

# Birth asphyxia and its contributing factors among the neonates delivered at Negest Eleni Mohammed memorial teaching hospital, Southern Ethiopia: A cross-sectional study

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## Research article

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# Abstract

**Background :** Birth asphyxia is a major contributor to neonatal mortality worldwide. In Ethiopia, birth asphyxia remains a severe condition that leads to significant mortality and morbidity. This study aimed to assess the prevalence and contributing factors of birth asphyxia among the neonates delivered at the Negest Eleni Mohammed Memorial Teaching Hospital, Southern Ethiopia.

**Methods:** A hospital based cross-sectional study design was employed from June 1- 30, 2019. Two hundred seventy nine study participants were selected using the systematic sampling method. Data were collected using a pretested structured interviewer administered questionnaire, check list and chart review . Data were entered into Epi-data version 3.1 and analyzed using statistical package for social sciences version 24. Descriptive and binary logistic regression analysis were made and P value of < 0.05 was considered significant.

**Result:** The overall prevalence of birth asphyxia among newborns was 15.1%. Factors that were significantly associated with birth asphyxia included mothers aged  $\geq 35$  [AOR=6.4, 95% CI (2.0, 20.5)], primigravida [AOR=5.1, 95% CI (2.0, 13.3)], prolonged second stage of labor [AOR=4.6, 95%CI (1.6, 13.3)], preterm birth [AOR=4.7, 95% CI (1.5, 14.1)], meconium stained amniotic fluid [AOR=7.5, 95% CI (2.5, 21.4)]and tight nuchal [AOR=3.1, 95% CI (1.2, 9.3)].

**Conclusion:** Birth asphyxia is still prevalent in the study setting. The results of this study show the need for better maternal care, creating awareness about contributing factors of birth asphyxia to the maternity health professionals, careful monitoring of labor, and identifying and taking proper measures that could help in reducing the occurrence of birth asphyxia.

## Background

Birth asphyxia is defined by the World Health Organization (WHO) as ‘the failure to initiate and sustain breathing at birth [1]. It is a major contributor to the neonatal mortality worldwide [2-5], and it contributes to 24% of all neonatal deaths [3] and 11% of deaths of those under 5 years worldwide [2]. Almost all asphyxia-related deaths (98%) occur due to asphyxia that occurred in the first week of life [6]. About 75% of the total asphyxia-related deaths were caused on the first day alone. Less than 2% of these deaths occurred after 72 hours of birth [5].

Birth asphyxia is a leading cause of brain damage. If severe, it can injure brain cells and cause potentially fatal conditions, including hypoxic-ischemic encephalopathy, brain injuries, autism, attention deficit hyperactivity disorder, behavioral problems, seizures, and cerebral palsy [7]. Additionally, survivors often face lifelong health problems (80%), such as disabilities, developmental delays, palsy, mental retardation, intellectual disabilities and behavioral problems [7-9]. Furthermore, it places financial and emotional burdens on the concerned families and communities as a whole [7].

Birth asphyxia is caused by a complex range of factors, which vary between industrialized and non-industrialized countries. The factors are grouped as occurring before birth (antepartum factors) (50-70%), during birth (intra-partum factors) (20-40%) and after birth (post-partum factors) (10%) [10, 11]. Antepartum factors include severe maternal hypotension or hypertensive diseases during pregnancy [12, 16], antepartum hemorrhage [13, 14], history of still birth [15], no antenatal care follow up or antenatal care visits [13, 15, 16], oligohydramnios [16], maternal fever [12, 13, 16, 17] and maternal anemia [12, 15, 16]. Intrapartum factors including malpresentation [12, 13, 15, 16, 35], prolonged second stage of labor [13,14,18], home delivery [12,17], obstructed labor( [12,17,19], oxytocin use [14] and meconium stained amniotic fluid [12, 15 - 17]. Fetal factors associated for birth asphyxia include low birth weight [12, 17, 16], large birth weight [18], multiple gestation [16], tight nuchal cord [13, 18], preterm delivery [12, 16, 18], resuscitation and fetal distress [16, 32].

In addition, some studies revealed that young age [12, 17, 21], advanced maternal age [20], and educational status (illiterate and primary education level) [15, 21] are contributing factors of birth asphyxia. The concept that difficult birth is the main reason of birth asphyxia and subsequent sequel has in industrialized countries been challenged the recent years. However, in developing countries intrapartum, events still are the most important cause of birth asphyxia [9].

The Federal Ministry of Health (FMOH) developed the first comprehensive National Child Survival Strategy (2005-2015) in 2005, aiming to reduce under-five mortality by two thirds. Since its development in 2005, several evidence-based interventions that need to be incorporated in the strategy have been initiated. These include community management of pneumonia through Integrated Community Case Management; community-based newborn sepsis management through the Community Based Newborn Care; Newborn Intensive Care Unit; Newborn Corner; and introduction of Hemophilus Influenza, Pneumococcal, and shifting PMTCT to "Option B+" [22]. The guidelines to treat birth asphyxia are also well established in Ethiopia and made available even at the health-center level to assess by classifying [23].

Despite this a high proportion of newborn deaths due birth asphyxia was reported in Ethiopia. From the observations thus far, the issue of birth asphyxia remains unresolved. Ethiopia's rate of neonatal mortality is still among the highest in Sub Saharan Africa [24, 25]. In 2015, nearly 240 babies in their first month died each day [26]. Birth asphyxia is the leading cause of neonatal deaths and accounts about 31.6% of neonatal mortality, followed by preterm birth (21.8%) and sepsis (18.5%) [27]. Moreover, the findings from studies conducted in Tigray [28] and Gondor [29] to identify causes of neonatal mortality revealed that birth asphyxia was responsible for 35% and 12.5% of neonatal deaths, respectively.

Analysis of birth asphyxia is important because it may reveal possible statuses leading to the birth asphyxia, which, if acted upon, may benefit a child's health. Therefore, this study aimed to assess the magnitude and risk factors of birth asphyxia among neonates delivered in the Negist Eleni Mohammed memorial teaching Hospital, Southern Ethiopia.

# Methods

## Study setting, population, sample size and technique

It was hospital-based cross-sectional study employed at Negest Eleni Mohammed memorial teaching Hospital from June 1- 30, 2019. Source populations were all mothers with their newborns delivered in the hospital during the study period. Study population were all randomly selected mothers with their newborns delivered during the study period and mothers who couldn't communicate were excluded from the study.

The sample size was determined by using the single population proportion formula. The following assumptions were used to estimate the sample size; the proportion of birth asphyxia was taken from the study conducted in Jimma Public Hospitals (12.5%) [13], 95% confidence interval, desired precision 4%, and 5% none response rate, the final sample size was 279.

Systematic sampling was employed to select study subjects. By considering average numbers of clients who deliver daily during the data collection period was estimated based on the previous day client flow of the units was obtained by referring delivery registration book/ record for a month prior to data collection. The study subjects were selected every 3 till final sample size filled. If a mother gives more than one baby, one baby was selected by using a simple random sampling method.

## Data collection procedure

Data were collected using a combination of a pretested structured interviewer-administered questionnaire, observation check list and client's chart reviewed, which was used to retrieve medical information and mother's test results that could not be captured by the interview. The questionnaire was developed based on the instrument that was applied in other related studies [13-21, 30, 31]. It was structured into four parts, namely, sociodemographic characteristics, antepartum factors, intrapartum factors and fetal condition and postpartum factors. Three B.Sc. degree midwives who are able to speak both Hadiyisa (local language) and Amharic were recruited for the data collection, and three M.Sc. midwives participated in supervising the data collectors. Data collection began from the admission of a mother to the labor ward and lasted till the 5<sup>th</sup> minute after delivery. The filled questionnaire was collected and signed by the supervisor after it was checked for any missing items and completeness.

To ensure the quality of data to be gathered from the study subjects, the questionnaire was translated first to the local language and then translated back to English by experts to check its consistency. The instruments were pretested on 5% of the sample size in similar settings, and necessary modifications were made based on the nature of gaps identified in the questionnaire. Additionally, data collectors and supervisors were oriented for a day by the investigators on the content of the questionnaire and the ways to collect the data. Moreover, the supervisors and the investigators closely followed the day-to-day data

collection process during the pretest and the actual data collection. Furthermore, at the end of each day, the questionnaires were reviewed by the investigators, and corrective measures were undertaken. Moreover, cross check was done on 10% of the sample size.

## Measurement

**Birth asphyxia:** in this study the definition of clinical asphyxia will be defined by hospital protocol as newborns with a 5-min Apgar score 7 and birth asphyxia dichotomized as present (birth asphyxia or absent (no-birth asphyxia)).

## Data processing and analysis

Data were entered using the Epi-data version 3.1 and exported to the SPSS version 24.0 software for analysis. Descriptive statistics; frequency and proportions were computed to summarize the data. Logistic regression analyses was made to identify contributing factors with birth asphyxia. First, bivariate logistic regression analysis was made for all independent variables. Multivariable logistic regression was performed for variables that have p-value 0.25 during the bivariate logistic regression analysis. The degree of association between independent, and dependent variables were assessed using odds ratio with 95% confidence interval. At the end, p 0.05 was considered as statistically significant in the multivariable model. The Hosmer-Lemeshow had p- value of 0.87 which illustrates that it is not statistically significant which confirmed the model was a good fit.

## Results

A total of 279 participants were involved in this study, wherein the response rate was 100%. Approximately, 83.9% of the participating mothers were aged 25–34 years. The majority of the participants were married 271 (97.1%), 224 (80.3%) of them were Hadiya ethnics, 209 (74.9%) were protestants in terms of their religion, and 185 (66.3%) were housewives. Regarding their educational status, 54 (19.4%) of them had pursued higher education, and 122 (43.7%) were rural residents (**Table 1**).

Furthermore, among the 279 study participants, 189 (32.3%) of them were multigravida. Twenty four (12.5%) participants had ever experienced abortion, while 23 (12.4%) of them had a history of still birth. The majority of the mothers, i.e. 252 (90.3%) participants, were at the gestational age of  $\geq 37$  weeks, while 157 (56.3%) had  $\geq$  four antenatal care visits. Moreover, 44 (15.8%) had faced pregnancy-related complications, wherein 13 (29.5%), 12 (27.3%), 11 (15%), 5 (11.4%), and 3 (6.8%) encountered antepartum hemorrhage, hypertensive disorders, premature rupture of fetal membranes, hyperemesis gravidarum,

and other, respectively. Among all the deliveries attended, 26 (9.6%), 19 (7%), and 13(4.8%) participants encountered prolonged second-stage labor, obstructed labor, and malpresentation/malposition during labor, respectively. With respect to the onset of labor, 154 (22.3%) were spontaneous and 40 (14.3%) mothers gave birth via caesarean section. Regarding their medical illnesses, 11 (3.9%) mothers suffered from a chronic medical problem. In addition, 52 mothers (18.6%) faced acute febrile illness during their current pregnancy, and in 42 (15.1%) participants, the intrapartum hemoglobin level was 11gm/dl (**Table 2**).

Moreover, 273(91% newborns had a normal birth weight, and 149 (53.4%) of them were males. Regarding fetal presentation, 264 (94%) cases were vertex presentation, while 270 (96.8%) deliveries were singleton. Further, in 27 (9.7%) participants, amniotic fluid was meconium stained, while 29 (10.4%) newborns faced tight nuchal cord. In this study, the overall prevalence rate of birth asphyxia was 42(15.1%) (**Table 3**).

**Table 1. Sociodemographic characteristics of mothers who delivered in the Negest Eleni Mohammed Memorial Teaching Hospital, Southern Ethiopia, June 2019.**

	Variable	Frequency(N=279)	Percent
Age group	15-19	17	6.1
	20-34	234	83.9
	35	28	10.0
Residence	Urban	157	56.3
	Rural	122	43.7
Marital status	Married	271	97.1
	Other	8	2.9
Religion	Protestant	209	74.9
	Orthodox	34	12.2
	Muslim	30	10.8
	Catholic	6	2.2
Ethnicity	Hadiya	224	80.3
	Kambata	28	10.0
	Silte	18	6.5
	other(specify)	9	3.2
Educational status	Able to read and write	29	10.4
	Primary school completed	101	36.2
	High and preparatory school	95	34.1
	Higher institution	54	19.4
Occupation	Government employee	41	14.7
	Merchant	43	15.4
	Housewife	185	66.3
	Others <sup>a</sup>	10	3.6

## Contributing factors of birth asphyxia

The outcome of the bivariate logistic regression analysis showed that, mothers aged  $\geq 35$ , primigravida, pregnancy related complication, primigravida, prolonged labour, preterm birth, meconium stained amniotic fluid and tight nuchal cord were contributing factors of birth asphyxia. However, in multivariable logistic regression analysis, mothers aged  $\geq 35$ , primigravida, prolonged second stage of labor, preterm birth, meconium stained amniotic fluid and tight nuchal cord were contributing factors of birth asphyxia. Mothers aged  $\geq 35$  were more or six times more likely to have experienced birth asphyxia respect to women in the age group between 20-34 years old [AOR=6. 4; 95%CI (2.0, 20.5)]. Similarly, the prolonged second stage of labor was 4.6 times more likely to have a birth asphyxia than their counterparts [AOR = 4.6; 95% CI (1.6, 13.3)]. Additionally, birth asphyxia was five times more likely to occur in primigravida in comparison to their counterparts [AOR = 5.1; 95% CI (2.0, 13.3)].

**Table 2. Obstetrics and medical characteristics of mothers among who delivered in the Negest Eleni Mohammed Memorial Teaching Hospital, Southern Ethiopia, June 2019.**

Variables		Frequency	Percent
Gravidity	Primigravida	90	32.3
	Multigravida	189	67.7
Gestational age at labor in weeks	Term	252	90.3
	Preterm	27	9.7
Number of Antenatal care visits		157	56.3
		121	43.4
Still birth(N=186)	No	163	87.6
	Yes	23	12.4
Ever had abortion (N=189)	No	165	87.3
	Yes	24	12.7
Pregnancy related complications	No	235	84.2
	Yes	44	15.8
Status of labor	Spontaneous	254	91.0
	Induction	17	6.1
	Elective CS	8	2.9
Prolonged second stage of labor(N=271)	No	245	90.4
	Yes	26	9.6
Malpresentation/malpresentation(N=271)	No	258	95.2
	Yes	13	4.8
Obstructed labor(N=271)	No	252	93
	Yes	19	7
Mode of current delivery	Normal vaginal	224	80.3
	Caesarian section	40	14.3
	Operative vaginal	15	5.4
Chronic medical illness	No	268	96.1
	Yes	11	3.9
Illness during pregnancy	No	218	78.1
	Acute febrile illness	52	18.6
	Anemia	5	1.8
	others	4	1.4
Hemoglobin Level(intrapartum)(N=261)	11gram/dl	219	78.5
	11gram/dl	42	15.1

**Table 3. Fetal and other factors among the neonates delivered at the Negest Eleni Mohammed Memorial Teaching Hospital, Hossana Town, Southern Ethiopia, June 2019.**

	Variables	Frequency	Percent
Sex of newborns	Female	130	46.6
	Male	149	53.4
Tight nuchal cord	No	250	89.6
	Yes	29	10.4
Fetal presentation	Vertex presentation	264	94.6
	Breech	9	3.2
	Others	6	2.2
Birth weight of newborn babies	Low birth weight	34	12.2
	Normal birth weight	224	80.3
	Macrosomia	21	7.5
Number of delivery/fetuses	Single fetus	270	96.8
	Twin	9	3.2
Resuscitation	No	247	88.5
	Yes	32	11.5
Meconium stained amniotic fluid	Yes	27	9.7
	No	252	90.3
Birth Asphyxia	No	237	84.9
	Yes	42	15.1

Furthermore, preterm birth was nearly 5 times more likely to develop birth asphyxia respect to their counterpart [AOR=4. 7; 95%CL (1.5, 14.1)]. Moreover, meconium stained amniotic fluid were 7.5 times more likely faced births asphyxia [AOR= 7.5; 95% CI (2.5, 21.4)] than their counterparts. Furthermore, tight nuchal cord were more or 3 times more likely to develop birth asphyxia respect to their counterpart [AOR=3. 1 95%CL (1.2, 9.3)] (Table 4).

## Discussion

In this study, the overall prevalence of birth asphyxia was found to be 15.1%. This is higher than seen in studies conducted in Tanzania, Dire Dawa (Ethiopia), and Jimma, which were 11.5%, 3.6%, and 12.5%, respectively [13, 21, 30]. The increased prevalence may be due to the hospitals from the study being referral hospitals, which had inferior health facilities. Further, this difference could be an indicator of the ineffectiveness of national strategies for maternal and newborn care services. In contrast, this study found a lower prevalence of birth asphyxia as compared to studies carried out in Zambia and Nigeria

which were 23% and 24.7%, respectively [9, 31]. The variation in our study might be due to differences in study design, setting, sample size and accessible maternal health care services.

In this study, mothers aged 35 were one of the contributing factors to birth asphyxia rates. The following discovery was very nearly found to be a universal fact: the increased age of the mother increased the risk of several adverse outcomes [32-34]. Similar findings were also reported from a study carried out in Cameroon [20] which revealed that mothers aged 35 were more likely to experience a birth asphyxia. However, in contrast to what was found in Ethiopia [21], and Pakistan [12, 18], a younger maternal age was not found to be a contributing factor of birth asphyxia in this study.

Primigravida was found to be a contributing factor of birth asphyxia and this was consistent with the research conducted in Ethiopia [13], India [16], and Pakistan [17, 18]. The most common obstetric complication was failure to progress in labor [35], which may subsequently result in the delivery of an asphyxiated baby.

This study also showed that mothers encountering a prolonged second stage of labor were at a greater risk for birth asphyxia with respect to their counterparts. These findings were similar to those of studies conducted in Ethiopia, Colombia and Pakistan [13, 14, 18]. One reason that babies born after a prolonged labor have a greater risk of birth asphyxia may be due to umbilical cord problems or the stress of too many contractions.

**Table 4. Contributing factors of birth asphyxia among the neonates delivered at the Negest Eleni Mohammed Memorial Teaching Hospital, Hossana Town, Southern Ethiopia, and June 2019.**

Variables	Birth asphyxia		COR(95%CI)	AOR (95%CI)	
	No	Yes			
Age group	<20	14	3	1.5(.4, 5.4)	.6(.1, 2.5)
	20-34(ref.)	204	30	1	1
		19	9	3.2(1.3, 7.8)*	6.4(2.0, 20.5)**
Residence	Urban(ref.)	137	20	1	1
	Rural	100	22	1.5(.8, 2.9)	.9(.4, 2.1)
Gravity	Primigravida	71	19	1.9(1.0, 3.8)*	5.1(2.0, 13.3)**
	Multigravida(ref.)	166	23	1	1
Pregnancy related complications	No	205	30	1	1
	Yes	32	12	2.6(1.2, 5.5)*	2.0(.7, 5.9)
Prolonged labor	No	216	29	1	
	Yes	16	10	4.7(2.0, 11.2)*	4.6(1.6, 13.3)**
Gestational age		219	33	1	1
		18	9	3.3(1.4, 8.0)*	4.7(1.5, 14.1)**
Color of amniotic fluid	Clear(ref.)	222	30	1	1
	Meconium stained	15	12	5.9(2.5, 13.8)*	7.5(2.5, 21.4)**
Tight nuchal cord	No	218	32	1	
	Yes	19	10	3.6(1.5, 8.4)*	3.1(1.2, 9.3)**

*Statically Significant at \*=p , \*\*=p*

Meconium stained amniotic fluid was a contributing factor to birth asphyxia, similar to what was reported in Ethiopia [13], India [15], and Pakistan [17]. Possibly, the presence of meconium in the amniotic fluid may cause aspiration of meconium-stained amniotic fluid to occur, and this can block small airways, deactivate surfactants and may also inhibit surfactant synthesis, resulting in birth asphyxia. As shown by the present study, prematurity

was found to have a significant association with birth asphyxia, which is in line with what has been found in Pakistan [13, 18] and India [16]. A baby being born before 37 completed weeks of pregnancy may develop birth asphyxia due to an insufficient amount of surfactant in the lungs.

Birth asphyxia was also found to be associated with a tight nuchal cord. This finding is similar to that of the studies conducted in Ethiopia [14] and Pakistan [18]. This might be related to tight nuchal cord cords can interrupt normal blood, nutrient, and oxygen exchange by compressing the umbilical cord, or restricts arteries and veins in the fetal neck, this can lead to [birth asphyxia](#) .

### **Limitations of the study**

In this study, Apgar score was used to diagnose asphyxia. However, using Apgar score alone to diagnose birth asphyxia has been found to be inappropriate and is an expression of the infant's physiologic condition at one point in time, which includes subjective components. Also, the study relied on hospital delivery. However, quite a number of deliveries occurred outside the hospital making it difficult to capture data such as birth asphyxia. So the estimates contained in this study may have underreported the cases at the community level.

## **Conclusions**

Birth asphyxia is still prevalent in the study setting. Primigravida, prolonged labour, preterm birth, and mothers aged  $\geq 35$  meconium stained amniotic fluid and tight nuchal cord were contributing factors of birth asphyxia. Results of this study show the need for the better maternal care, creating awareness about contributing factors of birth asphyxia to the maternity health professionals, careful monitoring of labor, identifying and taking proper measure could help in decreasing the occurrence of birth asphyxia. The results of the study will help policy-makers, program designers and Non-governmental organizations to support the study area. Additionally, the findings of the study can also help as a secondary data for further study in same area of inquiry.

## **Declarations**

### **Abbreviations**

AOR: Adjusted; CI: Confidence interval; COR: crude odds ratio; FMOH: Federal ministry of health; PMTCT: Prevention of mother-to-child transmission of HIV; WHO: World Health Organization

### **Ethics approval and consent to participate**

The ethical clearance letter was obtained from the office of the Vice President of Research and Community Services, Wachemo University. Additionally, permission was obtained from the hospital authority before commencing the data collection. Finally, written consent was

requested from each participant (mother), which has been included in the study during the data collection time, after explaining the objectives of the study to them. Parental consent was taken for respondents who were under 18 years of age. The participants were informed about the purpose, procedures, potential risks, and benefits of the study. Furthermore, the participants were ensured that refusal to consent or withdrawal from the study would not alter or put at risk their access to care.

### **Consent for publication**

Not applicable

### **Availability of data and materials**

All relevant data are within the manuscript and its supporting information files.

### **Competing interests**

The authors declare that they have no competing interests.

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We have not received any funding to conduct the study, develop the manuscript, or publish this manuscript.

### **Authors' contributions**

RA conceptualized the idea, carried out the analysis, interpreted the result, participated in the drafting the manuscript, revised the manuscript and approved the final manuscript for submission, responsible for submission and communication about the manuscript. BA, NG reviewed the manuscript and approved the final manuscript for submission. AA has conceptualized the idea, reviewed the manuscript and approved the final manuscript as submitted. HM has participated in conceptualization, data analyses and revised the manuscript and approved for the final manuscript for submission.

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