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ORIGINAL ARTICLE

TITLE: PRETERM SURVIVAL AND FACTORS ASSOCIATED WITH THEIR OUTCOME AT MODIBBO ADAMA UNIVERSITY TEACHING HOSPITAL, NORTH-EASTERN NIGERIA.

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ABSTRACT

Introduction: Preterm birth is a leading cause of under-five mortality and places considerable medical and financial strain on families and health systems. Survival rates remain low in resource-limited settings and vary across locations.

Aim: This study assessed survival rates and factors affecting outcomes among preterm admissions at Modibbo Adama University Teaching Hospital (MAUTH), Yola.

Methods: This retrospective descriptive study was conducted in the Special Care Baby Unit (SCBU) of MAUTH, Yola. It involved the review of case notes of preterm babies admitted between June 1, 2021 and May 31, 2023.

Result: Of 2,059 newborn admissions, 589 (28.6%) were preterm, and 542 (26.3%) met inclusion criteria. There were 256 (47.2%) males and 286 (52.8%) females (male-to-female ratio: 0.9:1). Survival was lowest among extremely low birth weight infants (12.2%) and extreme preterm babies (12.5%). Birth weight, gestational age, and place of birth were significantly associated with survival ($P < 0.0001$). Strong predictors of survival were birth weight (AOR = 7.61; 95% CI = 2.51–23.08; $P < 0.001$) and place of birth (AOR = 2.42; 95% CI = 1.30–4.48; $P = 0.005$).

Conclusion:

Prematurity contributes significantly to neonatal admissions and mortality in our facility. Decreasing gestational age, extremely low birth weight, and being outborn are associated with reduced survival in the studied population. To improve outcomes, a well-equipped Neonatal Intensive Care Unit (NICU) and targeted interventions like antenatal corticosteroid, use of Surfactant, and Caffeine citrate are recommended.

Keywords: Preterm, Gestational age, Birth weight, Risk factors, Survival

INTRODUCTION

Preterm birth, defined by the World Health Organization (WHO) as all births before 37 completed weeks of gestation, is a global challenge and a well-recognized major risk factor for mortality in children under five years of age.[1] An estimated 13.4 million babies (1 in 10 babies) were born preterm in 2020, and approximately 900,000 children died in 2019 of complications of preterm birth.[2] Preterm neonatal survival largely depends on organ maturity, determined by gestational age and birth weight, along with the availability of advanced medical interventions to help them cope with extrauterine life.[3] Many survivors face a lifetime of disability, including learning disabilities, visual and hearing problems.[1]

An obvious disparity in survival rates of preterm babies is globally recognized. According to the WHO, over 90% of extreme preterm babies (<28 weeks) born in low-income countries die within the first few days of life. In contrast, in high-income settings, less than 10% of babies of this gestational age die, largely due to access to advanced medical care.[4] In the United States of America, 90% of preterm infants with gestational age between 26 and 28 weeks survived to hospital discharge.[5] In contrast to sub-Saharan countries, which reported very high mortality. A study in Ghana,[6] reported an overall survival rate of 60.7%, with the lowest survival rates observed in extreme preterm infants (20%) and those with extremely low birth weight (14.3%). Similar study in Southern Nigeria reported an overall survival rate of 65.9%, with survival rates of 11.1% for extremely preterm and 47.8% for very preterm infants.[7] Another study in a tertiary centre in north-east Nigeria, though on different cohorts of preterm infants, reported a survival of 73.31% of preterm births compared to a previously documented survival rate of 65.9% of preterm admissions a decade earlier.[8,9] These findings highlight the variations in survival rates and emphasize the need for improved healthcare support for preterm infants in low- and middle-income countries, particularly those born at extremely low gestational ages or with very low birth weights.

It is essential to carry out neonatal audits regularly, as morbidity/mortality patterns may vary from place to place and even from time to time in the same place. [10] Therefore, this study was designed to determine the burden of preterm admissions, survival rates, and factors associated with survival of this group of neonates in Modibbo Adama University Teaching Hospital (MAUTH), Yola. Documenting the current burden and factors associated with the survival rate of this group of newborns will aid decisions on management and advocacy for improved care and for counselling of families of these babies.

METHODOLOGY

Study site: The study was conducted at the special care baby unit (SCBU) of MAUTH, Yola. The MAUTH, Yola, is a tertiary institution that serves as a referral hospital to some parts of the northeastern states (Borno and Taraba) and neighbouring Republic of Cameroun. The SCBU is the newborn unit of the hospital, where infants within the first 28 days of life are admitted. The unit is a 24-bed capacity equipped with 12 incubators, 5 resuscitaires/radiant warmers, 8 LED Phototherapy machines, oxygen concentrators, and a CPAP machine. It is

manned by 3 Paediatricians, resident doctors, and nursing staff with an average of one nurse to 6 patients. The unit consists of an inborn and outborn section. The inborn section admits all newborns delivered in MAUTH, while babies delivered outside the facility are admitted into the outborn section.

Study design: This is a retrospective descriptive study. It represents a sub-analysis of a broader unpublished research project titled 'Pattern of Neonatal Morbidity and Mortality: A Two-Year Experience at Modibbo Adama University Teaching Hospital, Yola, Adamawa State.'

Study population: The study, which was carried out over six months, included all preterm (delivered before 37 completed weeks of gestation) newborns admitted into the SCBU of MAUTH, Yola, from June 1, 2021, to May 31, 2023, with adequate records. We excluded babies with missing records (less than 80% of the required information).

Data Collection: The names and hospital numbers of preterm infants were obtained from the unit's admission register, and their case folders were subsequently retrieved from the Records and Information Department. Information obtained from the folders included age at admission, gestational age at birth (from the mother's first day of last menstrual period for mothers that had antenatal care or assessed using the modified Ballard maturity rating score), place of birth, mode of delivery, sex, birth weight (or weight on admission for those delivered outside the hospital without documented birth weight on referral note and presented within the first 24 hour of life), risk factor for preterm birth, co-morbidities at presentation, duration of hospital stay and outcome. Maternal information retrieved included age, parity, and gestational type (single or multiple). Participants without entry for a particular variable were excluded from the analysis for that variable.

Data analysis: Data was collected using a structured proforma and analyzed using IBM SPSS version 25. Preterm babies were categorized into four groups based on gestational age at birth: extreme preterm (<28 weeks), very preterm (28 to <32 weeks), moderate preterm (32 to <34 weeks), and late preterm (34 to <37 weeks).[4] Descriptive statistics were used to summarize the data, which were presented in tables and charts. Associations between variables were examined using bivariate and multivariate analyses. The Chi-square test or Fisher's exact test was applied where appropriate to determine statistical significance, which was set at $p < 0.05$.

Ethical Clearance: Ethical clearance for the study was obtained from the MAUTH Health Research Ethics Committee with clearance no: MAUTHY/HREC/23/261.

RESULTS

Of the 2059 neonates admitted into the SCBU during the two years, 589 (28.6%) were preterm babies. Only 542 (26.3%) of the preterm with complete records were studied. There were 256 (47.2%) males and 286 (52.8%) females, giving a male-to-female ratio of 0.9:1. The Majority, 327(60.3%), of the babies were inborn. Two hundred and sixty-three (48.5%) of the preterm were delivered via caesarean section, while 279 (51.5%) via spontaneous vaginal delivery. Most babies, 494 (91.1%), presented within the first 24 hours of life. Forty-four (8.6%) were extremely low birth weight, 132 (25.8%) very low birth weight, while 336 (65.6%) were low birth weight. Eighteen (3.5%) of the

babies were extreme preterm, 141 (27.7%) were very preterm, 133 (26.1%) were moderate preterm, while 218 (42.7%) were late preterm (Table 1)

Table 1: Demographic and clinical characteristics of study participants

Variable	Frequency	(%)
Age on admission (days) (n=542)		
<1	494	91.1
1-3	27	5.0
4-7	14	2.6
>7	7	1.3
Sex of baby (n=542)		
Male	256	47.2
Female	286	52.8
Gestational age (weeks) (n=510)		
<28	18	3.5
28-31	141	27.7
32-33	133	26.1
34-36	218	42.7
Birth weight of baby (g) (n=512)		
<1000	44	8.6
1000-1499	132	25.8
1500-2499	336	65.6
Place of birth (n=542)		
Inborn	327	60.3
Outborn	215	39.7
Outborn place of birth (n=215)		
Secondary facility	129	60.0
Primary health Centres	66	30.7
Home	18	8.4
Tertiary facility	2	0.9
Delivery Mode (n=542)		
SVD	279	51.5
C/S	263	48.5
Maternal age (years) (n= 533)		
<18	21	3.9
18-34	417	78.3
≥35	95	17.8
Parity (n=540)		
1	175	32.4
2-4	264	48.9
≥5	101	18.7
Gestation type (n=542)		
Singleton	375	69.2
Twins	139	25.6
Triplets	28	5.2
Length of Hospital Stay (in days) (n=542)		
1-7	339	62.6
8-14	131	24.2
15-21	38	7.0
22-28	17	3.1
>28	17	3.1

*SCBU- Special Care Baby Unit [+]SVD-Spontaneous Vertex Delivery [±]C/S- Caesarean Section

Table 2: Shows the risk factors for preterm delivery and the morbidities documented at presentation. Maternal hypertensive disorders 129(23.0), antepartum haemorrhage 77(14.2%) and multiple gestation 76(14.0%) were the most observed risk factors for preterm births. Sepsis/presumed sepsis 165 (30.4%), respiratory distress syndrome 53 (9.8%) and jaundice 41 (7.6%) were the commonest morbidities.

Table 2: Risk factors for preterm delivery and morbidities at presentation in SCBU

Variable	Frequency	Percentage
Potential Risk Factors for Preterm Delivery		
Maternal hypertensive disorder	129	23.8
Antepartum hemorrhage	77	14.2
Multiple gestations	76	14.0
Preterm rupture of membrane	62	11.4
Maternal infection	27	5.0
No antenatal care	23	4.2
Previous preterm delivery	14	2.6
Teenage pregnancy	8	1.5
Trauma/Accident	2	0.3
Others	10	1.8
Co-morbidities		
Sepsis	165	30.4
Respiratory distress syndrome	53	9.8
Neonatal Jaundice	41	7.6
Perinatal asphyxia	39	7.2
Hypoglycaemia	37	6.8
Anaemia	7	1.3
Congenital anomaly	6	1.1
Birth trauma	5	0.9
Necrotizing enterocolitis	4	0.7

The overall survival rate at discharge was 58.9% (319/542). A total of 135 infants (24.9%) died, while 88 (16.2%) were discharged against medical advice (DAMA). More than half of the deaths occurred within the first 72 hours of life. Of the deaths, 22 (16.3%) occurred within the first 24 hours, 53 (38.5%) between days 1 and 3, 40 (29.6%) between days 4 and 7, and 21 (15.6%) after the first week of life.

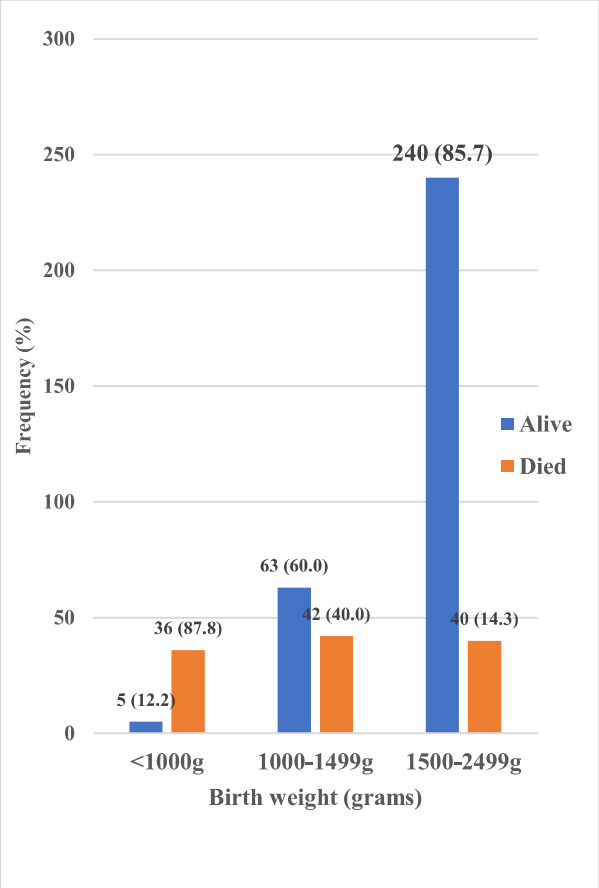

Figure 1: Percentage survival outcome based on weigh

Figure 1: Shows the percentage survival outcome based on weight. The survival rate was the lowest 5 (12.2%) in the ELBW babies and highest, 240 (85.7%), in the LBW babies. The lowest survival rate was observed in the extreme preterm babies 2 (12.5%), while the moderate and late preterm had survival rates of 85 (74.6%) and 147 (81.7%), respectively. (Figure 2).

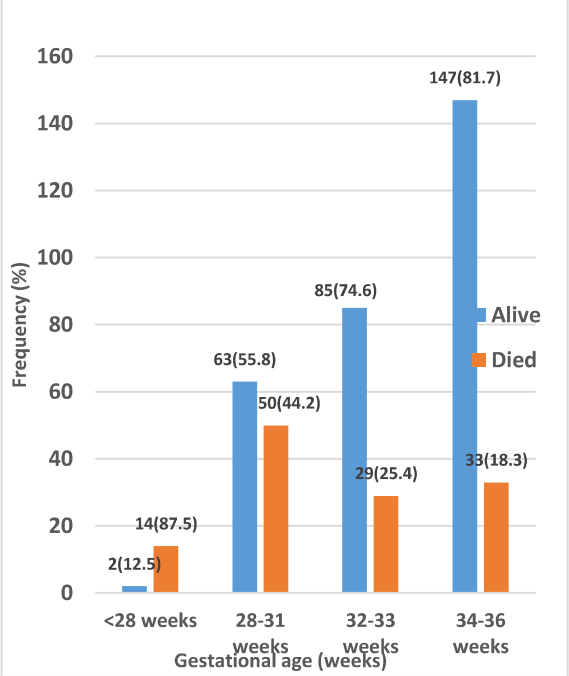

Figure 2: Percentage survival outcome based on gestational age.

Table 3: Shows the factors influencing the survival outcome of the subjects studied. Gestational age, birth weight, place of birth, and mode of delivery were found to be significantly associated with survival (P<0.0)

Table 3: **Factors influencing the survival outcomes of preterm babies.**

Variable	Outcome			Df	p-value
	Alive	Died			
	f (%)	f (%)	χ		
Age (days)†					
< 1 day	285(69.5)	125 (30.5)	2.630	3	0.452†
1-3 days	19 (76.0)	6 (24.0)			
4-7 days	10(71.4)	4 (28.6)			
8-28 days	5 (100.0)	0 (0.0)			
Sex					
Female	164 (68.9)	74 (31.1)	0.441	1	0.507
Male	155 (71.8)	61 (28.2)			
Gestational age					
< 28 weeks	2 (12.5)	14 (87.5)	49.101	3	**<0.0001***
28-31 weeks	63 (55.8)	50 (44.2)			
32-33 weeks	85 (74.6)	29 (25.4)			
34-36 weeks	147 (81.7)	33 (18.3)			
Birth weight (g)†					
<1000	5 (12.2)	36 (87.8)	107.042	2	**<0.0001***†
1000-1499	63 (60.0)	42 (40.0)			
1500-2499	240 (85.7)	40 (14.3)			
Place of birth					
Outborn	102 (57.3)	76 (42.7)	23.541	2	**<0.0001***
Inborn	217 (78.6)	59 (21.4)			
Mode of delivery					
C-section	185 (80.1)	46 (19.9)	21.716	1	**<0.0001***
Vaginal	134 (60.1)	89 (39.9)			
Mother's parity					
1	111 (70.3)	47 (29.7)	3.285	2	0.194
2-4	144 (67.3)	70 (32.7)			
≥ 5	64 (78.0)	18 (22.0)			
Maternal age (years)†					
< 18	10 (66.7)	5 (33.3)	1.932	-	0.381†
18-34	238 (69.0)	107 (31.0)			
≥ 35	65 (76.5)	20 (23.5)			

*Statistically significant † Fisher's exact test applied.

Table 4: Shows the multivariate logistic regression analysis of factors associated with the survival of preterm babies. Variables found to have a significant association with survival in bivariate analysis were subjected to multivariate logistic regression analysis. Outborn neonates delivered in other facilities had significantly higher odds than inborn neonates (AOR 2.42, 95% CI: 1.30–4.48, p=0.005). Compared to neonates with birth weight <1000 g, those weighing 1000–1499 g had a markedly higher likelihood of the outcome (AOR 7.61, 95% CI: 2.51–23.08, p<0.0001). The risk was even greater in those weighing 1500–2499g (AOR 21.88, 95% CI: 6.95–68.92, p<0.0001). Although survival improved with increasing gestational age, the associations were not statistically significant after adjustment for other variables (<28 weeks: AOR = 0.19; 95% CI: 0.03–1.17; p = 0.074; 28–31 weeks: AOR = 0.68; 95% CI: 0.33–1.41; p = 0.299; 32–33 weeks: AOR = 0.98; 95% CI: 0.49–1.98; p = 0.964). Similarly, mode of delivery did not significantly influence survival (AOR = 1.23; 95% CI: 0.69–2.18; p = 0.489). (Table 4).

Table 4: Multivariate logistic regression analysis of factors associated with survival of preterm babies

Variable	AOR	95% CI for AOR	p-value
Gestational age			
< 28 weeks	0.19	0.03 – 1.17	0.074
28-31 weeks	0.68	0.33 – 1.41	0.299
32-33 weeks	0.98	0.49 – 1.98	0.964
34-36 weeks	1		
Place of birth			
Out born	1		
Home	1.99	0.33 – 12.04	0.454
Inborn	2.42	1.30 – 4.48	**0.005***
Birth weight			
< 1000g	1		
1000-1499g	7.61	2.51 – 23.08	**<0.0001***
1500-2499g	21.88	6.95 – 68.92	**<0.0001***
Mode of delivery			
C-section	1.23	0.69 – 2.18	0.489
Vaginal	1		

AOR: Adjusted odds ratio; CI: Confidence Interval; C-section: Caesarean section

DISCUSSION

Prematurity accounted for nearly a third (28.6%) of neonatal admissions in our study, which is comparable to findings in Maiduguri (32.9%),[11] Jos (32.8%),[12] Ekiti (31.3%)[13] Bayelsa (24.0%),[7] and Sokoto (22.3%),[14] and India (28.3%),[15] but higher than in Nepal (16.5%).[16] The variation may be attributed to differences in healthcare infrastructure, referral patterns, and availability of obstetric and neonatal services. Regions with limited healthcare facilities often provide such specialized services for preterm babies only in tertiary institutions.

The common risk factor for preterm birth in our study was hypertensive disorder (23.8%), followed by antepartum haemorrhage (14.2%), multiple gestations (14.0%), and preterm premature rupture of membrane (11.4%). Hypertension in pregnancy was also documented as the commonest risk factor for preterm deliveries in a study in Nasarawa state, north-central Nigeria, and in Port Harcourt, south-south Nigeria.[17,18] Multiple gestation, as the third common risk factor for preterm delivery, was noted in this study and is comparable with reports from a study in Jos, north-central Nigeria.[19] In contrast to the present study, reports from southern Nigeria and Nepal identified premature rupture of the membrane as the most common factor associated with preterm birth.[7,16]

The commonest neonatal morbidities observed in this study were sepsis, respiratory distress syndrome, and neonatal Jaundice. A similar observation was reported in north central and southern Nigeria.[18,20] All these are attributable to the immaturity of the organ systems of preterm newborns.[21] These findings emphasize the importance of upgrading healthcare infrastructure and technology, such as advanced respiratory support technology, effective infection prevention practices in delivery rooms and while transporting preterm newborns to referral facilities, improved diagnostic and antimicrobial treatment options, and provision of effective technology for jaundice treatment to improve the survival of preterm babies.

The survival rate at discharge in the studied cohort was 58.9%. Sadly, this is relatively low when compared to other regions in Nigeria, such as Bayelsa (65.9%)[7] and Jos (75%).[19] Although the survival rate we reported does not include the 16.2% of neonates whose parents requested DAMA, it reflects regional disparities in health care resources that influence preterm survival. With the Post COVI9-19 economic recession and out-of-pocket health care financing highly prevalent in our setting, many preterm babies are unable to afford high-quality specialized care. Regional civil conflicts and insecurities in communities negatively impact accessibility to focused ante-natal care services; thereby increasing the burden of prematurity, with often poor neonatal survival rates.

Multiple factors are known to influence the outcome of newborns, particularly preterm babies. In our study, it was observed that gestational age, birth weight, place of birth, and mode of delivery were significantly associated with survival. Further analysis showed that birth weight and place of birth were strong predictors of survival. The stark contrast in survival rates across different birth weight categories in this study underscores the critical vulnerability of extremely low birth weight (ELBW) infants. While low birth weight (LBW) and very low birth weight (VLBW) babies achieved relatively favourable survival rates of 85.7% and 60.0% respectively, survival among ELBW infants (<1000 g) was strikingly poor, with a mortality rate of 87.8%. This finding is consistent with reports from Lagos, Nigeria, where an 88.2% mortality rate was documented,[22] but slightly higher than rates reported in similar low- and middle-income settings, such as Jos, Nigeria (76.3%),[10] Ghana (73.6%),[6] and Nepal (80%).[15] Limited access to advanced neonatal care and technology (lack of respiratory supports, surfactant therapy, and mechanical ventilators) likely contributes to this, highlighting the need for targeted interventions at all levels of health care delivery, advanced neonatal care, and improved health care financing.

Survival in this study improved with advancing gestational age, with late preterm infants showing the best outcomes and extreme preterm babies the poorest. This trend is consistent with other studies,[6,12,16,23] which highlighted the importance of GA as a key factor in determining survival outcomes, as they also observed an increased survival rate with increasing GA. The lower the gestational age, the more immature the lungs and hence the higher the risk of respiratory complications and the need for specialized care such as advanced respiratory support and surfactant therapy, which may not be readily available or affordable in resource-constrained settings.[24] However, despite the established role of gestational age, it did not emerge as an independent predictor of survival in our multivariate analysis. A large Nigerian multi-centre study (MPD-4-QED) similarly demonstrated that while both early gestation and very low birth weight predicted mortality, birth weight exerted a much stronger influence.[25] By contrast, facility-based studies from Enugu[26] and Maiduguri[27]identified gestational age as an important determinant of preterm survival, underscoring that differences in study populations, accuracy of gestational age estimation, and reliance on weight-based clinical decision-making may account for these variations. In our cohort, the stronger influence of birth weight likely overshadowed the effect of gestational age. In contrast, the survival of extremely preterm infants has steadily improved in high-income countries, largely due to technological advances, widespread use of antenatal corticosteroids, and improved neonatal intensive care, with reported survival rates of up to 80% in this group.[4]

Place of birth was also observed to be a strong predictor of survival, as more than a third of the study population delivered at home or in other health facilities died. Studies have shown an increase in morbidity and mortality as well as long-term neurodevelopmental problems in preterm infants delivered before

transfer to a facility capable of managing them, especially when birth occurs at less than 32 weeks of gestation.[28,29] Transfer of expectant mothers with high risk of premature delivery to tertiary hospitals capable of managing high-risk infants has been shown to improve neonatal outcomes, including mortality.[28–31] However, due to the nature of premature birth, transferring high-risk mothers to tertiary centers is not always possible, and infants are often born in small birth centres or at home.[29]

CONCLUSION

Prematurity contributes significantly to neonatal admissions and mortality in our facility. Extreme low birth weight and out born place of birth are associated with decreased survival in the studied population. Disparity in survival highlights the need for targeted intervention. In addition, strengthening the use of evidence-based pre-delivery and delivery-room interventions, such as antenatal corticosteroids, timely in utero transfer, skilled resuscitation, and early respiratory support, could further enhance the survival of this cohort of patients.

LIMITATION

DAMA rates are high, which could have impacted the outcome differently.

RECOMMENDATION

To improve outcomes for preterm babies, there is a need to improve the quality and availability of perinatal care, increase access to respiratory support technologies, strengthen infection prevention and control measures to reduce the risk of sepsis, increase investment in healthcare to improve access to quality care, particularly for vulnerable populations, and to support the implementation of recommended interventions.

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CONFLICT OF INTEREST: Nil

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