PREDICTING FACTORS OF LENGTH OF STAY AT A NEONATAL INTENSIVE CARE UNIT IN A TERTIARY HOSPITAL IN GHANA

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Abstract

Objective: The aim of this research was to determine the factors that influence the length of stay in the NICU of the Korle Bu Teaching Hospital (KBTH), Accra.

Methodology: This was a retrospective study involving 249 preterm infants who were admitted and discharged from the NICU, KBTH from November 2021 to October 2022. The multivariable negative binomial regression model was used to assess the factors associated with the number of hospital days among the newborns.

Results: The median number of days stayed in the NICU was 12 days (IQR: 8-21).

Predictor of shorter length of stay in the NICU was preterm infants with birthweight between 1500-2499g (aβ: -0.39, 95% CI: [-0.54, -0.24], p<0.001). Predictors of prolonged length of stay in the NICU were late initiation of breastmilk feeding (aβ: 0.31, 95% CI: [0.01, 0.60], p=0.040), preterm infants with neonatal jaundice (aβ: 0.15, 95% CI: [0.02, 0.28], p=0.023), neonatal sepsis (aβ: 0.44, 95% CI: [0.30, 0.57], p<0.001), and necrotising enterocolitis (aβ: 0.37, 95% CI: [0.16, 0.58], p<0.001).

Conclusion: Preterm infants who initiated breastmilk feeding late, developed neonatal sepsis, necrotising enterocolitis and neonatal jaundice were more likely to stay longer at the NICU. While those with birth weight between 1500-2499grams were likely to stay for a shorter period.

Key words: *length of stay, preterm, neonatal sepsis, necrotising enterocolitis*

Introduction

Preterm infants are likely to stay in a neonatal intensive care unit (NICU) for a longer period. This is because of their small size and the complications they may develop while on admission. Preterm infants are at the greatest risk of mortality. However, they may have to be nursed for long periods to gain adequate weight when they survive. In the process, they may develop complications such as late onset infections which would require antibiotics treatment for a longer period.[1] A prospective hospital-based study conducted in Ethiopia showed that, preterm infants who develop health care associated infections (HAIs) are more likely to have extended hospital stay.[1] In a systematic review with studies mostly from developed countries, it was found that preterm infants with necrotising enterocolitis, bronchopulmonary dysplasia, and retinopathy of prematurity are at high risk of prolonged length of stay (LOS).[2] It has been reported that being a male, very immature and small for gestational age are associated with prolonged length of stay.[3,4] In Port Harcourt, Nigeria, West[5] reported in a prospective hospital-based study that, LOS averagely ranged between 20 days for late preterm infants and 60 days for the extreme preterm infants. In Ethiopia, preterm infants with respiratory distress syndrome spent averagely 11 days to recover.[6] Thus, it is important for a facility or healthcare provider who sees to the day-to-day affairs of these infants to know the average LOS. Accurately predicting LOS at the NICU allows the health care providers to plan their resources, make decisions, counsel and educate parents. Most studies on LOS have come from high-income countries.[3,4,7] However, most preterm deliveries and mortalities are in low-and-middle-income countries (LMIC) like Ghana.[8]

In Ghana although there have been efforts to improve newborn and preterm survival over the past few years,[9,10] data on LOS of preterm infant admitted at the NICU is limited. Hence, it is vital to assess the possible factors that contribute to prolonged LOS in the NICUs in Ghana. Prolonged LOS could affect quality of care, patient safety and patient outcome.[11] The finding would help the care providers to plan administratively, conduct quality improvement research and help educate the parents of these vulnerable children. Thus, this study aimed to find the predictors of LOS among preterm infants admitted at the NICU of the Korle Bu teaching Hospital (KBTH), Accra.

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Materials and Methods

Study Design and Site

This is a retrospective study involving preterm infants admitted and discharged from the NICU, KBTH, Accra. The NICU of KBTH receives patients from the southern part of the country. It is a 60-bed capacity which takes care of preterm and term infants with varied complications. The average monthly admissions are about 150 infants. Forty-eight percent of these are preterm infants with varied conditions like respiratory distress syndrome, neonatal sepsis, neonatal jaundice, anemia of prematurity, and perinatal asphyxia. They are discharged home when they are not in distress, have

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achieved good thermoregulation in kangaroo mother care (KMC), have no acute medical or surgical condition that would endanger their survival at home, mother is able to take care of the baby and baby is gaining adequate weight.

Study Population

All preterm infants, 26-36 weeks post-conception, admitted and discharged alive in the NICU, KBTH from November 2021 to October 2022.

Exclusion Criteria

We excluded all preterm infants who died during the study period and those who stayed in the NICU for less than a day. Patients with missing information on sex, birth weight and gestational age were excluded. Furthermore, preterm infant with congenital anomalies and those who were transferred to other departments were also not included.

Study Variables

Data were extracted from the electronic medical records using Microsoft Excel 2016 spreadsheet. The variable of interest was length of NICU stay till discharge home. LOS was determined using days the infants were admitted to the day they were discharged home, and it was considered the dependent variable. Data were collected on the following independent or predictor variables: sex, gestational age (based on Modified Ballard's score),[12] mode of delivery, birth weight, time of initiation of feeds, time to achieve full feeds, co-morbidities (neonatal sepsis and or meningitis, necrotizing enterocolitis, neonatal jaundice, congenital anomalies, and infant of diabetic mother). We also collated data on maternal factors like age, occupation and maternal co-morbidities such as chronic hypertension, preeclampsia-eclampsia, gestational hypertension, gestational diabetes, sickle cell, asthma and HIV/AIDS. All the preterm infants admitted during the period in question constituted the study group. Patients were excluded if their data was incomplete.

Sample Size Estimates

The study sought to assess the length of stay in NICU among preterm newborns admitted and discharged alive. Due to the skewness observed in other studies,[2,13] and the study objective to estimate the median LOS, we adopted the sample size for continuous variables, given by $n=(z*\sigma/e)^2$, where, σ is the standard deviation of the length of stay, z is the standard normal score corresponding to the desired level of confidence and e is the margin of error. By approximation the standard deviation with interquartile range of 8 days,[14] at a 95% confidence level and a desire margin of error of 1 day, the minimum required sample size for the study is $n=(1.96*7\text{days}/1\text{day})^2$ = 188.2. However, due to the secondary data analysis and facility-based data extraction nature of the study, a total of 249 samples were successfully extracted within the study defined period and used for analysis.

Statistical Analysis

Stata IC version 16 (Stata Corp, College Station, TX, US) was used to analyze the data. Categorical characteristics of the study participants were described using frequency and percentages. Normally distributed continuous variables were summarized using the mean and standard deviation. Non-normally distributed variables were described using the median and interquartile range. The bar chart was used to describe the percentage of mothers with specific maternal conditions as well as the percentage of neonates with specific neonatal co-morbidities. The number of children were also described by the number of hospital days using the bar chart. The number of hospital days was categorized into the following four groups: <3 hospital days, 3-7 hospital days, 8-28 hospital days and >28 hospital days. The pie chart was used to describe the percentage of neonates according to the categories of number of hospital days.

The median and interquartile range of number of hospital days was estimated across all the maternal and child characteristics observed in the study. For characteristics with 2 categories, the Wilcoxon rank sum test was used to test the equality of medians between the two groups. For characteristics with 3 or more categories, the Kruskal Wallis test was used to test the equality of medians between the categories. For the categorized version of the length of stay, the Fisher's exact test was used to assess the association between the length of stay and the observed maternal and child characteristics.

The multivariable negative binomial regression model was used to assess the factors associated with the number of hospital days among the newborns. Both the crude and adjusted estimates were provided. Variables with significance level below 0.100 from the bivariate analysis (Wilcoxon rank sum test or Kruskal Wallis test) were only considered for the multivariate analysis. The 95% confidence interval of all crude and adjusted estimates and their corresponding p-values from the negative binomial regression model were estimated and provided in the analysis. All statistical analysis were considered significant at an alpha of 0.05.

Results

Characteristics of Child and Mother in the Study

A total of 249 children were considered for the analysis. The median age of the mothers was 30 years (IQR: 25-35 years). More than half of the newborns were males (51.8%). Most of the newborn (62.2%) were delivered through caesarean section. The median birthweight was 1,560 grams (IQR: 1,300-1,890 grams) with 13 below 1000 grams. The median gestational age at birth was 33 weeks (IQR: 31-34 weeks) with only 1 born before 28 weeks' gestation and 25.3% of them born between 28 and 31 weeks. Less than a quarter (23.3%) initiated breastfeeding during the first day, a third (33.3%) on day 2, 20.9% on day 3, 19.3% between day 4 and 7 and 3.2% after 7 days. Exclusive breastfeeding was practiced for 75.5% of the newborns, formula was given to 13.7% and 10.8% received both breastmilk and formula. (Table 1)

Table 1: Characteristics of study participants

Characteristics	Total N=249
Mother's age in years: Median (IQR)	30.0 (25.0-35.0)
Mother's age group	
15-19 years	23 (9.2)
20-29 years	84 (33.7)
30-39 years	125 (50.2)
40-49 years	17 (6.8)
Occupational class	
I	8 (3.2)
II	23 (9.2)
III-1	10 (4.0)
III-2	50 (20.1)
IV	96 (38.6)
V	42 (16.9)
Unknown	20 (8.0)
Sex	
Female	120 (48.2)
Male	129 (51.8)
Mode of delivery	
CS	155 (62.2)
SVD/BBA/Vacuum	94 (37.8)
Birthweight in grams: Median (IQR)	1560 (1300-1890)
Birthweight category	
<1,000 grams	13 (5.2)
1,000 to <1,500 grams	103 (41.4)
1,500 to <2,499 grams	133 (53.4)
Gestational age in weeks: Median (IQR)	33 (31-34)
Gestational age at birth category	
<28 weeks	1 (0.4)
28-31 weeks	63 (25.3)
32-33 weeks	84 (33.7)
34-36 weeks	101 (40.6)
Initial day of breastfeeding	
Day 1	58 (23.3)
Day 2	83 (33.3)
Day 3	52 (20.9)
Day 4-7	48 (19.3)
Day 8-14	8 (3.2)
Type of Feeds	
EBM	188 (75.5)
Formula	34 (13.7)
Mixed	27 (10.8)
Age of attainment of full feeds	
1-7 days	72 (28.9)
8-14 days	100 (40.2)
15-21 days	30 (12.0)
>21 days	18 (7.2)
Missing	29 (11.6)

Maternal Conditions

The most common maternal conditions were hypertension (36.9%) and ante-partum hemorrhage (15.7%). (Figure. 1)

Neonatal Co-Morbidities

The most common neonatal co-morbidities among the preterm infants were neonatal jaundice (61.8%), neonatal sepsis & meningitis (48.6%), and respiratory distress syndrome (28.1%). (Figure 2)

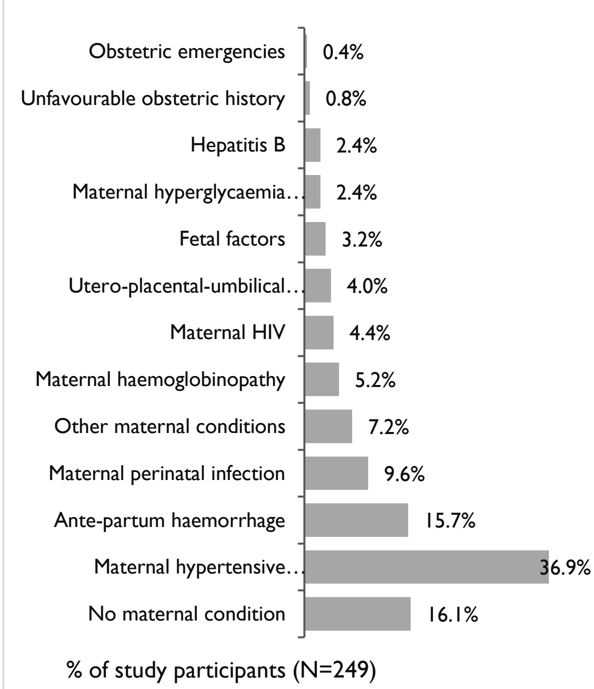

Figure 1: Prevalence of maternal conditions among mothers of the preterm infants

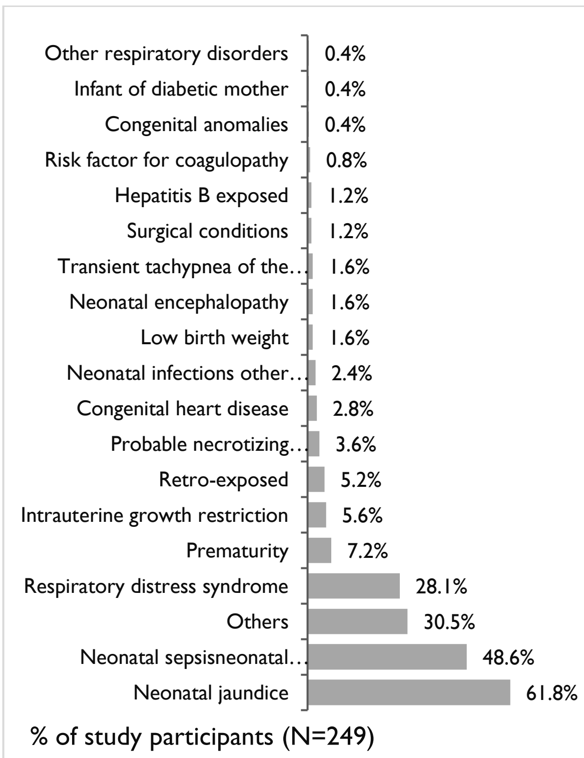

Figure 2: Prevalence of neonatal co-morbidities among study participants

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Length of stay in the NICU

The median number of days stayed in the hospital was 12 days with an interquartile range from 8 to 21 days. Among the 249 low birth weight neonates, 5.6% stayed for less than 3 days, 19.3% stayed for 3-7 days, 62.2% stayed for 8-28 days and 12.9% stayed beyond 28 days. (Figure 3)

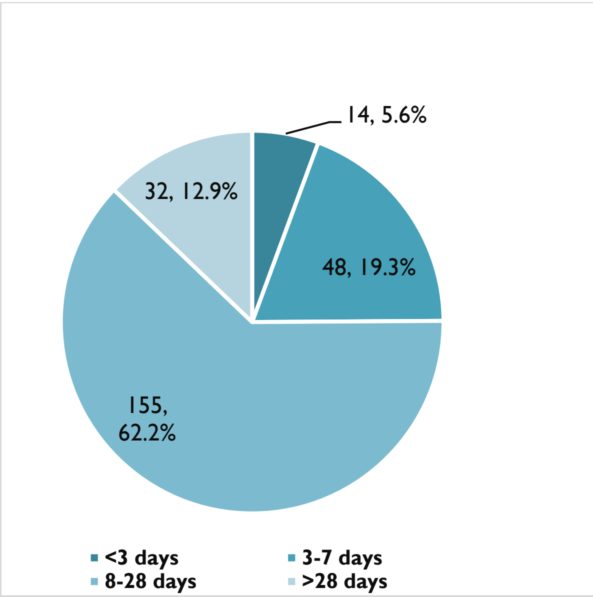

Figure 3: Length of stayed in the NICU

Bivariate Association Between Preterm Infant and Maternal Characteristics and Length Of Stay in the NICU

The median number of hospital days was statistically significantly higher among neonates with less than 1,000 grams of birth weight (29 days, IQR: 25-38 days) compared to neonates with 1,000 to <1,500 grams (18 days, IQR: 12-27 days) and neonates with 1,500 to 2,499 grams (8 days, IQR: 6-13 days) (p<0.001). Also, the median number of hospital days was significantly higher among neonates born before 32 gestational weeks (23 days, IQR:14-31 days) compared to newborns between 32-33 gestational weeks (13 days, IQR: 8.5-21 days) and 34-36 weeks (8 days, IQR: 5-12 days) (p<0.001). The median hospital days was lowest among neonates who initiated breastfeeding on day 1 (7 days, IQR: 3-11 days), followed by day 2 (10 days, IQR: 7-16 days), day 3 (14 days, IQR: 11-26 days) then days 4-7 (17 days, IQR: 12-25 days) and then days 8-14 (32.5 days, IQR: 19.5-39.5 days) (p<0.001). The median hospital days was highest among neonates who were given exclusive breastfeeding (13 days, IQR: 8-23 days) compared to neonates given formula only (8.5 days, IQR: 6-16 days) and mixed feeding (12 days, IQR: 7-23 days) (p=0.023). (Table 2). Table 2 also shows the association between preterm infant and maternal characteristics and the category of length of stay using the Fisher's exact test. (Table 2)

Bivariate association between preterm infant co-morbidities and length of stay in the NICU

The median number of days was statistically significantly higher among preterm infants with neonatal jaundice (13 days, IQR: 8-23 days) compared to those with no neonatal jaundice (10 days, IQR: 6-19 days) (p=0.017). Also, the median hospital days was higher among neonates with neonatal sepsis & meningitis (17 days, IQR: 12-28 days) compared to those with no neonatal sepsis & meningitis (9 days, IQR: 6-13 days) (p<0.001). The median hospital days was higher among neonates with respiratory distress syndrome (14 days, IQR: 9-26 days) compared to those with no respiratory distress syndrome (12 days, IQR: 7-18 days) (p=0.015**)**. The median hospital days was higher among neonates with probable necrotizing enterocolitis (27 days, IQR: 10-26 days) compared to those with no probable necrotizing enterocolitis (12 days, IQR: 7-19.5 days) (p<0.001). (Table 3)

Table 3 also shows the association between preterm infant co-morbidities and the category of length of stay using the Fisher's exact test. (Table 3) None of the maternal conditions were statistically significantly associated with the number of hospital days of the neonates from both the Wilcoxon rank sum test and the Fisher's exact tests.

Multivariable analysis of the factors associated with the length of stay in the NICU

The adjusted negative binomial regression model showed that the average hospital days was 11% less among male newborns compared to female newborns (aβ: -0.11, 95% CI: [-0.23, 0.02], p=0.088) although not statistically significant. The average hospital days was 39% less among neonates with birthweight between 1500 to 2499 grams compared to neonates with birth weight less than 1,500 grams (aβ: -0.39, 95% CI: [-0.54, -0.24], p<0.001). Compared to neonates born before 32 weeks' gestation, the average hospital days was 22% and 42% less among neonates within 32–33 weeks' gestation (aβ: -0.22, 95% CI: [-0.39, -0.05], p=0.011) and 34-36 weeks' gestation (aβ: -0.42, 95% CI: [-0.60, -0.24], p<0.001). The average hospital days stayed for newborn infants who initiated breastfeeding on day 4 and beyond was 31% higher compared to those who initiated on day 1 (aβ: 0.31, 95% CI: [0.01, 0.60], p=0.040).

The average hospital days was 15% higher among neonates with neonatal jaundice (aβ: 0.15, 95% CI: [0.02, 0.28], p=0.023), 44% higher among neonates with neonatal sepsis & meningitis (aβ: 0.44, 95% CI: [0.30, 0.57], p<0.001), 37% higher among those with probable necrotising enterocolitis (aβ: 0.37, 95% CI: [0.16, 0.58], p<0.001) and 32% higher among those with neonatal infections other than NNS (aβ: 0.32, 95% CI: [0.00, 0.63], p=0.047). (Table 4)

Table 2: Bivariate association between infant and maternal characteristics and length of stay in the hospital

		Number of days		Length of stay category				
		Stayed in hospital		<3 days	3-7 days	8-28 days	>28 days	
Characteristics	**N**	**Median (IQR)**	**P-value**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**P-value**
Overall	249	12.0 (8.0-21.0)		14 (5.6)	48 (19.3)	15 (62.2)	32 (12.9)	
Mother's age in years: Mean [±SD]				32.5 (28.0-36.0)	30.0 (26.5-33.5)	30.0 (25.0-36.0)	30.0 (24.0-34.0)	0.55^{K}
Mother's age group			0.850^{K}					0.78^{F}
15-19 years	23	13.0 (9.0-25.0)		1 (4.3)	2 (8.7)	16 (69.6)	4 (17.4)	
20-29 years	84	12.0 (7.0-18.5)		4 (4.8)	18 (21.4)	52 (61.9)	10 (11.9)	
30-39 years	125	12.0 (7.0-22.0)		9 (7.2)	23 (18.4)	76 (60.8)	17 (13.6)	
40-49 years	17	12.0 (7.0-24.0)		0 (0.0)	5 (29.4)	11 (64.7)	1 (5.9)	
Occupational class			0.593^{K}					0.23^{F}
I	8	9.0 (7.0-13.5)		0 (0.0)	2 (25.0)	5 (62.5)	1 (12.5)	
II	23	11.0 (6.0-27.0)		2 (8.7)	6 (26.1)	10 (43.5)	5 (21.7)	
III-1	10	16.0 (8.0-19.0)		0 (0.0)	2 (20.0)	6 (60.0)	2 (20.0)	
III-2	50	11.5 (8.0-27.0)		1 (2.0)	10 (20.0)	27 (54.0)	12 (24.0)	
IV	96	12.0 (7.0-17.0)		8 (8.3)	19 (19.8)	65 (67.7)	4 (4.2)	
V	42	12.0 (9.0-20.0)		3 (7.1)	5 (11.9)	29 (69.0)	5 (11.9)	
Unknown	20	18.0 (8.0-25.0)		0 (0.0)	4 (20.0)	13 (65.0)	3 (15.0)	
Sex			0.129^{W}					0.076^{F}
Female	120	13.5 (7.0-24.0)		4 (3.3)	27 (22.5)	69 (57.5)	20 (16.7)	
Male	129	11.0 (8.0-17.0)		10 (7.8)	21 (16.3)	86 (66.7)	12 (9.3)	
Mode of delivery			0.544^{W}					0.70^{F}
CS	155	12.0 (8.0-22.0)		7 (4.5)	29 (18.7)	100 (64.5)	19 (12.3)	
SVD/BBA/Vacuum	94	12.0 (6.0-19.0)		7 (7.4)	19 (20.2)	55 (58.5)	13 (13.8)	
Birthweight in grams: Median (IQR)				1918 (1600-2400)	1932 (1748-2140)	1480 (1300-1760)	1168 (1020-1380)	<0.001^{K}
Birthweight category			<0.001^{K}					<0.001^{F}
<1,000 grams	13	29.0 (25.0-38.0)		0 (0.0)	0 (0.0)	6 (46.2)	7 (53.8)	
1,000 to <1,500 grams	103	18.0 (12.0-27.0)		3 (2.9)	4 (3.9)	74 (71.8)	22 (21.4)	
1,500 to <2,499 grams	133	8.0 (6.0-13.0)		11 (8.3)	44 (33.1)	75 (56.4)	3 (2.3)	
Gestational age in weeks: Median (IQR)				34 (33-36)	34 (33-35)	33 (32-34)	30 (30-32)	<0.001^{K}
Gestational age at birth category			<0.001^{K}					<0.001
<32 weeks	64	23.0 (14.0-31.0)		0 (0.0)	5 (7.8)	38 (59.4)	21 (32.8)	
32-33 weeks	84	13.0 (8.5-21.0)		4 (4.8)	9 (10.7)	62 (73.8)	9 (10.7)	
34-36 weeks	101	8.0 (5.0-12.0)		10 (9.9)	34 (33.7)	55 (54.5)	2 (2.0)	
Day of initial breastfeeding			<0.001^{K}					<0.001^{F}
Day 1	58	7.0 (3.0-11.0)		11 (19.0)	19 (32.8)	26 (44.8)	2 (3.4)	
Day 2	83	10.0 (7.0-16.0)		2 (2.4)	20 (24.1)	53 (63.9)	8 (9.6)	
Day 3	52	14.0 (11.0-26.0)		0 (0.0)	5 (9.6)	38 (73.1)	9 (17.3)	
Day 4-7	48	17.0 (12.0-25.0)		1 (2.1)	4 (8.3)	35 (72.9)	8 (16.7)	
Day 8-14	8	32.5 (19.5-39.5)		0 (0.0)	0 (0.0)	3 (37.5)	5 (62.5)	
Type of Feeds			0.023^{K}					0.015^{F}
EBM	188	13.0 (8.0-23.0)		9 (4.8)	29 (15.4)	123 (65.4)	27 (14.4)	
Formula	34	8.5 (6.0-16.0)		4 (11.8)	10 (29.4)	20 (58.8)	0 (0.0)	
Mixed	27	12.0 (7.0-23.0)		1 (3.7)	9 (33.3)	12 (44.4)	5 (18.5)	
Age of attainment of full feeds			<0.001^{K}					<0.001^{F}
1-7 days	72	7.0 (5.0-10.0)		2 (2.8)	45 (62.5)	24 (33.3)	1 (1.4)	
8-14 days	100	13.0 (10.0-17.0)		0 (0.0)	0 (0.0)	93 (93.0)	7 (7.0)	
15-21 days	30	25.5 (19.0-29.0)		0 (0.0)	0 (0.0)	21 (70.0)	9 (30.0)	
>21 days	18	39.5 (29.0-48.0)		0 (0.0)	0 (0.0)	4 (22.2)	14 (77.8)	

Table 3: Bivariate association between neonatal co-morbidities and length of stay in the NICU

		Number of days Stayed in hospital	Wilcoxon Rank sum	Length of stay category				Fisher's Exact
				<3 days	3-7 days	8-28 days	>28 days	
Neonatal co-morbidities	**N**	**Median (IQR)**	**P-value**	**n/N (%)**	**n/N (%)**	**n/N (%)**	**n/N (%)**	**P-value**
Neonatal jaundice			0.017					0.004
No	95	10.0 (5.0-19.0)		11 (11.6)	21 (22.1)	49 (51.6)	14 (14.7)	
Yes	154	13.0 (8.0-23.0)		3 (1.9)	27 (17.5)	106 (68.8)	18 (11.7)	
Neonatal sepsis + neonatal meningitis			<0.001					<0.001
No	128	9.0 (6.0-13.0)		13 (10.2)	39 (30.5)	73 (57.0)	3 (2.3)	
Yes	121	17.0 (12.0-28.0)		1 (0.8)	9 (7.4)	82 (67.8)	29 (24.0)	
Others			0.556					0.380
No	173	12.0 (8.0-22.0)		12 (6.9)	30 (17.3)	107 (61.8)	24 (13.9)	
Yes	76	11.5 (7.0-20.0)		2 (2.6)	18 (23.7)	48 (63.2)	8 (10.5)	
Respiratory distress syndrome			0.014					0.012
No	179	12.0 (7.0-18.0)		13 (7.3)	34 (19.0)	116 (64.8)	16 (8.9)	
Yes	70	14.0 (9.0-26.0)		1 (1.4)	14 (20.0)	39 (55.7)	16 (22.9)	
Intrauterine growth restriction			0.599					0.660
No	235	12.0 (7.0-21.0)		14 (6.0)	45 (19.1)	147 (62.6)	29 (12.3)	
Yes	14	12.5 (10.0-23.0)		0 (0.0)	3 (21.4)	8 (57.1)	3 (21.4)	
Retro-exposed			0.065					0.180
No	236	12.0 (7.0-19.5)		13 (5.5)	48 (20.3)	144 (61.0)	31 (13.1)	
Yes	13	23.0 (10.0-26.0)		1 (7.7)	0 (0.0)	11 (84.6)	1 (7.7)	
Probable necrotising enterocolitis			<0.001					0.042
No	240	12.0 (7.0-19.0)		14 (5.8)	48 (20.0)	150 (62.5)	28 (11.7)	
Yes	9	27.0 (25.0-48.0)		0 (0.0)	0 (0.0)	5 (55.6)	4 (44.4)	
Congenital heart disease			0.365					1.000
No	242	12.0 (7.0-21.0)		14 (5.8)	47 (19.4)	150 (62.0)	31 (12.8)	
Yes	7	17.0 (9.0-27.0)		0 (0.0)	1 (14.3)	5 (71.4)	1 (14.3)	
Neonatal infections other than NNS			0.123					0.084
No	243	12.0 (7.0-21.0)		14 (5.8)	47 (19.3)	153 (63.0)	29 (11.9)	
Yes	6	23.0 (11.0-46.0)		0 (0.0)	1 (16.7)	2 (33.3)	3 (50.0)	
Low birth weight			0.594					0.810
No	245	12.0 (7.0-21.0)		14 (5.7)	48 (19.6)	151 (61.6)	32 (13.1)	
Yes	4	10.0 (9.0-13.0)		0 (0.0)	0 (0.0)	4 (100.0)	0 (0.0)	
Neonatal encephalopathy			0.939					1.000
No	245	12.0 (8.0-21.0)		14 (5.7)	47 (19.2)	152 (62.0)	32 (13.1)	
Yes	4	13.5 (9.0-16.0)		0 (0.0)	1 (25.0)	3 (75.0)	0 (0.0)	
Transient tachypnoea of the new-born			0.323					0.420
No	245	12.0 (8.0-21.0)		14 (5.7)	46 (18.8)	153 (62.4)	32 (13.1)	
Yes	4	7.5 (7.0-13.5)		0 (0.0)	2 (50.0)	2 (50.0)	0 (0.0)	
Surgical conditions			0.802					0.380
No	246	12.0 (8.0-21.0)		14 (5.7)	47 (19.1)	154 (62.6)	31 (12.6)	
Yes	3	8.0 (5.0-48.0)		0 (0.0)	1 (33.3)	1 (33.3)	1 (33.3)	
Hepatitis B exposed			0.081					0.540
No	246	12.0 (7.0-21.0)		14 (5.7)	48 (19.5)	153 (62.2)	31 (12.6)	
Yes	3	20.0 (17.0-42.0)		0 (0.0)	0 (0.0)	2 (66.7)	1 (33.3)	
Risk factor for coagulopathy			0.144					0.610
No	247	12.0 (8.0-21.0)		14 (5.7)	47 (19.0)	154 (62.3)	32 (13.0)	
Yes	2	6.5 (5.0-8.0)		0 (0.0)	1 (50.0)	1 (50.0)	0 (0.0)	
Congenital anomalies			0.193					0.380
No	248	12.0 (8.0-21.0)		14 (5.6)	47 (19.0)	155 (62.5)	32 (12.9)	
Yes	1	5.0 (5.0-5.0)		0 (0.0)	1 (100.0)	0 (0.0)	0 (0.0)	
Infant of diabetic mother			0.686					1.000
No	248	12.0 (7.5-21.0)		14 (5.6)	48 (19.4)	154 (62.1)	32 (12.9)	
Yes	1	10.0 (10.0-10.0)		0 (0.0)	0 (0.0)	1 (100.0)	0 (0.0)	
Other respiratory disorders			0.098					0.180
No	248	12.0 (7.5-21.0)		14 (5.6)	48 (19.4)	155 (62.5)	31 (12.5)	
Yes	1	54.0 (54.0-54.0)		0 (0.0)	0 (0.0)	0 (0.0)	1 (100.0)	

%: Row percentages. F: P-value from Fishers exact test. W: p-value from the Wilcoxon rank sum test. K: p-value from the Kruskal Wallis test

Table 4: Negative binomial regression models of factors associated with the length of stay in the hospital among preterm infants admitted at NICU, KBTH, Accra

	Negative binomial regression model of number of hospital days				
	Unadjusted model			**Adjusted model**	
Characteristics	**uβ [95% CI]**	**P-value**		**aβ [955 CI]**	**P-value**
Sex					
Female	0.00 [reference]			0.00 [reference]	
Male	-0.19 [-0.38, -0.01]	0.044		-0.11 [-0.23, 0.02]	0.088
Birth weight					
<1,500 grams	0.00 [reference]			0.00 [reference]	
1,500-2,499 grams	-0.81 [-0.97, -0.64]	<0.001		-0.39 [-0.54, -0.24]	<0.001
Gestational age					
<32 weeks	0.00 [reference]			0.00 [reference]	
32-33 weeks	-0.38 [-0.58, -0.17]	<0.001		-0.22 [-0.39, -0.05]	0.011
34-36 weeks	-0.93 [-1.12, -0.74]	<0.001		-0.42 [-0.60, -0.24]	<0.001
Breastfeeding initiation					
Day 1	0.00 [reference]			0.00 [reference]	
Day 2	0.33 [0.02, 0.65]	0.038		0.04 [-0.22, 0.30]	0.761
Day 3	0.73 [0.40, 1.06]	<0.001		0.20 [-0.08, 0.48]	0.155
Day 4+	0.82 [0.49, 1.14]	<0.001		0.31 [0.01, 0.60]	0.040
Type of feeds					
EBM only	-0.01 [-0.36, 0.34]	0.948		-0.17 [-0.41, 0.08]	0.179
Formula only	-0.47 [-0.87, -0.08]	0.019		-0.32 [-0.64, -0.01]	0.043
Mixed	0.00 [reference]			0.00 [reference]	
Neonatal comorbidities					
Neonatal jaundice	0.17 [-0.03, 0.38]	0.098		0.15 [0.02, 0.28]	0.023
Neonatal sepsis & meningitis	0.75 [0.59, 0.91]	<0.001		0.44 [0.30, 0.57]	<0.001
Respiratory distress syndrome	0.30 [0.10, 0.51]	0.004		0.06 [-0.07, 0.19]	0.339
Probable necrotising enterocolitis	0.85 [0.58, 1.12]	<0.001		0.37 [0.16, 0.58]	<0.001
Neonatal infections other than NNS	0.59 [0.03, 1.15]	0.040		0.32 [0.00, 0.63]	0.047

uβ: Unadjusted coefficient estimate. aβ: adjusted coefficient estimate. CI: Confidence interval

Discussion

The ability to predict the length of stay is very crucial in the clinical and administrative practices of a given facility as it provides the information for counselling of the parents and plan the day-to-day running of the institution. In this study, the median LOS was 12 days. This is similar to what was found by Aljohani and his team[13] in Saudi Arabia. However, this is prolonged compared to what Kanimozhi and team[14] found in India. This might be because our study population included only few extreme low birth weight infants who are known to stay in the NICU for a longer period. This is demonstrated in our study where preterm infants who were born at 32-36 weeks' gestation had shorter during of hospital stay compared to those born less than 32 weeks. There was also a similar trend concerning infants who weighed between 1500 and 2499g and those below 1500g, meaning the more advanced in age and in body weight the infant, the shorter the duration of stay.

In our study preterm infants who were exclusively formula-fed had on average shorter duration of hospital stay compared to those who were on mixed feeding and exclusive breastmilk feeding. Even though it is a common practice in this study centre to practice exclusive breastfeeding at birth, there are instances where preterm infants are fed with formula. For example, when there is a demise of a mother, or the mother is too ill to provide expressed breastmilk. Also, some parents of patients who are HIV-exposed do opt to formula-feed their babies. The finding in this study could be because the preterm formula has a higher protein content compared to the breastmilk[15] which contributes to adequate weight gain and as such the infants will meet the criteria for discharge earlier. This finding might be due to chance for that matter the authors advocate strongly that breastmilk feeding should be the primary option, and formula should be used in extreme circumstances such as stated above. The study found that preterm infants with co-morbidities like neonatal infections, neonatal jaundice and probable necrotising enterocolitis had prolonged stay. This is like findings by different authors from different geographical location.[2,16] These findings call for policies which will help reduce the frequent occurrences of these condition among this patient population. It is well-known that a simple activity like frequent handwashing goes a long way to preventing neonatal sepsis. It is also to be advocated that preterm infants should be fed with breastmilk to help curb the rate of necrotizing enterocolitis.

Maternal conditions as risk factors for LOS in the NICU is controversial.[2] None of the maternal conditions were associated with length of stay in the present study. This is contrary to finding in China by Zhang et al[7] who found that maternal hypertension, primigravida and caesarean section were associated with prolonged LOS.

Limitation

For being a retrospective study, we were not able to verify the information that were on the EMR. Concerning the variable "age of attainment of full feed", there were 29 (11.6%) participants that we could not retrieve their data because they were not documented on the EMR.

Conclusion

Knowing the length of stay of the preterm infants in the NICU will help alleviate the emotional and economic burden on the family and the institution attending to these infants. The factors affecting the LOS in the study population are birth weight, gestational age, time to initiate breastfeeding, neonatal infection, probable necrotising enterocolitis and neonatal jaundice. Appropriate measures like hand hygiene, early initiation of breastfeeding and early diagnosis and treatment of neonatal jaundice and neonatal sepsis can go a long way to reducing the LOS in this centre.

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Authors Contributions

KAE: conceptualization, methodology, interpretation of the results, wrote the first draft of the manuscript. NOK: conceptualization, collection of data, reviewing and editing the manuscript. YA: methodology, analysis of the data, interpretation of the results, reviewed the manuscript.

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