Neonatal near miss and associated factors among neonates admitted to neonatal intensive care unit of hospitals in East Wollega, Western Ethiopia, 2019

Edosa Amente Gutema[1] iD, Motuma Getachew Erena[2]
and Habtamu Kebebe Kasaye[3] iD

Abstract

Background: Neonatal near miss is an infant who nearly died but survived from birth to 28 days. Neonatal period is the most vulnerable time for child's healthiness and continued existence. Globally, about 2.5 million children died in their first month of life and 7000 die/day.

Objective: To assess neonatal near miss and associated factors among neonates admitted to intensive care unit at hospitals in East Wollega, West Ethiopia, 2019.

Methods: Quantitative, facility-based cross-sectional study was conducted from 15 July to 30 August 2019 on 403 neonates admitted to neonatal intensive care unit of hospitals. After ethical clearance, five recruited and trained nurses collected the data with pretested structured questionnaire. Neonates sampled were selected using systematic random sampling. Data entered into Epi-info version 7.1 and exported to SPSS Version 24. Binary logistic regression was performed, and adjusted odds ratio with P-value ≤ 0.05 at 95% confidence interval was used as statistically significant.

Results: All, 403, study participants were included in this study, yielding 100% response rate. From these, 196 (48.60%) neonates were near miss. In multivariable logistic regression, mother who lived in rural area (adjusted odds ratio = 3.84, 95% confidence interval = (1.78, 8.31)), cesarean section (adjusted odds ratio = 10.68, 95% confidence interval = (2.95, 38.71)), and neonates referred to hospitals (adjusted odds ratio = 3.32, 95% confidence interval = (3.27, 12.01)). Also, female neonates (adjusted odds ratio = 2.99, 95% confidence interval = (1.45, 6.14)) and multiple birth (adjusted odds ratio = 3.07, 95% confidence interval = (1.32, 7.16)) were significantly associated with neonatal near miss.

Conclusion: Neonatal near miss found to be high compared to previously existing research in Brazil. Health institutions, health professionals, and concerned bodies on plan and implementation of neonatal care need to consider these factors during pregnancy, delivery, and for neonates immediate after birth and in neonatal intensive care unit.

Keywords

Neonatal near miss, neonatal period, neonatal intensive care unit, East Wollega

Introduction

Neonatal period is the time from birth to first 28 days, and is further classified into three: very early (first 24 h), early (24 h to 7 days), and late neonatal period (7 days to <28 days).[1] Neonatal period is the most vulnerable time for a child's survival as it is a transition period from uterus to external environment, and rapid growth and development exhibited.[2] Newborn health is determinants to child health and survival and is the most hazardous period compared to any other time during the child's first year of life.[3]

[1]Ethiopian Public Health Institute, Addis Ababa, Ethiopia
[2]Department of Public Health, Wollega University, Institute of Health Science, Nekemte, Ethiopia
[3]Department of Midwifery, Wollega University, Institute of Health Science, Nekemte, Ethiopia

Corresponding author:
Edosa Amente Gutema, Ethiopian Public Health Institute, P.O. Box: 1242, Addis Ababa 1242, Ethiopia.
Emails: edosa@ephi.gov.et; idoamante07@gmail.com

Complications arising from preterm birth, asphyxia during labor, low birth weight, and sepsis were exposed neonates to near miss, even to death. A neonatal near miss (NNM) is an infant who was nearly died but survived during birth or within 28 days of expulsion from uterus (birth).[4] The NNM provides information that can help to evaluate quality of care and to set priorities for further assessments, planning, implementation, and health care improvement for newborn.[5]

Analogous to maternal near miss (MNM), when she nearly died but survived a complication that occurred during pregnancy, childbirth, or within 42 days of termination of pregnancy.[6] Presence of MNM in women is an independent risk factor for adverse prenatal outcomes. Hence, interventions rendered at improvement in maternal health of Ethiopia can lead to an improvement in prenatal outcomes.[7] There are no standard criteria and definition for NNM by World Health Organization.[8] The Latin American Center of Perinatology (CLAP) proposes definition for NNM any infants who fill one or both of pragmatic and management criteria but survived in its 27 days. The pragmatic criteria include gestational age, weight of the newborn, and the APGAR score at first and fifth minute. Whereas the management criteria judged by the presence or absence of nasal surfactant, intubation, parental antibiotics for about 7 days, blood-derived products, phototherapy during the first 24 h, vaso-active drugs, surgical procedures, anticonvulsants, cardiopulmonary resuscitation, and steroids for hypoglycemia.[11] As report of project, by United Nations Children's Fund (UNICEF), National Health and Family Planning Commission (NHFPC), and Maternal and Child Health (MCH) in China, to ensure safety and reduce their death, in year of 2016, NHFPC called for establishment of MNM and NNM for better care.

Globally, about 2.5 million children died in their first month of life in 2017 and about 7000 neonatal death every day,[9] and according to WHO report, in 2018, around 1 million neonates die in their first day and close to 1 million are dying within 6 days of their birth. Majority of these deaths occurs in developing countries, and around 70% of these deaths occur in Africa and South East Asia.[10]

Neonatal death rate and near miss were high along with MNM patients.[11,12] Neonatal mortality and morbidity are major global public health challenges, especially when it occurs in resource-limited setting. NNM contribute much to infant and under five mortality rates reduction by providing early diagnose and management of cases.[13] From nearly about 15 million annual preterm birth worldwide, preterm is the most cause for neonatal death, are directly or indirectly associated with NNM.[13]

In Ethiopia, there was a great improvement on under 5 years mortality; even though, the rate of neonatal mortality is about 29%, and again it is the same after 3 years as reported in 2019 Ethiopian Demographic Health Survey (EDHS).[14] It is the highest globally, nearly; 1 of 10 babies born in Ethiopia does not reach celebration of their first day of birth. One of six children dies before their fifth day of their birth.[15]

Neonatal mortality rate was 28 per 1000 LB in 2013.[16] As a report of EDHS survey 2016, in Ethiopia, the neonatal mortality rates were 29 per 1000 live births. At these mortality levels, one in every 15 Ethiopian children does not survive to their fifth birthday.[17]

Ethiopia is one of the countries who implement the sustainable development goal, "Ending preventable death of newborn and children less than 5 years" and striving toward its achievement by incorporating the goal in the National Reproductive Health Strategy (2016–2020). Therefore, the finding of this study will enlighten policy-makers of the NNM status and its associated factor, which can help them to track its status and work on the factors associated with the near miss. Furthermore, it creates consciousness for the health institution, non-governmental organization (NGO) and as a whole the society to be aware of the status of NNM and notice of the associated factors to curb the problem. Finally, the finding from this study could be used as a baseline for further rigorous studies.

Methodology

Study area

The study was conducted at Public Hospitals in East Wollega Zone, which found at the western part of Ethiopia. The town of East Wollega Zone, Nekemte town, is about 331 km to west of Addis Ababa, the Capital City of Ethiopia. According to Zonal population projection of 2017, the total population of East Wollega Zone were 1,500,999 (774,258 male and 726,741 female).[18] Less than five children and infants account for 246,614 and 48,332, respectively. Estimated 52,084 pregnant women lived in the district.

Five government public hospitals were present in East Wollega Zone include Nekemte Specialized Hospital, Wollega University Referral and Teaching Hospital, Gida Hospital, Arjo Hospital, and Sire Hospital. These hospitals had major clinical departments like internal medicine, surgery, pediatrics, gynecology/obstetrics, and others. Around 8496 and 708 neonates admitted to neonatal intensive care unit (NICU) of study hospitals annually and monthly, respectively. An average monthly admission to NICU of respective hospitals was as follows: Nekemte Specialized Hospital (218), Wollega University Referral and Teaching Hospital (174), Gida Hospital (120), Arjo Hospital (100), and Sire Hospital (96).[18]

Study design and period

Facility-based cross-sectional study design was employed from 15 July to 30 August 2019.

Target population

All neonates admitted to hospitals in East Wollega Zone.

Study population

All neonates admitted to the NICU of selected hospitals during study period.

Sample population

Neonates admitted to the NICU of Hospitals and systematically selected during study period.

Eligibility criteria

Inclusion criteria. All neonates admitted to the NICU of the selected hospitals during study period were included.

Exclusion criteria. Neonates admitted to NICU with major congenital malformation were excluded. Although in some studies, congenital malformation cases were considered as severity markers, many of these death cases may not have been preventable even with effective interventions.

Sample size determination

Since there is no published research on prevalence of the NNM in Ethiopia before/during study period, by taking proportion of 50% and using 95% confidence interval (CI) with 5% margin of error, the sample size was determined using single population proportion formula

$$n = \frac{\left(\frac{Z\alpha}{2}\right)^2 p\,(1-p)}{d^2}$$

$$n = \frac{(1.96)^2\,0.5(1-0.5)}{(0.05)^2} = 384$$

$$n = 384$$

By adding 5% of non-response rate: 19

$$n_{f=}384 + 19 = 403$$

Sampling procedure

Based on information from hospitals, an average number of neonates admitted in hospitals per month were around 708 and sample of 403 was taken, by systematic random sampling with interval equal to K, where K = N/n

$$K\ average = 708 / 403 = 1.76 = 2\ for\ each$$

The first neonate was selected by lottery method and then every other neonate was selected on discharge. Sample size assigned for these hospitals was based on their history of admission in third quarter (average of their monthly admission) (Supplemental Figure 2).

Variables

Dependent variable. It includes NNM.

Independent variables

Socio-demographic factors. These include age of mothers, marital status, residence, education level, occupation, and place of delivery.

Institutional and health care factors. These include availability of transportation and distance from health facility.

Obstetric factors. These include parity and mode of delivery.

Neonatal factors. These include birth weight, gestational age, birth asphyxia (which assist the APGAR score), and neonates' sex.

Operational definitions

NNM. It refers to situations where the newborns nearly died between 0 and 28 days, and they survived by either chance or because of the good quality of care they received.

For identification of NNM, two groups of criteria were established based on the results of previous study on the NNM.[19] If there is one of pragmatic or management criteria among the following, we diagnosed the neonate as NNM.

Pragmatic criteria. The pragmatic criteria are defined as follows:8,19

Neonate with birth weight of ≤1750 g.

A neonate with APGAR score ≤7 at 5 min.

A neonate born of gestational age ≤33 complete weeks.

Management criteria.8,19

- A neonate who were on parenteral antibiotic therapy (≥7 days before 28th of life):
  - Any intubation up to 7 days and before 28 days of life;
  - If there is one of phototherapy within 24 h of life, cardiopulmonary resuscitation, use of vasoactive drugs, use of anticonvulsants, use of surfactant, and use of blood products, use of steroids for the treatment of refractory hypoglycemia, and surgery are criteria to diagnose NNM.

Prolonged labor. It is considered when the labor, after the latent phase of first stage of labor, exceeds 12 h in primigravida or 8 h in multipart mothers.

Obstructed labor. It is considered when the presenting part of the fetus could not progress into the birth canal, despite strong uterine contractions.

Malpresentation. Ii is defined as any fetal presentation other than vertex.

Gestational age

Preterm denotes babies born from less than 37 weeks of gestational age.

Term denotes babies born from 37 to 42 weeks of gestational age.

Post-term denotes babies born >42 weeks of gestational age.

Data collection tool and procedure

Interviewer administered, structured questionnaire prepared in English and later on translated to Afan Oromo version was used to collect the data. In addition, a review of patient card (both maternal and neonatal) done.

The questionnaire contains different parts: socio-demographic characteristics, maternal characteristics, institutional characteristics, neonatal characteristics, and NNM criteria by pragmatic and management criteria. Five nurses among participants selected by systematic random sampling and two health officers were recruited for data collection and supervision, respectively. Questionnaires were developed from review of different relevant literatures on NNM and associated factors (Supplemental Figure 1).[6],[9],[20–24]

Data quality control

Data collection tool was pretested on 5% of samples size on analogous study subjects on neonates admitted in NICU of another hospital, which is not included in the study, Bako hospital 1 week preceding to real data collection. Based on the finding, possible amendments made were like arrangement of the flow of the questions and the removed of redundant questions. In addition, data collectors and supervisors were trained for 1 day. Checking the questionnaires was done daily throughout the data collection period. After completion of the data collection, each questionnaire was checked for completeness and consistency. The reliability test was conducted using Cronbach's alpha.

Statistical analysis

Collected data were checked for: completeness, coded, and entered into Epi-info version 7.1 and then exported to SPSS version 24 for cleaning and analysis. Descriptive statistics like univariate analysis and frequency distribution was computed. A binary logistic regression was used to see association between dependent and independent variables. Those variables with P-value ≤ 0.25 on bivariable logistic regression were candidate for multivariable logistic regression to determine the independent associations of each determinant variable with the outcome after controlling for the confounding effect. Model fitness, goodness of fit test, and multicollinearity were assessed by the Hosmer–Lemeshow and VIF (variance inflation factors), respectively. A 95% CI odds ratio with P-value < 0.05 were declared as statistically significant association. Finally, data were presented in the variety of narration, tables, and figures.

Result

Socio-demographic characteristics

In this study, total of 403 study participants were included in this study, yielding 100% response rate. Three hundred forty-seven, 347 (86.1%), of mothers of neonates were less than 35 years and the minimum age of respondents was 16 years, and the maximum 46 years with the mean age of 27.35 (SD = ±5.36). Nearly half of the respondent's 198 (49.1%) were lives in urban area. Majority 254 (63.0%) of the mothers gave birth in hospitals, while 54 (13.4%) delivered at home.

Maternal educational status shows that, 116 (28.8%) of them attended secondary (high) school, and 73 (18.1%) attended College/University. Besides, more than two out of five respondents, 171 (42.43%) were housewives and more than 25% of the respondent's average monthly income was less than 500 ETB (Ethiopian Birr). The lowest monthly income reported was 200 ETB whereas the maximum was 10,000 ETB; the median and inter-quartile range were 900 ETB and 1800 ETB, respectively.

Sixty-eight, 68 (17.85%), of paternal educational status was reported as never attending formal education, where as those nearly quarter 95 (24.93%) of them attended Collage/University. More than 50% of father's occupations were reported as being farmers 112 (29.40%) and government employees 102 (26.77%) (Supplemental Table 1).

Reproductive health history of respondents (mother of neonates). Two hundred eighty-five (70.7%) of the mothers have an experience of less than three number of deliveries and the median number of deliveries was 1 with a minimum of 1 and maximum of 7. Twenty-two (5.5%) of mothers had history of still birth and thirty-eight (9.4%) has a history of abortion. Inter-pregnancy interval <2 years between the current and last pregnancy were reported by 160 (39.7%). Most of the respondents 359 (89.1%) attended antenatal care (ANC) during the current pregnancy (Supplemental Table 2).

Although nearly half 198 (49.1%) of the respondents mentioned that, it takes less than an hour to reach a health facility. Nearly to quarter of participant, 97 (24.1), mentioned as it takes 3–5 h. The decision of place of delivery made by mothers' accounts for 190 (47.1%) where as those made by fathers was 187 (46.4%).

What's more, gestational diabetes 3 (0.7%), PIH (pregnancy induced hypertension) 52 (12.9%), maternal infection during pregnancy 21 (5.2%), APH (ante-partum hemorrhage) 21 (5.2%), and anemia 60 (14.9%) were experienced by the respondent.

Neonatal characteristics

More than half 220 (54.6%) of the neonates were males and more than 4/5th (353 (87.6%)) of neonates were singleton. One hundred nine (27.0%) of the neonates have malpresentation at delivery. Even though, two-third 261 (64.8%) of neonates born in the same hospitals they were receiving the NICU, one-fifth 88 (21.8%) were referred from other health facilities and more than tenth 4 (13.4%) of them were delivered and came from home. The mean age of gestation, at which the neonates born, was 36.49 (SD = ±3.07) with the most 336 (83.4%) of them being born at the gestational age of greater than 33 weeks. The mode of delivery reveals that, more than half (52.1%) of neonates were delivered by spontaneous vaginal delivery (SVD) while 20.6% were by CS (cesarean section) (Supplemental Table 3).

NNM

Magnitude of near miss. From a whole of 403 neonates, just about half (196 (48.6%), 95% CI = (43.79%, 53.5%)) were diagnosed as near miss using the pragmatic and management criteria (Supplemental Table 3).

Factors associated with NNM

In bivariable analysis, maternal educational level, maternal occupation, residency, average monthly income, time between current and past pregnancy, distance from health facility, ANC, place of delivery, mode of delivery, sex of neonate, and birth types were variables with P-value less than 0.25 and selected as candidate for multivariable analysis (Supplemental Table 4).

In multivariable logistic regression residency, delivery by CS, place of delivery, sex of neonates, and multiple pregnancies were independent predictors of NNM. Accordingly, neonates born from mothers who lives in rural area (AOR = 3.84, 95% CI = (1.78, 8.31)), delivery by CS (AOR = 10.68, 95% CI = (2.95, 38.71)), and delivery at home (AOR = 5.52, 95% CI = (3.56, 86.17)) were the socio-demographic and maternal factors that show statistically significant association with NNM.

Neonates referred to hospitals (AOR = 3.32, 95% CI = (3.27, 120)), female neonates (AOR = 2.99, 95% CI = (1.45, 6.14)), and multiple birth (AOR = 3.07, 95% CI = (1.32, 7.16)) were also neonatal characteristics which shows statistically significant association with NNM (Supplemental Table 5).

Discussion

Reducing the preventable death of neonates is one of the top agenda of sustainable development goal. This study aimed at assessing the magnitude of NNM and identifying those factors associated with it among neonates admitted to NICU in five hospitals in East Wollega Zone, Oromia, Ethiopia, 2019.

This study shows that the magnitude of NNM was 48.6% (95% CI = (43.79%, 53.5%)). The observed magnitude of NNM in this study was higher than studies conducted in Brazil, India, and Nigeria.[5,20,25] The observed difference might be attributable to either the use of both pragmatic or a management criterion, which recommended since it exhibits better performance (high sensitivities and specificities) than either set of criteria used alone or difference in exposure/proportion of maternal and obstetrics related problems and socio-economic status.

In this study, residency, sex of neonates, home delivery, multiple birth, and delivery by CS were statistically significant with NNM.

Delivery by CS was independent predictor of NNM, those neonates those delivered by CS was 11 times more likely to develop near miss compared with neonates delivered by SVD. This finding was similar with study done in India,[4] and it is less than that of two times in CS than SVD in Brazil.[21] On contrary, CS were protective factors against NNM in another study conducted in Brazil.[22] This difference might be due to difference in economic status between them that most of CS in developed countries done as elective. Moreover, high number of admissions to NICU from hospitals and late referral of mothers to hospital for CS from health centers in this study.

In this study, being female has statistically significant association with NNM (P = 0.003, AOR = 3, 95% CI = 1.45, 6.14). This means, female neonates were three times more likely to have NNM compared with male neonates in line with being male two times more likely to have neonatal sepsis that is risk to have parenteral antibiotics in NICU hospital in Mekele[23] that was criteria to diagnose NNM.

However, delivery at home found independent risk factor of NNM with (AOR = 5.52, 95% CI = (3.56, 86), P = 0.004) was six times more likely to have NNM than neonates delivered at hospital that was in line with studies done in Uganda.[24]

The link may be explained in terms of similarity in socio-demographic characteristics of community in Ethiopia and Uganda.[25] Furthermore, multiple birth identified as associated factor with NNM (AOR = 3.07, 95% CI = (1.32, 7.16), P = 0.028) similar in Brazil and Mekele.[24]

In this study, the main causes of NNM in the neonatal period of study area were complications arising from asphyxia during labor, gestational age less than 33 weeks, and neonatal sepsis that requires parenteral antibiotics for at least or more than 7 days. Other predictors for development of NNM were preterm, and respiratory distress from neonates admitted to NICUs of hospitals leading cause of NNM similar with studies done in Tigray and India.[24,25]

Limitation of the study

Because the study has conducted at NICU the prevalence, NNM might be a possibility overestimation. Besides, due to the nature of the study design, we could not be able to

establish the cause–effect relationship ("Egg chicken dilemma"). Moreover, mortality rates were not studied, as it needs a follow-up or cohort study.

Conclusion

The magnitude of NNM in this study was about 48.6% (95% CI = (43.79%, 53.5%)) in East Wollega Zone Hospitals. This study indicated that area of residency, sex of neonates, home delivery, multiple birth, and delivery by CS were statistically significant with NNM.

Recommendations

For health institutions and offices
- It is better to screen out pregnant mothers on a regular basis for multiple pregnancy, their gestational age, and indication for CS as warning sign, so that they will be alarmed as this can put in risk to poor neonatal outcome even up to end with death during ANC follow-up.
- Facilities should provide immediate newborn care for all neonates that could avoid severe asphyxia that leads to near miss.

For health professionals working in NICU and obstetric unit
- Paying attention to neonates admitted to NICU and giving priority for early diagnosis and treatments for these neonates will significantly decrease proportion of death.

For other researchers on further studies.
It will be more valuable if studies will be conducted on this subject matter with alternative prospective study design.

Author contributions

E.A.G. conceived the study, wrote the proposal, facilitated data collection, analysis, data interpretation, drafted the final report write up, and prepared manuscript. M.G. and H.K. participated in developing the tools and data collection process, data analysis, and involved in report write up. All authors read and approved the final manuscript.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical approval

Ethical clearance was obtained from Department of Public Health, Institute of Health Sciences, Wollega University Institutional Review Committee, and the letter of approval with reference number WU/RD/274/11 was granted.

Informed consent

Written informed consent was obtained from the subjects or the legally authorized representative of the subjects prior to study initiation.

ORCID iDs

Edosa Amente Gutema https://orcid.org/0000-0003-0519-9832
Habtamu Kebebe Kasaye https://orcid.org/0000-0003-3759-2604

Data availability and materials

The data set analyzed during this study available from the corresponding author on reasonable request. The questionnaires that we developed for the collection of data are provided as a supplementary file.

Supplemental material

Supplemental material for this article is available online.

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