

Research Article

Determinants of neonatal near miss among neonates admitted to Ambo University Referral Hospital and Ambo General Hospital, Ethiopia, 2019

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Abstract

Background: Neonatal Near-miss is defined as complications of neonates so severe as to be imminently life-threatening but survived due to chance or treatment. The number of neonates who survived morbidities were approximately 3 to 6 times greater than those who died. There was little evidence about neonatal near miss in Ethiopia. This study attempted to identify the determinants of neonatal near miss among neonates admitted to the Ambo University Referral Hospital and Ambo General Hospital.

Methods: Hospital-based quantitative unmatched case-control study was conducted at the Ambo University Referral Hospital and Ambo General Hospital from March 1 to 28, 2019. The respondents, 134 cases and 268 controls were recruited by simple random technique. Data were coded, entered and cleaned in EpiInfo version 7 and exported to SPSS. Both Bivariable and multivariable logistic regression was computed at 95% CI and the final model was checked by Hosmer and Lemeshow goodness-of-fit test. Multi collinearity and cofounders were not detected.

Result: Multivariate analysis showed that distance more than 15km away from health facilities [AOR=2.11, 95% CI: (1.09, 4.095)], Unwanted, and unplanned current pregnancy [AOR=3.71, 95% CI: (1.28, 10.79)], less than four Antenatal care visit [AOR=6.55, 95% CI: (3.07, 13.98)], Instrumental delivery [AOR=4.62, 95% CI: (1.78, 11.98)] were positively associated with Neonatal Near Miss. Whereas Term Neonates [AOR= 87%, 95% CI: (0.05, 0.32)], and Normal birth weight [AOR=91%, 95% CI: (0.03, 0.28)] were negatively associated with Neonatal Near Miss.

Conclusion: Distance from health facilities, Antenatal care visit, current pregnancy type, birth weight, gestational age and mode of delivery were determinants of Neonatal Near Miss. Therefore, providing adequate Antenatal services, health education and training is needed to improve neonatal health.

Background

Neonatal near-miss refers to conditions when the newborns become nearly died between the age of 0-28 days after birth, but survived either by chance or because of the good quality of care they received. This condition was not well defined yet and hardly documented and there was no common standard definition that agreed upon internationally [1,2]. However, the Latin American Centre for Perinatology (Centro Latino-

Americano de Perinatology- CLAP) prepared a standardized definition of the Neonatal Near miss [3] based on the results of previous studies [2-5] as any newborn infant who exhibited pragmatic and/or management criteria and survived the first 27 days of life.

Even though Millennium Development Goal for child survival was put in place to reduce maternal and neonatal morbidity and mortality to under 30 per 1000 live births by

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Keywords: Neonatal near miss; Determinants; Ambo; Ethiopia

Abbreviations: ANC: Antenatal Care; APH: Ante Partum Hemorrhage; CDC: Center for Disease Control and Prevention; CHMS: College of Medical and Health Sciences; CLAP: Centro Latino-Americano de Perinatology; CPAP: Continuous Positive Airways Pressure; CS: Caesarean Section; EDHS: Ethiopia Demographic Health Survey; GA: Gestational Age; HDP: Hypertensive Disorders of Pregnancy; ICU: Intensive care unit; IHRERC: Institution Health Research, Ethical Review Committee; MDG: Millennium Development Goal; MNCH: Maternal, Newborn & Child Health; MNM: Maternal near misses; NMR: Neonatal Mortality Rate; NNM: Neonatal Near Miss; PPH: Postpartum Hemorrhage; SVD: Spontaneous Vaginal Delivery; WHO: World Health Organization





2015, only 41% under-5 mortality rate has been declining globally till 2011 [6]. Global estimate of 2015 indicated that 2.7 million deaths of under-five child, from this almost One million deaths occurred during the first week in the neonatal period [7]. Almost all 99 percent of neonatal deaths, occur in developing countries, yet most scholars and other researcher's emphasis on the 1% of deaths in developing countries. The United Nation Agenda for Sustainable Development Goal from 2016 to 2030 was to end preventable deaths of newborns and indicated that the neonatal mortality should be less than 12/1000 Live Birth at the end of 2030 [8].

The neonatal period is the most vulnerable time that constitutes 75% of infant deaths and 50 percent of the neonatal deaths [7]. The highest amount of neonatal death was occurring in south-central Asian countries and sub-Saharan Africa [9]. Some studies show that the number of newborn babies who survived morbidities were approximately 3 to 6 times greater than those who already died [1,10,11].

Several literatures in different studies identify factors associated with neonatal near miss like, the socioeconomic characteristics of mothers [12-15], bad obstetric history [16], number of ANC visit, gestational age, presence of asphyxia, APGAR score < 7/8, cesarean delivery, [17], age group \geq 35 years, primi parity, hemorrhage, high blood pressure and maternal syphilis [18,19], low birth weight, prematurity, neonatal infection was factors associated with early neonatal morbidity and mortality [20].

In Ethiopia, the neonatal mortality rate was 29/1,000 Live Birth, and the post neonatal mortality rate was 19/1,000 Live Birth [21]. A study done at Addis Ababa St Paul's Hospital indicated that 23.1% were died in the neonatal ward after admitted, but the remaining were discharged as their condition was improved [17]. There was a little evidence of neonatal near miss in Ethiopia and almost no evidence in Western Ethiopia, Ambo. Therefore, this study was aimed to identify the determinants of the neonatal near miss among Neonates who were admitted to post-natal or neonatal wards at the Ambo University Referral Hospital and Ambo General Hospital, Western Ethiopia. The findings of this study primarily can generate information for health care providers in neonatal, labor and delivery wards and also could be served as a basic framework and a baseline information from other studies with similar interest.

Methods

Study area and study period

The study was conducted in the Ambo University Referral Hospital and Ambo General hospital from March 1 to 28, 2019. Ambo is located in the West Shewa Zone of the Oromia Region, west of Addis Ababa. The total population of Ambo town was 94,342 [22]. According to the 2017/2018 G.C HMIS report, Ambo University Referral Hospital has an annual delivery of

3250 while Ambo General Hospital has an annual delivery of 3120.

Study design and participants

Hospital-based quantitative unmatched case-control study was conducted among Neonates who were admitted to post-natal or neonatal wards within 28 days of birth in the Ambo University Referral Hospital and Ambo General Hospital during the study period.

Inclusion and exclusion criteria

Selecting Cases (Neonatal Near Miss): Neonates who were admitted to the selected hospitals during the study period as indicated from their medical records after diagnosed by Neonatologist or Pediatrician or Gynecologist or Residents were selected by data collectors according to CLAP definition of NNM, neonate with at least one of the near miss criteria who had a severe morbidity (organ dysfunction or failure) or exhibited pragmatic and/or management criteria but survived this condition within the first 27 days of life. The pragmatic criteria includes: birth weight < 1.7 kg, APGAR score < 7 at 5th minutes of life and GA < 33 weeks and management criteria includes: Parenteral antibiotic therapy, Nasal CPAP, Any intubation, Phototherapy within 24 hours of life, Cardiopulmonary resuscitation, Use of vasoactive drugs, Use of anticonvulsants, Use of surfactant, Use of blood products, Use of steroids, Surgery, Identification of severe congenital malformation, were recruited as NNM case [3,23,24]. Additionally, data from the record was retrieved.

Selection of controls: Neonates who were admitted to post-natal or neonatal ward and identified by a pediatrician or neonatologist or gynecologist or resident as a healthy baby (has no complication indicated for selection of case) were enrolled as a control. For each near-miss case, two controls within the same day of the near-miss event were selected.

Exclusion criteria

Those Mothers of neonates who gave birth at home were excluded from this study because of unknown present birth histories like the birth weight and Gestational age. Those neonates selected as a control but unfortunately came back as a case during the study period were excluded from the control without replacement but they were recruited as a neonatal near miss case. Neonates who did not present with their mothers during the study period were excluded because of unknown mothers' history.

Sample size determination and sampling procedures

The sample size was estimated using Epi Info 7 software, confidence level of 95%, power of the study, 80%, the case-control ratio 1:2, expected percent of exposures in control 15.8%, and percent exposure among cases 5.4%. It was estimated from one study done in North Eastern Brazil, age of mother > 35 years as one of the main exposure variable for



neonatal near-miss that provide the maximum sample size of 402 with 10% non-response rate [24]. Accordingly, this yield a minimum sample size of 134 cases and 268 controls. Two Governmental Hospitals were selected purposely (AURH and AGH). The respondents were recruited by simple random technique.

Data collection tool and procedure

Near misses' events were identified by data collectors in post-natal or neonatal wards according to the above-mentioned criteria. Data were collected in three rounds by 7 midwives and 8 neonatal nurses with the experience in data collection (the first 10 days by 5 data collectors and 2 supervisors, next 10 days by 5 data collector and 2 supervisors and third 10 days by 5 data collectors and 2 supervisors). The data were collected by using a structured hospital-based face to face interview pre-tested questionnaires administered by trained data collectors in the class arranged for data collection after the neonates were assured to be survived. In addition to that, pertinent information was abstracted from the medical records (case notes, operation notes, midwives' reports, and discharge summaries) of study respondents. The interviewers have informed the mothers about all details of the research. The women were encouraged to feel free and told that the confidentiality of their responses was assured and no information was shared with third parties, except the investigator. After this, women that were willing to participate and signed the informed consent document were interviewed in a quiet and comfortable room. Questionnaires were reviewed and checked for completeness, accuracy and consistency by the supervisor, and principal investigator and corrective measures were taken.

Operational definitions

Antenatal care: defined as, 4 prenatal consultations, one each quarter and one before delivery [25].

A healthy newborn: is defined as any birth to the best adaptation to extra uterine life (APGAR > 7) and had no clinically detectable malformation [25].

APGAR score: this variable was defined as 7-10 indicate healthy baby and 0-6 indicate distressed neonates [26,27].

Birth weight: was defined as Very low birth weight < 1.5 kg, low birth weight 1.5 kg-2.5 kg, normal birth weight 2.5-4 kg and macrosomia \geq 4 kg [28,29].

Gestational Age: gestational age has been defined as Preterm if GA<37, Term if GA=37- 42 and Post-term if GA > 42 weeks [25].

Maternal complication: Those mothers come with one of the following compliance: Obstructed labor, hypertensive disorders of pregnancy, Hemorrhage, Sepsis and Others [25].

Neonatal asphyxia: in this study context, it is defined by

clinical criteria (abnormal fetal heartbeat and APGAR score < 3 in 5 minutes) [30].

Data quality controls

To make the data valid and reliable; the structured questionnaire was pre-tested on 20 (5%) individuals from Gendeberat General Hospital, Ethiopia. Additionally, one-day training was provided for data collectors and supervisors by the principal investigator to create awareness on timely collection and data management of the basic technique of data collection, approaches and on the issue of confidentiality and privacy. To get informed consent and reliable data, a clear explanation of the purpose and procedure of the study was given to the study participants. Moreover, the data collectors were supervised daily by supervisors.

Methods of data analysis

Data were checked for consistency, coded and entered using EPI INFO 7 and exported to SPSS version 22 for analysis. Data cleanup and cross-checking were done before analysis. Both descriptive and analytical, statistical procedures were utilized. Tables were used for data presentation. Binary logistic regression was used to identify factors associated with Neonatal Near Miss on the basis of OR, 95% CI and p-value of less than 0.05. Variables with $p < 0.25$ in bivariable analysis were entered into a multivariable logistic regression model using the Backward Stepwise (Likelihood Ratio) to control confounding. During multivariable analysis model fitness has been checked by Hosmer-Lemeshow model fitness and which was insignificant ($p = 0.873$). No multi-collinearity was detected.

Results

Sociodemographic, obstetrics and neonatal related characteristics

In this study, a total of 402 participants were interviewed, with a response rate of 100%. We selected 134 cases and 268 controls by using the standardized Latin American Center for Perinatology Neonatal Near Miss Criteria. There was no significant difference between the two hospitals, they were almost homogenous despite that Referral hospital is used for teaching purposes. Table 1 show that sociodemographic characteristics of the respondents. Table 2 illustrates about obstetrics and neonatal related characteristics.

Determinants of neonatal near miss

Binary logistic regression identified those variables to be candidates for Multivariable analysis. Multivariable analysis indicated that those mothers who were ≥ 15 km (> 1 hour) far away from a health institution had odds of 2.11 times higher of experiencing neonatal near miss than those mothers of the nearby health institution [AOR=2.11, 95% CI: (1.09, 4.095)]. Mothers who were unintended current pregnancy had odds of 3.71 times higher experiencing neonatal near miss than



Table 1: Socio-demographic characteristics of mothers of neonates admitted (n=402) to the Ambo University Referral Hospital and Ambo General Hospital, 2019.

Variable	Category	Case (%)	Control (%)	Total frequency (%)
Age in years	15-19	10(7.5)	27(10.1)	37(9.2)
	20-24	29(21.6)	77(28.7)	106(26.4)
	25-29	34(25.4)	103(38.4)	137(34.1)
	30-34	24(17.9)	48(17.9)	72(17.9)
	35*	37(27.6)	13(4.9)	50(12.4)
Residence	Urban	59(44)	179(66.8)	238(59.2)
	Rural	75(56)	89(33.2)	164(40.8)
Distance from health facility	< 1 hour/5-15 km	34(25.4)	149(55.6)	183(45.5)
	≥ 1 hour/≥ 15 km	100(74.6)	119(44.4)	219(54.5)
Marital status	Never married	11(8.2)	10(3.7)	21(5.2)
	Married	113(84.3)	237(88.4)	350(87.1)
	Divorced/widow	10(7.5)	21(7.8)	31(7.7)
Educational level	No formal education	61(45.5)	36(13.4)	97(24.1)
	Primary	27(20.1)	87(32.5)	114(28.3)
	Secondary	28(20.9)	80(29.9)	108(26.9)
	More than secondary	18(13.4)	65(24.3)	83(20.6)
Occupation	Government	12(9)	48(17.9)	60(14.9)
	Farmer	43(32.1)	68(25.4)	111(27.6)
	Housewife	56(41.8)	84(31.3)	140(34.8)
	Merchant	10(7.5)	45(16.8)	55(13.7)
	Other/specify*	13(9.7)	23(8.6)	36(9.0)

Other*: student, daily laborer, no job, private employer

Table 2: Obstetrics and neonatal related characteristics of neonatal near miss among neonates admitted (n = 402) to the Ambo University Referral Hospital and Ambo General Hospital 2019.

Variables	Category	Near miss status		Total (%)
		Case (%)	Control (%)	
Parity	Nulliparous	36(26.9)	88(32.8)	124(30.8)
	Multiparous	53(39.6)	159(59.3)	212(52.8)
	Grand multiparous	45(33.6)	21(7.8)	66(16.4)
Fetal presentations during birth	Cephalic	79(59)	207(77.2)	286(71.4)
	Breech	40(29.9)	44(16.4)	84(20.9)
	Transverse/brow/face	15(11.1)	17(6.3)	31(7.7)
Current pregnancy type	Wanted planned	20(14.9)	76(28.4)	96(23.9)
	Wanted unplanned	58(43.3)	173(64.6)	231(57.5)
	Unwanted unplanned	56(41.8)	19(7.1)	75(18.6)
Have you visited ANC during this pregnancy?	Yes	93(69.4)	250(93.3)	343(85.3)
	No	41(30.6)	18(6.7)	59(14.7)
If yes, how much did you visit?	< 4 visits	111(82.8)	113(42.2)	224(55.7)
	≥ 4 visits	23(17.2)	155(57.8)	178(44.3)
Gestational age at birth	≤ 36 weeks	37(27.6)	21(7.8)	58(14.42)
	37-41 weeks	78(58.5)	226(84.3)	304(75.6)
	≥ 42 weeks	19(14.2)	21(7.8)	40(9.95)
Did complication happen during birth?	Yes	36(26.9)	61(22.8)	97(24.1)
	No	98(73.1)	207(77.2)	305(75.9)
If yes, which complication?	Obstructed labor	16(44.4)	21(58.3)	37(38.1)
	HDP	3(8.3)	9(25)	12(12.3)
	Hemorrhage	9(25)	6(16.7)	15(15.5)
	Sepsis	1(2.8)	1(2.7)	2(2.1)
	Other/specify**	7(19.5)	24(66.7)	31(32)
	Delivery mode	SVD	64(47.8)	172(64.2)
Birth weight	C/S	34(25.4)	78(29.1)	112(27.9)
	Instrumental	36(26.9)	18(6.7)	54(13.4)
	< 2.5 kg	42(31.3)	22(8.2)	64(15.9)
APGAR score	2.5-4 kg	81(60.4)	236(88.1)	317(78.9)
	≥ 4 kg	11(8.2)	10(3.7)	21(5.2)
Neonatal complication	< 7	56(41.8)	0	56(13.9)
	≥ 7	78(58.2)	268(100)	344(85.6)
	Prematurity	18(13.4)	0	18(13.4)
	Sepsis	36(26.9)	0	36(26.9)
	Congenital anomalies	8(6)	0	8(6)
	Birth asphyxia	48(35.8)	0	48(35.8)
Other/specify***	Jaundice	10(7.5)	0	10(7.5)
	Other/specify***	14(10.4)	0	14(10.4)

*compound presentation, **oligohydramnios, polyhydramnios, fetal distress, ***viral infection, bacterial infection, skin, CVS.



mothers who were wanted and planned current pregnancy [AOR=3.71, 95% CI: (1.28, 10.79)]. Neonates of mother's less than four ANC follow up had odds of 6.55 times higher experiencing neonatal near miss than neonates of mother's visited ANC follow up more than four times. [AOR=6.55, 95% CI: (3.07, 13.98)]. Neonates of 36-41 weeks of GA had odds of 87% times lower of experiencing neonatal near miss than neonates of ≥ 42 weeks of gestational age at birth [AOR=0.13, 95% CI: (0.051, 0.32)]. Neonates who were given birth by instrumental delivery were 4.62 times higher of experiencing neonatal near miss than neonates gave birth by spontaneous vaginal delivery [AOR=4.62, 95% CI: (1.78, 11.98)]. 91% of Neonates of normal birth weight were less likely experiencing neonatal near miss than neonates of ≥ 4 kg [AOR= 0.09, 95% CI: (0.03, 0.28)] (Table 3).

Discussion

In this study, distance ≥ 15 km (>1 hrs) from health facilities, less than four ANC follow up, unwanted and unplanned current pregnancy, gestational age ≥ 42 weeks, instrumental deliveries and birth weight ≥ 4 kg was identified as determinants of the neonatal near miss.

The study shows that mothers who were greater than 15km (≥ 1 hour) far away from health facilities had higher

odds of experiencing neonatal near miss than those mothers of nearby health facilities. This evidence is consistent with evidence from southern parts of Ethiopia [31,32]. In India and Vietnam villages with no health facility (≥ 15 km) were higher risk to have neonatal near miss [33,34]. In some countries, a lot of women were troubled reaching a health facility to get service due to long distance and this leads to Neonatal Near Miss [35]. The same evidence from Brazil show that long distance from a health facility (≥ 15 km) were the major factors caused Neonatal Near Miss [12-14]. It is scientifically known that being nearby health facility helps to get any necessary health services on time by the right person at the right places and also access to healthcare services improves overall population health status.

The odds of Neonatal Near Miss were six times higher among women who had less than four ANC visit, which is supported by studies in Eastern Brazil that shows fewer prenatal care visits were the leading determinants of Neonatal Near Miss [18,24,36]. However, the study done in Brazil and Morocco revealed that there was no association between Neonatal Near Miss and ANC follow up [12,19,36-39]. These controversies indicate gaps in knowledge about the participation to access prenatal care, the quantity, and quality of consultations in the determination of negative outcomes for the mother and the

Table 3: Determinants of neonatal near miss among neonates admitted ($n = 402$) to the Ambo University Referral Hospital and Ambo General Hospital, 2019.

Variables ($n = 402$)	Neonatal near miss		COR (95%CI)	AOR (95%CI)	
	Case	Control			
	N ^o (%)	N ^o (%)			
Age in years	15-19	10(7.5)	27(10.1)	1.00	1.00
	20-24	29(21.6)	77(28.7)	1.01(.438-2.36)	0.76(0.26-2.18)
	25-29	34(25.4)	103(38.4)	0.89(.392-2.03)	0.44(0.16-1.25)
	30-34	24(17.9)	48(17.9)	1.35(.562-3.24)	1.15(0.37-3.53)
	35*	37(27.6)	13(4.9)	7.67(2.94-20.1)*	2.07(0.58-7.46)
Distance from health facility	< 1 hour/5-15 km	36(26.9)	149(55.6)	1.00	1.00
	≥ 1 hour/ ≥ 15 km	98(73.1)	119(44.4)	3.68(2.33-5.82)*	2.11(1.09-4.095)**
Educational level	No formal education	60(44.8)	36(13.4)	6.12(3.15-11.9)*	1.50(0.47-4.78)
	Primary	25(18.7)	82(30.6)	1.12(.569-2.20)	0.35(0.12-1.02)
	Secondary	28(20.9)	80(29.9)	1.26(.643-2.49)	0.70(0.23-2.09)
	More than secondary	21(15.7)	70(26.1)	1.00	1.00
Occupation	Government	12(9)	48(17.9)	1.00	1.00
	Farmer	43(32.1)	68(25.4)	2.53(1.21-5.29)*	0.518(0.15-1.75)
	Housewife	56(41.8)	84(31.3)	2.67(1.30-5.46)*	0.737(0.23-2.37)
	Merchant	10(7.5)	45(16.8)	0.889(.350-2.26)	0.29(0.07-1.24)
	Other/specify***	13(9.7)	23(8.6)	2.261(.893-5.73)	1.83(0.51-6.57)
Current pregnancy type	Wanted planned	20(14.9)	76(28.4)	1.00	1.00
	Wanted unplanned	58(43.3)	173(64.6)	1.28(.717-2.27)	0.86(0.38-1.98)
	Unwanted unplanned	56(41.8)	19(7.1)	11.2(5.5-22.93)*	3.71(1.28-10.79)**
ANC visit	< 4 visits	111(82.8)	113(42.2)	6.62(3.97-11)*	6.55(3.07-13.98)**
	≥ 4 visits	23(17.2)	155(57.8)	1.00	1.00
Gestational age at birth	≤ 36 weeks	37(27.6)	21(7.8)	1.95(.858-4.42)	1.00(0.35-2.86)
	37-41 weeks	78(58.5)	226(84.3)	0.38(.195-0.75)*	0.13(0.051-0.32)**
	≥ 42 weeks	19(14.2)	21(7.8)	1.00	1.00
Delivery mode	SVD	64(47.8)	172(64.2)	1.00	1.00
	Cesarean section	34(25.4)	78(29.1)	1.17(.714-1.921)	1.81(0.91-3.60)
	Instrumental	36(26.9)	18(6.7)	5.38(2.85-10.2)*	4.62(1.78-11.98)**
Birth weight of the baby	< 2.5 kg	42(31.3)	22(8.2)	1.74(.639-4.72)	0.28(0.069-1.11)
	2.5-4 kg	81(60.4)	236(88.1)	0.31(.128-.762)*	0.09(0.026-0.28)**
	≥ 4 kg	11(8.2)	10(3.7)	1.00	1.00

*Significant at $p \leq 0.25$, **significant at p - value of ≤ 0.05 , *** student, daily laborer, no job, private employer



newborn in Ethiopia. Not only this, but also, in socioeconomic contexts, there are great disparities, such as in the case in Brazil, since they were developed countries than Ethiopia, they can provide good quality and quantity of ANC visits.

This study revealed that the odds of neonatal near miss among unwanted and unplanned current pregnancy were higher than those mothers wanted and planned current pregnancy. This evidence is supported by a study conducted in Cameroon that shows unwanted and unplanned pregnancy was significantly associated with the neonatal near miss [20]. Not only this, but also unintended pregnancy is a worldwide problem that affects women, their families, and society in the developing world can result in serious, long-term negative health effects [40]. Those mothers who were Unwanted and unplanned current pregnancy were not giving attention for their pregnancy because they are not interested in the pregnancy, this leads the fetus in the uterus exposed to many problems that later becomes severe neonatal morbidities (near miss). In Ethiopia most of the women become pregnant, suddenly, for that matter the pregnancy was indeed unwanted, therefore, not seek health facility for prenatal care and consultation, and they become high risk during the postnatal period. Not only this, but also, mothers who were unplanned and unwanted current pregnancy may not get important information regarding nutritional counsel and monitoring of fetal wellbeing were compromised. The other reason was related to less ANC followed up practice by the respondents that could directly influence the neonate's health.

Neonates of 36-41 weeks of gestational age were protected against neonatal near miss than neonates of ≥ 42 weeks of gestational age at birth. But a study conducted in Brazil, shows that more than 80 percent of those near miss case were < 30 weeks of gestational age [41,42] and also one of the Latin American Centre for Perinatology (CLAP) standardized definition component of NNM was age of < 36 weeks at birth [3,43]. This controversy has happened because in Ethiopia organ dysfunction and most complication were supposed to be related to prematurity than post-term neonates, this indicated that there was a little emphasis for post-term neonates. Additionally, as most of the respondents were from the rural area and uneducated, they did not know the exact date of delivery to seek health support for post-term neonates and this leads to neonatal near miss and morbidities than term neonates. The other reason was because of those studies were using large sample sizes than current study.

Neonates of normal birth weight were protective against of experiencing near-miss than macrocosmic neonates. This shows that those neonates birth weights $\geq 4.00\text{kg}$ at birth were risky to be near misses than normal birth weight baby. This result is in line with the study done in Tigray that shows neonate of normal birth weight was 55% lesser hazards of death [44]. In contrast to our study, evidence from Morocco and Brazil indicated that Newborns who were small for gestational

age and very low birth weight were strongly associated with NNM than neonates of normal birth weight [39,42,45]. This controversy is due to most of the pregnant women in Ethiopia had low awareness about sign and symptom and treatment of Diabetics and Gestational Diabetics disease that increase the weight of the baby and leads to neonatal near miss and morbidities [46,47]. Another issue is regarding differences in terminating the pregnancy plan, in Ethiopia, there is low attention for the macrocosmic baby than low birth weight baby since a lot of people think big baby is the sign of health. The other reason is because of different study set up and different socioeconomic status of current study and other studies.

The current study shows that Neonates who were given birth by instrumental delivery had higher odds of experiencing neonatal near miss than neonates gave birth by spontaneous vaginal delivery. Even though there was no study support this finding, it is a fact that instrumental delivery can cause a lot of adverse effect on neonates and mothers. But in other ways, evidence from Brazil stated that neonatal near miss rate was higher among babies delivered by cesarean section than in those delivered through vaginal birth [18, 41]. In line to this study evidence from the Southern part of Brazil indicated that cesarean section delivery was two times higher among NNM than vaginal delivery [1]. This controversy is due to different prevalence of cesarean section among developed countries and developing countries like Ethiopia. In Ethiopia, the prevalence of cesarean section was very small [48] and this indicates that the problem related to cesarean section like neonatal near miss also expected to be very small too. In Ethiopia, most of the physicians try instrumental delivery as the second option to vaginal delivery before going to perform a cesarean section, since instrumental delivery is performed on the real physical body of both mother and baby there is a high risk that leads neonates to near miss event.

In this study residence, occupation, marital status, complication during labor and delivery, parity, fetal presentation and were insignificantly associated with neonatal near miss. This evidence was supported by the study conducted in Brazil [19,41]. But in another study these factors were significantly associated with the neonatal near miss [12,18,49].

The strength of this study was employing a validated and standardized neonatal near miss identification criteria to avoid misclassification. The incomplete and irrelevant questionnaires were filled by replacing the old questionnaires that yield 100% response rate of the respondents. This study did not analysis the single points criteria used to select the case event; we used the criteria only to identify the neonatal near miss event.

Conclusion

Distance from health institution, ANC visit, type of the



current pregnancy, birth weight at birth, mode of delivery and gestational age at birth were determinants of the neonatal near miss. Among these, ANC visit, type of current pregnancy and mode of delivery were the strongest determinants of the neonatal near miss. The data analysed here can provide information that can contribute to global neonatal and maternal morbidity research agenda about the most frequent complications related to the neonatal near miss. Therefore, the Hospital Administrators Should prepare adequate and periodic training for health care providers working in neonatal wards, targeted ANC follow-up of women should be practiced in both hospitals, subsidizing transportation like an ambulance to facilities. Researchers should do further investigation to identify other factors by using other tools and other study design.

Declarations

Ethical approval and consent to participate

Ethical clearance was obtained from the Ethical Review Committee of the College of Medicine and Health Sciences, Haramaya University. An official letter of cooperation was given to the administrative offices of the two hospitals. Written and Verbal informed consent was obtained from each participant before starting of the administering questionnaire. Additionally, written informed consent was obtained from a parent or guardian for participants under 16 years old. The purpose of the study was explained and confidentiality was maintained.

Authors' contributions

EY wrote the proposal, participated in data collection, analysed the data and drafted the paper. NA and YD approved the proposal with some revisions, participated in data analysis and revised subsequent drafts of the paper. All authors read and approved the final manuscript.

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