Determinants of birth asphyxia among new-borns at Debre Markos referral hospital, Northwest Ethiopia: unmatched case-control study.

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Abstract

Background: Despite a global decline in under- five deaths, the rate remains slow in developing countries, around 4–9 million newborns develop birth asphyxia, the third cause of under-five deaths, causing irreversible neurological damage (25%). Globally, neonates account for 45% of under-five deaths, low-countries account for 23%, Ethiopia accounts for 34%, and birth asphyxia causes about 23-40% of neonatal death. Despite this evidence that birth asphyxia was a leading and preventable cause of neonatal morbidity and mortality in developing countries, birth asphyxia determinants were not systematically investigated and limited data in Ethiopia, particularly in the study area, and early identification and management of its main factors would reduce the problem. Thus, this study aimed to identify the determinants of birth asphyxia among newborns at Debre Markos referral hospital, Northwest Ethiopia.

Methods: This research followed a hospital-based an unmatched case-control study design at Debre Markos referral hospital, Northwest Ethiopia, among 372 newborns (124 asphyxia cases and 248 non-asphyxia controls) from August 1/2019 to October 30/ 2019. Ethical approval was received from the Debre Markos University Board of Institutional Review. A pretested structured questionnaire was used to collect data. Data were entered in Epi-data version 3.1 and transferred to STATA version 14.0 for analysis and logistic regression was used to determine possible factors of candidate variables with p-value <0.2 for the final model. Birth asphyxia determinants were considered using an adjusted odds ratio of 95% CI and p-value <0.05.

Results: Prolonged labour (>12 hours) [OR=3.10], meconium stained amniotic fluid [OR=6.80], assisted vaginal delivery (vacuum or forceps) and C/S delivery [OR= 3.42], gestational age < 37 weeks [OR= 3.72], non-cephalic presentation (OR: 2.43), cord prolapse [OR=2.95], premature rupture of membrane [OR=12.27] were predictors variables.

Conclusion: In this study, prolonged labor (>12 hours), meconium-stained amniotic fluid, assisted vaginal delivery, gestational age < 37 weeks, non-cephalic presentation, cord prolapse and premature rupture of membrane were determinants of birth asphyxia. Therefore, to reduce neonatal mortality associated with birth asphyxia, attention should be given to holistic pregnancy, labor and delivery care, and post-natal care. Furthermore, intervention strategies aimed at reducing birth asphyxia should target the identified factors.

Keywords: Determinants, Birth asphyxia, Ethiopia.

Abbreviations

APGAR: Appearance, Pulse, Grimace, Activity, and Respiration; CI: Confidence Interval; AOR: Adjusted Odds Ratio; COR: Crudes Odd Ratio; WHO: World Health Organization; ANC: Antenatal Care; C/S: Cesarean Section; SVD: Spontaneous Vaginal Delivery.

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Introduction

Background

Birth asphyxia can be defined as the failure of neonates to initiate and sustain breathing at birth which is characterized by a marked impairment of gas exchange; if prolonged leading to progressive hypoxemia, hypercapnia, and significant metabolic acidosis [1]. Birth asphyxia is one of the most causes of morbidity and mortality in neonates in developing countries, with an incidence rate of 100-250/1000 live births compared to 5-10/1000 live births in the developed world [2]. Globally, 45% of under-five children death occurs during the neonatal period, accounting for about one-fourth of the 4 million neonatal deaths, which is responsible for 23% neonatal deaths in low-income countries [3]. In developing countries, neonatal deaths accounted for 52% of all under-5 child mortality in South Asia, 53% in Latin America and the Caribbean, and 34% in sub-

Saharan Africa due to preventable causes including perinatal asphyxia [4]. In Ethiopia, birth asphyxia is one of the driving causes of neonatal mortality, constituting 34%. Studies conducted in Nigeria, Southern Nepal, and Khulna Urban Slum, Bangladesh also suggest that birth asphyxia is responsible for about 23.9%, 30%, and 39% of the neonatal deaths, respectively. Common outcomes after birth asphyxia include multisystem organ dysfunction, neonatal neurological problems such as seizure, coma, and hypotonic (neonatal encephalopathy) [5]. The effect of birth asphyxia is not limited only to death but also has to lead to physical, mental and social incapability in newborns due to severe hypoxic-ischemic organ damage [3]. Birth asphyxia is caused by a complex range of factors, grouped as occurring before birth (antepartum factors) (50–70%), during birth (intrapartum factors) (20–40%) and after birth (post-partum factors) (10%) [4, 5]. Common risk factors of birth asphyxia include maternal age under 16 or over 35 years old, gestational age <37 or >41 weeks, diabetes, drugs and alcohol, hypertensive disorders, bleeding in the second or third trimester, prolonged labor, cesarean section, instrumental delivery, prolonged and premature rupture of membranes, meconium staining, maternal infection and comorbidity during pregnancy [6, 7].

Commonly known determinants of birth asphyxia vary across regions, depending on the context. In Ethiopia, where birth asphyxia is the leading cause of neonatal mortality, early recognition and management of the determinants of birth asphyxia are paramount importance to prevent it, reducing neonatal mortality and improving the neonatal quality of life. It is therefore necessary to identify the specific determinants in a particular region to take appropriate local action. Despite this evidence that birth asphyxia was a leading and preventable cause of neonatal morbidity and mortality in developing countries, birth asphyxia determinants were not systematically investigated and there is limited data on the determinants of birth asphyxia in Ethiopia, particularly in the study area, and early identification and management of its main factors would reduce the problem. Thus, this study aimed to identify the determinants of birth asphyxia among new-borns at Debre Markos referral hospital, Northwest Ethiopia. The findings of this study will be used as an input for policymakers and program planners who work on the area to inform, plan, implement and evaluate health promotion policies and strategies on the reduction of under-five children mortality and improvement of child health care.

Materials and Methods

Study design, period and setting

Institution-based unmatched case-control study design considering as cases neonates with asphyxia and those without asphyxia as controls among new-borns delivered from August 1/2019 to October 2019 at Debre Markos referral hospital in East Gojjam, Amhara regional state which 299 km from Addis Ababa, Ethiopia's capital city. The town has a total population of 132363, of which 66,314 (50.5%) are female and 66,049 (49.5%) are male.

Study participants

The study population was both asphyxiated and un-asphyxiated newborns admitted to the Debre Markos referral hospital's neonatal intensive care units (NICU). All live newborns who were born after 28 weeks of gestation were screened for eligibility. The study classified participants into cases and controls. Newborn babies with < 7 APGAR scores at 5 minutes and biochemical marker evidence (metabolic acidosis and multiorgan failure) were defined as having asphyxia at birth (cases), while newborn babies with ≥7 APGAR scores at 5 minutes and no biochemical marker evidence (metabolic acidosis and multiorgan failure) were considered not to have asphyxia (controls). The research included newborns who met the case-control definition and whose mother gave informed consent. The study excluded newborns who had met the case-control definition but whose mothers had not been interviewed on a voluntary basis. We also excluded newborns with one or more life-threatening malformations, including congenital cyanotic heart defects and hydrops, and other severe birth defects.

Sample size calculation and sampling techniques

The sample size was estimated using an unmatched case-control formula (Kelsey), which assumed a confidence level of 95%, power (80%) and case-control ratio of 2, and odds ratio (OR) of 2 to be defined as significant using Epi-info7. The proportion of non-asphyxia neonates (controls) (31.3%) and asphyxia cases (60.0%) with prolonged labor exposure (>12 hours) were obtained from a previously conducted study [18] and the total sample size was obtained by adding 10% non-response rate, which was 372 (124 cases and 248 controls). Newborns were classified as cases and controls based on case and control classification criteria, and each asphyxiated baby was identified as a case, while each un-asphyxiated newborn was enrolled as a control. Cases and controls were recruited on a continuous basis between August 1, 2019 and October 30, 2019 until the appropriate sample size was reached for both groups.

Data collection tool and procedure

Data were collected using a pre-tested an adapted standardized questionnaire [3] administered by interviewees, observational and chart analysis was used to gather data on socio-demographic maternal variables, variables related to obstetric history (mother's age, education, pregnancy number, parity, history of pregnancy outcome, gestational age; antepartum factors (prime parity, maternal fever, pregnancy-induced hypertension, anemia, peripartum hemorrhage, history of previous neonatal deaths); intrapartum factors (mal-presentation, prolonged labor, meconium-stained liquor, pre-eclampsia, eclampsia, oxytocin augmentation of labor, complicated labor, mode of delivery); fetal factors (sex, birth weight, the maturity of the newborn). The tools were prepared in English and translated to Amharic; eventually, it was translated back to English to check the consistency. Birth asphyxia was determined using APGAR score which consisted

of five components such as appearance (color), pulse (heart rate), grimace (reflexes), activity (muscle tone) and respiration, each with a score of 0, 1, or 2. A score of (≥7) showed no asphyxiation of a newborn while a low score (< 7) revealed an asphyxiated newborn [4].

Data quality control

The quality of the data was ensured by using properly designed data collection tools. Data collectors and supervisors obtained two-day training on data collection procedures, techniques and methods. Prior to data collection, the questionnaire was tested in five percent (7 cases and 14 controls) at Lumame hospital to verify the questioner's accuracy. Clarification of question and time to complete the questionnaire was assessed. The supervisors and the principal investigator reviewed and updated the computed questionnaires every day, and the data collectors provided the necessary input for the next morning before the actual procedures began.

Study variables

Birth asphyxia was the dependent variable. While the independent variables include maternal characteristics and variables related to obstetric history (mother's age, education, pregnancy number, parity, history of pregnancy outcome, gestational age; antepartum factors (prime parity, maternal fever, pregnancy-induced hypertension, anemia, peripartum hemorrhage, history of previous neonatal deaths); intrapartum factors (mal-presentation, prolonged labor, meconium-stained liquor, pre-eclampsia, eclampsia, oxytocin augmentation of labor, complicated labor, mode of delivery); fetal factors (sex, birth weight, the maturity of the new-born).

Data analysis

Data was entered in Epi-data version 3.1 and transferred to STATA version 14.0 for analysis. Using descriptive statistics, socio-demographic factors, ante-partum, intra-partum, and neonatal related factors are presented using frequency tables, figures, and percentages. In the second stage, bivariate logistic regression was used to identify possible factors of candidate variables with p-value <0.2 for the final model. The model fitness test was carried out using the Hosmer – Lemeshow test, which is a statistical test for fitness for logistic regression models. Finally, the multivariable logistic regression model was fitted to identify significant determinants of birth asphyxia through backward stepwise method; determinants of birth asphyxia among new-borns were determined using their adjusted odds ratio with 95% CI and p-value < 0.05.

Operational definitions

Birth asphyxia: Neonate failure to start and sustain sufficient respiration within 5 minutes of birth with an Apgar score below 7 and biochemical marker evidence (metabolic acidosis and multiorgan failure)[2].

Cases (asphyxiated newborns): neonates born in the studied hospital and diagnosed with asphyxia by the attending health professionals using an Apgar score of less than 7 at 5 minutes after birth and biochemical marker evidence (metabolic acidosis and multiorgan failure).

Controls (un-asphyxiated newborns): neonates born in the studied hospital and diagnosed as un-asphyxiated by the attending health professionals using an APGAR score of more than 7 at 5 minutes and no evidence of biochemical markers (metabolic acidosis and multiorgan failure).

Results

Socio-demographic characteristics

In this study, a total of 372 newborns (124 cases and 248 controls) were included in the analysis. Of whom 57% of the mothers who gave birth to these neonates are aged between 19 - 34 years. About 71.8 % of the mothers who gave birth to these neonates were aged 19-34 years in the age range among cases. Moreover, 49.6 % of the responding mothers who gave birth to the neonates were aged between 19-34 years, from the controls. Also, 67.7% of the cases mothers and 24.6 % of the controls were rural inhabitants. Twenty-three (23.4%) of the cases mothers and 24.2% of the controls did not have formal education (Table 1).

	Response	**Birth asphyxia**	
Variables	Category	Yes (cases)	No (controls)
Residency	Urban	40 (32.3)	187 (75.4)
	Rural	84 (67.7)	61 (24.6)
Age	≤ 18	20 (16.1)	43 (17.3)
	19-34	89 (71.8)	123 (49.6)
	≥ 35	15 (12.1)	82 (33.1)
Marital status	Married	105 (84.7)	195 (78.6)
	Unmarried	19 (15.3)	53 (21.4)
Religion	Orthodox	110 (88.7)	223 (89.9)
	Muslim	12 (9.7)	22 (8.9)
	Protestant	2 (1.6)	3 (1.2)
Ethnicity	Amhara	120 (96.8)	242 (97.6)
	Oromo	4 (3.2)	6 (2.4)
Occupation	Government	25 (20.2)	74 (29.8)
	Private	20 (16.1)	55 (22.2)
	Merchant	15 (12.1)	33 (13.3)
	Housewives	52 (41.9)	44 (17.70
	Student	12 (9.7)	42 (16.9)
Education	Primary	50 (40.3)	71 (28.6)

	Secondary	21 (16.9)	64 (25.8)
	College	24 (19.4)	53 (21.4)
	Not read and write	29 (23.4)	60 (24.2)

Table 1. *Distribution of socio-demographic characteristics of cases and controls attending in Debre Markos referral hospital, Northwest Ethiopia 2019.*

Maternal and antepartum related factors

Sixty-nine (55.60 %) of the mothers in the cases and (48.8 %) of the controls were multipara. There was a higher rate of ANC 4 visits among cases (52.4 %) than controls (41.1%), and the incidence of comorbidity among cases during pregnancy (38.7 %) was higher in proportion than controls (24.2 %). A duration of < 37 weeks of pregnancy was more common among cases (32.3 %) than controls (11.2 %) (Table 2).

Variables	**Response**	**Birth asphyxia**	
Category		Yes (cases)	No (controls)
		Count (%)	Count (%)
Gravidity	Primi	55 (44.4)	127 (51.2)
	Multi	69 (55.60)	121 (48.8)
ANC follow up	Yes	65 (52.4)	102 (41.1)
	No	59 (47.6)	146 (58.9)
Comorbidity during pregnancy	Yes	48 (38.7)	60 (24.2)
	No	76 (61.3)	188 (75.8)
Fetal presentation	Noncephalic	36 (29.0)	36 (14.5)
	Cephalic	88 (71.0)	212 (85.5)
Mode of delivery	Assisted/ instrumental	42 (33.9)	33 (13.3)
	SVD	82 (66.1)	215(86.7)
Prolonged labor	> 12hr	86 (69.4)	83 (33.5)
	≤ 12hr	38 (30.6)	165 (66.5)
Labor type	Induced	24 (19.4)	38 (66.5)
	No induced	100 (80.6)	210 (84.7)
Meconium stained amniotic fluid	Yes	46 (37.1)	37 (14.9)
	No	78 (62.9)	211 (85.1)
Gestational age	< 37weeks	40 (32.3)	31 (12.5)
	≥ 37weeks	84 (67.7)	217 (87.5)
Fetal Outcome	Multiple	30 (24.2)	43 (17.3)
	Single	94 (75.8)	205 (82.7)
Fetal distress	Yes	53 (42.7)	48 (19.4)
	No	71 (57.3)	200 (80.6)
Birth weight	< 2500	69 (55.6)	90 (36.3)
	≥ 2500	55 (44.4)	158 (63.7)

Table 2. *Characterization of cases and controls of antepartum and intrapartum and fetal factors of birth asphyxia among new-borns delivered in Debre Markos referral hospital, Northwest Ethiopia 2019.*

Intrapartum related characteristics and neonatal/ fetal related factors

The non-cephalic fetal presentation was relatively common among cases (29.0 %) compared with controls (14.5 %). There was also a disparity in proportion in terms of prolonged labor (>12 hours), where (69.4%) of cases were born after prolonged labor and only (33.5%) of controls were born after prolonged labor. Forty-six (37.1 %) cases and (14.9%) controls had meconium stained on pelvic examination in their mothers. Forty (32.3%) of the cases and only (12.5 %) of the controls were preterm; (55.6 %) and (36.3 %) were low birth weight. There were (24.2 %) twin newborns among the cases and (17.3 %) among the controls Table 2.

Determinants of birth asphyxia

Bivariate analysis was performed in binary logistic regression analysis to analyze the possible determinants of birth asphyxia, and variables with a p-value of ≤ 0.2 were used in the multivariable model. The analysis of bivariate logistic regression showed that educational status, gravidity, ANC follow-up, co-morbidity during pregnancy, fetal presentation, delivery mode, prolonged labor, type of labor, meconium-stained amniotic fluid, gestational age, fetal outcome, fetal distress, and birth weight were associated with birth asphyxia. Multivariable logistic regression was performed by simultaneously taking into account those variables. Stepwise the backward regression elimination process was used to assess the confounding variables. Finally, birth asphyxia was only found to be associated with co-morbidity during pregnancy, fetal presentation, mode of delivery, prolonged labor, meconium-stained amniotic fluid, gestational age, fetal distress and birth weight at $p<0.05$ at 95% CI after adjustment for potential effects of confounding variables.

It was found that meconium-stained amniotic fluid has a significant association with the risk of birth asphyxia. In particular, neonates delivered from mothers with meconium-stained amniotic fluid were almost four times more likely than counterparts to develop birth asphyxia (AOR = 4.25, 95 % Cl; 2.67, 6.73). The likelihood of developing birth asphyxia among neonates born from prolonged-labor mothers (> 12 hours) was 2.69 times higher than their counterparts (AOR = 2.75, 95 % CI: 1.18, 6.94). Neonates with intrapartum fetal distress were 5.45 times more likely to experience asphyxia at birth than those born with normal fetal heart rate (AOR = 5.45; 95 % Cl: 2.48, 7.19). Assisted vaginal delivery (vacuum or forceps) and C/S delivery poses a 2.80-fold higher risk of newborn asphyxia compared to mothers with spontaneous vaginal delivery (AOR=2.80, 95% CI:1.20, 3.39). Neonates born with low birth weight were 4.20 times more likely to have birth asphyxia compared with those born with normal weight (AOR = 4.20,

95 % CI: 2.78, 6.71). Concerning fetal presentations, newborns with the non-cephalic presentation were 5.20 times more likely than those with a cephalic presentation to experience birth asphyxia (AOR: 5.20, 95% CI: 3.27, 8.28). Also, co-morbidity during pregnancy was 3.40 times more likely than their counterpart to develop birth asphyxia (AOR=23.40, 95% CI: 1.52, 3.67). Furthermore, preterm babies were 2.60 times more likely to develop birth asphyxia than the term (AOR = 2.60, 95 % CI:1.66, 4.45) (Table 3).

Variables	Response category	Birth Asphyxia			
		Yes (cases)	No (controls)	COR (95% CI)	AOR (95% CI)
Residency	Urban	69	187	1	1
	Rural	55	61	2.44(1.55, 3.86)	-
Education	Not read and	29	60	2.15(1.164, 3.96)	-
	Write				
	Primary	50	71	1.56 (.85, 2.84)	-
	Secondary	21	64	1.46(. 822,2.58)	-
	College	24	53	1	1
Gravidity	Primi	55	127	1.32(.85, 2.03)	-
	Multi	69	121	1	1
ANC follow up	Yes	65	102	1	1
	No	59	146	1.56 (1.022, 2.433)	-
Comorbidity during pregnancy	Yes	48	60	1.98 (1.25, 3.15)	3.40(1.52, 3.67)
	No	76	188	1	1
Fetal presentation	noncephalic	36	36	2.41 (1.43, 4.07)	5.20 (3.27, 8.28)
	Cephalic	88	212	1	1
mode of delivery	assisted/ instrumental	42	33	3.34(1.98, 5.63)	2.80(1.20, 3.39)
	SVD	82	215	1	1
Prolonged labor	> 12hr	86	83	4.45 (2.83, 7.16)	2.69(1.88, 4.63)
	≤ 12hr	38	165	1	1
Labor type	Induced	24	38	1.33 (.76, 2.33)	-
	None	100	210	1	1
meconium-stained amniotic fluid	Yes	46	37	3.37(2.03, 5.57)	4.25(2.67, 6.73)
	No	78	211	1	1
Gestational	< 37wk	40	31	3.33 (1.96, 5.68)	2.60 (1.66, 4.45)
Age	≥ 37wk	84	217	1`	1
Outcome	Multiple	30	43	1.52 (.90, 2.58)	-
	Single	94	205	1	1
Fetal distress	Yes	53	48	3.11 (1.93, 5.00)	5.45; 95% C(2.48, 7.19)
	No	71	200	1	1
Birth weight	< 2500	69	90	2.20 (1.42, 3.42)	4.20 (2.78, 6.71)
	≥ 2500	55	158	1	1

Table 3. *Bivariate and multivariable logistic regression among factors of cases and controls attending Debre Markos referral hospital, Northwest Ethiopia 2019.*

Discussion

Birth asphyxia is the leading cause of mortality for newborns; the effect of birth asphyxia is not limited only to death but also has to lead to physical, mental and social incapability in newborns due to severe hypoxic-ischemic organ damage [3]. Hence, to reduce the overall newborn mortality and its long-term consequences the quality of medical care before birth, at birth, and after birth is essential. This research is important to understand the current birth asphyxia factors that affect them, to intervene and to increase the satisfaction and use of maternal and neonatal health services by individuals, families, and communities and to establish criteria for improving the quality of maternal and newborn care in health care facilities. This research aimed to identify birth asphyxia risk factors to overcome the burden of the disease and its related problems. It has been attempting to look at the determinants of birth asphyxia by incorporating as many risk factors as possible. Birth asphyxia was found to be associated with co-morbidity during pregnancy, fetal presentation, delivery mode, prolonged labor, meconium-stained amniotic fluid, gestational age, fetal distress and low birth weight.

The odds of birth asphyxia were 4.25 times higher among neonates born from mothers with a history of meconium-stained amniotic fluid. This finding was similar to previous studies in Uganda, India, and Sweden [1-3]. The plausible reason could be that meconium-stained amniotic fluid occurs in peripartum inhalation with meconium-stained amniotic fluid, contributing to chemical pneumonia with pulmonary tissue swelling, mechanical airway congestion, and pulmonary air loss, leading to hypoxia [4]. The likelihood of developing birth asphyxia among neonates born from prolonged-labor mothers (> 12 hours) was 2.69 times higher than their counterparts. This result is compatible with the results of a study conducted in Dire Dawa and Malawi [5, 6]. This may be since, if labor does not proceed normally a mother may suffer serious complications, such as maternal and neonatal infection dehydration exhaustion or rupture of the uterus and fetus, which may contribute to the birth of asphyxia [7]. Neonates with intrapartum fetal distress had a nearly 5.74 times higher

risk of developing birth asphyxia. Similar results have been reported in previous studies in Northwest Ethiopia and Al-Diwaniya. A possible reason is that fetal distress is the primary indication of emergency C/S, a known risk factor for birth asphyxia. Assisted vaginal delivery (vacuum or forceps) and C/S delivery poses a 2.80 times higher risk of newborn asphyxia compared to mothers with spontaneous vaginal delivery. This result is comparable to the study done in Turkey, China, Nepal, and Cameroon. Newborns delivered by C/S may be either the majority of mothers have had complications, or the decision on C/S may be taken late after complications have occurred, the fetus chest may be stretched when the newborn passes through the birth canal in the vaginal delivery, which may evacuate the secretion. This reduces the chance of developing birth asphyxia. Neonates born with low birth weight were 4.20 times more likely to have birth asphyxia than those born with normal birth weight. Previous studies reported similar results in Iran, Thailand, and Nigeria. It could be because a high proportion of small babies may be pre-term, after all they may not have adequate surfactants that could contribute to difficulty breathing and having discomfort in the cardiopulmonary transfer and eventually developed birth asphyxia. Concerning fetal presentations, newborns with the non-cephalic presentation were 5.20 times more likely than those with a cephalic presentation to experience birth asphyxia. These findings were supported by the study done in Cameron, Uganda, Nigeria, Thailand. It may be due to a higher likelihood of umbilical cord prolapse, head entrapment, birth complications, and perinatal mortality. Also, co-morbidity during pregnancy was 3.40 times more likely than their counterpart to develop birth asphyxia. This may be because diseases and complications during pregnancy are the most significant risk factors for perinatal mortality, peripartum complications were the most important factors associated with increased risk of birth asphyxia. Newborns born with a gestational age < 37 weeks 2.60 times are more likely to develop birth asphyxia compared to neonates with a gestational age of ≥ 37 weeks. This study is in line with a study conducted in Jordan and Brazil. This may be attributed to premature infants who are more vulnerable to ischemia due to incomplete blood-brain barrier development, and preterm infants face multiple morbidities including the organ system, particularly lung immaturity triggering a respiratory failure.

Strengths and limitations

This was the first birth asphyxia study in the study area and was able to show determinants of birth asphyxia. We used the case-control study design that was appropriate to address the research question and enabled the identification of possible birth asphyxia predictors. This research is quantitative; if qualitative approach was also used it would be stronger to examine the extra determinants of birth asphyxia in depth. This research was often revealing of maternal bias as they recalled their previous past. Using small samples, it's difficult to generalize to society at large. Therefore, larger studies need to demonstrate true associations in the population.

Conclusion

This study identified that the main determinants of birth asphyxia were fetal distress, assisted / instrumental delivery, low birth weight, non-cephalic presentation, preterm, prolonged labor, co-morbidity during pregnancy and meconium tainted amniotic fluid. Most of these factors are preventable through holistic care for pregnancy, labor and delivery, and post-natal care. Therefore, to reduce neonatal mortality associated with birth asphyxia, attention should be given to holistic pregnancy, labor and delivery care, and post-natal care. Furthermore, intervention strategies aimed at reducing birth asphyxia should target the identified factors.

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Authors' contributions

YMA, TYA, MG and MT: Approved the proposal with some revisions, developed the design and methodology of the study, literature review, quality evaluation, statistical analysis, data interpretation and drafting of the manuscript.

YMA, AN, YAA and WSS: Wrote the proposal, participated in data collection, and analyzed the data. They were also participated in statistical analysis and interpretation, quality assessment, prepared the final draft of the manuscript. Finally, all authors read and approved the final manuscript.

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Availability of data and materials

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

Ethics approval and consent to participate

The ethical clearance letter has been received from the research and review committee at Debre Marks University. Additionally, prior to beginning data collection permission was obtained from the hospital authority. Finally, an informed written consent was received from each participant mothers after explaining to them the research objectives. The participants were briefed on the study's purpose, procedures, potential risks, and benefits. In addition, the participants were told that failure to agree to or withdraw from the study would not change or endanger their access to treatment.

Consent for publication

Not applicable.

Competing interests

The authors state no competing interests.

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