Neonatal Birth Trauma and Its Predisposing Factors Among Newborns Admitted to Public Hospitals in Eastern Ethiopia: A Cross-Sectional Study

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Abstract

Objectives: This study is to investigate the magnitude and predisposing factors for neonatal birth trauma in public hospitals in eastern Ethiopia. It is a major cause of neonatal morbidity and mortality. Despite its higher burden, evidence is limited in eastern Ethiopia. **Methods**: A cross-sectional study was conducted on 492 newborns selected using systematic random sampling. Data were analyzed using a binary logistic regression model. Statistical significance was set at $P < .05$. **Results:** The magnitude of neonatal birth trauma was 16.9% with 95% CI: 13.7-20.5%). In multivariable analysis, instrumental delivery, early preterm (<34 weeks), macrosomia, fetal malpresentation, male sex and, facility-based delivery such as hospital and health center-based delivery were factors associated with neonatal birth trauma. **Conclusions**: The magnitude of neonatal birth trauma was relatively high. Promoting health facilities-based delivery, prevention of preterm birth, the early decision on the mode, and minimizing instrumental deliveries help reduce neonatal birth trauma.

Keywords

birth trauma, newborn, neonate, associated factors, birth injury, Ethiopia

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Background

The National Vital Statics defines neonatal birth trauma (NBT) as "an injury of the neonate's body function or structure due to an adverse event that occurred at birth." Neonatal birth trauma is usually discussed interchangeably with the term "birth injury," which is used to describe minor skin lacerations to severe life-threatening conditions such as subgaleal hemorrhage, which is responsible for morbidity and mortality.[1-4]

NBT is a significant factor that increases the burden of morbidity and mortality.[5] For example, of the 2.4 million neonates who died in 2019, birth trauma accounted for 10% of deaths.[6] According to the 2018 World Health Organization (WHO) ranking report, NBT causes 0.13 to 33 per 100 000 population in low- and middle-income countries.[7] Deaths due to birth trauma accounted for 16.25 per 100 000 population in Ethiopia.[7] Moreover, NBT is a significant cause of short- and long-term deformities and disabilities.[8]

The magnitude and risk factors for NBT vary from nation to nation; more importantly, it is determined by the availability of standardized obstetrical care.[9] For instance, the magnitude of the NBT ranges from 12.3% to 24.7% in Ethiopia.[10,11] Studies have identified the factors associated with NBT in different countries. These risk factors can be classified into maternal, fetal, or obstetric complications and lack of poor obstetric care processes, such as lack of antenatal care follow-up, maternal diabetes mellitus, prolonged and obstructed labor, macrosomia, instrumental delivery, malpresentation, maternal age that is less than 16 or greater than

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35 years, prematurity, skilled health professionals, low birth weight, malposition, oligohydramnios, and multiple pregnancies.[3,12,13] Despite the Federal Ministry of Health in Ethiopia implementing interventions to decrease neonatal mortality and improve survival, less than half of the deliveries are conducted by skilled health professionals, and a high number of deaths are reported due to NBT.[14,15]

Although studies on the magnitude and risk factors for NBT among neonates exist, there is a paucity of data regarding NBT and its predisposing factors in eastern Ethiopia. Understanding the contextual risk factors for NBT helps in designing appropriate interventions to reduce the burden of NBT. Hence, this study aimed to investigate the magnitude and predisposing factors for NBT in public hospitals in eastern Ethiopia.

Methods and Materials

Study Setting, Design, and Population

A multicenter, cross-sectional study design was conducted among newborns admitted to the neonatal intensive care units (NICUs) of public hospitals in eastern Ethiopia. Hiwot Fana Comprehensive Specialized University Hospital (HFCSUH) is a teaching referral hospital of Haramaya University and Jugol General Hospital are located in Harar Town and serves more than 6 million people in eastern Ethiopia. Approximately 1900 neonates are admitted to the NICUs annually. Dilchora Referral Hospital and Sabina General Hospital are governmental hospitals located in Dire Dawa, serving more than 1 million people. Approximately 1200 neonates are admitted to the NICUs per year. All neonates who were admitted within 28 days of neonatal life to the NICUs from April 1 to June 30, 2022, were included. However, neonates born at less than 28 weeks of gestational age and with major congenital anomalies were not included in this study.

Sample and Sampling Procedure

The sample size was calculated using EPI-Info version 7.2.5 software with the following assumptions: the proportion for the residential distance from health facilities (exposed) was 46.6%, and power was 80% with a 95% confidence interval (CI).[11] A 10% was added for the non-response rate. Then, the final sample was 492. The calculated sample was proportionally allocated to the selected hospitals following the estimated patient flow on admission for the previous 3 months (January to March 2022) in all four selected hospitals (n = 1030) as the sampling frame, and a systematic random sampling technique was used to select participants from each hospital with every kth value = 2 to select the final sample (n = 492).

Data Collection

We collected the data using a structured interviewer-administered questionnaire that was adopted from different literature and a pretested structured validated data abstraction checklist.[16-18] The checklist contains information on the sociodemographic conditions of the mother and neonate, obstetric factors, treatments received, and neonatal status. Neonatal birth trauma was defined as neonates with one of the physical injuries during the birth process that was evaluated by physicians or clinicians on admission and admitted with at least one of the following diagnoses: extracranial trauma, cephalohaematoma, subgaleal hemorrhage, musculoskeletal injuries, neurological trauma, brachial palsy, Kulmpke's palsy, soft tissue injury, and abdominal visceral injury.[17-19] Perinatal asphyxia is defined as clinical evidence of neonate failure to initiate spontaneous breathing, the need for resuscitation after birth, an Apgar score of less than 7 at the 5th minute, or neonates with clinical evidence of hypoxic encephalopathy.[36] Birth weight was categorized as low, normal, or large if birth weight was <2500 g, 2500 to 3999 g, and ≥4000 g, respectively.[35] Gestational age was classified as early preterm (less than 34 weeks) "preterm" if delivery was before 37 complete weeks of gestation, "term" if the baby was born at 37 to 42 completed weeks of gestation, and "post term" if the baby was born after 42 completed weeks of gestation.

Data Quality Management

The questionnaire was pretested on 5% of the sample at Haramaya General Hospital, which was not included in the final analysis. Moreover, data collectors and supervisors were trained for two days. The overall data collection process was closely supervised, and the completeness of each questionnaire was checked daily. During data cleaning, we applied a logical checking technique to identify errors. Finally, we performed double data entry to countercheck the data consistency.

Data Processing and Analysis

Data were entered into Epi data version 3.1 and analyzed using Statistical Package for the Social Sciences (SPSS) version 26.0. We described the characteristics of the participants using tables, figures, and text. We applied a binary logistic regression model to determine

Table 1. Socio-Demographic Characteristics of Mothers Whose Neonates Admitted to NICUs at Public Hospitals in Eastern Ethiopia, 2022 (n = 492).

Variables	Category	Frequency (n)	Percent (100%)
Maternal age in years	Less than 20	92	18.7
	20-24	189	38.4
	25-29	138	28.0
	30-34	66	13.4
	35 and above	7	1.4
Marital status	Single	34	6.9
	Married	416	84.6
	Widowed	33	6.7
	Divorced	9	1.8
Occupation	Daily laborer	23	4.7
	Merchant	148	30.1
	Employed	25	5.1
	Housewife	296	60.2
Educational level	No formal education	217	44.1
	primary school	202	41.1
	secondary school	55	11.2
	College and above	18	3.7
Maternal distance from Hospital	Greater than 15 km	101	20.5
	5-15 km	193	39.2
	less than 5 km	198	40.2
Maternal BMI (mg/k^2)	<18.5 (Underweight)	119	24.2
	18.5-24.99 (Normal weight)	339	70
	25 and above (Overweight)	34	7.0
Residence	Urban	269	54.7
	Rural	223	45.3

the predisposing factors associated with NBT. Variables with P values $\leq .25$ in the bivariable analysis were transferred into the multivariable analysis to control for confounding factors. We tested the goodness of fit of the model using the Hosmer–Lemeshow test (>0.05). A multicollinearity test was performed to determine the correlation between independent variables using variance inflation factors (VIF > 10). The adjusted odds ratio (AOR) with a 95% CI and a P value <.05 were considered statistically significant.

Ethics Approval and Consent to Participate

This study was performed according to the Declaration of Helsinki. We conducted this study after ethical clearance from the Haramaya University College of Health and Medical Science Institutional Health Research Ethical review committee (IHRERC) (Ref. no: IHRERC/065/2022). Then, an official letter of cooperation was sent to each hospital. Written informed consent was obtained from all parents of the newborns. The participants' information was kept confidential.

Results

Maternal Sociodemographic Characteristics

Four hundred ninety-two neonates with mothers participated in this study, with a 100% response rate. The mean and SD for maternal age was 24.12 ± 4.61 years. Of these, 189 (38.4%) mothers were aged 20 to 24 years, and 138 (28%) were 25 to 29 years. Four hundred sixteen (84.6%) participants were married. Two hundred seventeen (44.1%) mothers had no formal education. The mean and SD body mass index (BMI) and height of the mothers were 20.2 ± 2.49 SD kg/m^2 and 1.63 ± 0.08 SD meters, respectively. Nearly half (54.7%) of the mothers were urban dwellers (Table 1).

Maternal Obstetric and Medical-related Characteristics

Of the total, 406 (82.5%) mothers were multiparous. Four hundred sixty-six (94.7%) mothers had antenatal care follow-ups, and of these, 39 (4.9%) had at least 4 antenatal care visits. Regarding the medical illness of

Table 2. Obstetric Characteristics of Mothers Whose Neonates Admitted to NICUs at Public Hospitals in Eastern Ethiopia, 2022 (n = 492).

Variables	Category	Frequency (n)	Percent (100%)
Gravidity	Primi gravida	87	17.7
	Multi gravida	405	82.3
Parity	Primi para	86	17.5
	Multi para	406	82.5
Antenatal care follows up	Yes	466	94.7
	No	26	5.3
Number of antenatal care follows-up (n = 466)	One time	23	4.9
	Two times	182	39.1
	Three times	222	47.6
	Four times and above	39	4.9
Diabetes mellitus	Yes	8	1.6
	No	484	98.4
Chronic hypertension	Yes	11	2.2
	No	481	97.8
Gestational hypertension	Yes	69	14.0
	No	423	86.0
Placenta previa	Yes	13	2.6
	No	479	97.4
Placenta abruption	Yes	11	2.2
	No	481	97.8
Maternal anemia	Yes	53	10.8
	No	439	89.2
Oligohydramnios	Yes	183	37.2
	No	309	62.8

the mothers, 183 (37.2%) mothers had oligohydramnios, 69 (14.0%) had pregnancy-induced hypertension, and 53 (10.8%) were anemic (Table 2).

Intrapartum-Related Characteristics

Four hundred nineteen mothers (85.2%) gave birth in the hospital, while only 26 (5.3%) mothers were delivered at home. Three hundred ninety-nine laborers were followed using a partograph. Vertex fetal presentations accounted for 387 (78.7%) deliveries, and 255 (51.8%) deliveries were spontaneous vaginal deliveries. The study showed that the prolonged duration of labor was 180 (36.6%), while normal labor was 312 (63.4%). Seventy (14.2%) deliveries were assisted with a vacuum, whereas 58 (11.8%) were assisted with forceps. Three hundred nine (62.8%) deliveries were attended by midwives (Table 3).

Neonatal-Related Characteristics

Of the total admitted neonates, 420 (85.4%) were an early neonatal age. The mean ± SD of gestational age was 36.98 ± 2.31 weeks, and the mean ± SD of birth weight was 2801 ± 789 g. The head circumference of

212 neonates (43.1%) was measured at less than 32 cm. There were 317 (64.4%) male neonates. Approximately 283 (57.5%) newborns had a first-minute Apgar score between 4 and 7, and 20 (4.1%) had a score less than 3 (Table 4).

Magnitude of NBT

The overall magnitude of NBT was 83 (16.9%) (95% CI: 13.7-20.5%). The common types of NBT were extracranial trauma (73, 88%), soft tissue trauma (58, 69.9%), musculoskeletal trauma (16, 19.3%), and neurological trauma (12, 14.5%). Extracranial trauma: Forty (48.2%) neonates were diagnosed with cephalohaematoma. Twenty-three (27.7%) neonates had subgaleal hemorrhage. Among soft tissue traumas, facial and skin bruises accounted for 18 (21%). Of the neurological traumas, facial palsy occurred in 5 patients (6%) (Table 5).

Predisposing Factors for Neonatal Birth Trauma

Regarding predisposing factors, in the multivariable binary logistic regression analysis, NBT was associated with facility-based delivery, instrumental

Table 3. Intrapartum-Related Factors of Mothers Whose Neonates Admitted to NICUs at Public Hospitals in Eastern Ethiopia, 2022 (n=492).

Variables	Category	Frequency (n)	Percent (100%)
Partograph used	Yes	399	81.1
	No	93	18.9
Premature rupture of membrane	Yes	181	36.8
	No	311	63.2
Place of delivery	Hospital	419	85.2
	Health center	47	9.6
	Home delivery	26	5.3
Fetal presentation	Breach	47	9.6
	Face	26	5.3
	Brow and others	32	6.5
	Vertex	387	78.7
Mode of delivery	Spontaneous vaginal delivery	255	51.8
	Instrumental delivery	128	26.0
	Cesarean delivery	109	22.2
Types of instrumental delivery	Forceps	58	11.8
	Vacuum	70	14.2
Qualification of birth attendants	Gynecologist (Obstetrician)	77	15.7
	Residents	106	21.5
	Midwifery	309	62.8
	Nurses	28	5.7
	Trained birth attendants	15	3.0

Table 4. Neonatal-Related Characteristics of Neonates Admitted to NICUs of Public Hospitals in Eastern Ethiopia, 2022 (n=492).

Variables	Category	Frequency (n)	Percent (100%)
Age in days	Early neonatal age (<7 days)	420	85.4
	Late neonatal age(8-28 days)	72	14.6
Gestational Age (weeks)	Early preterm (<34 weeks)	61	12.4
	Late preterm (34-36 weeks)	85	17.3
	Term (37-42 weeks)	341	69.3
	Post-term ≥ 42 weeks	5	1.01
Birth weight	Less 2500 g	164	33.3
	2500-3999 g	299	60.8
	≥4000 g	29	5.9
Sex	Male	317	64.4
	Female	175	35.6
Head circumference	Less than 32 cm	212	43.1
	Greater than 37 cm	21	4.3
	32-37 cm	259	52.6

delivery, fetal presentation, early preterm birth, birth weight (>4000 g), and male sex. Neonates who were delivered through instrumental delivery were 7.4 times (aOR=7.40; 95% CI: 3.25-16.80) more likely to suffer from NBT than caesarian-delivered newborns. Newborns delivered in early preterm (<34 weeks) were 3.5 times (aOR=3.5; 95% CI: 1.34-9.04) more likely to have birth trauma than term neonates. Macrosomia neonates had a 3.65-fold (aOR=3.65; 95% CI: 1.42-9.41) increased risk of NBT compared to normal birth-weight babies. Furthermore, face presentations were 4.1 times (aOR=4.1; 95% CI: 1.37-12.25) more likely to have neonatal birth injuries compared with their counterparts. Being a male neonate was 2.14 times (aOR=2.14; 95% CI: 1.14-4.02) higher risk for NBT compared with female. However, neonates delivered in

Table 5. Types of NBT Among those Admitted to NICUs at Public Hospitals in Eastern Ethiopia, 2022 (n = 492).

Types of birth trauma	Frequency	Percent (%) neonates with birth trauma (n = 83)	Overall Percent (n = 492)
Extracranial trauma	73	88.0	14.8
Caput succedaneum	10	12.0	2.0
Cephalohematoma	40	48.2	8.1
subgaleal hemorrhage	23	27.7	4.7
Neurological trauma	12	14.5	2.4
Facial palsy	5	6.0	1.2
Erb's palsy	3	3.6	0.6
Spinal cord injury	4	4.8	0.81
Soft tissue trauma	58	69.9	11.8
Facial and skin bruises	18	21.0	3.6
Ecchymosis/bruise	27	32.5	5.5
Skin laceration	8	9.6	1.63
Conjunctival hemorrhage	5	6.0	1.0
Musculoskeletal trauma	16	19.3	3.25
Clavicular	8	9.6	1.63
Humeral	5	6.0	1.0
Femoral	2	2.4	0.4
Skull fracture	1	1.2	0.2
Other birth injuries*	3	3.6	0.61

*Others: organ injuries in the abdomen and others.

hospitals (aOR = 0.19; 95% CI: 0.062-0.57) and health centers (aOR = 0.96; 95% CI: 0.022-0.42) were less likely to suffer from NBT than home-delivered newborns by 81% and 4%, respectively (Table 6).

Discussion

NBT is among the top 10 causes of neonatal morbidity and mortality.[5] The morbidity and mortality rates of neonates with birth trauma vary worldwide. Obstetric and neonatal services that are provided during antenatal care, delivery, and admission are crucial to reducing the burden of NBT. Therefore, this study aimed to investigate the magnitude and predisposing factors for NBT in public hospitals in eastern Ethiopia.

In the present study, the magnitude of NBT was 16.9% (95% CI: 13.7-20.5%). This finding is in agreement with the finding from Jimma, Ethiopia (15.4%).[10] However, it is slightly higher than other studies in Addis Ababa Ethiopia (12.3%),[11] (9%)[20], and India (11.76%).[21] Moreover, the present finding was significantly higher than many studies conducted in Finland (1.6%),[9] India (1.54%),[22] Bangladesh (4.9%),[23] Australia (2.2%),[24] Pakistan (4.11%),[14] Iran (2.2%),[17] (2.7%),[25] Cameroon (1.84%),[16] Western Iraq (1.74%),[8] and Ghana (3.66%).[13] The possible justification for variations in the magnitude of NBT in the current study might be the different in the sample size, study setting (ie, the current study was conducted in a multicenter facility-based study), the

infrastructure of health care facilities, skills of birth attendants to attend labor and delivery process, duration of the study period, and inclusion home-based delivery.

However, this study finding is lower than the studies carried out in different countries such as Southern Ethiopia (24.7%),[19] Southwest Nigeria (67.2%),[16] Israel (24.3%)[26], and the United States (23%).[18] The possible reasons might be variations in sample sizes (ie, in Nigeria's study, 134 of 90 (67.2%) participants had birth trauma), the experience of health personnel, and data coverage, such as a nationwide survey. It may also be related to variations in the diagnosis of birth trauma and maternal and neonatal care during the delivery process in these countries.

In the present study, the predisposing factors significantly associated with NBT were facility-based delivery, instrumental delivery, fetal presentation, early preterm birth, birth weight (>4000 g), and male sex. Neonates delivered by instrumental delivery were 7.40 times more likely to suffer from birth trauma than those delivered by the caesarian section. The current finding is supported by other studies in different countries, such as Ethiopia,[10,11,27] India[22] Nigeria,[28] and Pakistan.[29] This might be related to the application of instruments such as forceps and/or vacuum on the fetal head during delivery, which may expose it to NBT.

Moreover, malpresentation was 4.1 times more likely to increase the risk of NBT than normal vertex presentation. This is because malpresentation exposes newborns to birth injuries compared with normal presentations

Table 6. Factors Associated With Neonatal Birth Trauma Among Neonates Admitted to NICUs at Public Hospitals in Eastern Ethiopia, 2022 (n = 492).

Variables	NBT (%)		COR (95% CI)	AOR (95% CI)	*P*-value
	Yes (n = 83)	No (n = 409)			
Residence					
Urban	39 (47)	230 (56)	0.69 (0.43-1.12)*	0.72 (0.39-1.34)	.300
Rural	44 (53)	179 (44)	1.00	1.00	
Antenatal care follow up					
Yes	75 (90.4)	391 (96)	2.32 (0.97-5.52)*	0.9 (0.29-2.81)	.675
No	8 (9.6)	18 (4)	1.00	1.00	
Place of delivery					
Hospital	65 (78.3)	354 (87)	0.47 (0.17-0.99)*	0.19 (0.062-0.57)**	.003
Health center	10 (12)	37 (9)	0.61 (0.21-1.80)*	0.96 (0.022-0.42)**	.002
Home	8 (9.6)	18 (4)	1.00	1.00	
Mode of delivery					
Spontaneous vaginal delivery	13 (15.7)	237 (58)	0.39 (0.18-0.89)*	1.28 (0.34-4.80)	.143
Instrumental delivery	64 (77.1)	76 (19)	5.93 (3.02-11.66)*	7.40 (3.25-16.80)**	.000
Cesarean section	6 (7.2)	96 (23)	1.00	1.00	
Gestational Age					
Early preterm (<34 weeks	13 (15.7)	48 (11)	1.26 (0.65-2.48)*	3.50(1.34-9.04)**	.011
Late preterm (34-36 weeks)	9 (10.8)	76 (18)	0.55 (0.26-1.20)	0.81(0.32-2.10)	.670
Term(37-42 weeks)	61 (73.5)	285 (69)	1.00	1.00	
Birth weight					
Low birth weight	20 (24.1)	144 (35)	0.75 (0.43-1.30)	0.56 (0.26-1.18)	.130
Macrosomia	16 (19.3)	13 (3)	6.6 (3.00-14.62)*	3.65 (1.42-9.41)**	.007
Normal birth weight	47 (56.6)	252 (62)	1.00	1.00	
Sex					
Male	59 (71.1)	258 (63)	1.44 (0.86-2.41)*	2.14 (1.14-4.02)**	.018
Female	24 (28.9)	151 (37)	1.00	1.00	
Maternal BMI (mg/k^2)					
<18.5 (Underweight)	22 (26.5)	104(25)	1.21 (0.70-2.10)	1.35 (0.68-2.68)	.390
25 and above (Overweight)	11 (13.3)	18 (4)	3.5 (1.56-7.78)*	1.53 (0.55-4.30)	.420
18.5-24.99 (Normal weight)	50 (60.2)	287 (70)	1.00	1.00	
Fetal presentation					
Breach	8 (9.6%)	39 (10)	1.24 (0.55-2.79)	1.06 (0.37-2.65)	.910
Face	10 (12)	16 (4)	3.77 (1.63-8.74)*	4.10 (1.37-12.25)**	.032
Brow and others	10 (12)	22 (5)	2.74 (1.23-6.12)*	2.50 (0.90-5.70)	.820
Vertex	55 (66.3)	332 (81)	1.00	1.00	
Partograph used					
Yes	62 (74.7)	337 (82)	0.63 (0.36-1.10)*	0.70 (0.34-1.49)	.330
No	21 (25.3)	72 (18)	1.00	1.00	
Onset of labor					
Induced	20 (24.1)	74 (18)	1.44 (0.82-2.52)*	0.60 (0.26-1.36)	.220
Spontaneous	63 (75.9)	335 (82)	1.00	1.00	
Pregnancy induced HTN					
Yes	21 (25.3)	48 (12)	2.55 (1.43-4.55)*	1.44 (0.70-3.00)	.340
No	62 (74.7)	361 (88)	1.00	1.00	

Abbreviations: COR, crude odds ratio; AOR, adjusted odds ratio; NBT, neonatal birth trauma.
*Statistically significant in COR. **statistically significant in aOR at *P*-value ≤ .05.

during delivery. This finding is in line with studies conducted in different settings, such as Ethiopia,[10,11] America,[2] and India.[30] Likewise, places of delivery such as hospitals and health centers reduce the risk of NBT by 81% and 4% when compared to home delivery, respectively. This result is in agreement with a study finding in Ghana[13] that home-delivery neonates were more affected by NBT than hospital and health center deliveries.

Furthermore, gestational age at birth as early preterm was more likely to be exposed to NBT than term gestational age. This study was supported by other studies in Iraq,[17] Southwest Nigeria,[16] Pakistan[14], and Iran.[30] This is because preterm neonates are physically and physiologically immature, which exposes them to extracranial brain hemorrhage.

In the current study, neonates who delivered with a birth weight greater than 4000 g had a 3.65 times higher risk of NBT than normal-weight babies. The present finding is in agreement with studies in different settings, such as Ethiopia,[20] Tanzania,[31] India,[32] Pakistan,[30] Indonesia[33], and Nigeria.[16] This is because a large baby is difficult to deliver via spontaneous vaginal delivery and is traumatized by instrumental devices during health workers' assistance. In addition, male neonates were 2.14 times more likely to suffer from NBT than female newborns. This association is supported by other studies in Iran[17] and Enugu Nigeria.[34]

Limitations

Our study has some limitations. First, an institutional-based study is not generalizable to the entire population. Second, the study was conducted in hospitals that had too many neonatal admissions, which might overestimate the magnitude of NBT. Third, the present study was cross-sectional in design and did not indicate a cause-effect relationship.

Conclusions

The magnitude of the NBT was relatively high. Facility-based delivery, instrumental delivery, malpresentation, gestational age less than 34 weeks at birth, birth weight (>4000 g), and male sex were predisposing factors independently associated with NBT. Promoting health facility-based delivery, the prevention of preterm birth, intrauterine weight estimation, and early decisions to minimize instrumental deliveries are important to reduce the burden of NBT. Ministry of Health, regional health offices, and healthcare providers should give attention to NBTs.

Author Contributions

GT, AD, and NA conceived and designed the study. MK drafted the manuscript. AD, NA, AAL, and MK extensively reviewed the manuscript and incorporated intellectual input. All authors read, provided feedback, and approved the final version of the manuscript.

Availability of Data and Materials

All data of this study are available from the corresponding author upon reasonable request.

Consent for Publication

Not applicable

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.

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