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Journal:	*BMJ Open*
Manuscript ID	bmjopen-2021-054574
Article Type:	Original research
Date Submitted by the Author:	23-Jun-2021
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Keywords:	Paediatric clinical genetics & dysmorphology < GENETICS, Neonatal intensive & critical care < INTENSIVE & CRITICAL CARE, NEONATOLOGY, Paediatric intensive & critical care < ANAESTHETICS

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MORBIDITY AND MORTALITY PATTERN OF PRETERM LOW BIRTH WEIGHT NEONATESADMITTED IN AMHARA REGION REFFERAL HOSPITALS OF ETHIOPIA: RETROSPECTIVE FOLLOWUP STUDY

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Word count=3401

Abstract

Objective: This study was conducted to assess morbidity and mortality pattern of preterm low birth weight neonates admitted in Amhara region referral hospitals of Ethiopia.

Methodology: Retrospective follow- up study was conducted on preterm low birth weight neonates admitted in Amhara region referral hospital between January 01 /2017 and December 30 /2018. Data were entered into Epi- data 4.4.2.1 and exported to STATA 14 for cleaning and analysis. Logistic regression model was used to analyze the data.

Result: This study revealed that 37.8 %(95%CI: 32.4-43.5) of participants were died. The most common morbidities found in preterm low birth neonates was 219 (75.26%) hypothermia followed by 201(69.07%), 145(49.83%), 39(13.4%) and 24(8.25%) with sepsis, respiratory distress, jaundice and congenital anomalies respectively. Sepsis (AOR: 2.06(95% CI: 1.05-4.02), respiratory distress (AOR: 3.28 (95% CI: 1.81-5.95), congenital anomalies (AOR: 3.14(95%CI: 1.16-8.54), hypoglycemia (AOR 3.81(95%CI: 1.27-11.44) were independent factors associated with mortality.

Conclusion: In this study, mortality of preterm low birth neonatal was higher and public health issue. Hypothermia, Sepsis, respiratory distress, jaundice, and congenital anomaly were common morbidities. Sepsis, respiratory distress, hypoglycemia, and congenital anomaly were independent factors of mortality.

Key words: morbidity, mortality, pattern, preterm low birth weight, Amhara region, Ethiopia

Article summary

Strength and limitation of the study

- The study was conducted at multisite referral hospitals, which increases the likelihood of generalizability to the entire population that the sample was drawn.
- This study used a multivariate logistic regression analysis to regulate all likely confounders.
- Data were collected from secondary source and some factors that can't be found in the patient medical chart which will have a significant association with death may be missed.

Introduction

Globally, in 2017 there was about 5.4 million under- five mortality, out of which 2.5 million were died in the first 28 days, with approximately two- third and 80% of the neonates were delivered with preterm and low birth weight respectively(1). An increasing number in delivery of preterm low birth weight (LBW) neonates were one of the leading causes for the leveling off infant mortality and neonatal mortality rates in 2013 in the United States of America (2). In many Asian and African countries being born preterm LBW was found as the main risk factor for the development of different morbidities and neonatal mortality (3,4). In Sri Lanka, about 28% of neonates were died due to Low birth weight and prematurity (4).

Preterm LBW- related morbidities were found as the main causes of admission in the neonatal intensive care unit (NICU). In Bangladesh, 12.4% of admission were due to preterm LBW and preterm LBW were the cause for 6.5% of deaths (5). Furthermore, preterm LBW lead to

prolonged stay of neonates in the hospital and can lead to adverse neurodevelopmental outcome shows the greatest concern for the family and the society in future (6). In different regions of Ethiopia being born preterm low birth weight was the major contributor for neonatal deaths and neonate born with less birth weight and preterm showed higher mortality during the neonatal period than normal birth weight and term neonates(7,8)(9)(10). In the southwest region of Ethiopia from all neonatal deaths of 22.8%, more than two- third (76%) of death were caused by LBW and prematurity (10).

Despite the initiation of modern techniques of NICU facilities, preterm LBW neonates are still at high risk for the development of numerous morbidities (11). The overall mortality of preterm low birth weight neonates varies depending on the pattern of morbidities (12). Preterm low birth weight neonates are predisposed to infectious diseases due to their immature immune system and develops many severe morbidities such as; hypoglycemia, respiratory distress syndrome (RDS) (13), sepsis , jaundice, apnea, and birth asphyxia(14,15). The rate of mortality rate in preterm LBW neonates was different depending on morbidity type (16,17). The risk of developing morbidities was varying in a different category of preterm LBW neonates. The extremely low birth weight (ELBW) and extremely preterm neonates had higher rates of all the morbidities and mortalities(18).

Some trials are started to implement now for the prevention of preterm LBW birth and reductions of neonatal morbidity and mortality related to preterm LBW. The sustainable development goal three emphasizes on reducing neonatal deaths with the goal of 12 neonatal deaths per 1000 live births per country by 2030 through different interventions including of:

kangaroo mother care and extra support for feeding Low birth weight and preterm babies with breast milk and other many interventions at postnatal period (19).

Despite these trials, many findings of previous studies in Ethiopia had identified a high prevalence of preterm LBW neonates and had a higher risk of neonatal morbidity and mortality in those preterm LBW neonates. Eventhouh prevalence of preterm LBW birth is high there is an information gap about the pattern of morbidity and mortality in preterm low birth weight neonates and the factors associated with mortality in this study area. Therefore, this study aimed to assess the morbidity and mortality pattern of preterm low birth weight neonates admitted in Amhara region referral hospitals of Ethiopia to fill information gap. The finding of the study will help to identify major morbidities and know about the causes of mortality for preterm LBW neonates and to apply prevention strategy of modifiable causes of mortality for health care providers. Further for Amhara region referral hospitals will help to see the gaps on preterm LBW neonatal mortality. More over the study will also provide some insights for future researches to work along this line.

Methods

Study design, area and period

Institutional based retrospective follow- up study was conducted among preterm LBW neonates admitted in the NICU ward of selected Amhara region referral hospitals between January 01/2017 and December 30 /2018.The study was conducted in selected referral hospitals of the Amhara region. Among all four referral hospitals in the region; Felege Hiwot Referral Hospital

(FHRH), Debremarkos, Dessie, and Debrebirhan, two of them (FHRH, Dessie referral hospital) were selected by lottery method. The study was conducted from December 2018 to June 2019.

Population, eligibility criteria

All neonates with a gestational age of less than 37 weeks weighing500-2499g admitted in Amhara region referral hospitals of NICU ward were the source population. All selected preterm low birth weight neonates admitted in Amhara region referral hospitals of NICU ward from January 01/2017 to December 30 /2018 were the study population. Live birth neonates with a gestational age of less than 37 weeks weighing 500-2499g admitted in Amhara region referral hospitals of NICU ward were eligible in the study.

Sampling techniques and procedure

From four referral hospitals found in the Amhara region, FHRH and Dessie Referral Hospital were selected by lottery method. The samples were proportionally allocated for each hospital. All preterm LBW neonates admitted in the NICU ward between January/ 1 /2017- December/ 30 /2018 were recruited by using the admission registration book by recording their medical record numbers sequentially. A Simple random sampling technique was used to select a required number of study participants.

Variables of the study

The dependent variable was an outcome of preterm LBW neonates dichotomized into death or alive. The independent variables of the study included were include: Socio-demographic variables (Sex of neonate, age of neonate, age of mother), Maternal and obstetric related variables (Maternal disease (HIV, DM), pregnancy status, Pregnancy- induced hypertension) ,

complication/morbidity related variables (Sepsis, necrotizing enterocolitis, intraventricular hemorrhage, asphyxia, RDS, jaundice, pulmonary hemorrhage, congenital anomalies, hypothermia, hypoglycemia) and neonatal related variables (place of delivery, mode of delivery) were included.

Data collection tools and procedures

After reviewing of different literature, the checklist was adapted to address the objective of the study. The checklist consists of information on maternal and neonatal socio-demographic data, neonatal- related factors, complication/morbidity factors, maternal and obstetrics- related factors. Data were extracted from each neonatal medical chart by using a structured checklist adapted from different literature.

Data quality assurance

To ensure the quality of data, different measures were undertaken. One day of training was given to data collectors and supervisors on the objective of the study and how to gather information by using the prepared data extraction checklist. Data were collected by six nurses working in NICU who were taking NICU training. One MSC nurse supervisor was assigned for support and facilitation of data collection in each selected site of the data collection area. Supervision of data collectors about the data collection process was done by the supervisor. The supervisor checked daily evaluation about the completeness of the filled checklist.

Data processing, analysis and presentation

After checking data completeness and consistency, the collected data were coded and entered into to Epi-data statistical software package version 4.4.2.1. Then the data exported to STATA

version14 for cleaning and analysis. Descriptive statistics were carried out and presented using tables and texts. Bivariate and multivariable analysis was done in logistic regression to determine the association between factor variables and the dependent variable. Based on bivariate analysis, those variables having p-value < 0.25 in the binary logistic regression were transferred to the multivariable analysis, and those variables having P-value < 0.05 at 95% confidence level were considered as independent factors for mortality of preterm low birth weight neonates. The final measure of association between independent and dependent variables was expressed by the adjusted odds ratio.

Results

Two hundred ninety- one preterm low birth neonates' charts were reviewed and each individual preterm low birth weight neonates had a different length of hospital stay.

Neonatal and maternal socio-demographic characteristics

From the 291 total sampled preterm low birth weight neonates, the majority 185 (63.57%) were male. Two hundred five (70.45%) mothers were belonging to the age category of 20-34 years **(Table 1).**

Table 1.Socio-demographic characteristics of preterm low birth weight neonates and their mothers admitted in NICU of Amhara region referral hospitals, Ethiopia, 2019 *(n=291).*

Characteristics	Category	Total N (%) N=291	Alive N (%) N=181	Death N (%) N=110
Sex of the neonate	Female	106(36.43)	70 (66.04)	36(33.96)
	Male	185(63.57)	111(60)	74(40)

	<20	46(15.81)	29(63.04)	17(36.96)
Maternal age (year)	20-34	205(70.45)	128(62.44)	77(37.56)
	>=35	40(13.75)	24(62.2)	16(37.8)

Maternal and obstetrics related characteristics

The Majority of 45 (15.46%) preterm low birth weight neonates were born from mothers who had a diagnosis of pregnancy- induced hypertension **(Table 2)**.

Table 2: Maternal medical and obstetrics characteristics of preterm low birth weight neonates and neonatal outcome admitted in NICU of Amhara region referral hospitals, Ethiopia, 2019 (n=291)

Characteristics		Category	Total N (%) N=291	AliveN(%) N=181	Death N(%) N=110
Maternal chronic Medical disease		No	281(96.56)	178 (63.35)	103(36.65)
		Yes	10(3.44)	3(30)	7(70)
Maternal chronic Medical disease	**HIV**	No	285(97.94)	179 (62.81)	106(37.19)
		Yes	6(2.06)	2(33.33)	4(66.67)
	DM	No	289(99.31)	181 (62.63)	108 (37.37)
		Yes	2(0.69)	-	2(100)
	Others	No	289(99.31)	180(62.28)	109(37.72)
		Yes	2(0.69)	1(50)	1(50)
Obstetric complications		No	228(78.35)	149(65.35)	79 (34.65)
		Yes	63(21.65)	32(50.79)	31(49.21)

Obstetric complication	**PIH**	No	246(84.54)	158(64.23)	88(35.77)
		Yes	45(15.46)	23(51.11)	22(48.89)
	placenta-abruption	No	279(95.88)	175 (62.72)	104(37.28)
		Yes	12(4.12)	6(50)	6(50)
	placenta-Previa	No	285(97.94)	178(62.46)	107(37.54)
		Yes	12(2.06)	6(50)	6(50)

Neonatal related characteristics

Two hundred seventy- three (93.81%) preterm low birth weight neonates were born in health institutions. The Majority (79.73%) of the preterm low birth weight neonates were born via the vaginal mode of delivery. Two hundred nineteen (80.22%) preterm low birth weight neonates had less than seven APGAR scores at the first minute. One hundred fifty- two (55.68%) preterm low birth weight neonates had more than seven APGAR score at five minutes **(Table.3).**

Table.3: Neonatal- related characteristics of preterm low birth weight neonates and neonatal outcome admitted in NICU of Amhara region referral hospitals, Ethiopia, 2019 *(n=291).*

characteristics	**Category**	**Total N (%) N=291**	**Alive N (%) N=281**	**Death N (%) N=110**
Place of delivery	Health institution	273(93.81)	171(62.64)	102(37.36)
	Home	18(6.19)	10(55.56)	8(44.44)
Mode of	Cesarean	59(20.27)	43(72.88)	16 (27.12)

delivery	Vaginal	232(79.73)	138(59.48)	94(40.52)
Type of	Single	185(63.57)	118(63.78)	67(36.22)
pregnancy	Multiple	106(36.43)	63(59.43)	43(40.57)
APGAR score	<7	219(80.22)	129(58.9)	190(41.1)
1st min.	>=7	54(19.78)	42(77.78)	12(22.22)
APGAR score	<7	121(44.32)	65(53.72)	56(46.28)
5th min.	>=7	152(55.68)	106(69.74)	46(30.26)

Morbidity and Mortality Pattern

Preterm Low birth weight- related morbidities Pattern

In this study 219 (75.26%), 201(69.07%), 145(49.83%), 39(13.4%), 24(8.25%), and 21(7.22%) 10(3.44%), 23(7.9%) and 7(2.41%) of neonates were diagnosed with hypothermia, sepsis, RDS, jaundice, congenital anomaly, hypoglycemia, necrotizing enterocolitis, meningitis, and perinatal asphyxia morbidities respectively**(Table.4).**

Table.4:medical and surgical morbidity- related factors of preterm low birth weight neonates admitted in NICU of Amhara region referral hospitals, Ethiopia, 2019 (n=291).

Morbidity characteristics	**Category**	**Total N(%) N=291**	**Alive N(%) N=181**	**Death N(%) N=110**
Sepsis	No	90(30.93)	69(76.67)	21(23.33)
	Yes	201(69.07)	112(55.72)	89(44.28)

RDS	No	146(50.17)	115(78.77)	31(21.23)
	Yes	145(49.83)	66 (45.52)	79(54.48)
Jaundice	No	251(86.6)	159(63.10)	93 (36.90)
	Yes	39(13.4)	22(56.41)	17(43.59)
Congenital anomaly	No	267(91.75)	170(63.67)	97(36.33)
	Yes	24(8.25)	11(45.83)	13(54.17)
Hypoglycemia	No	270(92.78)	172(63.7)	98(36.30)
	Yes	21(7.22)	9(42.86)	12(57.14)
Hypothermia	No	72(24.74)	50(69.44)	22(30.56)
	Yes	219(75.26)	131(59.82)	88(40.18)
Perinatal asphyxia	No	284(97.59)	181(63.73)	103(36.27)
	Yes	7(2.41)	-	7(100)
Meningitis	No	268(92.1)	167(62.31)	101(37.69)
	Yes	23(7.90)	14(60.87)	9(39.13)
Necrotizing enter	No	281(96.56)	179 (63.7)	102(36.3)
colitis	Yes	10(3.44)	2(20)	8(80)

Factors associated with mortality of preterm low birth weight neonates

In this study, the overall proportion of preterm low birth weight neonatal mortality was 37.8 %(95%CI: 32.4-43.5). In this study Sepsis, RDS, congenital anomaly, and hypoglycemia have remained independent factors of mortality for preterm low birth weight neonates (Table.5).

In this study, preterm low birth weight neonates with sepsis had 6% higher odds of mortality as compared to neonates without sepsis (AOR: 2.06(95% CI :1.05-4.02). Preterm low birth weight neonates diagnosed with RDS had 3.28 times higher odds of mortality than preterm low birth weight neonates without RDS (AOR: 3.28 (95% CI: 1.81-5.95). Preterm low birth weight neonates with congenital anomaly had 3.14 times odds of mortality as compared to preterm low birth weight neonates without congenital abnormality (AOR: 3.14(95%CI:1.16-8.54). Preterm low birth weight neonates with a diagnosis of hypoglycemia had 81% higher odds of mortality than their counterparts (AOR 3.81(95%CI: 1.27-11.44).

Table.5: factors associated with mortality of preterm low birth weight neonates admitted in NICU of Amhara region referral hospitals, Ethiopia, 2019 *(n=291)*.

Characteristics	Category	Alive	Death	COR(95%Cl)	AOR(95% CI)	P>|z|
Sepsis	No	69	21	1	1	
	Yes	112	89	2.61(1.49-4.58)	2.06(1.05-4.02)	0.035**
RDS	No	115	31	1	1	
	Yes	66	79	4.44(2.66-7.42)	3.28(1.81-5.95)	0.000**
Congenital	No	170	97	1	1	
anomaly	Yes	11	13	2.07(.89-4.81)	3.14(1.16-8.54)	0.025**
Hypoglycemia	No	172	98	1	1	
	Yes	9	12	2.34(.95-5.75)	3.81(1.27-11.44)	0.017**
Hypothermia	No	50	22	1	1	
	Yes	131	88	1.53(.86-2.7)	1.34(.68-2.65)	0.401
PIH	No	158	88	1	1	

	Yes	23	22	1.72(.91-3.26)	1.98(.92-4.25)	0.081
APGAR 1st min.	<7	129	190	2.44(1.22-4.9)	1.72(.72-4.13)	0.228
	>=7	42	12	1	1	
APGAR 5th min	<7	65	56	1.99(1.21-3.26)	1.24(.66-2.31)	0.513
	>=7	106	46	1	1	

NB: **=significant at p-value<0.05 in multivariable analysis, 1=considered as reference category

Discussion

This retrospective follow- up study was carried out to determine a pattern of preterm LBW neonates' morbidity, mortality, and factors associated with their mortality .In this study, the overall proportion of preterm low birth weight neonatal mortality was 37.8 %(95%CI: 32.4-43.5). This result is higher than studies conducted in India at 6.5%(18)and Iran at 28.7%(20). The difference from a study in Iran might be that study was excluded neonates with severe fetal malformations whereas this study did not exclude those neonates, which may increase mortality risk. The discrepancy from a study in India may be due to that the study focusing only on short-term outcomes, whereas our study was on the neonatal period.

However, this result is lower than the study conducted in Isfahan city, Iran 64.4 %(21)and Telangana, India88.8%(22). The possible reason for this difference might be the difference in inclusion criteria, where a study in Iran involves neonates with a birth weight category of less than one thousand five hundred grams and gestational age of less than thirty weeks. The risk of mortality may become high as the birth weight and gestational age of neonate is decreased.

Our study was also revealed that neonatal hypothermia (75.26%), Sepsis (69.07%), RDS, (49.83%), jaundice, (13.4%), and congenital anomaly (8.25%) were the most common morbidities and reason for admission to NICU. This result is supported by studies conducted in Sharda hospital, India (16), Western Nepal(17), Telangana, India(18), Isfahan city, Iran(21), teaching hospital, Telangana, India (22), New South Wales, and Australian Capital Territory(23).

In this study, preterm low birth weight neonates with sepsis had 6% higher odds of mortality as compared to neonates without sepsis (AOR: 2.06(95% CI :1.05-4.02). This result was supported by the study conducted in Telangana, India (18)New South Wales and Australian Capital Territory (23), Mahatma Gandhi Memorial Government Hospital, India (24). The possible reason might be that preterm low birth weight neonates mostly had immature host defense mechanisms makes them susceptible to devastating infection that finally may lead to neonatal death.

In addition, Preterm low birth weight neonates diagnosed with RDS had 3.28 times higher odds of mortality than preterm low birth weight neonates without RDS (AOR: 3.28 (95% CI: 1.81-5.95). This result was supported by a study conducted in Aga Khan University Hospital, Karachi, Pakistan(6), Telangana, India(18), New South Wales and Australian Capital Territory (23), Mahatma Gandhi Memorial Government Hospital, India(24). The possible reason might be that neonates with RDS had the complication of lung collapse that may facilitate death easily in preterm low birth weight neonates.

Preterm low birth weight neonates with a diagnosis of hypoglycemia had 81% higher of odds of mortality than their counterparts (AOR 3.81(95%CI: 1.27-11.44). This was supported by a study done in Telangana, India (18), Mahatma Gandhi Memorial Government Hospital (24). This might be due to the fact that preterm neonates had an immature organ that leads to failure in

glycogen storage may end up with death. In addition, this study found that preterm low birth weight neonates with a diagnosis of congenital anomaly had 3.14 times higher odds of death as compared to their counterparts (AOR: 3.14(95%CI:1.16-8.54). This result is supported by other studies conducted in Telangana, Indi(6), Mahatma Gandhi Memorial Government Hospital, India(24). The possible reason might be preterm low birth neonates with congenital anomalies have the risk of developing different systemic complication like neurological, cardiovascular, respiratory, and gastrointestinal those can may leads to mortality.

Conclusion

In conclusion, this study revealed that morbidity and mortality pattern of preterm low birth neonates were higher in this setting than national estimates of SDGs and findings of Ethiopian demographic health survey 2019. Hypothermia, Sepsis, RDS, jaundice, and congenital anomaly were the most common morbidities. Neonatal sepsis, respiratory distress, hypoglycemia, and congenital anomaly were independent factors of mortality among preterm low birth weight neonates.

Abbreviations

DM: Diabetes Mellitus, FHRH: Felege Hiwot Referral Hospital, GA: Gestational Age, HIV: Human Immune Virus, LBW: Low Birth Weight, NEC: Necrotizing Enterocolitis, NICU: Neonatal Intensive Care Unit, PIH: Pregnancy Induced Hypertension, PTLBW: Preterm Low Birth Weight, RDS: Respiratory Distress

Ethics approval and consent to participate

To conduct this study ethical clearance letter was obtained from the institutional review board of Mekelle University, college of health sciences with reference number 1270/2019. Permission letters were written for FHRH and Dessie referral hospital. Data were collected after consent of cooperation was obtained from Felege Hiwot referral hospital and Dessie referral hospital administrator.

Patient consent for publication: Not required

Availability of data and materials: The raw data file could be provided for research purposes only, upon request via e-mail of the corresponding author.

Competing interests: The authors declare that they have no competing interests.

Funding: There is no received specific grant from any funding agency

Patient and public involvement: Patients and/or the public were not involved in the design or conduct of this research. .

Authors' contributions

All authors contributed equally to this work. YD, BF, MS $ DT participated in all phases of the study including topic selection, design, data collection, data analysis, and interpretation. All authors also contribute to writing this manuscript. All authors read and approved the final manuscript.

Acknowledgement

It is our pleasure to thank Felege Hiwot referral hospital and Dessie referral hospital staffs of pediatric, neonatology care team, and the card extractors. It is also our pleasure to thank the data collectors and supervisors.

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MORBIDITY AND MORTALITY PATTERN OF PRETERM LOW BIRTH WEIGHT NEONATES ADMITTED TO REFERRAL HOSPITALS IN THE AMHARA REGION OF ETHIOPIA: RETROSPECTIVE FOLLOWUP STUDY

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2021-054574.R1
Article Type:	Original research
Date Submitted by the Author:	21-Feb-2022
Complete List of Authors:	Genie, Yalemtsehay; Mizan-Tepi University, Department of nursing Kebede, Belete; Jimma University Silesh, Mulualem ; Debre Berhan University, Department of midwifery Tilahun, Desalew; Jimma University, Nursing
Primary Subject Heading:	Paediatrics
Secondary Subject Heading:	Paediatrics, Intensive care, Nursing
Keywords:	Paediatric clinical genetics & dysmorphology < GENETICS, Neonatal intensive & critical care < INTENSIVE & CRITICAL CARE, NEONATOLOGY, Paediatric intensive & critical care < ANAESTHETICS

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MORBIDITY AND MORTALITY PATTERN OF PRETERM LOW BIRTH WEIGHT NEONATES ADMITTED TO REFERRAL HOSPITALS IN THE AMHARA REGION OF ETHIOPIA: RETROSPECTIVE FOLLOWUP STUDY

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Word count=3429

Abstract

Objective: This study aimed to assess the morbidity and mortality patterns of preterm neonates with low birthweight admitted in the Amhara region referral hospitals in Ethiopia.

Design: Hospital-based retrospective follow-up study

Setting: Amhara region referral hospitals, Ethiopia

Participants: : A total of 291 preterm neonates low birth weight were admitted to referral hospitals in the Amhara region between January 1 /2017 and December 30/2018 were reviewed. Data were entered into Epi-data 4.4.2.1 and exported to STATA 14 for analysis and variables with a p-value of <0.05 at 95% confidence level in multivariable logistic regression model analysis were declared as statistically significant associated factors of mortality.

Primary outcome: Morbidity and mortality patterns in preterm low birth weight neonates

Results: This study revealed that 37.8% (95%CI: 32.4-43.5) of preterm low-birthweight neonates died. The most common morbidities found were 219 (75.26%) hypothermia, followed by 201(69.07%), 145(49.83%), 39(13.4%) and 24(8.25%) with sepsis, respiratory distress, jaundice and congenital anomalies respectively. Sepsis (AOR: 2.0;(95% CI:1.03-3.89), respiratory distress (AOR: 4.6; (95% CI: 2.51-8.40), hypoglycemia (AOR 3.91; (95%CI: 1.09-10.52), APGAR score at fifth minute <7 (AOR 0.39; (95%CI: (.18-.82) and duration of hospital stay below mean (<9.82 days) (AOR 0.17; (95%CI: 0.09-0.33) were associated with mortality.

Conclusion: The mortality rate of preterm low birthweight neonates was high, indicating that this is a public health issue. Hypothermia, sepsis, respiratory distress, jaundice, and congenital anomalies were the common morbidities. Sepsis, respiratory distress, hypoglycemia, Apgar

score at fifth minute <7 and duration of hospital stay below the mean were independent factors of mortality**.** However, need to be further investigated in future research and appropriately addressed using prospective follow-up.

Keywords: morbidity, mortality, pattern, preterm low birth weight, Amhara region, Ethiopia

Article summary

Strength and limitation of the study

- The study was conducted at multiple referral hospitals, which increased the generalizability of the findings to the entire population.
- This study used a multivariate logistic regression analysis to regulate all likely confounders.
- Data were collected from secondary sources and some factors were not available in the patients' medical charts, thereby creating the potential for missing factors that might have a significant association with death.

Introduction

Globally, in 2017 there were about 5.4 million cases of mortality under the age of five, out of which 2.5 million died in the first 28 days, with approximately two-thirds and 80% of the neonates being delivered with preterm and low birthweight (LBW), respectively(1). The increasing number of preterm LBW neonates was one of the leading contributors to the leveling off of infants and neonatal mortality rates in 2013 in the United States of America (2). In many Asian and African countries, being born preterm LBW is the main risk factor for the development of various morbidities and neonatal mortality (3,4). In Sri Lanka, approximately 28% of neonates die because of LBW and prematurity (4).

Preterm LBW-related morbidities were the main causes of admission to the neonatal intensive care unit (NICU). In Bangladesh, 12.4% of admissions were due to preterm LBW and which was the cause of 6.5% of deaths (5). Furthermore, preterm LBW leads to prolonged hospital stay in neonates and can leads to adverse neurodevelopmental outcomes, with massive implications for the family and society in the future (6). In different regions of Ethiopia , preterm LBW is the major contributor to neonatal death, and neonates born both LBW and preterm show higher mortality rates during the neonatal period than those with normal birth weight and term neonates(7,8)(9)(10). Of all the neonatal deaths in the southwestern region of Ethiopia (22.8%), more than two-thirds of these (76%) were caused by LBW and prematurity (10).

Despite the introduction of modern techniques in NICU facilities, preterm LBW neonates are still at a high risk of developing numerous morbidities (11). The overall mortality of preterm neonates with LBW varies depending on the pattern of morbidities (12). Preterm neonates with LBW are predisposed to infectious diseases because of their immature immune system and

develop severe morbidities such as hypoglycemia, respiratory distress syndrome (RDS) (13), sepsis, jaundice, apnea, and birth asphyxia(14,15). The mortality rate of preterm LBW neonates differs depending on the type of morbidity (16,17). The risk of developing morbidities varied among different categories of preterm LBW neonates. Extremely low birth weight (ELBW) and extremely preterm neonates have higher rates of morbidity and mortality(18).

Currently, some trials aim to implement novel techniques for the prevention of preterm LBW births and to reduce neonatal morbidity and mortality related to preterm LBW. The United Nations sustainable development goal 3 emphasizes reducing neonatal deaths with the goal of reaching 12 or fewer neonatal deaths per 1000 live births per country by 2030. They aim to achieve this through different interventions including kangaroo mother care and extra support for feeding LBW and preterm babies with breast milk as well as other interventions during the postnatal period (19).

Despite these trials, many previous studies in Ethiopia have identified a high prevalence of preterm LBW neonates and a higher risk of neonatal morbidity and mortality in preterm LBW neonates. Although the prevalence of preterm LBW births is high, there is an information gap regarding the pattern of morbidity and mortality in preterm LBW neonates and the factors associated with mortality in this study area. Therefore, this study aimed to assess the morbidity and mortality pattern of preterm LBW neonates admitted to referral hospitals in the Amhara region of Ethiopia to fill this information gap. The findings of this study will help to identify major morbidities and understand the causes of mortality in preterm LBW neonates and facilitate healthcare providers in the application of prevention strategies for any modifiable causes of morbidity and mortality. Furthermore, referral hospitals in the Amhara region will provide an

advanced insight into the factors associated with preterm LBW neonatal mortality. Finally, this study will provide insights for future research that is needed along this line.

Methods and materials

Study design, area, and period

An institution-based retrospective follow-up study was conducted among preterm LBW neonates admitted to the NICU ward in selected referral hospitals of Amhara region between January 1, 2017 and December 30, 2018. There are four referral hospitals in the region, (Bahirdar, Debremarkos, Dessie and Debrebirhan Referral Hospitals), out of which, two of them were selected by lottery method (Bahirdar, Felege Hiwot Referral Hospital (FHRH). This study was conducted between January 1/ 2019 and February 1/2019(data collection period)

Population, eligibility criteria

All neonates with a gestational age of less than 37 weeks weighing 500-2499 g admitted to the NICU wards of the Amhara region referral hospitals were the source population. All selected preterm LBW neonates admitted to the referral hospitals of the NICU ward from January 1/ 2017 to December 30 /2018 were included in the study. Live birth neonates with a gestational age of less than 37 weeks weighing 500-2499 g admitted to the NICU wards of the Amhara region referral hospitals were eligible for the study.

Sampling techniques and procedure

The samples were allocated proportionally to each hospital. All preterm LBW neonates admitted to the NICU ward between January 1/ 2017 and December 30 /2018 were recruited using the

admission registration book by recording their medical record numbers sequentially. A simple random sampling was used to select the required number of participants.

Sample size determination

The sample size was determined by using a single population proportion formula considering the following assumptions; 95% confidence level, margin of error (0.05) and the rate of preterm mortality 25.2% from previous study conducted in Gondar, Ethiopia(20)

$n= (\underline{Z\alpha/2)^2 \times p\ (1-p)}/\ (d)^2$

$n= (1.96)^2*0.252*0.748/\ (0.05)^2 =289.65\sim290$

The sample size after adding a 10% non-response rate was 319

Variables of the study

The dependent variable was the outcome of preterm LBW neonates dichotomized as deceased or alive.

The independent variables of this study were **as** follows:

-***Socio-demographic variables*** :(sex, age, age of mother, and duration of hospital stay)

-***Maternal and obstetric variables:*** (maternal chronic diseases (HIV, DM), pregnancy status, pregnancy related complications (pregnancy-induced hypertension)

- **Neonatal complication/morbidity variables:** (sepsis, necrotizing enter-colitis, asphyxia, RDS, jaundice, pulmonary hemorrhage, congenital anomalies, hypothermia, hypoglycemia) and neonatal related variables (place of delivery, mode of delivery).

Operational definitions

Pattern: frequent/repeated ways in which morbidity and mortality occur or wide spread incidence of morbidity and mortality

Morbidity: was defined as the diagnosis identified by health professionals using clinical, laboratory or other investigation methods (RDS, Sepsis, congenital anomalies, asphyxia, jaundice, pulmonary hemorrhage, necrotizing enter colitis, hypoglycemia and hypothermia) which were recorded in the neonate's medical chart

Mortality: was defined as death in the NICU before discharge as certified by the death certificate (death summary note) in the chart

Preterm low birth weight: neonates with a gestational age of less than 37 weeks and weighing less than 2500 g

Data collection tools and procedures

After reviewing the literature, an existing checklist was adapted to address the objectives of the study. The checklist consists of information on maternal and neonatal socio-demographic data, neonatal-related factors, complication/morbidity factors, and maternal and obstetric-related factors. Data were extracted from each neonatal medical chart by using the resulting structured checklist.

Data quality assurance

Different measures were taken to ensure the data quality. One day of training was provided to the data collectors and supervisors on the objective of the study and how to gather information

using the prepared data extraction checklist. The data collectors included were six nurses working in the NICU who had NICU training. An MSc nurse supervisor was assigned to support and facilitate data collection at each selected data collection site. The supervisor supervised the data collectors throughout the data collection process. The supervisor conducted daily evaluations of the checklists' completeness.

Data processing, analysis, and presentation

After checking for completeness and consistency, the collected data were coded and entered into the Epi-data statistical software package version 4.4.2.1. The data were then exported to STATA version 14 for cleaning and analysis. Descriptive statistics performed and were presented in the tables. Bivariate and multivariate analyses were conducted using logistic regression to determine the association between factors and dependent variables. Based on the bivariate analysis, those variables with a p-value < 0.25 in the binary logistic regression were transferred to the multivariate analysis, and those variables with a P-value < 0.05 at 95% confidence level were considered independent factors for the mortality of preterm LBW neonates. The final measure of the association between independent and dependent variables was expressed as the adjusted odds ratio (AOR).

Patient and public involvement

The study participants were not involved in the development of the research question or design, conduct, reporting, implementation or dissemination plans and evaluation.

Results

Out of 319 preterm LBW neonates medical chart reviewed, 28(8.8%) medical charts were excluded due to since 20 charts were not available at the time of data collection and 8 of them were incomplete medical charts. The remaining 291 preterm LBW neonates were included in the analysis making response rate of 91.2%.

Neonatal and maternal socio-demographic characteristics

Of the 291 total sampled neonates, the majority (n=185; 63.57%) were male. The mothers of 205 (70.45%) of the neonates belonged to the age category of 20-34 years. Most of the participants (60.1%) had Length of Stay more than nine days in NICU **(Table 1).**

Table 1: Socio-demographic characteristics of preterm low birth weight neonates and their mothers admitted to NICU in Amhara region referral hospitals, Ethiopia, 2019 *(n=291).*

Characteristics	Category	Total N (%) N=291	Alive N (%) N=181	Death N (%) N=110	**p-value**
Sex of the neonate	Female	106(36.43)	70 (66.04)	36(33.96)	0.307
	Male	185(63.57)	111(60)	74(40)	
Maternal age (years)	<20	46(15.81)	29(63.04)	17(36.96)	0.778
	20-34	205(70.45)	128(62.44)	77(37.56)	
	>=35	40(13.75)	24(62.2)	16(37.8)	
Neonatal age at admission	<24 hours	186(63.9)	116(62.4)	70(37.6)	
	1-7 day	99(34)	60(60.6)	39(39.4)	
	>7day	6(2.1)	5(83.3)	1(16.7)	
Mean Length of Stay in NICU (days)	<9.82	116(39.9)	95(81.9)	21(18.1)	0.00
	≥9.82	175(60.1)	86(49.1)	89(50.9)	

Maternal and obstetrics related characteristics

The majority (n=45; 15.46%) of preterm low birth weight neonates were born to mothers who had a diagnosis with pregnancy-induced hypertension **(Table 2).**

Table 2: Maternal medical and obstetrics characteristics of preterm low birth weight neonates and neonatal outcome admitted to NICU in Amhara region referral hospitals, Ethiopia, 2019 (n=291).

Characteristics		Category	Total N (%) N=291	Alive N(%) N=181	Death N (%) N=110	**p-value**
Maternal chronic Medical disease		No	281(96.56)	178 (63.35)	103(36.65)	
		Yes	10(3.44)	3(30)	7(70)	
Maternal chronic Medical disease	HIV	No	285(97.94)	**179**(62.81)	106(37.19)	
		Yes	6(2.06)	2(33.33)	4(66.67)	
	DM	No	289(99.31)	181(62.63)	108 (37.37)	
		Yes	2(0.69)	-	2(100)	
	Others	No	289(99.31)	180(62.28)	109(37.72)	
		Yes	2(0.69)	1(50)	1(50)	
Obstetric complications		No	228(78.35)	149(65.35)	79 (34.65)	0.036
		Yes	63(21.65)	32(50.79)	31(49.21)	
Obstetric complication	PIH	No	246(84.54)	158(64.23)	88(35.77)	0.095
		Yes	45(15.46)	23(51.11)	22(48.89)	
	placenta-abruption	No	279(95.88)	175 (62.72)	104(37.28)	0.37
		Yes	**12**(4.12)	6(50)	6(50)	
	placenta-Previa	No	285(97.94)	178(62.46)	107(37.54)	0.533
		Yes	12(2.06)	6(50)	6(50)	

Neonatal characteristics

The vast majority (n=273; 93.81%) of preterm LBW neonates were born in healthcare institutions. The majority (79.73%) of these were born via vaginal delivery. Two hundred nineteen (80.22%) preterm low birth weight neonates had a 1-minute Apgar score of <seven. A hundred fifty-two (55.68%) preterm low birth weight neonates a 5-minute APGAR score of greater than seven (**Table 3)**.

Table 3: Neonatal characteristics of preterm low birth weight neonates and neonatal outcome admitted to NICU in Amhara region referral hospitals, Ethiopia, 2019 *(n=291).*

characteristics	Category	Total N (%) N=291	Alive N (%) N=181	Death N (%) N=110	p-value
Place of delivery	Health institution	273(93.81)	171(62.64)	102(37.36)	0.55
	Home	18(6.19)	10(55.56)	8(44.44)	
Mode of delivery	Cesarean	59(20.27)	43(72.88)	16 (27.12)	0.6
	Vaginal	232(79.73)	138(59.48)	94(40.52)	
Type of pregnancy	Single	185(63.57)	118(63.78)	67(36.22)	
	Multiple	106(36.43)	63(59.43)	43(40.57)	
APGAR score 1st minute	<7	135(53.6)	90(66.67)	45(33.33)	0.144
	>=7	156(46.4)	91(58.33)	65(41.67)	
APGAR score 5th min.	<7	220(75.6)	149(67.73)	71(32.27)	0.001
	>=7	71(24.4)	32(45.07)	39(54.93)	

Morbidity and Mortality Pattern of preterm LBW neonates

Morbidity distribution

In this study 219 (75.26%), 201(69.07%), 145(49.83%), 39(13.4%), 24(8.25%), and 21(7.22%) 10(3.44%), 23(7.9%) and seven (2.41%) neonates were diagnosed with hypothermia, sepsis, RDS, jaundice, congenital anomaly, hypoglycemia, necrotizing enter colitis, meningitis, and perinatal asphyxia, respectively. Most participants who had a diagnosis with sepsis (44.28%), RDS (54.48%) hypothermia (40.18%) and hypoglycemia (57.14%) were died **(Table4).**

Table 4: overall morbidity characteristics of preterm low birth weight neonates admitted to NICU in Amhara region referral hospitals, Ethiopia, 2019 (n=291).

Morbidity characteristics	Category	Total N (%) N=291	Alive N (%) N=181	Death N(%) N=110	**p-value**
Sepsis	No	90(30.93)	69(76.67)	21(23.33)	0.001

	Yes	201(69.07)	112(55.72)	89(44.28)	
RDS	No	146(50.17)	115(78.77)	31(21.23)	0.000
	Yes	145(49.83)	66 (45.52)	79(54.48)	
Jaundice	No	251(86.6)	159(63.10)	93(36.90)	0.424
	Yes	39(13.4)	22(56.41)	17(43.59)	
Congenital anomaly	No	267(91.75)	170(63.67)	97(36.33)	0.09
	Yes	24(8.25)	11(45.83)	13(54.17)	
Hypoglycemia	No	270(92.78)	172(63.7)	98(36.30)	0.064
	Yes	21(7.22)	9(42.86)	12(57.14)	
Hypothermia	No	72(24.74)	50(69.44)	22(30.56)	0.145
	Yes	219(75.26)	131(59.82)	88(40.18)	
Perinatal asphyxia	No	284(97.59)	181(63.73)	103(36.27)	
	Yes	7(2.41)	-	7(100)	
Meningitis	No	268(92.1)	167(62.31)	101(37.69)	0.891
	Yes	23(7.90)	14(60.87)	9(39.13)	
Others*	No	281(96.56)	179 (63.7)	102(36.3)	
	Yes	10(3.44)	2(20)	8(80)	
Others*=including neonatal enterocolitis ,meconium aspiration syndrome, anemia and pulmonary hemorrhage					

Morbidity distribution with maternal and neonatal characteristics

In this study , sepsis was **observed** in 75.7%, 76.1%, 60.0%, 71.7%,71.2% and 74.6% of the male neonates, neonates born from mothers aged <20 years, neonates born from mothers with chronic medical disease, neonates born from mothers with obstetric complications, neonates born with APGAR score of 1st min <7 and APGAR score of 5th min <7 in NICU respectively . Respiratory distress syndrome was found on approximately 74.2% of the ELBW neonates in NICU. Similarly, Respiratory distress syndrome observed approximately in 50.3%, 55.0% and 80.0% of the male neonates, neonates born from mothers aged ≥35 years and neonates born from mothers with chronic medical disease respectively among preterm LBW neonates **(Table 5).**

Table 5:Morbidity distribution of preterm low birth weight neonates admitted in NICU of Amhara region referral hospitals, Ethiopia, 2019 (n=291)

		Morbidities					
Characteristics	Category	Sepsis	RDS	Jaundice	Hypoglycemia	Hypothermia	Meningitis

Sex of neonate	Female	57.5%	49.1%	14.2%	5.7%	78.3%	6.6%
	Male	75.7%	50.3%	13.0%	8.1%	73.5%	8.6%
Maternal age (year)	<20	76.1%	54.3%	6.5%	4.3%	76.1%	15.2%
	20-34	67.3%	47.8%	15.1%	8.3%	73.7%	5.4%
	>=35	70.0%	55.0%	12.5%	5.0%	82.5%	12.5%
Maternal chronic Disease	No	69.4%	48.8%	13.9%	7.1%	75.1%	8.2%
	Yes	60.0%	80.0%	_	10.0%	80.0%	_
mode of delivery	C/s	62.7%	45.8%	13.6%	3.4%	72.9%	10.2%
	vaginal	70.7%	50.9%	13.4%	8.2%	75.9%	7.3%
Obstetric complications	No	66.7%	46.9%	14.0%	7.5%	74.6%	8.3%
	Yes	77.8%	60.3%	11.1%	6.3%	77.8%	6.3%
PIH	No	67.9%	48.4%	14.2%	6.9%	73.6%	8.9%
	Yes	75.6%	57.8%	8.9%	8.9%	84.4%	2.2%
Place of delivery	Health institution	68.5%	50.5%	14.3%	7.3%	75.1%	8.1%
	Home	77.8%	38.9%	_	5.6%	77.8%	5.6%
Type of pregnancy	Single	67.6%	47.0%	11.9%	6.5%	71.9%	11.4%
	Multiple	71.7%	54.7%	16.0%	8.5%	81.1%	1.9%
APGAR 1st min.	<7	71.2%	57.7%	12.8%	7.1%	75.0%	5.8%
	>=7	66.7%	40.7%	14.1%	7.4%	75.6%	10.4%
APGAR 5th min.	<7	74.6%	60.6%	14.1%	8.5%	73.2%	5.6%
	>=7	67.3%	46.4%	13.2%	6.8%	75.9%	8.6%
weight category(gram)	<1000	67.7%	74.2%	12.9%	9.7%	80.6%	0.0%
	1000-1499	68.1%	57.4%	12.8%	9.6%	75.5%	8.5%
	1500-2499	69.9%	41.0%	13.9%	5.4%	74.1%	9.0%

Factors associated with mortality of preterm low birth weight neonates

Preterm LBW neonates with sepsis had two times higher odds of mortality compared to those without sepsis (AOR: 2.0 ;(95% CI: 1.03-3.89)). Preterm LBW neonates diagnosed with RDS had 4.6 times higher odds of mortality than those without RDS (AOR: 4.6; (95% CI: 2.51-8.40)). Preterm LBW neonates with a diagnosis of hypoglycemia had 3.91 times higher odds of mortality than their counterparts (AOR 3.91; (95%CI: 1.09-10.52)).

Preterm LBW neonates with fifth minute APGAR score of greater than seven had 61% times less likely to die than their counterparts(AOR 0.39; (95%CI: (.18-.82)). Preterm LBW neonates with

duration of hospital stay above mean duration (≥9.82 days) had 83% lower odds of mortality than their counterparts (AOR 0.17; (95%CI: 0.09-0.33)) **(Table 6).**

Table 6: Multivariate logistic regression analysis of factors associated with mortality of preterm low birth weight neonates admitted to NICU in Amhara region referral hospitals, Ethiopia, 2019 *(n=291).*

Characteristics	Category	Alive	Death	COR(95%Cl)	AOR(95% CI)	P>|z|
Sepsis	No	69	21	1	1	
	Yes	112	89	2.61(1.49-4.58)	2.0(1.03-3.89)	0.040*
RDS	No	115	31	1	1	
	Yes	66	79	4.44(2.66-7.42)	4.6(2.51-8.40)	0.000*
Congenital anomaly	No	170	97	1	1	
	Yes	11	13	2.07(.89-4.81)	2.41(.87-6.67)	0.090
Hypoglycemia	No	172	98	1	1	
	Yes	9	12	2.34(.95-5.75)	3.91(1.09-10.52)	0.035*
Hypothermia	No	50	22	1	1	
	Yes	131	88	1.53(.86-2.7)	1.58(.79-3.14)	0.192
Maternal History of PIH	No	158	88	1	1	
	Yes	23	22	1.72(.91-3.26)	1.76(.81-3.83)	0.155
APGAR 1st minute	<7	45	90	0.7(.43- 1.13)	1.12(.57-2.20)	0.737
	>=7	65	91			
APGAR 5th minute	<7	65	56	0.39(.25-.68)	0.39(.18-.82)	0.013*
	>=7	106	46	1	1	
Duration of hospital stay(days)	<9.82	95	21	0.214(.12-.37)	0.17(.09-.33)	0.000*
	≥9.82	86	89	1	1	

NB: *=significant at p-value<0.05 in multivariable analysis, 1=considered as reference category
PIH= pregnancy induced hypertension
9.8179=Mean duration of hospital stay from admission to discharge(alive) or to death (days)

Discussion

Background

This retrospective follow- up study conducted to determine the morbidity and mortality patterns in preterm LBW neonates, and identify factors associated with mortality.

General finding

In this study, the overall rate of preterm LBW neonatal mortality was 37.8 %(95%CI: 32.4-43.5). The present study also revealed that neonatal hypothermia (75.26%), sepsis (69.07%), RDS (49.83%), jaundice (13.4%), and the presence of congenital anomalies (8.25%) were the most common morbidities and the reasons for admission to NICU. Moreover, Sepsis, respiratory distress, hypoglycemia, APGAR score at fifth minute <7 and duration of hospital stay below the mean were independently associated with mortality.

Comparison with similar studies

In the current study, approximately 37.8 %(95%CI: 32.4-43.5) preterm LBW neonates were died. This result was higher than that found by studies conducted in India at 6.5%(18)and Iran at 28.7%(21). A key difference between the present study and the previous study conducted in Iran was that the previous study excluded neonates with severe fetal malformations whereas the present study did not exclude those neonates, which may have increased the mortality risk of neonates in the sample. This discrepancy with the study conducted in India may be because this study focused only on short-term outcomes, whereas the present study covered a longer neonatal period.

The present finding of the overall mortality rate is lower than that of studies conducted in Isfahan city, Iran 64.4 %(22)and Telangana, India88.8%(23). This difference may be related to differences in the inclusion criteria between the studies, where the study in Iran included neonates with birth weights of less than 1500 g and those with a gestational age of less than 30 weeks. The risk of mortality is considerably higher in neonates with lower birthweights and gestational age.

The current study also revealed that neonatal hypothermia (75.26%), sepsis (69.07%), RDS, (49.83%), jaundice, (13.4%), and congenital anomalies (8.25%) were the most common morbidities and reasons for admission to the NICU. This result is supported by studies conducted in Sharda hospital, India (16), Western Nepal(24), Telangana, India(18), Isfahan city, Iran(22), teaching hospital, Telangana, India (23), New South Wales, and the Australian Capital Territory(25).

In the present study, preterm LBW neonates with sepsis had two times higher odds of mortality compared to neonates without sepsis (AOR: 2.0(95% CI: 95% CI: 1.03-3.89). This result is in agreement with those of a study conducted in Telangana, India (18), New South Wales and Australian Capital Territory (25), and Mahatma Gandhi Memorial Government Hospital, India (26). A possible reason for this is that preterm LBW neonates typically have immature host defense mechanisms making them susceptible to devastating infections that can often lead to neonatal death.

In addition, preterm LBW neonates diagnosed with RDS had 4.6 times higher odds of mortality than preterm low birth weight neonates without RDS (AOR: 4.6 (95% CI: 2.51-8.40). This result is supported by studies conducted at Aga Khan University Hospital, Karachi, Pakistan(6),

Telangana, India(18), New South Wales and Australian Capital Territory (25), and Mahatma Gandhi Memorial Government Hospital, India(26). A possible reason for this is that neonates with RDS often have the complication of lung collapse, which may facilitate death more readily in preterm LBW neonates.

Preterm LBW neonates with a diagnosis of hypoglycemia had 3.91 higher of odds of mortality than who had no diagnosis of hypoglycemia (AOR 3.91; (95%CI: 1.09-10.52)). This finding supports those studies conducted in Telangana, India (18) and Mahatma Gandhi Memorial Government Hospital (26). This may be related to preterm neonates having immature organs, often leading to failure in glycogen storage and ultimately causing death.

In addition, this study found that preterm LBW neonates with a fifth minute APGAR score of greater than seven had 61% lower likely to die than their counterparts(AOR 0.39; (95%CI: (.18-.82)). This result is supported by the study conducted in China (27).A possible reason for this study may be that an APGAR score of less than seven indicates neonates in an asphyxiated state which implies indirect death of the neonate.

Preterm LBW neonates with a length of hospital stay above the mean duration (≥9.82 days) had 83% lower odds of mortality than their counterparts (AOR 0.17; (95%CI: 0.09-0.33)). This may be the reason why the short length of hospital stay indicates the lower neonatal age, is predisposed to the risk of being unable to adapt to the environment and can develop different complications that can lead to mortality.

This study was conducted at two referral hospitals in the region, thus increasing the generalizability of the findings to the entire population. This study had some limitations. As this

was a retrospective study, it did not address some of the participant-related associations of mortality in preterm LBW neonates.

Policy implication and future research

Currently, some trials running aim to implement novel techniques for the prevention of preterm LBW births and to reduce neonatal morbidity and mortality related to preterm LBW in Ethiopia. In 2012, the World health assembly put a plan for the year 2025 third target of 30% reduction,3% relative reduction per year in low birth weight between 2012 and 2025 by applying multiple interventions at the country and community level, pre pregnancy interventions and antenatal care interventions for all women(28). However, the current study's findings indicated that preterm LBW related morbidity and mortality were high owing to different associated factors. This highlights that neonates born prematurely and with low birth weight are at a higher risk of developing comorbidities and related mortalities. Thus, the government of Ethiopia needs to strengthen existing trials and strategies to decrease the proportion of different morbidities and preterm and LBW related mortality in neonates by preventing predictive factors. In addition to governmental organizations, other non-governmental organizations should focus on morbidity and mortality reduction intervention programs to control the prevalence of different morbidities and mortalities in preterm LBW neonates. Additional attention should be given to preterm LBW neonates with sepsis, respiratory distress, hypoglycemia, Apgar score at fifth minute <7 and duration of hospital stay below the mean. Preterm LBW neonates diagnosed with sepsis have a significant impact on their mortality. Similar findings in a previous study confirmed that sepsis can affect the survival status of neonates(18), (25). Immature host defense mechanisms make preterm neonates susceptible to devastating infections that can lead to death. In this study,

Preterm neonates diagnosed with RDS also had higher mortality. Other similar findings indicated that if neonate is with RDS diagnosis had high risk of mortality (6), (18), (25). RDS creates respiratory insufficiency in neonates that may leads to death. Preterm LBW a neonate with hypoglycemia morbidity is also had high risk of mortality. Other similar findings showed that neonates with diagnosis of hypoglycemia had high mortality (18), (26). Since preterm neonates having immature organs, often leading to failures in glycogen storage and ultimately causing death. Health education and motivation should be given for those mothers who had preterm low birth weight neonates with sepsis , respiratory distress , hypoglycemia, APGAR score at fifth minute <7 and duration of hospital stay below mean. Different concerned bodies at different health institutions including clinicians should be encouraged to minimize the risk of different morbidities and mortalities.

Abbreviations

DM: Diabetes Mellitus, FHRH: Felege Hiwot Referral Hospital, GA: Gestational Age, HIV: Human Immune Virus, LBW: Low Birth Weight, NEC: Necrotizing Enter colitis, NICU: Neonatal Intensive Care Unit, PIH: Pregnancy Induced Hypertension, PTLBW: Preterm Low Birth Weight, RDS: Respiratory Distress

Ethics approval and consent to participate

To conduct this study, an ethical clearance letter was obtained from the institutional review board of Mekelle University, college of health sciences with reference number 1270/2019. Permission letters were written for FHRH and Dessie referral hospital. Data were collected after

consent of cooperation was obtained from administrators at Felege Hiwot referral hospital and Dessie referral hospital.

Patient consent for publication: Not required

Availability of data and materials: The raw data file could be provided for research purposes only, upon request via e-mail of the corresponding author.

Competing interests: The authors declare that they have no competing interests.

Funding: There is no received specific grant from any funding agency

Authors' contributions

All authors contributed equally to this work. YD, BF, MS $ DT participated in all phases of the study including topic selection, design, data collection, data analysis, and interpretation. All authors also contribute to writing this manuscript. All authors read and approved the final manuscript.

Acknowledgement

It is our pleasure to thank Felege Hiwot referral hospital and Dessie referral hospital staffs of pediatric, neonatology care team, and the card extractors. It is also our pleasure to thank the data collectors and supervisors.

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Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

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In your methods section, say that you used the STROBE cross sectionalreporting guidelines, and cite them as:

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		Reporting Item	Page Number
Title and abstract			
Title	#1a	Indicate the study's design with a commonly used term in the title or the abstract	1
Abstract	#1b	Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background / rationale	#2	Explain the scientific background and rationale for the investigation being reported	4 -5
Objectives	#3	State specific objectives, including any prespecified hypotheses	5
Methods			

Study design	#4	Present key elements of study design early in the paper	6
Setting	#5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of selection of participants	6$7
	#7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable NA	
Data sources / measurement	#8	For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable NA.	
Bias	#9	Describe any efforts to address potential sources of bias	7
Study size	#10	Explain how the study size was arrived at	7
Quantitative variables	#11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why NA.	
Statistical methods	#12a	Describe all statistical methods, including those used to control for confounding	9&10
Statistical methods	#12b	Describe any methods used to examine subgroups and interactions NA	9&10
Statistical methods	#12c	Explain how missing data were addressed	9&10
Statistical methods	#12d	If applicable, describe analytical methods taking account of sampling strategy NA	
Statistical methods	#12e	Describe any sensitivity analyses NA	
Results			
Participants	#13a	Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for for exposed and unexposed groups if	

		applicable. NA	
Participants	#13b	Give reasons for non-participation at each stage NA	
Participants	#13c	Consider use of a flow diagram NA	
Descriptive data	#14a	Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders. Give information separately for exposed and unexposed groups if applicable.	10-12
Descriptive data	#14b	Indicate number of participants with missing data for each variable of interest NA	
Outcome data	#15	Report numbers of outcome events or summary measures. Give information separately for exposed and unexposed groups if applicable. NA	
Main results	#16a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	15$16
Main results	#16b	Report category boundaries when continuous variables were categorized	16
Main results	#16c	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period NA	
Other analyses	#17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses NA	
Discussion			
Key results	#18	Summarise key results with reference to study objectives	16-19
Limitations	#19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	19
Interpretation	#20	Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	19$20

Generalisability	#21	Discuss the generalisability (external validity) of the study results	20

Other Information

Funding	#22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	16 NA