

Research Article

Early Neonatal Death in Northern Ethiopia and its Predictors

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Abstract

Background: Globally 2.5 million children died in the first month of life in 2017. There are approximately 7 000 newborn deaths every day, amounting to 47% of all child deaths under the age of 5-years, up from 40% in 1990. In Ethiopia neonatal mortality was 29 deaths per 1,000 births in 2016 and in Tigray it was 34 deaths per 1000 lives. As a result this study will assess incidence and predictors of early neonatal death in the region which is not well studied yet.

Methods: facility based prospective cohort study design among 480 pregnant mothers was applied. Cox proportional hazard model were used to determine the independent predictors of Preterm birth. All analyzes were performed using SPSS version 20.

Result: The overall incidence of early neonatal death is 4.3%. But the incidence among mothers with short inter-pregnancy interval is 10.1%. This study shows that, predictors for early neonatal death are low birth weight (Adjusted Hazard Ratio (AHR): 9.867, 95% confidence interval (CI): 1.891-51.487), less than seven Apgar score (AHR: 7.13, 95% CI: 1.290-

39.432), any problem during her pregnancy (AHR: 7.699, 95% CI: 1.250-47.429) and no PNC follow up till third day (AHR: 7.076, 95%CI: 1.047-47.829).

Conclusion: The incidence of early neonatal death is higher when it is compared with most of the studies done in Africa. And the main predictors are birth weight, Apgar score, any problem in current pregnancy, PNC follow up till third day and Baby hospital stay. Therefore, health providers should focus on giving care for those neonates who born with low birth weight, low Apgar score, stay for long time in hospital and those neonates from mothers with any complication during their pregnancy. In addition health providers should counsel and encourage mothers to have full PNC follow up after delivery.

Keywords: Inter pregnancy interval; Neonatal death; Prospective cohort; Northern Ethiopia

Abbreviations: ANC: Antenatal care; AOR: Adjusted Odd Ratio; APGAR: Appearance Pulse Grimace Activity and Respiration; CI: Confidence Interval; IPI: Inter Pregnancy Interval; PNC: Postnatal Care

Background

In 2017, 2.5 million neonates died in the world. There are approximately 7000 neonatal deaths every day, which accounts to 47% of all child deaths under the age of 5-years, up from 40% in 1990. About the same number of babies were born stillbirth (in 2015). The world has made significant progress in child survival since 1990. Which is evidenced by the number of neonatal mortality which is decreases from 5.0 million in 1990 to 2.5 million in 2017. However, the decline in neonatal mortality from 1990 to 2017 has been slower than that of post-neonatal under-5 mortality: 51% compared with 62% globally [1].

Seventy five percent of all neonatal deaths occur within the first seven days of birth, and about 1 million newborns die within the first 24 hours. Preterm birth, intrapartum-related complications (birth asphyxia or lack of breathing at birth), infections and birth defects cause most neonatal deaths in 2016 [1].

Sub-Saharan Africa and south Asia are Regions with highest neonatal mortality, with each estimated at 27 deaths per 1,000 live births in 2017. A risk of neonatal death is nine times higher in sub-Saharan Africa or in South Asia than in those of high-income countries. A newborn in the highest mortality country is 50 times

more like to die within the first month of life than a newborn in the lowest mortality country [2].

In Ethiopia, neonatal mortality is decreased from 49 deaths per 1,000 live births in 2000 to 29 deaths per 1,000 births in 2016, a reduction of 41% over the past 16 years. and 1 out of 15 children dies within the first five days of birth and in Tigray there was 34 deaths per 1000 lives [3] and Compared with neonates in Addis Ababa, those in Amhara (adjusted HR: 1.88; 95% CI: 1.26 – 2.83), Benishangul Gumuz (adjusted HR: 1.75; 95% CI: 1.15 – 2.67) and Tigray (adjusted HR: 1.54; 95% CI: 1.01 – 2.34) regions carried a significantly higher risk of dying [4].

Maternal mortality is common among mothers who had short inter-pregnancy interval. children born less than 2 years after the preceding birth are more than twice more likely to die with the first five years of birth than children born 4 or more years after their preceding sibling (114 deaths per 1,000 live births compared with 55 deaths per 1,000 live births) [5]. Likewise, the probability of child death before the age of a year is higher among those born from mothers with short inter-pregnancy interval (the infant mortality rate is 92 deaths per 1,000 live births for a birth interval fewer than 2 years and 44 deaths per 1,000 live births for children born 4 or more years after the preceding birth) [3].

This study assessed the incidence of early neonatal death among the normal inter-pregnancy interval and short inter-pregnancy interval and other predictors of early neonatal death in the region which is not studied yet. As a result, this will be important for further study and baseline information for the relationship between the inter-pregnancy interval and early neonatal death.

Methods and Materials

Study setting, design and sample size

The study design was facility-based prospective cohort study design. It was conducted in Northwest health facilities of Tigray Region, Northern Ethiopia, located at a distance of 1087 km from Addis Ababa, the capital city of Ethiopia. The source populations were all laboring pregnant mothers who were attending delivery in Northwestern Zone health facilities.

Double proportion formula using Epi-info-Calc was used to calculate the sample size. statistical software with the following assumption: 95% CI, 90% power, ratio of unexposed to exposed was 2:1 and percentage of exposed among preterm birth of 8.5% (14), odds ratio of 2.7 (14), Loss to follow-up rate in this study was estimated to be 10%, and hence an overall sample size of 480 pregnant women were included in the study.

To see the sampling procedure, four Hospitals and 8 health centers were selected randomly from the selected zone of the region. Then the total sample size was distributed proportionally to the health facilities based on eligible pregnant mothers for ANC in the health institutions and then systematic sampling method was used to reach to the study participants. Data were collected using standardized, structured and face to face interviewer questionnaire, card reviewing and measurements. Finally Data were entered into Epi Data3.5.1 statistical software and analyzed using SPSS version 20.0 package.

Early neonatal death is the death of neonate who delivered at or more than 28 weeks' gestational age with the sign of life but unfortunately dies immediately or within the 7th days of postpartum day.

Birth to pregnancy interval was calculated by counting the period time from the start of the index pregnancy (as evidenced by last menstrual period) and the date of the preceding live birth.

Outcome measures

Censoring: right censoring are those cases with normal weight, preterm birth, low birth weight, stillbirth, a congenital anomaly.

Event: early neonatal death

Inter-pregnancy interval: Inter-pregnancy interval was documented as the time interval between delivery of the first pregnancy and the conception of the subsequent pregnancy

Exposed group: mothers with an inter-pregnancy interval from 0 to 24 months as a short interval

Unexposed group: mothers with inter-pregnancy from 24 to 36 months or longer

Results

Socio-demographic characteristics of participants

From Four hundred eighty pregnant women followed there were 20 (4.17%) lost in follow-up until delivery. From these the mean age of the followed mothers was 30 years with SD of ± 5.92 ; the range of their age was from 15 to 48 years and above half 260 (56.5%) were between 25 and 34 years. the marital status of almost all or 450(97.8%) of the respondents was married. Two out of five 164 (35.7%) of the study participants had no formal education. Regarding the mothers' occupation, four out of ten participants 205(44.6) were a housewife and above half 273 (59.3%) of the participants come from rural (Table1).

Past-obstetrics and current pregnancy characteristics

From 460 followed women Two third, 308 (67.0%) of them had an optimum interpregnancy interval and three fourth 346(75.2%) of them had ≤ 4 pregnancy and 312 (67.8%) of them were multiparous.

Related to the bad obstetrics history (experience of perinatal death), one-tenth of (n=418) women had to experience perinatal death in their preceding pregnancy. Around three out of four, or 332(72.2%) of the participants' current pregnancy was planned.

Regarding ANC visits, almost all 445(96.7%) of the pregnant women had at least one ANC visit. and Four hundred thirteen (89.8%) of the pregnant women had maternal obstetrical problems in the current pregnancy.

When the hemoglobin level of the women is seen, eight out of ten (n=375) of the study participants had hemoglobin levels above 11g/dl. Most of the followed women (n=374) gave birth through spontaneous vaginal delivery for their current baby (Table 2).

Incidence and predictors of early neonatal death

The overall incidence of early neonatal death is 4.3%. But the incidence among mothers with short inter-pregnancy interval is 10.1%.

Table 1: Socio-demographic characteristic of Pregnant mothers in Tigray, Northern Ethiopia, 2018 (N=460).

Variables	Categories	Frequency	Percentage
Maternal age in completed years	15-24	75	16.3
	25-34	260	56.5
	≥ 35	125	27.2
Marital Status	Married	450	97.8
	Unmarried	4	0.9
	Divorced/ widowed	6	1.3
Educational Level	None	164	35.7
	Primary	82	17.8
	Secondary	135	29.3
	College and above	79	17.2
Occupation	Housewife	205	44.6
	Farmer	125	27.2
	Employed	130	28.3
Residence	Rural	187	40.7
	Urban	273	59.3

Table 2: Past-obstetrics and Current Pregnancy characteristics of pregnant mothers in Tigray, Northern Ethiopia, 2018 (N=460).

Variables		Frequency	Percentage
Inter pregnancy interval	Optimum (24–36 months)	308	67.0
	Short(<24 months)	152	33.0
Gravidity	≤ 4 pregnancy	346	75.2
	≥ 5 pregnancy	114	24.8
Parity	Primipara	148	32.2
	Multipara	312	67.8
History of perinatal death	No	418	90.9
	Yes	42	9.1
Planned pregnancy	No	128	27.8
	Yes	332	72.2
ANC Follow up	No	15	3.3
	Yes	445	96.7
Number of ANC Visits	≥4 times	225	57.3
	1-3 times	190	42.7
Initiation of ANC Visit	Within 16 weeks	22	4.9
	24-28 weeks	244	54.8
	28-32 weeks	169	38.0
	34-36 weeks	10	2.2
*Current pregnancy maternal Problem	No	413	89.8
	Yes	47	10.2
Maternal Hemoglobin Level	≥11g/dl	375	81.5
	<11g/dl	85	18.5
Maternal Rh factor	Positive	449	97.6
	Negative	11	2.4
*Maternal& fetal Intra partum Complication	No	414	90.0
	Yes	46	10.0
Mode of Delivery	Cesarean Section	45	9.8
	Instrumental	18	3.9
	Induction/Augmentation	23	5.0
	Spontaneous Vaginal Delivery	374	81.3
Sex of Newborn	Male	281	61.1
	Female	179	38.9

*Current pregnancy maternal Problem - APH, preeclampsia, anemia, uterine rupture/scar dehiscence
*Maternal& fetal Intra partum Complication – PPH, Obstructed labor, prolonged labor, uterine rupture/scar dehiscence

Based on the Bi-variable and multivariable Cox-Regression analysis birth weight, APGAR score, Any problem in the current pregnancy, PNC follow up till the third day and Baby hospital stay are the main predictors of early neonatal birth in this study.

Accordingly neonates with birth weight less than 2.5 Kg are almost nine times (9.867(1.891-51.487)) more likely to die within the first 7 days of birth; babies born with less than seven APGAR score are seven times (7.131(1.290-39.432)) more risker to early neonatal death; those mothers who had Any problem in current pregnancy are more than seven (7.699(1.250-47.429)) times more likely to have early neonatal death; those mothers who had no PNC follow up till the third day are seven (7.076(1.047-47.829)) times more likely to die their neonates in the early neonatal period.

Discussion

The result of this study shows that the overall incidence of early neonatal death is 4.3% or 43 deaths per 1000 live births and it is 10.1 % among mothers with short inter-pregnancy intervals. In addition to this, the predictors were birth weight, APGAR score,

Any problem in the current pregnancy, PNC follow up till third day and Baby hospital stay.

The percentage of early neonatal death is higher than Afghanistan (1.4% or 14 per 1000 live births) [6], Borkinofaso (2.6% or 26.6 per 1000 lives) [7], Nigeria (3.8% or 38 per 1000 lives) [8], rural west Gojam zone, northern Ethiopia (1.86% or 18.6 per 1000 lives) [9] but lower than Shaanxi Province, China (7.9% or 79 per 1000) [10].

The inter-pregnancy interval in our study is no predictor even though it was found as a significant factor in studies done in Ethiopia [4], Nigeria [8], and Afganistan [6].

As this study showed lower birth weight is a predictor of early neonatal death; it was also found significant in studies done in Nigeria [8] and Afganistan [6]. This may be due to low birth weight neonates have a harder time eating, gaining weight, keeping their body temperature and fighting infection.

The other predictor is the presence of any problem during pregnancy time which is similar to the studies done in lower-

Table 3: Bi-variable and multivariable Cox-Regression analysis for predictors of premature birth, Northern Ethiopia, 2018 (N=460).

Characteristics		N	Outcome n (%)		Hazard ratio 95% CI	
			Event	Censored	Crude	Adjusted
IPI (inter-pregnancy interval)	Exposed	138	14(10.1)	124(89.9)	5.922(2.267-15.468)	1.116(0.192-6.483)
	Non-exposed	302	6(2)	296(98)	1	1
Birth weight	>=2500 gram	395	6(1.5)	389(98.5)	1	1
	< 2500 gram	45	14(31.1)	31(68.9)	28.075(10.733-73.440)	9.867(1.891-51.487)
APGAR score	>7	403	6(1.5)	397(98.5)	1	1
	<7	37	14(37.8)	23(62.2)	33.07(12.60-86.77)	7.131(1.290-39.432)
Number of ANC Visits	>=4	251	4(1.6)	247(98.4)	1	1
	1-3	176	13(7.4)	163(92.6)	4.828(1.570- 14.820)	0.794(0.175-3.598)
Any problem in current pregnancy	No	405	12(3)	393(97)	1	1
	Yes	35	8(22.9)	27(77.1)	8.720(3.538-21.488)	7.699(1.250-47.429)
PNC follow up till third day	No	175	14(8)	161(92)	3.78(1.441-9.913)	7.076(1.047-47.829)
	Yes	265	6(2.3)	259(97.7)	1	1
Mothers hospital stay	<24	328	8(2.4)	320(97.6)	1	1
	>=24	112	12(10.7)	100(89.3)	4.423(1.806-10.833)	0.160(0.022-1.164)
Baby hospital stay	<24	388	3(0.9)	385(99.1)	1	1
	>=24	88	7(8)	81(92)	9.433(2.438-36.497)	23.053(1.419-374.578)

income countries [11], and Indonesia [12], this is for the reason that most of the time those newborns born from such type of mothers are low birth weight, premature or with abnormal intrauterine growth pattern. And this may make them difficult to adapt themselves to the extra-uterine life (Table 3).

APGAR score also is a predictor which is the same with the study done in Indonesia [12] and in Brazil [13]. This may be because those neonates are prone to a hospital stay and may be exposed to hospital-acquired infections.

But the limitation of this study is failed to assess the incidence and predictors of the whole first-month life of the neonates since the study was till the first seven days.

Conclusion

The incidence of early neonatal death is higher when it is compared with most of the studies done in Africa. And the main predictors are birth weight, Apgar score, any problem in the current pregnancy, PNC follow up till third day and Baby hospital stay. In addition to this, the incidence is 10.1 % among the exposed mothers (mothers with short inter-pregnancy interval).

Recommendation

Based on the findings health providers should focus on giving care for those neonates who born with low birth weight, low Apgar score, stay for a long time in hospital and those neonates from mothers with any complications during their pregnancy. Besides, health providers should counsel and encourage mothers to have full PNC follow up after delivery to decrease the incidence of neonatal mortality.

Declarations

Ethics approval and consent to participate

Ethical clearance was obtained from the ethical review board of

Mekelle University College of health science (ERC1287/2017). Permission was obtained from the Tigray regional health bureau, northwest Zonal Health Department/office, and from all the selected health facilities. After the objectives of the study was explained verbal Informed consent was obtain from each participant; this because most of the study participants were unable to read and write; in addition, the data collection method was interview base, which was approved by ethical review board of Mekelle University College of health science. There is no consent taken from parents/guardians on this study.

Consent for publication: 'Not applicable'

Availability of data and material: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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

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Authors' contributions: MB- This is the principal investigator who develops the proposal and prepares the manuscript; BH- entered the collected data; GT- did the result write up and interpretation of the analyzed data and HG- did the analysis part. All authors read and approved the final manuscript. Brhane Hagos, Gebremariam Temesgen, Haftom Gebrehiwot Weldearegay equally contributed to this work.

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