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Original Article

A Study of Neonatal Near-misses and the Contributing Factors among Neonates Born in Public Hospitals in Addis Ababa, Ethiopia: A Retrospective Cross-sectional

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ABSTRACT

Background: Neonatal mortality remains one of the most pressing concerns in the world despite enormous improvements in neonatal intensive care. Although there is a decline in neonatal death in Ethiopia, it is still a major problem. In this study, the prevalence and contributing factors of neonatal near-misses were investigated in neonates admitted to sampling public hospitals in Addis Ababa, Ethiopia.

Methods: A facility-based retrospective cross-sectional study of 367 participants was conducted. An interviewer-administered, pre-tested structured questionnaire developed from pertinent literature was used to collect data on mothers by phone. The secondary data were gathered from the mothers' and the newborn's medical records using a pre-tested standardized checklist. An adjusted odds ratio (AOR) with a 95% confidence interval (CI) was computed to determine the level of significance.

Results: Neonatal Near Miss [NNM] prevalence was 25.6% (95% CI 21.0-30.5). The NNM was associated with the mother's work (AOR: 0.123, 95% CI: 0.018-0.859), as well as previous preterm deliveries (AOR: 11.83, 95% CI: 1.856- 75.398), Cesarean section (2.39 AOR, 95% CI: 1.229-4.652), pregnancy-related hypertension (2.67, 95% CI: 1.343-5.324), and infection (AOR (AOR 8.925, 95 % CI 2.580 - 30.873). More than half of newborns [51.0 %] were male. In terms of newborn presentation, 91.8 % of newborns had a cephalic presentation, while Breech presentation accounted for 6.9 %. Twenty-seven [7.4%] of the research participants had birth injuries, and 74% suffered from subglacial hemorrhages.

Conclusion: Most of the near-miss variables that can be altered or prevented are obstetric, medical, and neonatal-related. Early detection and treatment of the problems may help to improve neonatal outcomes. The Ethiopian government should pay greater attention to the health sector to expand prenatal care visits. Further prospective research is also required to look into additional reasons for newborn mortality.

Keywords: Addis Ababa, Ethiopia, Neonatal near miss, Prevalence

Introduction

The neonatal phase, which is defined as the time between birth and the age of 28 days (1), is the period in which infants run the highest risk of death. Nearly a third of neonatal deaths in the first month of life occur on the day of birth, and almost all of them happen during the first week (2). Neonatal near misses (NNMs), which are medical events that could have killed a newborn under 28 days old, are avoided by chance or as a result of the high caliber of treatment they received (1). A Neonatal Near Miss (NNM) is a life-threatening medical event in which a newborn under the age of 28 days is on the verge of death but survives by chance or due to the good quality of care (1). Because there is no universally accepted definition or identifying criteria for NNM cases, it has been employed in a variety of ways. The Latin American Centre for Perinatology (CLAP) of the Pan American Health Organization suggests that NNM be referred to as any newborn that satisfies

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managerial and/or pragmatic requirements and survives the first 27 days of life(2). A pragmatic criterion includes a birth weight of fewer than 1750 grams, a 5-minute Apgar score of less than 7, and gestational age below 33 weeks. However, management criteria also consider any intubation during the first 27 days of life, parenteral therapeutic antibiotics (up to 7 days and before 28 days of life), phototherapy during the first 24 hours of life, the use of vasoactive drugs, anticonvulsants, surfactants, blood products, and steroids for refractory hypoglycemia, cardio-pulmonary resuscitation, and any surgical procedure. Some management criteria, including the use of an antenatal steroid, parenteral nutrition, and congenital abnormalities, were also presented, which had not been recorded in previous studies(2).

Worldwide, 2.4 million cases of newborn mortalities were recorded in 2019—an average of 6700 each day(3). In 2017, 2.5 million newborns died worldwide as a result of prematurity, birth asphyxia, infections, and congenital anomalies, with an estimated neonatal mortality rate of 18 fatalities per 1,000 live births(4). According to data from a previous Iranian study, sepsis, preterm birth, and congenital multiple abnormalities are the most common causes of neonatal mortality(5). The majority of neonatal deaths take place in low- and middle-income nations. For instance, there were 28 infant deaths per 1,000 live births in Sub-Saharan Africa (SSA), with 50% of all newborn deaths occurring in Ethiopia, Nigeria, the Democratic Republic of the Congo, Tanzania, and Uganda(6). Ethiopia's neonatal death rate increased from 29 to 30 per 1000 live births between 2015 and 2019 (7).

However, according to a previous study, the average pooled 12- years prevalence of newborn mortality in Ethiopia was 20.3 (95% confidence interval: 18.9-21.8) per 1000 live births(8), which was lower than the country's 2016 Demographic Health Survey[DHS] reported 29 deaths per 1000 live births(9). Neonatal death was more common among mothers who had fewer than three prenatal visits throughout their pregnancy, with an OR of 1.76 (95% CI: 1.42, 3.16).(10)

The vast majority of infant death and morbidity cases worldwide meet NNM's pragmatic criteria. For instance, hypoxia caused 24% of infant mortality, whereas preterm problems caused 35% of mortality globally(11). The United Nations Sustainable Development Goal (SDG) for the period 2016 to 2030 was to eliminate preventable infant deaths, with a target of less than 12 per 1000 live births by 2030(12). Ethiopia will not be able to meet the SDG target of a low newborn death rate by 2030 if the current trend continues(13).

There has been a paucity of research into the prevalence of neonatal near-miss and their associated variables in the studied area. The evaluation of NNM cases would contribute to the development of new service delivery and program models at the community and healthcare system levels. Therefore, this study aimed to identify the prevalence and determinant factors of neonatal near-miss among neonates admitted in selected public hospitals in Addis Ababa, Ethiopia.

Methods

Study Design and Period

A facility-based retrospective cross-sectional study design was conducted in four selected public hospitals in Addis Ababa, Ethiopia from February 1 to February 29, 2021.

Study Population and inclusion and exclusion criteria

The study population consists of live neonates at selected hospitals who met the research's criteria. All live neonates born at designated hospitals between January 1 and December 31, 2020, met the selection criteria. The study excluded mothers who gave birth at home and were critically ill during the data collection period. In addition, mothers who had twins and charts of neonates with no discharge summary or with missing information [date of birth, date of newborn death, etc.] were excluded.

Sample size determination

The sample size of the study was determined using a single population proportion calculation, based on a 32.9 percent proportion from a retrospective cross-sectional study conducted in Debretabor(14). Parameters including a 32.9% prevalence of NNM, a 95% CI, 5% margin of error, and a 10% non-response rate were used to determine the sample size (n=334). After adjusting for a 10% non-response rate, the sample size was increased to a total of 367 mother-newborn pairs.

Sampling method

Only 10 of the 12 specialized public hospitals in Addis Ababa offer NICU services, and four of those ten were chosen randomly for the study. Based on the live delivery history of newborns from January 1, 2020, to December 30, 2020, the

sample size for each hospital was calculated. The newborn and maternal medical records were included consecutively in the order they were discharged from the postnatal ward and NICU until the estimated sample size was reached.

Measuring outcome variables

The study's outcome variable is a neonatal near miss (NNM), which was defined using both pragmatic and management criteria. When a newborn encounters at least one of the stated criteria and yet survive, the situation is referred to as a "neonatal near miss" (NNM). Birth weight of 1750g, gestational age of 33 weeks, and/or a 5-minute Apgar score of 7 or above, nasal conti-nuous positive airway pressure, systemic therapeutic antibiotics for up to 7 days and before 28 days, intubation during the first 28 days of life, bag and mask ventilation, cardiopulmonary resuscitation, phototherapy within the first 24 hours of life, the use of steroids for refractory hypoglycemia, blood products, and vasoactive drugs for refractory hypoglycemia, as well as any surgical procedures, were all among management criteria. The explanatory variables included socioeconomic and demographic characteristics (age, income, Household size, maternal and paternal educational status, place of residence, maternal occupational status, marital status), maternal obstetric history(ANC, frequency of ANC, parity, gravidity, gestational age at first ANC visit, abortion history, premature rupture of membrane, mode of delivery, congenital anomalies, birth injuries) and maternal medical history (diabetic mellitus, pregnancy-induced diabetic mellitus, anemia, hypertension, infection, and pregnancy-induced hypertension).

Data Collection Method

A variety of data collection methods were employed. An interviewer-administered, pre-tested structured questionnaire developed from literature was used to collect data on mothers by phone(15, 16). The questionnaire collects data on mothers' socio-demographic characteristics, obstetric and reproductive histories, medical histories of pregnancies, information about their newborns, and institutional characteristics. The secondary data were gathered from the mothers' and the newborn's medical records using a pre-tested standardized checklist. Data collectors used CLAP criteria to identify near misses in infants' medical records(2). Eight B.Sc. nurses collected the data with support from two M.Sc. Clinical Midwives who aided with data supervision, mentoring, and facilitation.

Data Analysis

The data were cleaned, coded, and entered into Epi-Data version 4.6 before being entered into SPSS version 25 for analysis. The mean, standard deviation, and frequency distributions were computed as descriptive statistics. Multivariable logistic regression was employed for the study. For multivariable logistic regression analysis, independent variables with marginal associations (P 0.20) in the bivariate analysis were selected to look for association with NNM. To examine the strength of the association, adjusted odds ratios (AOR) with 95% CI were employed. A p-value ≤0.05 was used to indicate statistical significance. The STROBE guideline was used to ensure the reporting of this cross-sectional study.

Ethical Approval

The Addis Ababa University College of Health Sciences School of Nursing and Midwifery approved the protocol [ID 6/2021]. The participants were chosen for the study after obtaining written informed consent. Additionally, confidentiality and anonymity were upheld.

Results

Mothers' Socio-Demographic Characteristics

In total, 367 mother-neonates were assessed for the study. Forty-two percent of the mothers in the overall group were aged 25 to 29, with a mean age of 26.6 years and a standard deviation of 4.66 years. Almost all mothers 357 (97.3 percent) were married and lived with their husbands, and 319 (84.2 percent) were permanent residents of the city. Regarding the educational background of the study's participants, 135 (36.8%) had only finished primary school (grades 1–8). Of the total participants, more than half (59.1%) were housewives. One hundred and twenty mothers (32.7%) had monthly earnings in the range of 165 to 3200 Ethiopian Birr, with a median income of 4,000 birrs. [74.4USD]

Prevalence of NNM and Characteristics of the new-born

According to the findings, there were 18.53% neonatal near-misses among neonates delivered at public hospitals in Addis Ababa. More than half (51.0%) of babies were male. In terms of newborn presentation, 6.9% of infants were delivered in the breech position, while 91.8% were born with their heads first. Twenty-seven [7.4%] of the newborn in our study had birth injuries, and 74% suffered from subglacial hemorrhages. (Table 1).

Table 1. Characteristics of the newborn in public hospitals, Addis Ababa, Ethiopia, 2021.

Variable	Category	Frequency[n=367]	Percent
Sex	Male	187	50.9
	Female	180	49.0
Presentation	Cephalic	337	91.8
	Breech	25	6.9
	Others [Transverse/face/brow]	5	1.3
Birth injury	Yes	27	7.4
	No	340	92.6
Type of birth injury [n=27]	Subglacial hemorrhage	20	74.07
	Cephalohematoma	5	18.5
	Brachial plexus injury	1	3.7
	Other	1	3.7
Congenital anomaly	Yes	21	5.7
	No	346	94.3
Neonatal Near Miss	Yes	68	18.53
	No	299	81.47

Characteristics of neonatal near misses

According to the study's findings, the most common pragmatic indicators of NNM cases were low birth weight below 1750, 33(9.0 %), 22(6.0 %) infants scored Apgar less than 7 at 5th minutes, and 21(5.7%) had less than 33 weeks of gestation, respectively. On the other hand, 88 (24%) of the neonates met the management requirements, with parental antibiotics for approximately 7 days being administered to 72 (19.6%), nasal CPAP used by 48 (13.1%), and bag and mask ventilation being used by 25 (outstandingly) neonates, respectively. (Table 2).

Table 2. Neonatal near miss characteristics among newborns at public hospitals, Addis Ababa, 2021

Criteria	Variables	Category	Frequency[n=367]	Percent
Pragmatic criteria	Gestational Category	> 34 weeks	346	94.3
		<33weeks	21	5.7
	Weight category	>1750gm	334	91.0
		< 1750gm	33	9.0
	Apgar core 5th minuet	>7	345	94.0
		< 7	22	6.0
Management criteria	Nasal CPAP	No	319	86.9
		Yes	48	13.1
	Any intubation	No	362	98.6
		Yes	5	1.4
	Parenteral antibiotics for about 7days	No	295	80.4
		Yes	72	19.6
	Transfusion of blood derivatives	No	344	93.7
		Yes	23	6.3
	Phototherapy during the first 24hrs	No	362	98.6
		Yes	5	1.4
	Vasoactive drugs	No	360	98.1
		Yes	7	1.9
	Surgical procedures	No	361	98.4
		Yes	6	1.6
	Anticonvulsants	No	355	96.7
		Yes	12	3.3
	Bag and mask ventilation	No	342	93.2
		Yes	25	6.8
	Cardiopulmonary resuscitation	No	360	98.1
		Yes	7	1.9
	Use of corticosteroid for treatment of refractory hypoglycemia	No	362	98.6
		Yes	5	1.4
Overall management criteria		No	276	76
		Yes	88	24

Table 3. Factors associated with NNM in selected public hospitals, Addis Ababa, 2021

Variables	Category	NNM		COR with 95% C.I	AOR with 95% C.I
		No, N(%)	Yes, N(%)		
Occupation of the mother	Housewife	161(74.2)	56(25.8)	.290 (.085 - .987)	0.269 (0.058 -1.245)
	Merchant	23(79.3)	6(20.7)	.217 (.049 - .963)	0.123 (0.018 - 0.859)
	Government employer	42(75.0)	14(25.0)	.278 (.073 - 1.052)	0.199 (0.033- 1.199)
	private work	42(77.8)	12(22.2)	.238(.062 -.918)	0.212 (0.037 - 1.195)
	Daily laborer	5(45.5)	6(54.5)	Reference	
A history of preterm birth	Yes	3(42.9)	4(57.1)	4.000 (.878 - 18.213)	11.828 (1.856 - 75.398)
	No	270(75.0)	90(25.0)	Reference	
Hypertension	Cesarean section	103(67.3)	50(32.7)	1.324 (.537 - 3.267)	2.391 (1.229 - 4.652)
	Yes	44(60.3)	29(39.7)	2.322 (1.348 - 4.000)	2.674 (1.343 - 5.324)
	No	229(77.9)	65(22.1)	Reference	
Infection	Yes	21(61.8)	13(38.2)	1.926 (.923 - 4.019)	3.706 (1.375 - 9.988)
	No	252(75.7)	81(24.3)	Reference	
Birth injury	Yes	12(44.4)	15(55.6)	4.130 (1.856 - 9.188)	4.759 (1.711 - 13.241)
	No	261(76.8)	79(23.2)	Reference	
Congenital anomaly	Yes	6(28.6)	15(71.4)	8.558 (3.212 - 22.797)	8.925 (2.580 - 30.873)
	No	267(77.4)	78(22.6)	Reference	

Factors associated with neonatal near miss

The NNM was associated with the mother's work (AOR: 0.123, 95% CI: 0.018-0.859), as well as previous preterm deliveries (AOR: 11.83, 95% CI: 1.856- 75.398), Cesarean section (2.39 AOR, 95% CI: 1.229-4.652), pregnancy-related hypertension (2.67, 95% CI: 1.343-5.324), and infection (AOR (AOR 8.925, 95 % CI 2.580 - 30.873) (Table 3).

Discussion

The purpose of this study was to assess the prevalence of NNM and associated variables in - public hospitals of Addis Ababa. According to the findings of this study, the magnitude of NNM was 25.61 percent, with a 95% CI (21.0 -30.5). This is lower than the figure reported in research conducted in Jimma, Ethiopia, which reported 26.7 percent of NNM cases (16). The finding of the study is also lower than those of a previous study from Hawassa, South Ethiopia, according to which 33.4 percent of the population had NNM(17). Additionally, this figure is lower than the one reported in a study on Brazilian university hospitals, which found 30.37 percent of NNM cases(18) but slightly higher than the results reported from Northeastern Brazil, which estimated NNM cases at 22%(19). Compared to a Ugandan study, however, the current figure is lower (36.7 percent) (20). This could be linked to a Ugandan study of mothers who experienced substantial obstetric difficulties throughout pregnancy, labor, and delivery, and these complications could lead to life-threatening diseases in neonates, putting them in the NNM. The prevalence of NNM in this study, however, is more than the 7.2 percent reported in a WHO multicounty survey. (21). The observed variation in NNM prevalence could be related to differences in participants' socioeconomic characteristics, institutions' healthcare delivery systems, and/or the study design used. This study found a statistically significant relationship between mothers' employment and the development of NNM. This is supported by three studies conducted in the US, Ireland, and Iran, all of which found a strong correlation between women's occupational environments and obstetric outcomes (22-24). Merchants may have more free time to care for and rest for themselves and their newborns. In this study, mothers with a history of preterm delivery were 11.82 times more likely to develop NNM than mothers without a history of preterm delivery. This demonstrates that preterm births are more likely to occur spontaneously in following pregnancies for women who had previously given birth preterm(25). Similarly, our findings are consistent with a study conducted in the United States, which found that a history of

preterm delivery increases the chance of re-current preterm delivery by 17-37 percent(26). It appears that a history of preterm birth could predispose a woman to NNM. In clinical practice, neonates with low birth weight, low gestational age, or those requiring respiratory treatments should be closely monitored because these characteristics are linked to greater neonatal mortality and NNM(18). In this study, it was discovered that Cesarean-section delivery has a higher chance of NNM than spontaneous vaginal delivery. Mothers who underwent a Cesarean section are 2.4 times more likely to have neonates with the NNM condition than those with natural delivery. This result is aligned with research conducted in Jimma Zone, Southwest Ethiopia, and Gamo Gofa, Southern Ethiopia (12). (13), and Gurage Zone in Ethiopia (10), all of which revealed that Cesarean birth increased the incidence of NNM. Cesarean delivery has also been linked to an increased risk of low APGAR scores, newborn resuscitation, and NICU admission in several studies(27, 28). This could be brought on by a variety of factors, including the underlying cause of why the mother's CS is so crucial to the fetus' health, the potential risks associated with the surgical wound, and the anesthetic's potential to trigger NNM. Maternal infection increased the likelihood of NNM by 3.7 times when compared to mothers who did not have an infection during pregnancy. This evidence supports findings from a study in Birmingham, Alabama, which found a link between maternal infection and low birth weight, preterm delivery, and congenital abnormalities(29). The probability of NNM was 2.6 times higher among mothers in our study without a history of pregnancy-related hypertension. This result is in line with research from Brazil. (30, 31), which indicated that hypertension during pregnancy was connected to an increased risk of NNM cases. This finding is backed up by two further investigations conducted in Hawassa, South Ethiopia, and Jimma Zone, Southwest Ethiopia, which found a link between hypertension and NNM(16, 17). This could be attributed to hypertension's effect on uteroplacental insufficiency, which reduces blood flow and nutrients to the baby, putting the newborn at risk for intrauterine growth restriction, asphyxia, premature delivery, and low birth weight, all of which can contribute to NNM. This study found that neonates born with a congenital abnormality had 8.9 times increased likelihood of experiencing a Neonatal Near Miss. According to a study carried out in Addis Ababa and the Amhara Region of Ethiopia, congenital abnormalities were identified as a risk associated with low birth weight neonates(32). In addition, a study done in Gujarat, India found that congenital abnormalities were linked to preterm birth, low birth weight, and stillbirth(33). Our findings also suggest that neonates who suffered a birth injury had a 4.7 times higher likelihood of having NNM than those who did not. This study's findings are consistent with a German study that found a strong correlation between birth injuries and birth asphyxia(34) This result could be related to neonates with delivery injuries, particularly to the head, which could provoke severe hemorrhage and encephalopathy, hypovolemic shock, and a poor APGAR score. As a result, cardiac resuscitation and blood transfusion are required.

This study contributes to the existing literature and might be utilized as a resource for health policymakers and program coordinators working in the healthcare system on neonatal health. The researchers used the verified and standardized NNM assessment criteria to improve the study's validity. However, this retrospective analysis is subject to some limitations. The information was taken from existing medical records, some of which were missing. A prospective follow-up of pregnant women to the end of the neonatal period after birth might have yielded more reliable results. This is recommended to gather reliable maternal, healthcare, and neonatal characteristics that could be used to identify newborn near-misses. As the data was only collected from mothers who delivered live newborns in the selected hospitals at particular times, cases reported from the community may have gone overlooked. Extrapolating the findings to the broader population would be difficult; however, given this was a facility-based study.

Conclusion

The prevalence of NNM in our study was lower than those reported in most previous studies. In this study, the mother's occupation, prior preterm births, delivery method, hypertension, infections contracted during pregnancy, birth trauma, and congenital anomalies were all connected to NNM. Most of the NNM variables that can be altered or prevented are related to obstetric, medical, and neonatal factors. As a result, local health planners and healthcare professionals must team up to improve maternal healthcare services, particularly in terms of early detection of problems and proper therapy. In addition, more research is needed utilizing different study methods to find other components.

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Conflicts of interest

Not applicable.

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