had partial coverage. Multiple pregnancies and abnormal Doppler findings were each noted in 12.5% of the cohort.

The average duration of initial IV fluid therapy was 78.77 ± 32.43 hours, during which the mean cumulative weight loss was 12.06 ± 5.00%. The average time to regain birth weight was 11.73 ± 3.72 days, and full enteral feeds were achieved in 7.11 ± 2.12 days. The median duration of hospital stay was 30 days (range 14–45), and the mean gestational age at discharge was 36 weeks. Regarding complications, late-onset sepsis was absent (0%), while necrotizing enterocolitis was observed in 1.25%, patent ductus arteriosus in 13.75%, and chronic lung disease in 6.25% of the infants.

Table 1: Baseline Characteristics of Study Population

Characteristic	Number (percentage)	Mean ± SD
Male	37 (46.25%)	
Female	43 (53.75%)	
Mean birth weight (g)		1199 ± 215.7
Extremely Low Birth Weight	10 (12.5%)	
Mean Gestation (weeks)		30 ± 2.5
Small for Gestational Age (SGA)	10 (12.5%)	
Appropriate for Gestational Age (AGA)	36 (45%)	
Unclassified (possibly LGA or missing)	34 (42.5%)	
Inborn	33 (41.25%)	
Outborn	47 (58.75%)	
Antenatal Steroid – Complete	17 (21.25%)	
Antenatal Steroid – Partial	11 (13.75%)	
Multiple Pregnancies	10 (12.5%)	
Abnormal Doppler	10 (12.5%)	
Duration of initial IV fluids (hr)		78.77 ± 32.43
Cumulative weight loss (%)		12.06 ± 5.00
Days to reach full feeds		7.11 ± 2.12
Days to regain birth weight		11.73 ± 3.72
Gestational age at discharge (weeks)		36
Median hospital stay (days)	30 (range 14–45)	
Late-onset sepsis	0 (0%)	
Necrotising enterocolitis	1 (1.25%)	
Patent ductus arteriosus	11 (13.75%)	
Chronic lung disease	5 (6.25%)	

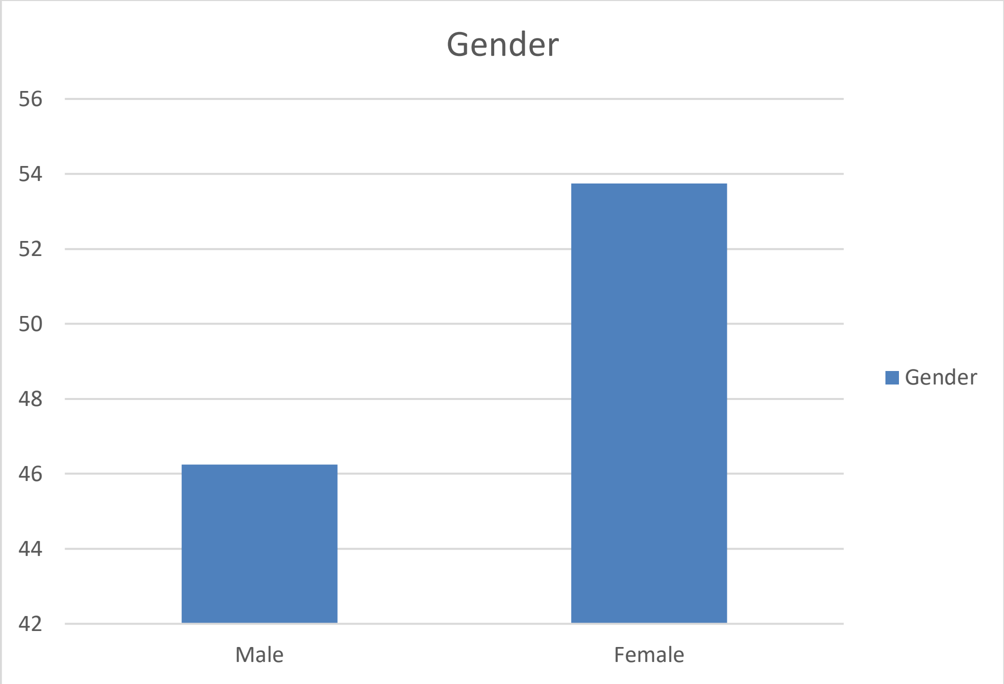

Figure 1: Demographic profile according to Gender

Table 2 shows the growth metrics (weight, length, and head circumference) of all newborns (ALL), those appropriate for gestational age (AGA), and those small for gestational age (SGA) at delivery, discharge, and 40 weeks post-menstrual age (PMA). AGA newborns continuously had higher values than SGA infants across all metrics. All groups exhibited significant development at 40 weeks PMA as compared to discharge, with weight rising by 0.5–0.6 kg, length by 4.5–5 cm, and head circumference by 1–1.5 cm. Though their development was less noticeable than that of the AGA and ALL groups, SGA newborns had the lowest measures throughout. From birth to 40 weeks postpartum, the findings show steady development in all parameters, with differences between infants who are AGA and those who are SGA.

Table 2: Growth Metrics by Gestational Age Classification

Z Score	At Birth	At Discharge	At 40 Weeks PMA
Weight (kg)			
ALL	2.25	2.1	2.6
AGA	2.5	2.4	2.8
SGA	1.2	1	1.5
Length (cm)			
ALL	47.5	46	50.5
AGA	48	47	51.5
SGA	42	40.5	45
Head Circumference (cm)			
ALL	33.5	32.5	34.5
AGA	34	33	35
SGA	30	29	31.5

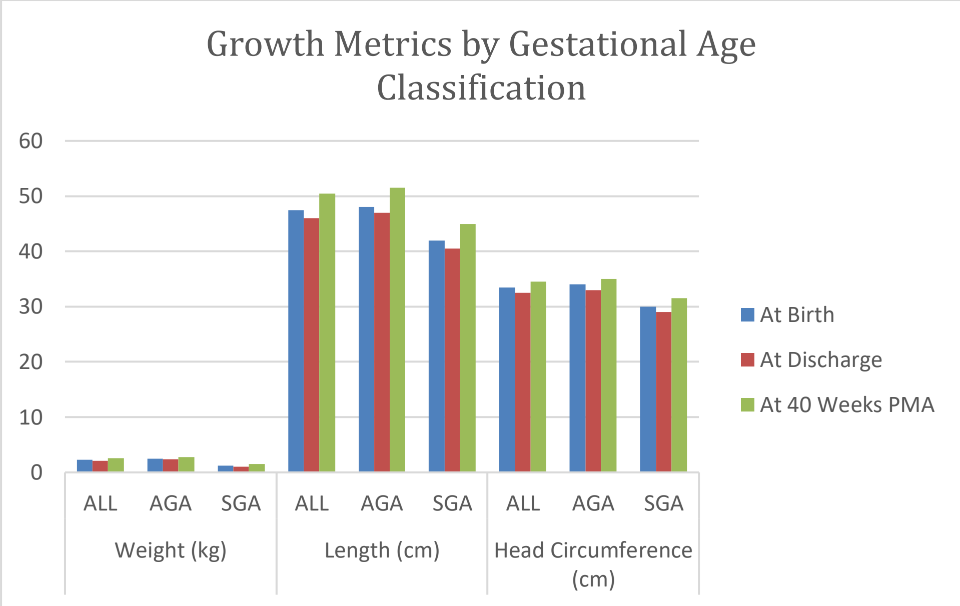

Figure 2: Growth Metrics by Gestational Age Classification

Discussion

The baseline characteristics of the study population provide valuable insight into the demographics and clinical outcomes of very low birth weight (VLBW) preterm neonates. With a near-equal gender distribution (46.25% male and 53.75% female), the study ensures balanced representation. The average birth weight of 1199 ± 215.7 g and average gestational age of 30 ± 2.5 weeks reaffirm that most neonates in this cohort were preterm and underweight.

Out of the total neonates, 12.5% were categorized as Small for Gestational Age (SGA), 45% as Appropriate for Gestational Age (AGA), and 42.5% remained uncategorized—likely including Large for Gestational Age (LGA) or cases with missing classifications. The presence of 41.25% inborn and 58.75% outborn deliveries emphasizes the importance of neonatal referral systems and the quality of perinatal care across facilities.

SGA neonates represent a particularly vulnerable subgroup. Their dual burden of prematurity and intrauterine growth restriction places them at a higher risk for postnatal complications and poor developmental outcomes [8]. During hospitalization, growth Z-scores in both AGA and SGA infants showed a declining trend, yet AGA infants maintained consistently better growth velocities. This is consistent with literature suggesting SGA infants typically follow a lower growth trajectory and may experience delayed catch-up growth [9,10].

Antenatal steroid exposure plays a crucial role in fetal lung maturity and overall neonatal outcomes. In this cohort, 21.25% had complete coverage, and 13.75% had partial coverage. This relatively low coverage may impact early morbidities and postnatal adaptation. Similar findings have been reported by Faye et al. [11], who emphasized the role of antenatal interventions in reducing extrauterine growth retardation, which was observed in 86% of neonates in their cohort.

Our results demonstrated that during the early postnatal period, the average weight loss during the initial IV fluid phase was 12.06 ± 5%, with regaining of birth weight occurring by 11.73 ± 3.72 days. Full enteral feeds were achieved in an average of 7.11 ± 2.12 days. These findings reflect adequate fluid and nutritional support. However, continuous monitoring remains essential, particularly in SGA infants, to support timely catch-up growth.

Interestingly, no cases of late-onset sepsis were observed, suggesting" strong infection control practices. However, other complications such as necrotizing enterocolitis (1.25%), patent ductus arteriosus (13.75%), and chronic lung disease (6.25%) were documented. These complications are frequently associated with low gestational age and prolonged hospital stay, reinforcing the need for early detection and management protocols.

The analysis of growth parameters (Table 2) revealed significant increases in weight, length, and head circumference (HC) across all groups between birth and 40 weeks post-menstrual age (PMA). AGA neonates consistently outperformed SGA neonates in all growth measures, though all infants showed measurable improvement. SGA infants had the lowest baseline values and the slowest growth progression, which aligns with known intrauterine compromise and postnatal vulnerability [12].

A subgroup analysis based on maternal nutrition (Figure 4) further highlighted the significant role of prenatal care. SGA and AGA neonates born to mothers with poor nutritional status had substantially lower anthropometric outcomes than those born to well-nourished mothers. This aligns with existing literature, such as Blencowe et al. [13], which links intrauterine growth restriction (IUGR) to maternal undernutrition and adverse perinatal outcomes, particularly in resource-limited settings.

Chand et al. [14] reported that morbidities in LBW infants were differentially associated with birth weight and gestational age. Their study, in line with ours, emphasized hypothermia and hypocalcemia in lower birth weight neonates and stressed the need for vigilant thermal and metabolic care. Our study also supports continuous monitoring of postnatal growth as an indicator of health and neurodevelopmental prognosis. NICU professionals should remain vigilant, as poor growth during this critical period may correlate with long-term neurodevelopmental delays [15, 16]. Lastly, the mean gestational age at discharge was 36 weeks, and the median hospital stay was 30 days. These values reflect the extended care required for VLBW infants and reinforce the importance of sustained medical and nutritional support throughout the NICU stay.

Conclusion

This study highlights the distinct growth challenges faced by very low birth weight (VLBW) preterm neonates, particularly those categorized as Small for Gestational Age (SGA). Despite overall improvements in weight, length, and head circumference by 40 weeks post-menstrual age, SGA infants consistently lagged behind their AGA counterparts, indicating the need for early, targeted nutritional and clinical interventions. The findings also underscore the influence of maternal nutrition, antenatal care, and inborn status on neonatal outcomes. Continuous growth monitoring and individualized care plans are essential to optimize both short- and long-term developmental trajectories in this vulnerable population.

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