RESEARCH ARTICLE

Early Neonatal Death and Associated Factors Among Babies Born in North Shoa, Ethiopia

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Abstract

Background: Early neonatal death is the death of newborns from birth to seven completed days after birth or birth weight of at least one kilogram. Early neonatal death is one of the health indicators for prenatal, intrapartum, and newborn care. It is one of the major challenges for under-five mortality. There are limited numbers of studies conducted related to early neonatal deaths in our country. Most of the researchers have used secondary data and are institution based. Therefore, this study may provide information about early neonatal death in rural communities of Ethiopia.

Objective: To assess the magnitude of early neonatal death and associated factors among babies born in North Shoa, Oromia from January to march 2020.

Methods: A community-based cross-sectional study was conducted in the rural area of the North Shoa Zone from January 1 to March 30, 2020. Epi-data 4.2 and SPSS Version 23 were used for data entry and analysis. The variable associated with the outcome variable in Bivariable analysis p value <0.25 was considered for further multivariable analysis to control for potential confounders. Crude and Adjusted Odd Ratios were calculated to assess the association between dependent and independent variables with 95% CI. The variable, which shows $p \leq 0.05$, was considered statistically significant.

Result: The magnitude of Early neonatal death was 9(9.4%) (95%, CI: 7%-11%). Maternal age less than 18 years, mothers unable to read and write, gestational age less than 37 weeks, unable to cry immediately after delivery, and the short inter-pregnancy interval was significantly associated with early neonatal death.

Conclusion: Generally, this study has high early neonatal death, which needs more attention. Maternal age less than 18 years, mothers unable to read and write, gestational age less than 37 weeks, unable to cry immediately after delivery, and the short inter-pregnancy interval was significantly associated with early neonatal death.

Keywords: Ethiopia, Neonatal death, Newborn, Oromia, Still birth

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Background

Early neonatal death is defined as the death of a newborn between zero and seven days after birth [1]. The early neonatal period is the most vulnerable period in an individual's and the death rate during this period is higher than at any other period of life [2, 3]. It is significantly caused by factors such as the mode of delivery, low Apgar score, gestational age of less than 37 weeks, birth asphyxia, traumatic delivery, and inadequate care during pregnancy, labor, and delivery. Early neonatal death is a health indicator for prenatal, intrapartum, and newborn care. It is affected by several factors and important determinants that need to be assessed before reaching conclusions about quality-of-care issues [10-12].

Numerous maternal and fetal variables, as well as institutional factors, have an impact on newborn mortality. Congenital malformations, male fetus, multiple parties, premature cesarean birth, hypoxia, and pregnancy-related hypertension are among more variables that might lead to a nearly fatal newborn outcome [4, 5].

Globally, every year an estimated 4 million babies die in the first four weeks of life (the neonatal period), with the highest risk of death being on the first day of life [6]. Early neonatal death represents 73% of all postnatal deaths worldwide. Despite a 50% reduction in childhood mortality, the reduction of ENND has significantly lagged behind other Millennium Developmental Goal achievements and is a growing contributor to overall mortality in children aged <5 years [1, 7].

Globally, in 2015, among 5.9 million child deaths, nearly 2 million deaths occurred in the first week of life (early neonatal period) [8] the highest rates are generally in sub-Saharan Africa [6, 9], where almost all (99%) neonatal deaths arise in low-income and middle-income countries [6]. The reduction rate of neonatal deaths between 1990 and 2015 in low and middle-income countries is 5.3% (from 5.1 million to 2.7 million), which is slower than that of post-neonatal and under-five mortality in which 47 % and 58 %

child death worldwide, respectively [10].

In 2015, maternal complications in labour carried a high risk of neonatal death, and poverty is strongly associated with an increased risk [11] and it is significantly higher among low birth weight and preterm births. Nearly 1/3rd of death occurred on the 1st day or within 24 hours of life [12-14].

Ethiopia, like other sub-Saharan countries, has a high perinatal mortality, particularly early neonatal death. A significant change has been made to reduce child mortality, but the rate of decline in neonatal mortality is slower (49 to 29 death per1000 live births) due to high neonatal mortality [15]. In 2015 neonatal mortality rate was 28 per 1000 live births (87,410), and early neonatal death contributes more than 3/4th of total neonatal death [16]. The change in neonatal death is still stagnant and needs attention in rural and urban communities.

Despite the existing research regarding perinatal death neonatal deaths, there is limited understanding of the factors associated with early neonatal death in north Shoa, Oromia region. Little attention has been given to examining specific factors that impact early neonatal death.

Early neonatal death contributes to more than 3/4th of total neonatal death [14]. The change in neonatal death is still stagnant and needs attention in rural and urban communities.

This study may provide information about early neonatal death in rural communities of Ethiopia, which contributes to sustainable development program engagement, action, and partnership by all countries to reduce neonatal mortality by 12 or fewer by 2030 using primary data than secondary data about the problem.

Methods and Materials

The Study Area. Period and Design

A community-based cross-sectional study was conducted in North Shoa Zone from January

one to March 30, 2020, which is bordered on the South by Oromia special zone surrounding Addis Ababa, on the southwest by West Shewa on the north Amhara region and southeast by East Shewa.

The total population in the Zone is 1431305, 717552 male and female, respectively [17, 18]. The Zone has 14 woredas, which have three hospitals that currently give service (one general and two primaries) and 52 health centers.
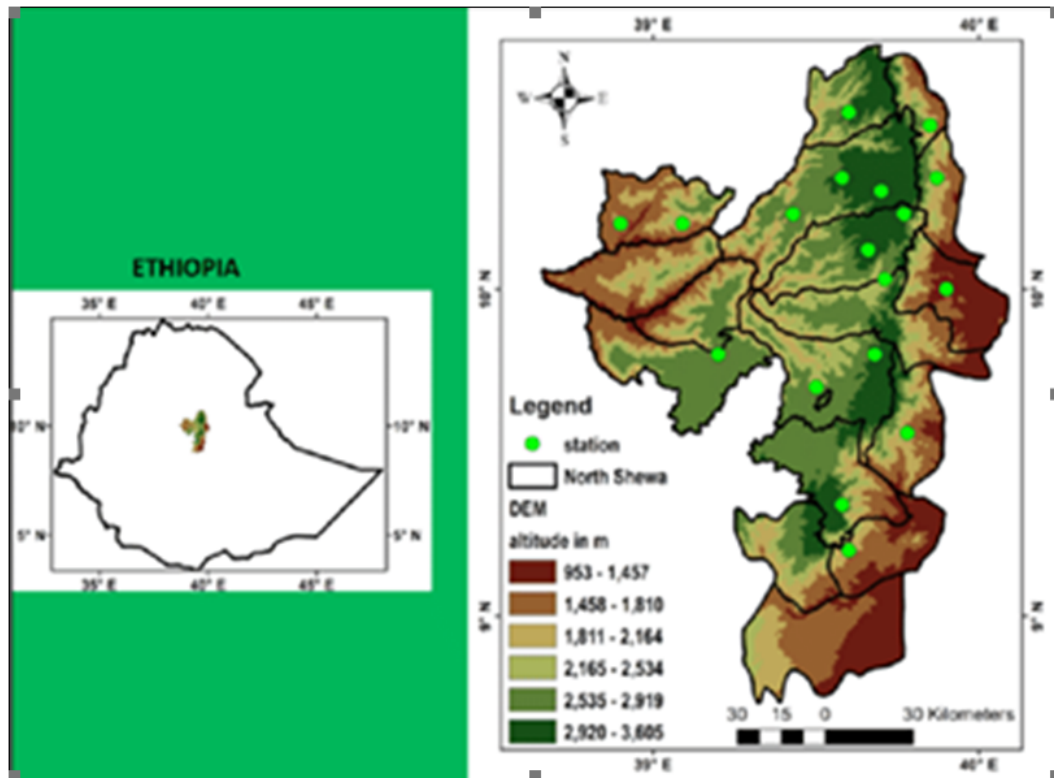
Figure 1 Map of the study area

According to 2017 zonal health statistics data, around 18350 women give birth annually in hospitals, health centers, and health posts [18]. The zone is found under the Oromia regional state and divided into 18 districts. Among these, five districts' mothers residing in the Kebeles were included in this study.

Population

Source population

All mothers who gave live birth within North Shoa, Oromia, Ethiopia, were the source population of this study.

Study population

All mothers who gave live birth within the last month before the data collection period were the population of this study.

Inclusion and exclusion criteria

Babies who were born after 28 weeks of gestation and those who had more than one- thousand-gram weight up to the first 7 days after birth were included in this study.

Sample size determination

The sample size was calculated using the single population proportion formula (n=(Z/2)2p (1p)/d2) with 0.05 margins of error at the 95 % confidence level (CI), Since the proportion closer to 50% will give the largest sample size, was used in the sample size calculation. The sample size was then multiplied by 1.5 to account for the design effect, and the possible non-response rate during the study sample size was increased by 10% to n=634.

Sampling procedure

North shoa, Oromia, Ethiopia				
Dagam	Kuyyu	Warra jarso	Wuchale	Debra libanos
N1=441	N2=508	N3=552	N4=353	N5=397

Proportional   allocation n1=n*N1/Nt

| d1 | d2 | d3 | d4 | d5 | d6 | k1 | k2 | k3 | k4 | k5 | k6 | k7 | J1 | J2 | J3 | J4 | J5 | J6 | J7 | J8 | W1 | W2 | W3 | W4 | W5 | d1 | d2 | d3 | d3 | d4 | d6 |

Simple random sampling

Total n=634
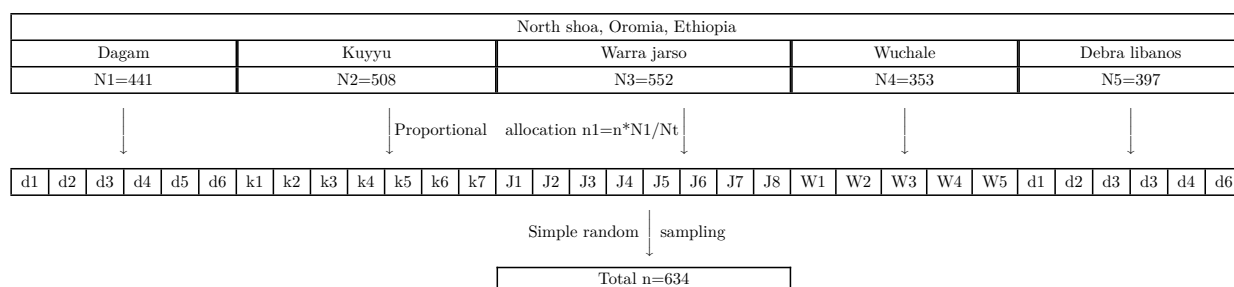
Multi-stage sampling technique was used. Initially, out of 14(fourteen) districts of the Zone, five districts were selected by using simple random sampling techniques (lottery method) OR rule of thumb (30%). From a total of 101 kebeles (the smallest administration unit) at the selected districts; 6 out of 20, 7 out of 22, 8 out of 25, 5 out of 16, and 6 out of 18 kebeles were selected by using lottery methods from dagam, kuyyu, warra jarso, wuchale and deebirelibanos districts respectively. Then the census was conducted to identify the number of women who gave birth in the last month in the selected kebeles. Based on the census, a total of 2251 women were identified. Of those, 441 were in the Dagam district, 508 were in kuyyu district, 552 were in Warra jarso district 353 were in Wuchale district and 397 were in the Debirelibanos district. A simple random sampling technique was used to get a total of 634 women.

Households were sampling units of this study, and the final sample size was allocated proportionally for each kebele based on the number of mothers. Therefore, 124 mothers from the Dagam district, 143 from the Kuyyu district, 156 from the Warra jarso district, 99 from Wuchale district, and 112 from Debirelibanos district were allocated to participate in the study. Then, the study households were selected from each kebele through a simple random sampling technique by using a computer-generated random numbers starting from kebele one after developing the sampling frame that has a list of individual's house number, which was given during the census. One mother per household was interviewed. When two or more eligible mothers who gave live birth in the last month were found in one household, only one was interviewed by using the lottery method.

Data collection method

An adapted data collection tool was used for data collection for different literature reviews and adjusted for this study in English [19-22] and translated to local language, Afan Oromo by an expert who has a BA in Afan Oromo language, then back-translated to English by an independent translator for its consistency. Pre-test was done on 10% of the total participants (63 mothers) in Canco districts near the study area. During the pretest, the questionnaire was assessed for its clarity, readability, comprehensiveness, accuracy, and optimal time for completing the interview. Modifications and corrections were performed based on the results of the pretest.

The data was collected by using a face-to-to-face interview with a pretested structured questionnaire at women, homes, outdoor living areas, and open and closed quiet places without someone other than the mother, and it lasted 30 to 40 min. Mothers who lost their newborns were interviewed at least ten days after the death of the newborn to ensure their recovery from their bereavement.

Data was collected by using 10 data collectors and 5 supervisors who had a diploma and above in the midwifery profession. Three days training was given to data collectors and supervisors on the objective of the study, method of data collection, and data submission. The principal investigator and supervisors checked the consistency and completeness of the data daily. The internal consistency/reliability of the item was checked by computing Cronbach's alpha. The

value of Cronbach's alpha was within the range of the normal value.

Operational definitions

Early neonatal death is a death of a newborn within the first seven days of life [15].
Babies with Severe malformation refers to babies with incompatibility to survive after birth [23].
Prematurity is defined as a birth that occurs before 37 completed weeks of gestation [24].
Bad obstetric history refers to stillbirth, miscarriage, previous fatal outcomes of more abortions, Intrauterine growth restriction, and fetal death [25].

Data processing and analysis

All filled questionnaires were checked for completeness and consistency, coded, and data entry was used Epi-data version 4.2. Data were exported to SPSS version 23 for further analysis. Descriptive statistics like the mean, median, frequency, and percentage were used. Bivariate logistic regression analysis was used to identify candidate variables for multivariable logistic regression. Variables with a P-value less than 0.25 were candidates for multivariable logistic regression. Multivariable analysis was used to determine the factors that are independently associated with obstetric violence. The odds ratio at 95 CI was computed to measure the strength of the association between the outcome and explanatory variables. Variables that had a P value less than 0.05 were considered statistically significant. Finally, the results were presented in texts, tables, and graphs. Multicollinearity checked the linear correlation among the predictors using VIF, tolerance, and standard error. Hosmer- Lemeshow test was found to be non-significant, and the omnibus test was significant, which indicated the model was fitted adequately.

Results

Socio-demographic characteristics of mothers

A total of 631 mothers who gave birth in rural areas of North Shoa Zone participated in this study, with a response rate of 99.5%.

Table 1 Socio demographic characteristics of mothers gave birth in North Shoa, Oromia

Variables	Characteristics	Frequency	Percent (%)
Maternal age	≤18	39	6.2
	19-34	492	78
	≥35	100	15.8
Marital status	Married	580	91.9
	Single	17	2.7
	Widowed	6	0.9
	Divorced	20	3.2
	Other	8	1.3
Occupational status	Housewife	404	64.02
	Private employee	70	11.1
	Government employee	76	12
	Laborer/merchant/student	81	12.8
Religion	Orthodox	541	85.7
	Protestant	29	4.6
	Muslim	61	9.7
Ethnicity	Oromo	541	85.7
	Amhara	82	12.99
	Other	8	1.3
Educational status	Unable to read and write	231	36.6
	Primary	280	44.4
	Secondary and above	120	19.0

The mean (±SD) age of the mothers was 26.68 (±5.96) years. The majority (78%) of mothers' age group were between 19-34 years old, with the remaining moms being under the age of 18 and greater than 35years old. About 580(91.9%) of them were married and the rest were single, widowed, divorced/other. Of the total participants 541(85.7%) were Orthodox, 61(9.7%) were Muslim and 29(4.6%) were protestant. Among the respondents, 286(45.3%) and 345 (54.7%) lived in urban and rural areas respectively (Table 1).

Obstetric and maternal health service characteristics during the last pregnancy

Among the total of 631 mothers included in the study, 273(43.3%) were primiparous followed by 252(39.9%) were multipara, while the rest, 106(16.8%) were grand multipara. From those who were multiparous and grand multiparous women, 86(24.0%) of mothers had a birth interval of less than two years, and 272(76.0%) had greater than or equal to two years based on their last delivery.

Table 2 Obstetrics factors of mothers who gave birth in North Shoa, Oromia

Variables	Characteristics	Frequency	Percent (%)
Parity	Primi-para	273	43.2
	Multipar	358	56.7
ANC Follow up	Yes	440	69.7
	No	191	30.3
Obstetric complication	Yes	207	32.8
	No	424	67.2
Number of ANC visit	1 time	217	49.3
	2 & 3 time	162	36.8
	4 time	61	13.9
Time of ANC initiation	<16 week	136	21.5
	≥ 16 weeks	495	78.5
Immediate PNC check- up	Yes	112	17.7
	No	519	82.3
Place of delivery	Hospital	127	20.1
	Health center	167	26.5
	Health post	58	9.2
	Home	279	44.2
Delivery assisted by	TBA	164	26
	Families	115	18.2
	HEW	58	9.2
	HCP	294	46.6
Having bad obstetrical history	Yes	151	23.9
	No	480	76.1
Length of nearest health facility	<30 minute	334	52.9
	≥30 minute	297	47.1
Birth Interval (among multi and grand paras)	<2 years	86	24.0
	>2 years	272	76.0

The majority, 440(69.7%) of the respondents, had at least one one-time antenatal care follow-up during their last pregnancy. Only 136(21.5%) mothers visited the antenatal care clinic before 16 weeks of gestation, as recommended. More than 334(52.9%) of the respondents reported that they spent more than 30 minutes to reach the nearest health institution.

Out of 631 participants, the majority, 574(91.0%), had no chronic illness; only 57(9%) had chronic illness. Of those who had a chronic illness, most, 23(40.4%) had chronic hypertension, followed by 19(33.3%) who were HIV posetive 10(17.5%) had diabetic mellitus, and the rest 5(8.8%) had anemia. Regarding the place of delivery, more than 279 (44.2%) of women gave birth at home, followed by 167 (26.5%) who gave birth at the health center and 12(20.1%) were at hospital, while the rest, 58 (9.2%) at the health post.

The dominant birth attendants as a report of the mothers were HCP which was 294(46.6%), followed by 164(26%), 115(18.2%), 58(9.2%) TBA, and families/relatives, and HEW respectively. Moreover, most 394(62.4%) of the mothers gave their recent birth through spontaneous vaginal delivery (SVD). Only 112(17.7%) women stated they received immediate PNC check-ups within seven days of delivery. Among 631 participants, 151(23.9%) women had at least one bad obstetrical history without considering the current pregnancy. Among those who had had bad obstetrical history, the majority, 61(40.4.9%) of the women, had at least one history of abortion, followed by 49(32.4%), had at least one history of stillbirth while the rest 41, (27.1%) had at least one history of neonatal loss without counting the outcome of recent pregnancy as seen in table 2.

Newborn characteristics

Of the total 631 newborns, the majority, 364(57.7 %), were male newborns, while the rest, 267(42.3%), were female newborns. The majority, 511(81.0%), were born after 37 and below 40 weeks of gestational age, followed by 120(19.0%), who were delivered before 37 weeks of gestational age. Among all babies, 13(2.1%)had congenital

anomalies, and 618(97.9%) were born without congenital anomalies. From the total 631 babies, 79(12.5%), were admitted to NICU. Among those who were admitted to NICU, 32(40.5%) were due to prematurity, followed by 21(26.6%) due to unable to feed, 19(24.1%) with neonatal infection and 7(8.8%) did not know the reason of her baby admitted to NICU.

The majority, 502(79.5%) of newborns cry immediately after delivery and the rest, 129(20.5%) did not cry immediately after delivery.

Magnitude of early neonatal death

Of the total 631 newborns, 59(9.4%) died in the early neonatal period (95%, CI: 7%-11%). From this neonatal death, the majority, 32(54.2%) neonatal deaths occurred within the first 24 hours of neonatal life in the study area as can be seen in figure 1.

Results of multivariate logistic regression analysis

In bivariate logistic regression, factors associated with early neonatal mortality were the maternal educational status of being unable to read and write, maternal age less than 18 years, no regular antenatal care follow-up, gestational age<37 weeks, having bad obstetric history, history of chronic illness, place of birth, short interpregnancy and status of the newborn immediately after birth.

Finally, after nine variables (with P-value less than 0.25 in bivariate logistic) were subjected to multivariate logistic regression, four variables were found to be significantly associated with early neonatal death. Maternal age less than 18 years, gestational age<37 weeks, immediate cry, and educational status were factors significantly associated with early neonatal death.

Factors associated with early neonatal death among babies born in North Shoa, Oromia, Ethiopia

In this finding, babies whose mothers are less than 18 years old were 1.67 times more likely to report early neonatal death (AOR 1.67(1.162-2.936)).

Table 3 Bivariate and multivariate analysis of factors associated with early neonatal death among babies born in North Shoa, Oromia

Variables	END status		COR (95% CI)	AOR (95% CI)	P value
	Dead	Alive			
Education status					
Unable to read and write	34	197	2.786(1.67-4.122) *	1.96(1.367-3.635)**	0.001
Primary	18	262	1.115(0.63-2.56)	0.654(0.251-1.706)	
Secondary & above	7	113	1	1	
Maternal age					
≤ 18	6	33	2.090(1.090-3.320) *	1.67(1.162-2.936)	0.00
19-34	50	442	1.301(0.790-3.320)		
≥ 35	8	92	1		
NICU admission					
Yes	8	71	1.106(0.542-2.793)		
No	51	501	1		
ANC					
Yes	33	407	1		
No	23	168	1.688(1.092-3.593)*		
Gestational age					
<37	23	97	3.129 (2.172-4.773)*	2.231(1.562-3.332)**	0.001
≥ 37	36	475	1	1	
Immediate PNC check-up					
Yes	9	103	1		
No	50	469	1.220(0.184-1.473)		
History of chronic disease					
Yes	8	49	1.674(1.016-2.921)*		
No	51	523	1		
Bad obstetric history					
Yes	20	131	1.726(1.283-3.277)*		
No	39	441	1		
Status of neonate immediately after birth					
Cry	37	465	1		
Not cry	22	107	2.583(1.715-4.122)*	1.686(1.0151-3.242)**	0.003
Birth attendant					
HCP	22	272	1		
HEWs	6	52	1.426(0.395-2.012)		
Other	31	248	1.545(0.695-2.25)		
Place of delivery					
Facility	25	327	1		
Home	34	245	1.815(1.1295-3.032)*		
Distance from nearest health facility					
<30 minute	27	307	1		
≥ 30 minute	32	265	1.373(0.295-2.455)		
Interpregnancy interval					
<2 years	46	313	2.927(1.951-4.53)*	1.786(1.251-3.644)**	0.00
>2 years	13	259	1	1	

CI=confidence interval, COR=crude odd ratio, AOR=Adjusted odd ratio. *=significantly associated in bivariate analysis, **=significantly associated in multivariate analysis

Mothers who were unable to read and write were 1.96 times more likely to have early neonatal loss as compared to those who were primary and above (AOR, 1.96(1.367-3.635)).

Babies born before the completion of 37 weeks gestation were 2.2 times more likely to die than babies born in greater or equal to 37 weeks (AOR, 2.231(1.562-3.332)). Babies who hadn't cried immediately after delivery were eight times more likely to die during the early neonatal period than those who immediately cried after delivery (1.686(AOR, 1.0151-3.242)).

Babies born having short interpregnancy intervals (less than two years' interval) were1.786 times more likely to die than long interpregnancy intervals 1.786 (1.251-3.644). See table 3.

Discussions

Magnitude of early neonatal death

In this study, early neonatal death is 9.4 % (95%, CI: 7%-11%), which indicates more than eight babies are expected to die out of 100 babies born before they celebrate their first week of birth. This result is significantly higher than in the study conducted in South Africa and East Iran based on a cross-sectional study that was 2.92% and 1.68% respectively [26-28]. This finding may be due to the setting of the study since it targeted rural communities, where inaccessible health facilities for early neonatal treatment; it may be due to poor transport access, which leads to home birth and traditional neonatal treatment. This finding is also higher than the study conducted in six developing countries (Argentina, Egypt, India, Peru, and South Africa), where about 9 early neonatal deaths per 1000 live births [29].

The discrepancy may be explained by the setting of the study in which the previous study was conducted only on institutions as it missed home birth, which could affect the survival of the neonatal period because of disadvantages (unsafe delivery) in home birth over birth in health facilities. In addition, the figure in the previous study is an average value of the number of deaths in six countries that might minimize the magnitude of early neonatal death.

Early neonatal death in this study is significantly lower than in a study conducted at Hawasa University Specialized and Referral Hospital and Wolayta Sodo Specialized University Hospital [19, 21, 30]. This study is also lower than other studies conducted in Ethiopia [31]. The difference may be attributed to the setting of the study. In the case of this study, the study was conducted in a community where much more early neonatal death may be expected as it addresses all neonates, including neonates born at home. Therefore, it is not surprising to be higher in this. The present study is supported by the study conducted in Cameroon, where more than 12% of early neonatal deaths occur [32].

Factor associated with Early Neonatal Death

Short interpregnancy interval in the present study is significantly associated with early neonatal death. It may be explained by the fact that as the interpregnancy interval becomes shorter, the probability of overlapping breastfeeding and pregnancy also increases, which affects pregnancy outcomes, including weight and early neonatal death [33, 34]. Evidence suggests that preterm birth, low birth weight, neurodevelopmental delay, and perinatal or neonatal mortality are all more likely to occur when the birth interval is short. The finding is in line with the findings from Sweden and Afghanistan [35, 36].

In the present study, the absence of an immediate cry after birth was associated with early neonatal death. This result may be associated with distal causes that lead to the inability of a neonate to cry, which is indicative of interruption of the entrance of air to the lung of a baby and then finally able to cause early neonatal death [37]. The finding is also similar to the study conducted in Cameroon [32].

In this study, younger maternal age is associated with early neonatal death. This is because most of the mothers in this age group are primiparous, and they may give birth to babies with

low birth weight, small for gestational age, which in turn increases early neonatal death. In addition, they may lack experience in handling and caring for their babies. Furthermore, they may lack awareness about the course of pregnancy, labor, adequate advice on birth preparedness and complication readiness during prenatal care [38]. This finding is similar to the study conducted in Afghanistan [36]. However, this study contradicts a study conducted in Nigeria [39]. The disagreement may be explained by the study setting and sample size variations.

In the present study, gestation during the birth of a newborn was associated with early neonatal death, whereas babies born with gestational age less than 37 weeks were significantly associated with early neonatal death. This is explained by preterm birth having premature organs that hinder the easy adaptation of extra uterine life, or it might be due to lack of regular antenatal care, the inadequacy of advice on danger signs, or the absence of long-term training in neonatal nursing since this study addressed birth at their home [40]. This result is similar to the study conducted at Hawasa University Specialized Hospital [30].

Conclusion and Recommendations

North Shoa, Oromia, has a high rate of early newborn death, which requires additional attention when compared with data in EDHS 2016. Significantly correlated characteristics included maternal age under 18 years, gestational age under 37 weeks, short inter-pregnancy interval, and newborn status right after delivery.

Ethics approval and consent to participate

Ethical approval and clearance were obtained from the Institutional Health Research Ethics Review Committee (IHRERC), College of Health and Medical Sciences of Haromaya University. Official letters were submitted to the North Shoa Oromia Health Bureau. Permission was also obtained from the concerned bodies. Written informed consent was obtained from their mothers/parents/legal guardians (legally authorized representatives).

Participants' involvement in the study was voluntary basis, and those who were unwilling to participate in the study & those who wished to quit their participation at any stage were informed to do so without any restriction. Confidentiality was maintained at all levels of the study by namelessly avoiding the names of the participants in the questionnaire. The collected data were kept under lock and key for security and used only for the study. All methods were carried out by the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

Consent for publication

Not applicable

Availability of data and materials

All data included in this manuscript can be accessed from the corresponding author upon request through the email address.

Computing interests

The authors declare that they have no competing interests.

Author contributions

(**AW**) conceptualized, designed the study, collected, analyzed, and interpreted the data, and drafting of the manuscript. (**TGA**), (**MBG**), (**MA**), and (**AA**) Designed the study, analyzed and interpreted the data and drafting of the manuscript, and advised the whole research paper.

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