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POSTNATAL GROWTH AMONG VERY LOW BIRTH WEIGHT NEONATES AT KENYATTA NATIONAL HOSPITAL (KNH), KENYA

Priscillah Jepkorir Koech, Lecturer and Neonatologist, Department of Paediatrics and Child Health, School of Medicine, Kenyatta University, P.O. Box 43844-00100, Nairobi, Kenya, Florence .V Murila, Senior Lecturer and Neonatologist, Department of Paediatrics and Child Health, The University of Nairobi, P.O. Box 30197-00100 Nairobi, Kenya, Brian Maugo, Lecturer and Neonatologist, Department of Paediatrics and Child Health, The University of Nairobi, P.O. Box 30197-00100 Nairobi, Kenya, Jalemba Aluvaala MbchB, MMed, MSC, DPhil, Lecturer and Researcher, Department of Paediatrics and Child Health, The University of Nairobi, P.O. Box 19676-00202 KNHN Nairobi, Kenya

Corresponding author: Priscillah Jepkorir Koech Lecturer and Neonatologist Department of Paediatrics and Child Health, School of Medicine, Kenyatta University, P.O. Box 43844-00100, Nairobi, Kenya. Email: koech.priscillah@ku.ac.ke prixtkb@gmail.com

POSTNATAL GROWTH AMONG VERY LOW BIRTH WEIGHT NEONATES AT KENYATTA NATIONAL HOSPITAL (KNH) KENYA

P. J. Koech, F.V. Murila, B. Maugo and J. Aluvaala

ABSTRACT

Background: Very Low Birth Weight (VLBW) are neonates with birth weight between 1000 grams(g) and 1499 g. They are predominantly premature having been born before attaining 37 weeks of gestation. Their postnatal growth is associated with short term and long-term effects. Little is known about postnatal growth and enteral feeding of VLBW in Low- and Middle-Income Countries (LMICs). In Kenya, a previous study was published more than a decade ago.

Objectives: To determine the in-patient postnatal growth patterns and nutrition of VLBW new-borns at Kenyatta National Hospital (KNH), a tertiary referral hospital in Nairobi, Kenya

Methods: A six-month prospective cohort study was conducted at the KNH-New-born Unit (NBU) in 2022. Seventy-nine VLBW neonates admitted within the first 24 hours of life and surviving to day 14 were consecutively enrolled, excluding those with congenital malformations. Data on socio-demographic characteristics, anthropometric measurements, feeding practices, and comorbidities were collected using a structured tool. Analysis was performed using SPSS version 23.0. The population was described by summarizing variables into percentages and means. Postnatal growth was measured by analysing the proportion of VLBW regaining birthweight at 14 days of life and median time in days to achieving full enteral feeds of 150ml/kg /day. Statistical significance was interpreted at 95% confidence level. Growth velocities were expressed as means or medians with standard deviations (SD) or interquartile ranges (IQR). Statistical significance was set at $p \leq 0.05$

Results: By day 14 of life, 39 VLBW new-borns (49%) had regained their birth weight. The median postnatal growth rates were weight gain of 14.4 g/kg/day, length gain of 0.48 cm/week, and head circumference increase of 0.43 cm/week. The most common comorbidities observed were respiratory distress syndrome, neonatal jaundice, and neonatal sepsis. No independent factors were found to be significantly associated with regaining birth weight by day 14.

Conclusion: This study found that the feeding practices and postnatal growth rates at KNH are approaching the World Health Organization (WHO)-recommended weight gain rate of 15 g/kg/day.

Recommendation: Standard care practices and ongoing quality improvement initiatives at KNH should be maintained and strengthened to continue improving outcomes for VLBW neonates.

INTRODUCTION

Background

Low birth weight (LBW), defined as a birth weight less than 2500 grams(g), remains a global public health concern, particularly in low- and middle-income countries (LMICs) where the prevalence reaches 15.5%, accounting for over 96% of cases worldwide ^{1,2}. Very low birth weight (VLBW, 1000–1499 g) new-borns are often preterm and face multiple morbidities such as respiratory distress syndrome (RDS), necrotizing enterocolitis (NEC), intraventricular haemorrhage (IVH), patent ductus arteriosus (PDA), and neonatal sepsis ^{2,3}. Mortality and morbidity risks rise steeply as gestational age and birth weight decrease, with a logarithmic relationship observed between survival and prematurity severity ^{2,4}. Nutrition is a cornerstone of care in VLBW, aiming to approximate intrauterine growth to optimize long-term outcomes. WHO recommends exclusive breastfeeding for the first six months, and guidelines emphasize early initiation of minimal enteral feeding, progressing to full feeds of 150 millilitres per kilogram per day (ml/kg/day) ⁵⁻⁷. Optimal postnatal growth is defined as weight gain of 15 g/kg/day alongside proportional increases in length and head circumference, yet achieving these targets is often complicated by comorbidities

and feeding intolerance ^{3,8-10}. International reference standards, such as those from the Intergrowth-21st (IG21) project, provide benchmarks for monitoring VLBW growth velocity, but achieving these standards remains a challenge across diverse settings ¹².

Knowledge Gap

Much of the existing literature on VLBW growth and nutrition originates from high-income countries with advanced neonatal care, which may not reflect the realities of Low- and Middle-Income Countries (LMICs) ^{6,7,12}. In sub-Saharan Africa, a few studies have demonstrated suboptimal weight gain, delayed time to regain birth weight, and prolonged transition to full enteral feeding compared with international targets ^{3,13-15}. For instance, South African studies reported average growth velocities of 13.2 g/kg/day with delays of over two weeks in regaining birth weight, while Kenyan studies showed mean weight gain rates of 13.5 g/kg/day with more than half of VLBW infants falling below the recommended 15 g/kg/day ^{3,16}. Kangaroo Mother Care (KMC) has demonstrated potential in enhancing growth outcomes in local settings; however, variations in feeding practices, comorbidity profiles, and healthcare resources contribute to inconsistent results ¹⁷. Although the World Health Organization (WHO) and Kenyan

national guidelines recommend similar feeding protocols for stable and unwell VLBW neonates, delays in achieving full enteral feeds are frequently observed, particularly among unstable infants dependent on intravenous supplementation^{18,20–24}. Importantly, most Kenyan studies on VLBW growth are over a decade old, predating recent advances in neonatal care at Kenyatta National Hospital (KNH). Furthermore, earlier studies rarely assessed the combined impact of comorbidities and feeding transitions on postnatal growth, leaving critical gaps in understanding how these factors interact within the local context.

Main Objective

Given the paucity of updated local evidence, this study aimed to describe the inpatient postnatal growth patterns and nutritional outcomes of VLBW neonates admitted at KNH. Specifically, it sought to determine the proportion of VLBW infants regaining birth weight within 14 days of life, establish the average time required to achieve full enteral feeding, document postnatal growth rates in terms of weight (g/kg/day), length, and head circumference (cm/week), and identify the comorbid conditions that influence growth trajectories in this vulnerable population. By addressing these objectives, the study intends to generate context-specific data that may guide clinical practice, inform policy, and align neonatal nutritional care with both international standards and the evolving realities of LMIC health systems.

METHODOLOGY

Study design

This study was a prospective cohort study that described the inpatient postnatal

growth patterns and nutrition of VLBW neonates.

Study site

The study was conducted at the Kenyatta National Hospital – Newborn Unit (KNH–NBU), located in Nairobi, Kenya. KNH is the largest tertiary referral and teaching hospital in the country, providing both basic and specialized neonatal services. The NBU admits an average of 250 neonates per month, of whom approximately 12% are very low birth weight (VLBW, 1000–1499 g). KNH–NBU provides critical care, nutritional support, and follow-up for high-risk neonates, serving as a referral center for facilities across the region.

Study population

The study population consisted of VLBW admitted on day one of life between January 2022 and June 2022.

Eligibility criteria

Inclusion

Newborns within 24 hours of life.

Newborns with birth weight between 1000 grams and 1499 grams

Exclusion

Congenital malformations.

Death before 14th day.

Sample size determination

According to health records estimates in KNH, approximately 160 VLBW newborns are admitted semiannually. The survival rate beyond 7 days was estimated at 50%. This allowed eligible number approximately 80 VLBW. The study was allocated a limited period of time not exceeding 6 months. Therefore, sample size was determined using the formula for finite populations and the estimated number of infants admitted in a quarter used.

$$n = \frac{NZ^2P(1 - P)}{d^2(N - 1) + Z^2P(1 - P)}$$

Where

n' = sample size with finite population correction,

N = size of the target population = 80

Z = Z statistic for 95% level of confidence = 1.96

P = Estimated proportion of infants who regain birth weight by 14 days = 60% (16)

d = margin of error = 5%

$$80 \times 1.96^2 \times 0.6 \times 0.4$$

$n =$

$$\frac{80 \times 1.96^2 \times 0.6 \times 0.4}{0.05^2 (80-1) + 1.96^2 \times 0.6 \times 0.4}$$

A minimum of 66 VLBW infants were sampled to determine growth rates within 5% level of precision.

Sampling Procedure

Consecutive sampling was used and followed till 14th day.

Study Variables

The variables that were collected were included: - socio demographic data, basic maternal characteristics, infants' birth history comorbid factors, weight, length and head circumference. *Data collection procedures*

A structured questionnaire was used to collect data. The baseline information of the infants and their mothers were recorded. The metrics of measurements used included the weighing scale to measure weight in grams, stadiometer and tape measure to measure length and head circumference in centimeters respectively. A research assistant with a Bachelor of Science in Nutrition was recruited to assist in data collection at the NBU.

Follow up information on the changes in weight, length and the head circumference of the infants was recorded everyday using follow-up forms. The relevant information in relation to the nutritional and comorbid factors of the infant during their time of admission in the NBU was abstracted from the medical charts. The total amount of enteral feeds calculated as ml/kg/day. The investigator continuously reviewed the filled data collection tools to ensure completeness and accuracy. The RED Cap

data was used to corroborate data collected by principal investigator.

Data management and analysis

Data was entered and managed in Microsoft Excel data entry sheet. Statistical analysis was done in SPSS version 23.0 statistical software. The population was described by summarizing the socio-demographic and clinical characteristics into percentages and means or medians for categorical and continuous data respectively. The number of study participants who regained birth weight by 14 days were identified and presented as a proportion of all VLBW infants studied. Time to achieving full enteral feed was calculated as median number of days with interquartile range (IQR). The changes in weight, length and head circumference were calculated per day and week and presented as mean difference. The co-morbid factors were determined and presented as percentages. Factors influencing changes in growth parameters were tested using Student's t and ANOVA tests as appropriate. Multivariable analysis using binary logistic regression model was done to determine factors that were independently associated with regain of birthweight while controlling for confounding variables. All statistical tests were interpreted at 5% level of significance (p value less or equal to 0.05 was considered to be significant).

Study Limitation

The time constraints due to the strict timeline for the fellowship program couldn't allow for recruitment of a larger sample size

to improve the precision of estimation and the power to test for associations. However, this research will form a foundation to inform other investigators on designing bigger studies on the subject.

Ethical Considerations

Ethical approval was obtained from the Kenyatta National Hospital/University of Nairobi Ethics and Research Committee (KNH/UON-ERC) reference number: P728/09/2021 and the National Commission for Science, Technology and Innovation (NACOSTI) license, NACOSTI/P/22/16051. Permission was also granted by the Newborn Unit (NBU) in-charge. Confidentiality was maintained throughout the study. A link-log containing patients' identifying information was used, with

physical records stored securely in locked cabinets and electronic data stored in password-protected digital files, with passwords updated regularly.

RESULTS

Study Population

This study followed up 79 VLBW newborns (table 1) until the 14th day of life. Of these, 51 (64.6%) were born within Kenyatta National Hospital (KNH) and 28 (35.4%) were referrals. The majority were female, 48 (60.8%), compared to 31 (39.2%) males. The median gestational age was 30 weeks (IQR 28–32; range 24–36) based on the last menstrual period. The mean birth weight was 1241.6 ± 168.5 grams (range 1000–1500).

Table 1
VLBW characteristics at admission

Variable	Frequency (%) n=79
Place of birth	
KNH	51 (64.6)
Referral	28 (35.4)
Gender	
Male	31 (39.2)
Female	48 (60.8)
Clinical gestation in weeks	
Median (IQR)	30.0 (28.0-32.0)
Min-max	24.0-36.0
Birth weight in grams	
Mean (SD)	1241.6 (168.5)
Min-max	1000.0-1500.0

VLBW = Very Low birth Weight; KNH = Kenyatta National Hospital; IQR = Interquartile Range; SD = Standard Deviation.

Maternal characteristics

As shown in Table 2, the mothers had a median age of 27.5 years (range 17–43). Most were multiparous (46, 58.2%), married (52, 65.8%), and unemployed (32, 40.5%). Over

half (45, 57.0%) had attained secondary or tertiary education, and the majority (69, 87.3%) received antenatal care.

Table 2

Variable	Frequency (%)
Age in years	
Median (IQR)	27.5 (21.8-34.0)
Min-max	17.0-43.0
Parity	
Primipara	25 (31.6)
Multipara	46 (58.2)
Not known	8 (10.1)
Marital status	
Single	13 (16.5)
Married	52 (65.8)
Not indicated	14 (17.7)
Occupation	
Salaried	5 (6.3)
Informally employed	3 (3.8)
Self-employed	21 (26.6)
Unemployed	32 (40.5)
Not indicated	18 (22.8)
Level of education	
None	1 (1.3)
Primary	15 (19.0)
Secondary	26 (32.9)
Tertiary	19 (24.1)
Not indicated	18 (22.8)
Antenatal clinic visits	
Yes	69 (87.3)
No	2 (2.5)
Unknown	8 (10.1)

n=number, IQR=Interquartile Range

Regaining birth weight by 14 days of life

As shown in Table 3, a total of 79 Very Low Birth Weight (VLBW) newborns were

assessed on the 14th day of life. Of these, 39 (49%) had regained their birth weight by that time.

Table 3

Regaining birthweight by day 14 after birth

Variable	N=79 (%)	95% CI
Regained birthweight (n=49)		
Yes	39 (49.0)	34.7-63.3
No	40 (51.0)	36.7-65.3

% percentage n=number CI=Confidence Interval.

Time to achieving full enteral feed (150 ml/kg/day) in VLBW

Table 4 shows that 56 VLBW (67.5%) achieved full enteral feeds (150 ml/kg/day)

by day 14 of life, while 27 (32.5%) did not. The median time to full feeds was 8 days (IQR 7–9; range 3–14). among those who achieved full feeds, 4 died before day 14.

Table 4*Achievement of full enteral feed (150 ml/ kg/day)*

Variable	Frequency (%)	95% CI
Achieved full enteral feed (150 ml/ kg/day)		
Yes	56(67.5)	54.4-75.9
No	27 (32.5)	24.1-45.6
Time to achieving full enteral feed in days		
Median (IQR)	8 (7-9)	-
Min-Max	3-14	

n=number, IQR=Interquartile Range, CI=Confidence Interval

Postnatal growth rate of VLBW infants

In Table 5, the median weight gain was 14.4 g/kg/day and it ranged from 2.8 to 66.7

g/kg/day. The change in length was 0.48 cm per week and the head circumference increased by 0.43 cm per week.

Table 5*Postnatal growth rate of VLBW*

Variable	Median (IQR)	Min-Max
Weight gain velocity in g/kg/day (n=50)	14.4 (11.1-18.4)	2.8-66.7
Length in cm/week (n=49)	0.48 (0.27-0.59)	0.11 – 1.24
Head circumference in cm/week (n=49)	0.43 (0.30-0.57)	0.00-1.02

VLBW= Very Low Birth Weight, n=number,

IQR=Interquartile Range

Comorbidities affecting VLBW Newborns

As shown in Table 6, respiratory distress syndrome was the most common comorbidity affecting 64.6% of the infants.

More than a half (50.6%) of the infants had neonatal jaundice while 22.8% had neonatal sepsis.

Table 6*Co-morbidities*

Variable	Frequency (%)
Co-morbidities	
Respiratory Distress Syndrome (RDS)	51 (64.6)
Neonatal jaundice	40 (50.6)
Neonatal sepsis	18 (22.8)
Feeding intolerance	12 (15.2)
Apnoea of prematurity	8 (10.1)
Anaemia	6 (7.6)
Hypothermia	2 (2.5)
Hypoglycaemia	2 (2.5)

n=number

Factors associated with regaining birthweight

There were no factors that significantly influenced regaining of birthweight by 14th day as shown below (table 7).

Table 7
Factors associated with regaining birthweight

Variable	Regained birthweight		OR (95% CI)	P value
	Yes	No		
Place of birth				
KNH	14 (58.3)	20 (80.0)	0.4 (0.1-1.2)	0.100
Referral	10 (41.7)	5 (20.0)	1.0	
Gender				
Male	10 (41.7)	11 (44.0)	0.9 (0.3-2.8)	0.869
Female	14 (58.3)	14 (56.0)	1.0	
Clinical gestation in weeks				
Mean (SD)	30.1 (2.7)	30.0 (2.3)	-	0.811
Birth weight in grams				
Mean (SD)	1318.2 (126.8)	1280.4 (165.5)	-	0.375
Apgar score at 10 minutes				
Median (IQR)	9 (8-9)	9 (7-9)	-	0.599
Achieved full enteral feed (150 ml/ kg/day)				
Yes	24 (100.0)	23 (92.0)	-	0.490
No	0	2 (8.0)	-	
Time to achieving full enteral feed in days				
Median (IQR)	7 (7-8)	8 (7-10)	-	0.065
Presence of comorbidities				
Yes	16 (66.7)	19 (76.0)	0.6 (0.2-2.2)	0.470
No	8 (33.3)	6 (24.0)	1.0	

SD=Standard Deviation, KNH = Kenyatta National Hospital; IQR = Interquartile Range

DISCUSSION

This study evaluated enteral feeding and postnatal growth in hospitalized VLBW newborns at a tertiary hospital in a low- and middle-income country. Most infants were female (48/79, 60.8%), consistent with a previous study at the same site ⁶. The median gestational age was 30 weeks, similar to reports from other sub-Saharan African cohorts, and the mean birth weight was 1241 g, comparable to that reported by Muhudhia ^{3,19}. Approximately half of the infants (39/79, 49%) regained their birth weight by 14 days, aligning with recommended timelines for VLBW infants ².

Two-thirds of infants achieved full enteral feeds by day 14, with a median time of 8 days, slightly longer than WHO

recommendations ¹. Exclusive breast milk was used for enteral feeding at Kenyatta National Hospital. The median postnatal weight gain was 14.4 g/kg/day, with weekly increases in length and head circumference of 0.48 cm and 0.43 cm, respectively. These rates exceed those reported by Were, who documented a weight gain of 13.5 g/kg/day and weekly increases in length and head circumference of 0.34 cm and 0.32 cm more than a decade ago at the same site ^{2,6}.

The observed growth rates are comparable to those reported in a large multicentre prospective cohort study by Ehrenkranz and approach the recommended weight gain of 15 g/kg/day^{2,3}. They were slightly higher than regional reports of 13.2 g/kg/day ³. This improvement may reflect enhanced care at the study site, including more qualified

personnel, improved equipment, adherence to national guidelines, and implementation of kangaroo mother care^{17,23,24}. Standardized, evidence-based feeding protocols also support improved outcomes²¹.

Respiratory distress syndrome and neonatal jaundice were the most common comorbidities, consistent with findings from the INTERGROWTH-21 multicentre study and other regional reports^{2,12}.

Study Limitations

The time constraints due to the strict timeline for the fellowship program couldn't allow for recruitment of a larger sample size to improve the precision of estimation and the power to test for associations. However, this research will form a foundation to inform other investigators on designing bigger studies on the subject.

CONCLUSION AND RECOMMENDATION

Improvements in clinical care and feeding practices at KNH have likely enhanced postnatal growth in VLBW infants, with growth rates approaching recommended targets. Ongoing quality care is essential, and larger, longer-term studies are needed to determine the time to full enteral feeds and factors affecting mortality and morbidity.

The current study showed that feeding practice and postnatal growth rate is approaching the recommended growth rates of VLBW.

The standard of care practices and quality improvement to be upheld. A follow-up study with a larger sample size and longer period of study should be done in order to define approximate time to achieving full enteral feeds and factors affecting mortality and morbidity in KNH newborn Unit.

Credit Author Statement:

Priscillah Jepkorir Koech: Conceptualization, Methodology, Data collection, Formal analysis, Writing – Original Draft.

Florence V Murila, Brian Maugo and Jalemba Aluvaala: Supervision, Validation, Writing – Review & Editing

Conflict of Interest:

The authors declare no conflict of interest.

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