J Afric Neonatal 2024;4: 89 – 96

ORIGINAL

Ronita DC Luke
Irene E Akhigbe
Nellie VT Bell
Haja S Sovula
Michael J Koroma
David AJ Jonjo

Survival status and predictors of mortality among preterm neonates admitted to a tertiary hospital in Sierra Leone

Received: 6th October 2024
Accepted: 23rd October 2024

Ronita DC Luke (✉)
Irene E Akhigbe, Nellie VT Bell, Haja S Sovula, Michael J Koroma, David AJ Jonjo
Department of Paediatrics,
University of Sierra Leone Teaching Hospital complex
Freetown-Sierra Leone
Email: ronita.luke@gmail.com

Abstract *Background:* Prematurity contributes significantly to the neonatal mortality burden in sub-Saharan Africa. The survival rate of preterm neonates and its predictors may be varied from setting to setting and time to time due to different reasons. This study therefore aimed to assess the survival status and predictors of mortality among preterm neonates at a tertiary hospital in Sierra Leone.
Method: A prospective study of 82 consecutively enrolled preterm neonates was conducted from May to July 2024. Interviewer-administered questionnaires and physical assessment of neonates were used to obtain socio-demographic and clinical data for mothers and their preterm neonates. Descriptive statistics were generated and tests of association done with multinomial logistic regression to establish the determinants of mortality outcome. A p-value <0.05 was considered statistically significant.
Results: At the end of this study, 20.7% (17/82) of admitted preterm neonates died, with 76.5% (13/17) of the deaths occurring within 72 hours of admission. Birth weight (p <0.001), gestational age (p <0.001), type of gestation (p=0.026), APGAR score at 5 minutes (p<0.001), post natal age (p=0.016), hypothermia (p=0.003) and lack of kangaroo mother care (p<0.001) were significantly associated with survival of preterm babies.
Conclusion: This study shows that in spite of limited resources and access to neonatal intensive care facilities, a decent survival rate can be achieved for babies born too soon. Factors such as singleton pregnancy, gestational age, birth weight, low apgar scores, hypothermia, hypoglycaemia, respiratory distress syndrome, post natal age and kangaroo mother care were significant predictors of mortality.

Keywords: Preterm, Neonates, Survival, Predictors, Mortality, Sierra Leone

Résumé: *Contexte:* La prématurité contribue de manière significative à la mortalité néonatale en Afrique subsaharienne. Le taux de survie des nouveau-nés prématurés et ses facteurs prédicteurs peuvent varier d'un endroit à l'autre et d'un moment à l'autre pour différentes raisons. Cette étude visait donc à évaluer l'état de survie et les facteurs prédicteurs de mortalité parmi les nouveau-nés prématurés dans un hôpital tertiaire en Sierra Leone.
Méthode: Une étude prospective de 82 nouveau-nés prématurés inscrits consécutivement a été menée de mai à juillet 2024. Des questionnaires administrés par des enquêteurs et l'examen physique des nouveau-nés ont été utilisés pour obtenir des données socio-démographiques et cliniques sur les mères et leurs nouveau-nés prématurés. Des statistiques descriptives ont été générées et des tests d'association ont été effectués à l'aide d'une régression logistique multi nominale afin d'établir les facteurs de mortalité. Une valeur p <0,05 a été considérée comme statistiquement significative.
Résultats: À la fin de cette étude, 20,7 % (17/82) des nouveau-nés prématurés admis sont décédés ; 76,5 % (13/17) des décès étant survenus dans les 72 heures suivant l'admission. Le poids de naissance (p <0,001), l'âge gestationnel (p <0,001), le type de gestation (p=0,026), le score d'APGAR à 5

minutes (p<0,001), l'âge post-natal (p=0,016), l'hypothermie (p=0,003) et l'absence de soins maternels kangourou (p<0,001) ont été significativement associés à la survie des prématurés.
Conclusion: Cette étude montre qu'en dépit de ressources et d'un accès limités aux installations de soins intensifs néonatals, un taux de survie décent peut être atteint pour les bébés nés trop tôt. Des facteurs tels que la grossesse unique, l'âge gestationnel, le poids de naissance, les scores d'apgar faibles, l'hypothermie, l'hypoglycémie, le syndrome de détresse respiratoire, l'âge post-natal et les soins à la mère kangourou étaient des prédicteurs significatifs de la mortalité.

Mots-clés: Prématurés, nouveaunés, survie, prédicteurs, mortalité

Introduction

Worldwide, an estimated 15 million preterm babies were born in 2010, with over 60% of these births occurring in sub- Saharan Africa and South Asia.[1] Preterm related complications in addition to perinatal asphyxia and neonatal infections, accounted for three-quarters of the 2.4 million neonatal deaths (6700 neonatal deaths per day) recorded globally in 2019.[2] The mortality attributable to preterm births among Africans showed twelve times higher figures compared to Europeans,[3] as half of the neonatal deaths in the continent are caused by preterm complications with highest rates reported in West Africa (nearly 16 per 1000 live births).[4,5]

Preterm neonates are physiological immature and have limited compensatory responses to the extra-uterine environment.[6] Consequently, they have a higher risk of morbidities and mortalities, with survivors having higher risk of life-long physical, neurological, visual, learning, and hearing disabilities.[7-11] In developed countries, the use of antenatal steroids, surfactant therapy, and mechanical ventilation in caring for preterm babies, are identified factors associated with improved outcomes.[12,13] The same, however, cannot be said of developing countries where all these facilities may not be readily available.[14-16] It is imperative therefore to determine the factors associated with preterm survival in developing countries, as this could guide decision making in timing of delivery in mild-to-moderately complicated pregnancies and improve quality of newborn care in settings where preterm deliveries are inevitable. This study was therefore done to determine the survival status of preterm infants and to identify the factors associated with mortality.

Materials and Methods

Study design and population

A hospital-based prospective study was conducted among all preterm neonates admitted to the neonatal unit of Ola During Children Hospital (ODCH) from May 1, 2024 to July 31, 2024 using a non-probability sampling method.

Study Setting

The Ola During Children Hospital (ODCH) is a government hospital that receives additional support from international non-governmental organisations. It is located in the densely populated eastern part of the Western Area Urban, Sierra Leone. The neonatal unit has a capacity of 33 cots and two incubators, and caters for preterm and sick new-born infants born within the institution, babies referred from other centres, and self-referrals. The number of admitted neonates varies from time to time; the average annual admission rate being 2,800. In the unit, there are different equipment including oxygen concentrators and cylinders, incubators, photo-therapy machines, CPAP machines, resuscitaires and radiant warmers. There is however no facility for parenteral nutrition, surfactant administration, mechanical ventilation and blood gas analysis.
The unit has neonatologists and resident pediatricians who are complimented by neonatal and general nurses.

Eligibility criteria

All preterm neonates admitted to the neonatal unit, during the time of data collection; and whose caregivers were available and provided consent were included in the study. Those without caregivers were excluded, as relevant information could not be obtained.

Data collection

The data was collected by four trained resident doctors under the supervision of a senior paediatric resident. A pre-tested interviewer-administered questionnaire and checklist were used by the investigators to collect the data. At admission, the investigators interviewed the mothers/caregivers of the preterm neonates after obtaining consent. Additional information was obtained from the mothers' clinical records including their antenatal care cards, delivery notes, and/or hospital referral forms. The investigators made a daily follow-up of the neonates in the neonatal unit to determine their admission outcomes.

Study Variables

Data was collected on maternal socio-demographic status, obstetric, and medical characteristics, and medical diagnosis at admission of the preterm neonates. These variables included maternal age, area of residence, marital status, level of education, parity, pregnancy, and labour complications. In addition, information on place of delivery, mode of delivery, antenatal corticosteroid use, postnatal age at admission, gender, gestational age, birth weight, APGAR scores, and resuscitation history was collected.

Prematurity was described as live born neonates delivered before 37 completed weeks. For mothers who did

not have a first trimester ultrasound scan and who did not know dates of their last normal menstrual period, the new Ballard score was used to estimate the gestational age.[17] Based on gestational age, preterm were further classified as; extremely preterm (less than 28 weeks), very preterm (28 to 32 weeks), moderate preterm (32 to 33 weeks and 6 days) and late preterm (34 to 36 weeks and 6 days.[18] The birth weights were classified into Extreme Low Birth Weight (ELBW) <1000g, Very Low Birth Weight (VLBW) 1000-1499g, Low Birth Weight (LBW) 1500-2499g and Normal Birth Weight (NBW) 2500-3999g.[19] Anthropometric assessment was carried out using Lubchenco curve.[20] Standard treatment protocols were used to ensure uniformity in patient care. Data was checked for completeness, accuracy, clarity, and consistency before the interview was terminated. The outcome was classified as died or survived.

Data analysis

Data was entered into the Statistical Package for Social Sciences (SPSS) version 25.0 for IBM electronic spreadsheet. Means and frequencies were computed and presented in tables and charts.

The association between univariate factors and the risk of death was evaluated using chi square or Fisher's exact test as appropriate, after which the power of the variables with significant associations to predict neonatal mortality was evaluated by means of multinomial logistic regression using SPSS. The level of significance was set at p <0.05 in all the statistical analyses.

Ethics

Ethical clearance was obtained from the Ethics Committee of the hospital. Permission to execute the study was granted by the management of the hospital. Informed consent was obtained from participants.

Results

Maternal Socio-Demographic and Obstetrics Related Characteristics

The mean maternal age was 25.4 (±5.5) years with the majority seen between 18-24 years (31; 37.8%). Over half (45; 54.9%) of the mothers were rural residents, and a nearly equal number, 43 (52.4%) were married. The majority of pregnancies resulted in singleton birth (61; 74.4%), which was mostly via spontaneous vaginal delivery (58; 70.7%) as shown in Table 1.

Demographic and Clinical Characteristics of Preterm Neonates

The characteristics of preterm neonates are presented in Table 2.

During the study period, 82 out of 87 (94.3%) admitted preterm neonatesmet the eligibility criteria for this study and were recruited. Of the five (5/87; 5.7%) excluded, four were low birth weight babies and one was very low birth weight. They were all males. Among the 82 preterm neonates recruited, 46 (56.1%) were inborn while 36 (43.9%) were out born. Over half (44; 53.7%) of the preterm neonates were females and the males were 38 (46.3%), give a M;F ratio of 1:1.2. Low birth weight babies accounted for 52.4% (43/82) and about one-fifth were small for gestational age (17; 20.7%). Based on gestational age, 6 (7.3%) were extremely preterm (<28 weeks of gestation), 13 (15.9%) very preterm (28–31 weeks), 12 (14.6%) moderate preterm (32–33 weeks), and 51 (62.2%) were late preterm (34–36 weeks). More than half (45, 54.9%) of preterm neonates did not get kangaroo mother care (KMC) services, with hypothermia reported in almost half the numbers of babies (37; 45.1%).

Table 1: Maternal Socio-Demographic and Obstetrics Related Characteristics

Variables	Frequency (N=82)	Percentage
Maternal Age (years)		
< 18	11	13.4
18-24	31	37.8
25-34	26	31.7
≥35	14	17.1
Marital status		
Single	39	47.6
Married	43	52.4
Educational Level		
None	15	18.3
Primary	19	23.2
Secondary	39	47.6
Tertiary	9	11.0
Maternal Residence		
Rural	45	54.9
Urban	37	45.1
Parity		
1	34	41.5
2-4	41	50.0
≥5	7	8.5
Type of Gestation		
Singleton	61	74.4
Multiple	21	25.6
PROM		
Yes	40	48.8
No	42	51.2
Pregnancy Induced Hypertension		
Yes	27	32.9
No	55	67.1
Other Obstetrics Complications		
Yes	59	72.0
No	23	28.0
Antenatal Corticosteroid Given		
Yes	31	37.8
No	51	62.2
Mode of Delivery		
Vaginal	58	70.7
Caesarean section	24	29.3

PROM = Prolong Rupture of Membranes

Outcomes of Preterm Neonates

In this study, 20.7% (17/82) of admitted preterm neonates died, and 79.3% (65/82) survived. Preterm

neonates who survived included those who recovered and were discharged; none left against medical advice (Fig 1). Seventy-six point five percent (13/17) of preterm neonatal deaths occurred within 72 hours from admission (Fig 2).Over half (34/65; 52.3%) and 15 (23.1%)of the discharges spent 11-15 days and at least 16 days on admission respectively (Fig 3). Discharge criteria included not being treated for any acute illness, normal vital signs for at least three days, appropriate weight gain for at least three consecutive days with discharge weight > 1.8kg, baby can breastfeed or mother can cup feed conveniently and mother or caregiver are comfortable taking care of the baby at home.

Table 2: Demographic and Clinical Characteristics of Preterm Neonates

Variables	Frequency	Percentage
Sex		
Female	44	53.7
Male	38	46.3
Gestational Age (weeks)		
< 28	6	7.3
28-31	13	15.9
32-33	12	14.6
34-36	51	62.2
Birth Weight (grams)		
< 1,000	8	9.8
1,000-1,499	15	18.3
1,500-2,499	43	52.4
≥2,500	16	19.5
Weight for Age		
SGA	17	20.7
AGA	65	79.3
1st min. APGAR Score		
0-3	19	23.2
4-6	42	51.2
≥7	21	25.6
5th min. APGAR Score		
0-3	7	8.5
4-6	42	51.2
≥7	33	40.3
Source of admission		
Inborn	46	56.1
Outborn	36	43.9
Postnatal Age at Admission (days)		
<1	58	70.7
≥1	24	29.3
Respiratory Distress Syndrome		
Yes	41	50.0
No	41	50.0
Neonatal Sepsis		
Yes	60	73.2
No	22	26.8
Perinatal Asphyxia		
Yes	42	51.2
No	40	48.8
Hypothermia		
Yes	37	45.1
No	45	54.9
Hypoglycaemia		
Yes	14	17.1
No	68	82.9
Kangaroo Mother Care		
Yes	37	45.1
No	45	54.9

SGA=Small for Gestational Age; AGA= Appropriate for Gestational Age

Table 3: Predictors of mortality among preterm babies

Risk factors	Admission outcome Discharged alive n (%)	Died n (%)	*P-Value
Maternal Age (years)			0.499
< 18	7 (63.6)	4 (36.4)	
18-24	24 (77.4)	7 (22.6)	
25-34	21 (84.0)	4 (16.0)	
≥35	12 (85.7)	2 (14.3)	
Type of Gestation			0.026
Singleton	52 (85.2)	9 (14.8)	
Multiple	12 (60.0)	8 (40.0)	
Sex of baby			0.594
Female			
Male			
5th min. APGAR Score			<0.001
0-3	1 (16.7)	5 (83.3)	
4-6	34 (81.0)	8 (19.0)	
≥7	29 (87.9)	4 (12.1)	
Gestational Age (weeks)			<0.001
< 28	0 (0.0)	5 (100.0)	
28-31	9 (69.2)	4 (30.8)	
32-33	10 (83.3)	2 (16.7)	
34-36	45 (88.2)	6 (11.8)	
Birth Weight (grams)			<0.001
< 1,000	0 (0.0)	7 (100.0)	
1,000-1,499	11 (73.3)	4 (26.7)	
1,500-2,499	39 (90.7)	4 (9.3)	
≥2,500	14 (87.5)	2 (12.5)	
Postnatal Age at Admission (days)			0.016
<1	41 (71.9)	16 (28.1)	
≥1	23 (95.8)	1 (4.2)	
RDS			0.001
Yes	26 (65.0)	14 (35.0)	
No	38 (92.7)	3 (7.3)	
Hypothermia			
Yes	23 (63.9)	13 (36.1)	0.003
No	41 (91.1)	4 (8.9)	
Hypoglycaemia			0.038
Yes	8 (57.1)	6 (42.9)	
No	56 (83.6)	11 (16.4)	
KMC			<0.001
Yes	36 (97.3)	1 (2.7)	
No	28 (63.6)	16 (36.4)	
Duration of stay (days)			0.065
0-5	4 (21.1)	15 (78.9)	
6-10	12 (85.7)	2 (14.3)	
11-15	34 (100)	0	
≥16	15 (100)	0	

RDS= Respiratory Distress Syndrome; KMC= Kangaroo Mother Care

Table 4: Results of multinomial logistic regression of mortality with risk factors for death

Risk factor	Wald	SE	*p*	AOR (95% CI)
Gestational Age	0.007	0.812	0.933	1.071 (0.218, 5.262)
Birth Weight	3.164	1.125	0.075	0.135 (0.015, 1.226)
5th min APGAR score	3.304	1.087	0.069	0.139 (0.016, 1.167)
Type of Gestation	0.061	1.319	0.804	1.386 (0.104, 18.398)
Post natal Age	0.655	1.377	0.418	0.328 (0.022, 4.875)
RDS	0.933	0.949	0.334	0.400 (0.062, 2.568)
Hypoglycaemia	0.521	2.261	0.470	5.117 (0.061, 43.813)
Hypothermia	3.860	1.043	0.049	0.129 (0.017, 0.995)
KMC	8.356	0.670	0.004	25.197 (3.310, 4.735)

p = probability, AOR (95% CI) = adjusted odds ratio (95% Confidence interval), SE = Standard Error, KMC = Kangaroo Mother Care, RDS = Respiratory Distress Syndrome

Fig 1: Admission outcomes of preterm neonates

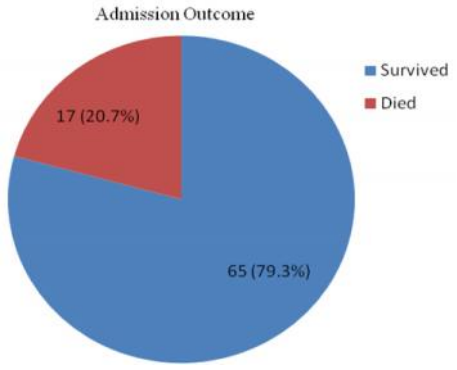


Fig 2: Distribution of preterm neonatal deaths based on duration of hospital stay

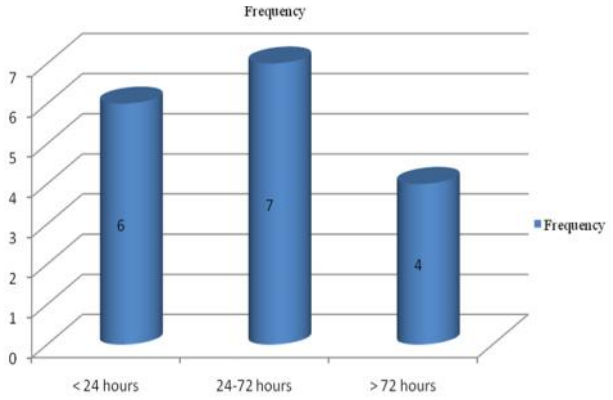
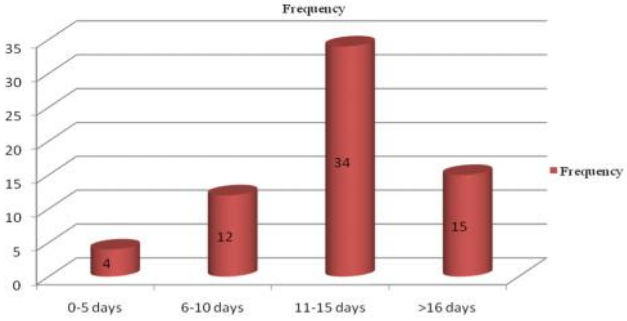


Fig 3: Distribution of preterm discharges based on duration of hospital stay



Predictors of mortality among preterm babies

Table 3 shows the predictors of mortality among preterm babies.
Survival of the preterm neonate was independent of the sex of the baby and maternal age. However, the weight of a baby (p <0.001), gestational age (p <0.001), type of gestation (p=0.026), APGAR score at five minutes (p<0.001), post-natal age (p=0.016), hypothermia (p=0.003) and KMC (p<0.001) were significantly associated with mortality.

Table 4 shows the results of the logistic regression analysis of factors associated with mortality among preterm babies. In the multinomial analysis, preterm neonates who did not receive KMC services had 25 times more likelihood of death compared to those who received KMC (AOR: 25.197; 95% CI: 3.310-4.735; P=0.004). Also, preterm diagnosed with hypothermia at presentation were more likely to die (AOR: 0.129; 95% CI: 0.017-0.995; P=0.129).

Discussion

This prospective study was aimed to assess the survival status and predictors of mortality among preterm neonates admitted to a public tertiary hospital in Sierra Leone. One-fifth (20.7%) of the admitted preterm neonates died during the study period. This is consistent with the findings from Uganda[21] (22.1%) and Nigeria[22] (24.0%), but however lower than the 27.7% and 34.9% reported from Ghana and Ethiopia respectively.[23,24] In contrast, the mortality from this study was higher than the 1.9%[25] and 9.1%[26] from studies conducted in China and Iran respectively. This marked disparity in mortality could be due to inequalities in neonatal care services, as some preterm neonates could have been treated in more specialized and equipped facilities compared to the care provided in inadequately equipped neonatal units.

With respect to the timing of mortality, our results indicated that 76.5% (13/17) of preterm neonates die within the first 72 hours into admission. This finding is similar to those by other authors.[27] The early neonatal deaths may have resulted from the complications of prematurity coupled with the direct complications of pregnancy, in addition to the unavailability of surfactant therapy and mechanical ventilators in these settings.

Common preterm morbidities seen in descending order at admission were sepsis (73.2%), perinatal asphyxia (51.2%), respiratory distress syndrome (50%), hypothermia (45.1%), and hypoglycaemia (17.1%). A study in Ethiopia also found that hypothermia, hypoglycemia, jaundice, perinatal asphyxia, respiratory distress, and sepsis were common among preterm neonates at admission.[28] In Tanzania however, a prospectivecohort study reported hypothermia (37.4%), followed by RDS (32.3%), infection (9.1%), perinatal asphyxia (7.1%),

and necrotizing enterocolitis (2.0%) as admitting diagnosis.[29] These wide variations in proportions may be due to differences in postnatalages at presentation, diagnostic criteria, newborn care practices and inclusion of varying gestational age subcategories of preterm neonates.

The factors associated with mortality of preterm neonates are multifactorial and diverse. The current study revealed that babies from singleton gestations were more likely to survive compared to those from multiple gestations. Similar findings were reported from other studies that also found a significant association of multiple gestations with preterm mortality.[30,31] The complications associated with multiple gestations may be the reason for this finding, as neonates of multiple gestations are more likely to have a lower birth weight, and thus require hospitalization.[32]

Similar to other studies, mortality of preterm neonates was inversely proportional to gestational age[25,33-35] as lower gestational age increases their susceptibility for different preterm birth complications and death. Additionally, preterm neonates who were resuscitated at birth were more likely to die. In the current study, preterm neonates who were resuscitated were also most likely to have had a low 5-minute Apgar score, which is a sensitive indicator for the quality of resuscitation provided and a predictor of long term outcome. Our findings are congruent with studies in Ethiopia[24]and Nigeria,[36] which emphasize the role of optimal obstetric care and newborn resuscitation in reducing preterm mortalities.

Receiving KMC service was noted to be a protective factor for preterm mortality, as KMC helps prevent the neonates from developing hypothermia, hypoglycemia, and infection thereby increasing their chances for survival.[35,37,38]

Strength and Limitations of the Study

This was a prospective study and included preterm neonates of all gestation age subcategories therefore it gives qualified data by avoiding missed deaths due to chart incompleteness commonly encountered in retrospective studies. Since the study period was for only 3 months, it may mask seasonal variability in preterm deliveries and hence admissions. Additionally, the small sample size may limit generalisation of findings. The unavailability of modern treatment modalities such as surfactant and mechanical ventilation may have affected the quality of care rendered.

Conclusion and Recommendation

This study shows that in spite of limited resources and access to neonatal intensive care facilities, a decent survival rate can be achieved for babies born too soon. Factors such as singleton pregnancy, gestational age, birth weight, low APGAR scores, hypothermia, hypoglycaemia, respiratory distress syndrome, post natal age and lack of kangaroo mother care, are significant predictors of mortality. To improve preterm newborn survival, specific strategies that target improvements in facility-based continuum of care such as quality Antenatal Care, neonatal resuscitation, respiratory support, and thermal care should be reinforced.

Acknowledgments

The authors acknowledge our research assistants and all the staff of the Neonatal Unit, for the invaluable support provided during data collection. We are also grateful to the management of the hospital.

Author Contributions
All authors made substantial contributions to the conception and design of the study, acquisition of data, data analysis and interpretation, drafting the article or revising it critically for important intellectual content, gave final approval of the version to be published, and agree to be accountable for all aspects of the work.
Conflict of interest: None
Funding: None

References

1. Blencowe H, Cousens S. Review: addressing the challenge of neonatal mortality. *Trop Med Int Health. 2013;18 (3):303–312. doi:10.1111/ tmi.12048*
2. WHO, UNICEF. Reaching the Every Newborn National 2020 Milestones country Progress, Plans and Moving Forward; 2017; p. 2015–8.
3. Liu L, Oza S, Hogan D, Chu Y, Perin J, Zhu J, et al. Global, regional, and national causes of under-5 mortality in 2000–15: an updated systematic analysis with implications for the sustainable development goals. *Lancet. (2016); 388:3027–35. doi: 10.1016/ S0140-6736(16)31593-8*
4. Lawn J, Mongi P, Cousens S. counting them and making them count. In: Africa ' s newborns [Internet]. 2015; p. 16. Available from: https:// www. google. com/ url? sa= t&rct= j&q= &esrc= s& source= web& cd= &ved= 2ahUK EwjVu 96HkK j2AhV XPewKHRzPBlsQFnoECAM QAQ&url= https% 3A% 2F% 2Fwww. who. int% 2Fpmn ch% 2Fmed ia% 2Fpub licat ions% 2Faon section_I. pdf&

5. Lawn JE, Kinney M. Preterm birth: now the leading cause of child death worldwide. *Sci Transl Med. 2014;6(263):19–22.*
6. Engle WA, Tomashek KM, Wallman C. "Late-preterm" infants: a population at risk. *Pediatrics. 2007;120(6):1390–1401. doi:10.1542/peds.2007-2952*
7. Federal Ministry of Health of Ethiopia AA. Neonatal Intensive Care Unit (NICU) Training Management Protocol (2014).
8. Gebreslassie HG, Gebregziabher B, Hailu T, Gebreegziabiher G. Patterns of preterm neonatal death and associated factors in ayder referral hospital neonatal unit (five years record review), Tigray Region, North Ethiopia. *Int J ContempPediatr. (2018). p.10060–5*
9. Hirvonen M, Ojala R, Korhonen P, Haataja P, Eriksson K, Gissler M, et al. Visual and hearing impairments after preterm birth. *Pediatrics. (2018);142:e20173888. doi: 10.1542/peds.2017-3888*
10. Majewska J, Zajkiewicz K, Wacław-Abdul K, Baran J, Szymczyk D. Neuromotor development of children aged 6 and 7 years born before the 30th week gestation. *BioMed Res Int. (2018) 2018:2820932. doi: 10.1155/2018/2820932*
11. Vaughn VC,McKay RJ, Behrman RE, NelsonW.E. Textbook of Pediatrics. 21st ed. Philadelphia, PA:WB Saunders Company (2019).
12. Richardus JH, Graafmans WC, Verloove-Vanhorick SP, Mackenbach JP; EuroNatal International Audit Panel; Euro Natal Working Group. Differences in perinatal mortality and suboptimal care between 10 European regions: Results of an international audit. *BJOG. 2003;110(2):97-105.*
13. Labcharoenwongs P, Chamnanvanakij S, Rasamimari P, Saengaroon P. Mortality and morbidity of very low birth weight (VLBW) and preterm infants of gestational age <33 weeks at phramongkutklao Hospital. *R Thai Army Med J. 2002; 55:205-11.*
14. Ibhanesebhor SE, Afadapa MA. Epidemiology of preterm delivery in Benin City. *Niger J Paediatr. 1996; 23:27-32.*
15. Sritipsukho S, Suarod T, Sritipsukho P. Survival and outcome of very low birth weight infants born in a university hospital with level II NICU. *J Med Assoc Thai. 2007;90(7):1323-9.*
16. Trotman H, Lord C. Outcome of extremely low birthweight infants at the University Hospital of the West Indies, Jamaica. *West Indian Med J. 2007;56(5):409-13.*
17. Ballard JL, Khoury JC, Wedig K, Wang L, Eilers-Walsman BL, Lipp R. New Ballard score, expanded to include extremely premature infants. *J Pediatr. 1991; 119:417–423.*
18. Mandy AGT. Incidence and mortality of the preterm infant. Up To Date[Internet]. 2020; Available from: https:// www. google. com/ url? sa= t&rct= j&q= &esrc= s& source= web& cd= & cad= rja&uact= 8&ved= 2ahUK Ewje6 7SWoK j2AhU 8wAIH HbdrD m8QFn oECBA QAQ&url= https% 3A% 2F% 2Fwww. uptod ate. com% 2Fcon tents% 2Finc idence- and- mortality- of- theprete rm- infant% 2Fpri nt% 3Fsea rch% 3Dant enatal- corticoste roids- therapyfor- reduction- of- neonatal- morbidity- and- mortality- fromprete rm- delivery% 26sou rce% 3Dsea rch_ result% 26sel ected Title% 3D10~150% 26usa ge_type% 3Ddef ault% 26dis play_ rank% 3D10&usg= AOvVa w3_ H2dJH mciTY22hRj b9jPN.
19. Kimberly G.L. Identifying the High-risk Newborn and Evaluating Gestational Age, Prematurity, Postmaturity, Large-for-Gestational-Age, and Small-for-Gestational-Age Infants. In: Cloherty JP, Eichenwald EC, Stark AR (editors). Manual of Neonatal Care. 6th Edition. Lippincott Williams & Wilkins, 2008; 41 -58.
20. Lubchenco L, Hansman C, Dressler M, Boyd E. Intrauterine growth as estimated from live born birth weight data at 24 to 42 weeks of gestation. *Pediatrics*. 1963; 32:793–800.
21. Abdallah Y, Namiiro F, Mugalu J. Is facility based neonatal care in low resource setting keeping pace? A glance at Uganda's National Referral Hospital. *Afr Health Sci. 2016;16(2):347–355. doi:10.4314/ ahs.v16i2.2*
22. Lyoke AC, Lawani OL, Ezugwu EC. Prevalence and perinatal mortality associated with preterm births in a tertiary medical center in South East Nigeria. *Int J Women's Health. 2014; 6:881–888. doi:10.2147/IJWH.S72229*
23. Agbeno EK, Osarfo J, Ashong J, Anane- Fenin B, Okai E, Ofori AA, et al. (2021) Determinants of preterm survival in a tertiary hospital in Ghana: A ten-year review. *PLoS ONE 16(1): e0246005. https:// doi.org/10.1371/journal. pone.0246005*
24. Wesenu M, Kulkarni S, Tilahun T. Modeling determinants of time-to- death in premature infants admitted to neonatal intensive care unit in Jimma university specialized hospital. *Ann Data Sci. 2017;4 (3):361–381. doi:10.1007/ s40745-017-0107-2*
25. Xu F, Kong X, Duan S, Lv H, Ju R, Li Z, et al. Care practices, morbidity and mortality of preterm neonates in China, 2013–2014: a retrospective study. Sci Rep. 2019;9 (1):2013–4 Available from: https:// doi. org/ 10. 1038/ s41598- 019- 56101-x.

26. Haghighi L, Nojomi M, Mohabbatian B, Najmi Z. Survival predictors ofpreterm neonates: hospital based study in Iran (2010-2011). *Iran J Reprod Med. 2013;11(12):957–64.*
27. Sankar MJ, Natarajan CK, Das RR, Agarwal R, Chandrasekaran A, Paul VK. When do newborns die? A systematic review of timing of overall and cause-specific neonatal deaths in developing countries. *J Perinatol. 2016;36:S1–S11. doi:10.1038/ jp.2016.27*
28. Yismaw AE, Tarekegn AA. Proportion and factors of death among preterm neonates admitted in University of Gondar comprehensive specialized hospital neonatal intensive care unit, Northwest Ethiopia. *BMC Res Notes. 2018; 11:867. doi:10.1186/s13104-018-3970-9*
29. Mbawala GB, Fredrick F, Kamugisha E. Factors associated with mortality among premature babies admitted at Bugando Medical Centre, Mwanza - Tanzania. *East Afr J Public Health. 2014;11 (1):641–645.*
30. Garg P, Abdel-Latif ME, Bolisetty S, Bajuk B, Vincent T, Lui K. Perinatal characteristics and outcome of preterm singleton, twin and triplet infants in NSW and the ACT, Australia (1994–2005). *Arch Dis Child Fetal Neonatal Ed. 2010;95:F20–F24. doi:10.1136/ adc.2009.157701*
31. Papiernik E, Zeitlin J, Delmas D. Differences in outcome between twins and singletons born very preterm: results from a population-based European cohort. *Human Reprod. 2010;25 (4):1035–1043. doi:10.1093/humrep/dep430*
32. Albasri SF, Shouib GM, Bajouh OS, Nasrat HA, Ahmad E, Algreisi FM. Maternal and neonatal outcomes in twin and triplet gestations in Western Saudi Arabia. *Saudi Med J. 2017;38 (6):657–661. doi:10.15537/ smj.2017.6.17699*
33. Fajolu I, Akintan PE, Ezenwa B, Ezeaka VC. Survival of extremely preterm neonates in a resource-limited setting. *Iran J Neonatol. 2019;10(3):32–37. doi:10.22038/ ijn.2019.38772.1611*
34. Kong X, Xu F, Wu R. Neonatal mortality and morbidity among infants between 24 to 31 complete weeks: a multicenter survey in China from 2013 to 2014. *BMC Pediatr. 2016; 16:174. doi:10.1186/ s12887-016-0716-5*
35. Muhe LM, Mcclure EM, Nigussie AK. Major causes of death in preterm infants in selected hospitals in Ethiopia (SIP): a prospective, cross-sectional, observational study. *Lancet Glob Health. 2019;7 (8): e1130–e1138. doi:10.1016/S2214-109X(19) 30220-7*
36. Bello M, Pius S, Ibrahim BA. Characteristics and predictors of outcome of care of preterm newborns in resource constraints setting, Maiduguri, Northeastern Nigeria. *J Clin Neonatol. 2019;8:39–46. doi:10.4103/jcn.JCN*
37. Shah S, Zemichael O, Meng HD. Factors associated with mortality and length of stay in hospitalised neonates in Eritrea, Africa: a cross-sectional study. *BMJ Open. (2012);2:e000792. doi: 10.1136/bmjopen-2011-000792*
38. Shah R, Mullany LC, Darmstadt GL, Talukder RR, Rahman SM, Mannan I, et al. Neonatal mortality risks among preterm births in a rural B angladeshi cohort. Paediatr Perinat Epidemiol. (2014); 28:510–20. doi: 10.1111/ppe.12145