International Journal of Life Sciences Biotechnology and Pharma Research Vol. 8, No. 2, July- December 2019 Online ISSN: 2250-3137
Print ISSN: 2977-0122

ORIGINAL RESEARCH

To evaluate the somatic growth of children with a very low birth weight

[1]Raghupathi R, [2]Kodhati Swami Rao, [3]Dr. Sandhya Rani Atkuri, [4]G Venkatesh

[1]Assistant Professor, Department of Paediatrics, Prathima Institute of Medical Sciences, Nagunoor, Karimnagar, Telangana, India
[2]Assistant Professor, Department of Paediatrics, Chalmeda Ananda Rao Institute of Medical Sciences, Bommakal, Karimnagar, India
[3]Assistant Professor, Department of Paediatrics, IQ City Medical College and Hospital, Durgapur, West Bengal, India
[4]Assistant Professor, Department of General Medicine, Gouridevi Institute of Medical Sciences, Durgapur, West Bengal, India

Corresponding Author
G Venkatesh
Assistant Professor, Department of General Medicine, Gouridevi Institute of Medical Sciences, Durgapur, West Bengal, India

Received: 19 August, 2019 Accepted: 25 September, 2019

ABSTRACT
Aim: To evaluate the somatic growth of very low birth weight (VLBW) infants through individualized nutritional and medical interventions, tracking growth progress until 40 weeks postmenstrual age. **Materials and Methods:** This prospective observational study included 100 VLBW infants (<1500 g), admitted within the first 72 hours of life and discharged alive. Infants with major congenital anomalies or syndromes were excluded. Anthropometric measurements (weight, length, and head circumference) were recorded at birth, discharge, and 40 weeks postmenstrual age. Feeding protocols were tailored based on birth weight and clinical stability. Z-scores for anthropometric parameters were calculated to assess growth patterns over time. Statistical comparisons identified significant differences in growth outcomes. **Results:** The cohort included 55% males, with most infants (45%) born between 28–32 weeks of gestation. Forty percent were classified as small for gestational age (SGA). Weight increased from 1200 ± 200 g at birth to 2600 ± 250 g at 40 weeks. Length improved from 35.5 ± 3.2 cm at birth to 48.2 ± 3.1 cm, and head circumference increased from 26.5 ± 2.5 cm to 33.8 ± 2.4 cm. Maximum weight loss occurred within 5 ± 2 days after birth, with infants regaining birth weight in 15 ± 5 days. Feeding practices varied by birth weight, with infants <600 g taking longer to reach full feeds (14 ± 2 days). Z-scores for weight (-1.8 to -0.8), length (-1.5 to -0.7), and head circumference (-1.6 to -0.9) demonstrated significant catch-up growth. **Conclusion:** Tailored nutritional and medical strategies significantly improved somatic growth in VLBW infants, with notable catch-up in weight, length, and head circumference. However, disparities in weight gain compared to length and head circumference suggest the need for enhanced nutritional interventions, particularly for SGA infants. Individualized feeding practices effectively minimized complications and promoted optimal growth.
Keywords: Very low birth weight, somatic growth, nutritional interventions, catch-up growth, small for gestational age.

INTRODUCTION

Somatic growth, encompassing both physical and developmental aspects, is a pivotal indicator of neonatal health, particularly in very low birth weight (VLBW) infants, defined as those weighing less than 1500 grams at birth. These infants face significant challenges due to their premature birth and reduced nutritional reserves, necessitating specialized care to promote optimal growth and development. Somatic growth serves as a vital marker of overall health and neurodevelopmental outcomes in VLBW infants. Achieving appropriate growth rates is crucial during the neonatal period and beyond, influencing long-term health outcomes such as cognitive function and metabolic health. Inadequate growth during this critical period is associated with increased risks of neurodevelopmental impairments and chronic diseases later in life.[1] Therefore, monitoring and promoting optimal somatic growth are fundamental aspects of neonatal care for VLBW infants. Several interrelated factors contribute to somatic growth in VLBW infants. Nutrition plays a central role, as these infants often require specialized feeding strategies to meet their high metabolic demands and promote catch-up growth. Breast milk, with its immunological and nutritional benefits, is preferred but may need fortification to meet the increased nutrient requirements of VLBW infants. Formula feeding is also common, offering controlled nutrient content but requiring careful monitoring to prevent overfeeding and associated complications. Medical interventions and comorbidities significantly impact growth outcomes.[2-4]Respiratory distress syndrome, sepsis, and necrotizing enterocolitis are common in VLBW infants, complicating feeding tolerance and nutrient absorption. Timely management of these conditions is crucial to minimize their adverse effects on growth and development. The developmental environment of the neonatal intensive care unit (NICU) also influences somatic growth. Factors such as noise levels, light exposure, and handling practices can affect physiological stress and nutrient utilization in VLBW infants. Developmentally supportive care practices, including minimizing stressors and promoting kangaroo care, have been shown to improve growth outcomes and neurodevelopmental outcomes in this population. Optimizing nutrition is paramount in promoting somatic growth in VLBW infants. Recent research emphasizes the importance of individualized feeding plans tailored to each infant's unique nutritional needs.[5] Human milk fortification with added proteins, fats, and minerals has been shown to support better growth outcomes compared to unfortified breast milk or formula alone. Innovations in parenteral nutrition and enteral feeding protocols aim to provide adequate macronutrients and micronutrients while minimizing the risks of feeding intolerance and complications.

MATERIALS AND METHODS

This prospective observational study was conducted in the Department of Pediatrics, focusing on very low birth weight (VLBW) infants (birth weight <1500 g) admitted within the first 72 hours of life. Only infants discharged alive were included in the study and were followed until 40 weeks postmenstrual age. Infants with major congenital anomalies, such as significant cardiac defects, anencephaly, obstructive uropathy, congenital diaphragmatic hernia, or intestinal atresia, as well as those with identifiable syndromes, were excluded.

Classification and Measurements

Infants were classified as small for gestational age (SGA) if their birth weight was below the 10th percentile according to Fenton’s growth charts. Anthropometric measurements including weight, length, and head circumference (HC) were recorded at birth, discharge, and at 40 weeks postmenstrual age.

- **Weight** was measured using a standard electronic scale with a precision of ±5 g, ensuring infants were unclothed during measurement.
- **Length** was assessed using an infantometer, with infants positioned supine, legs extended, and feet pressed against the movable footpiece.
- **Head circumference** was measured with non-stretchable fiberglass tape around the occipitofrontal diameter.

Weight Loss and Recovery

Maximum weight loss was calculated as the difference between the lowest weight recorded and the birth/admission weight. The age at maximum weight loss and the duration to regain birth weight were documented for each infant.

Feeding Protocols

Feeding protocols varied based on birth weight and hemodynamic stability:
Infants weighing <600 g were fed 1 ml of expressed breast milk every 6 hours starting at 24 hours of life, with volume increases of 1 ml/day every 48 hours.Infants weighing 600–999 g received 1 ml every 4 hours under the same incremental schedule.Infants weighing 1000–1399 g started with 2 ml every 4 hours at 12 hours of life, with increases of 3 ml/day every 36 hours.Infants >1400 g were started on 2 ml every 2 hours with increases of 4 ml/day every 24 hours.Enteral feeds were gradually increased to a target volume of 200 ml/kg/day. Intravenous fluids were discontinued once enteral feeding reached 100 ml/kg/day. Minimal enteral nutrition (MEN) was initiated in hemodynamically stable infants, with only breast milk preferred for MEN whenever possible.

Feeding Adjustments

Feed progression was monitored based on tolerance, absence of significant abdominal distension, and lack of bilious or bloody aspirates. Feeds were withheld for 24 hours in cases of recurrent aspirates, or longer if necrotizing enterocolitis (NEC) was suspected.

Follow-Up and Monitoring

Infants were followed until 40 weeks postmenstrual age. Addresses and contact details were recorded to ensure follow-up, and non-compliant families were contacted. For infants who did not complete follow-up, available anthropometric data up to the last recorded visit were considered.

Statistical Analysis

Z-scores for weight, length, and HC were calculated at birth, discharge, and 40 weeks postmenstrual age. Mean Z-scores were compared across these time points for the entire cohort and separately for SGA and appropriate for gestational age (AGA) infants. Statistical comparisons were performed to identify significant differences in growth patterns.

RESULTS

Table 1: Demographic Characteristics of Study Participants

The study included 100 very low birth weight (VLBW) infants, with a slight male predominance (55%). The gestational age distribution showed that the majority of infants (45%) were born between 28–32 weeks, while 35% were born between 33–36 weeks, and 20% were born extremely preterm (<28 weeks). Small for gestational age (SGA) infants comprised 40% of the cohort, highlighting a significant proportion of growth-restricted neonates among the participants.

Table 2: Anthropometric Measurements

The mean birth weight of the infants was 1200 ± 200 g, which increased to 1400 ± 180 g at discharge and 2600 ± 250 g by 40 weeks postmenstrual age, reflecting consistent weight gain during the study period. Length followed a similar trajectory, improving from 35.5 ± 3.2 cm at birth to 40.1 ± 2.8 cm at discharge, and reaching 48.2 ± 3.1 cm at 40 weeks. The head circumference also showed progressive growth from 26.5 ± 2.5 cm at birth to 29.0 ± 2.2 cm at discharge, and 33.8 ± 2.4 cm at 40 weeks. These improvements underscore the effectiveness of nutritional and medical interventions in promoting catch-up growth in VLBW infants.

Table 3: Weight Loss and Recovery

The mean maximum weight loss experienced by the infants was 120 ± 30 g, occurring at an average of 5 ± 2 days after birth. The time to regain birth weight was 15 ± 5 days. These findings are consistent with expected physiological patterns of early weight loss and subsequent recovery in neonates, with the recovery period slightly extended due to the vulnerabilities of VLBW infants.

Table 4: Feeding Practices

The feeding practices varied according to the birth weight of the infants:Infants weighing <600 g took the longest to reach full feeds, with an average of 14 ± 2 days due to the cautious increment rates (1 ml every 48 hours).Infants weighing 600–999 g required an average of 12 ± 2 days to achieve full feeds.Those weighing 1000–1399 g achieved full feeds in 10 ± 1 days with a slightly faster increment rate (3 ml/day every 36 hours).Infants >1400 g reached full feeds in just 8 ± 1 days due to their relatively better tolerance and faster feeding progression (4 ml/day every 24 hours).These practices ensured individualized and safe feeding progression, minimizing feeding intolerance and complications.

Table 5: Z-Score Comparison for Anthropometric Parameters

The Z-scores for weight, length, and head circumference showed significant improvements over time:**Weight Z-scores** improved from -1.8 ± 0.5 at birth to -1.4 ± 0.4 at discharge, and further to -0.8 ± 0.3 by 40 weeks, indicating substantial catch-up growth.**Length Z-scores** increased from -1.5 ± 0.6 at birth to -1.2 ± 0.5 at discharge, and to -0.7 ± 0.4 at 40 weeks.**Head circumference Z-scores** improved from -1.6 ± 0.5 at birth to -1.2 ± 0.4 at discharge, and to -0.9 ± 0.3 at 40 weeks.

Table 1: Demographic Characteristics of Study Participants

Characteristic	Number (n)	Percentage (%)
Total Infants	100	100%
Gender		
Male	55	55%
Female	45	45%
Gestational Age		
<28 weeks	20	20%
28–32 weeks	45	45%
33–36 weeks	35	35%
Small for Gestational Age (SGA)		
Yes	40	40%
No	60	60%

Table 2: Anthropometric Measurements

Measurement	At Birth (Mean ± SD)	At Discharge (Mean ± SD)	At 40 Weeks (Mean ± SD)
Weight (g)	1200 ± 200	1400 ± 180	2600 ± 250
Length (cm)	35.5 ± 3.2	40.1 ± 2.8	48.2 ± 3.1
Head Circumference (cm)	26.5 ± 2.5	29.0 ± 2.2	33.8 ± 2.4

Table 3: Weight Loss and Recovery

Parameter	Mean ± SD
Maximum Weight Loss (g)	120 ± 30
Age at Maximum Weight Loss (days)	5 ± 2
Time to Regain Birth Weight (days)	15 ± 5

Table 4: Feeding Practices

Birth Weight Group (g)	Initial Feeding Volume (ml)	Increment Rate (ml/day)	Time to Reach Full Feeds (days)
<600	1 every 6 hours	1 every 48 hours	14 ± 2
600–999	1 every 4 hours	1 every 48 hours	12 ± 2
1000–1399	2 every 4 hours	3 every 36 hours	10 ± 1
>1400	2 every 2 hours	4 every 24 hours	8 ± 1

Table 5: Z-Score Comparison for Anthropometric Parameters

Parameter	At Birth (Mean ± SD)	At Discharge (Mean ± SD)	At 40 Weeks (Mean ± SD)
Weight (Z-Score)	-1.8 ± 0.5	-1.4 ± 0.4	-0.8 ± 0.3
Length (Z-Score)	-1.5 ± 0.6	-1.2 ± 0.5	-0.7 ± 0.4
Head Circumference (Z-Score)	-1.6 ± 0.5	-1.2 ± 0.4	-0.9 ± 0.3

DISCUSSION

Our study demonstrated that the majority of VLBW infants were born between 28–32 weeks of gestation (45%), with a male predominance (55%) and 40% being classified as small for gestational age (SGA). These findings align with the study by Soni et al. (2016), which reported similar trends, attributing the high proportion of 28–32 week gestations to improved neonatal care enabling better survival in moderately preterm infants.6 The proportion of SGA infants is also comparable to findings by Blencowe et al. (2015), which emphasized that intrauterine growth restriction (IUGR) remains a significant contributor to SGA births, particularly in resource-constrained settings.[7]

The steady improvement in weight, length, and head circumference (HC) observed in our study underscores the effectiveness of individualized feeding and medical support. The mean weight at 40 weeks (2600 ± 250 g) is consistent with results from the cohort study by Rochow et al. (2016), which reported similar catch-up growth in VLBW infants under optimized nutritional protocols.[8] However, the slightly lower Z-scores for weight (-0.8 ± 0.3 at 40 weeks) compared to length (-0.7 ± 0.4) and HC (-0.9 ± 0.3) indicate a disproportionate growth recovery pattern, also observed by Ehrenkranz et al. (2014). This discrepancy may be linked to the prioritization of head and organ growth over somatic growth during recovery.[9]

The mean maximum weight loss of 120 ± 30 g and the time to regain birth weight (15 ± 5 days) observed in this study are consistent with expected physiological trends, as described by Griffin et al. (2016).[10]However, the longer time required for VLBW infants compared to term infants reflects the metabolic challenges and slower feed tolerance in this population. Similar findings were reported by Stoll et al. (2015), who highlighted that achieving energy balance is delayed in extremely preterm infants, leading to prolonged recovery periods.[11]

The gradual feeding progression outlined in our study minimized feeding intolerance, with the time to reach full feeds varying significantly by birth weight. Infants weighing <600 g required the longest time (14 ± 2 days), while those >1400 g achieved full feeds more rapidly (8 ± 1 days). These results align with the findings of Choudhary et al. (2017), which demonstrated that careful feeding advancements in VLBW infants improve tolerance and reduce complications such as necrotizing enterocolitis (NEC). The reliance on minimal enteral nutrition (MEN) as the initial feeding strategy is supported by Klingenberg et al. (2015), who emphasized its benefits in stimulating gut motility and preventing intestinal atrophy.[12]

The significant improvement in Z-scores for weight, length, and HC from birth to 40 weeks reflects successful catch-up growth in our cohort. Similar trends were observed by Olsen et al. (2015), who reported that VLBW infants showed marked improvement in Z-scores with standardized nutritional interventions. The lesser degree of improvement in weight Z-scores compared to length and HC is consistent with findings by Franz et al. (2018), which suggested that achieving optimal weight gain in preterm infants is more challenging due to their metabolic immaturity and higher energy expenditure.[13]

CONCLUSION

This study highlights the critical importance of tailored nutritional and medical interventions for very low birth weight (VLBW) infants, demonstrating significant improvements in weight, length, and head circumference over time. While growth catch-up was evident, disparities in weight Z-scores compared to length and head circumference suggest the need for enhanced nutritional strategies. The findings underscore the value of individualized feeding practices in minimizing complications like feeding intolerance and promoting optimal growth. Early identification and support for small for gestational age (SGA) infants further improve outcomes.

REFERENCES

1. Patel AL, Johnson TJ, Engstrom JL, et al. Impact of early human milk on sepsis and health-care costs in very low birth weight infants. J Perinatol. 2017;37(1):92-97. doi:10.1038/jp.2016.198

2. Zozaya C, Díaz C, Saenz de Pipaón M. How should we define postnatal growth restriction in preterm infants? Neonatology. 2018;114(2):177-180. doi:10.1159/000488464
3. Miller J, Tonkin E, Damarell RA, et al. A systematic review and meta-analysis of human milk feeding and morbidity in very low birth weight infants. Nutrients. 2018;10(6):707. doi:10.3390/nu10060707
4. Carter BM, Holditch-Davis D, Brandon DH. The impact of maternal stress on neurodevelopmental outcomes in preterm infants. Adv Neonatal Care. 2015;15(5):306-314. doi:10.1097/ANC.0000000000000213
5. Underwood MA. Human milk for the premature infant. Pediatr Clin North Am. 2013;60(1):189-207. doi:10.1016/j.pcl.2012.09.008
6. Soni A, Gupta P, Mehta S. Survival trends in VLBW infants: A multi-center analysis. *Indian J Pediatr*. 2016;83(5):370-375.
7. Blencowe H, Cousens S, Oestergaard MZ, et al. Preterm birth-associated neurodevelopmental impairment estimates. *Pediatr Res*. 2015;77(3):181-188.
8. Rochow N, Fusch G, Mühlinghaus A, et al. Establishing growth norms for preterm infants. *Am J Clin Nutr*. 2016;103(3):639-651.
9. Ehrenkranz RA, Das A, Wrage LA, et al. Early nutrition mediates developmental growth and neurodevelopment in preterm infants. *Pediatrics*. 2014;134(1):41-49.
10. Griffin IJ, Tancredi DJ, Bertino E. Growth failure in VLBW infants: Management challenges. *Pediatrics*. 2016;137(2)
11. Stoll BJ, Hansen NI, Bell EF, et al. Neonatal outcomes of extremely preterm infants. *N Engl J Med*. 2015;372(18):1803-1813.
12. Klingenberg C, Embleton ND, Jacobs SE, et al. Enteral feeding practices in VLBW infants. *J Pediatr Gastroenterol Nutr*. 2015;60(2):264-270.
13. Franz AR, Pohlandt F, Steinbach G, et al. Nutrition and growth outcomes in preterm infants: Balancing caloric intake and clinical risks. *J Perinatol*. 2018;38(1):48-55.