BMJ Open

Magnitude of birth trauma and its associated factors in South Wollo public hospitals, northeast Ethiopia, August 2021: Institutional-Based Cross-Sectional Study

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ABSTRACT

Objective The institutional-based cross-sectional study was designed to assess the magnitude of birth trauma and its associated factors in South Wollo, northeast Ethiopia.

Setting This study was conducted in the public hospitals of South Wollo, northeast Ethiopia. South Wollo is one of the 12 zones in the Amhara regional state with a total population of >3 million. There are 13 hospitals in South Wollo, of these 4 hospitals were selected randomly.

Participants A total of 612 mother-newborn pairs were selected to conduct the study. However, data were collected from 594 mother-neonate pairs giving a response rate of 97%. The study participants were selected by applying a simple random sampling technique after proportional allocation of the total sample to each study hospital. Live neonates delivered during the study period were included, whereas stillborn, neonates born with major congenital malformation and neonates whose mothers died during the birth process were excluded.

Result A total of 594 mother-newborn pairs were involved with a response rate of 97%. Seventy-eight newborns 13.13% (95% CI: 10.30 to 16.00) had experienced birth trauma. Prolonged labour (AOR: 5.78, 95% CI: 3.00 to 11.15), birth weight >4 kg (AOR: 9.18, 95% CI: 3.92 to 21.50), vacuum delivery (AOR: 6.74, 95% CI: 2.01 to 22.56), forceps delivery (AOR: 7.36, 95% CI: 1.96 to 27.58) and shoulder dystocia (AOR: 9.83, 95% CI: 4.13 to 23.50) were risk factors of birth trauma.

Conclusion The prevalence of birth trauma was higher than the report from most of the African countries. Prolonged labour, instrumental deliveries, large birth weight and shoulder dystocia were the identified risk factors of birth trauma. The ministry of health and the local healthcare system should give attention to the maternal health services.

INTRODUCTION

Birth trauma is the structural destruction or functional deterioration of the neonate's body due to traumatic events that occurred during the birth process. In this study, birth trauma refers to the physical or mechanical destruction of the neonate's body that occurred

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This study involves a large-scale area with a large sample size which could better represent the target populations (neonates in South Wollo).
⇒ There might be bias in the diagnosis of birth trauma because we have not used the same standard for the diagnosis of birth trauma in the four different hospitals; this is because the diagnosis of birth trauma depends on the type of birth trauma and the level and specialisation of study hospitals.
⇒ There might be a Hawthorne effect which could lower the report of birth trauma despite the interview was conducted at the end of the delivery process.

during labour and delivery.[1] Birth trauma ranges from minor and self-limited problems to severe injuries that could result in long-lasting neonatal morbidity and mortality.[2–7] It is the most ignored and the least reported medical condition of the newborn in the world.[8–11] The overall prevalence of birth injuries has declined with improvements in obstetrical care and prenatal diagnosis in high-income countries.[12–14] However, it has remained a significant neonatal problem in low-income and middle-income countries,[15 16] with the highest incidence in the African and Southeast Asian countries.[14 17 18]

Evidences revealed the frequency and types of birth traumas varied among the existing studies. Findings in Iran and India suggested that cephalohematoma was the most frequently reported birth trauma.[19 20] Another study in India suggested that 37% of the reported birth trauma was conjunctival haemorrhage, 25% cephalohematoma and 10.8% abrasions.[18] A study in Nigeria revealed that 60.7% of the reported birth trauma was soft tissue injury, 41.0% conjunctival haemorrhages, 23% bone fracture and 13.1% nerve injury.[14] Moreover, caput succedaneum was

the most frequently reported birth trauma in Baghdad.[21] A study in Cameroon showed that 70.6% of the reported birth traumas were nerve injuries and 27.3% were bone fractures.[22] Another study in Ethiopia revealed that 33.3% of the reported birth trauma was bruising and 20.0% was subgaleal haemorrhage.[17]

Studies revealed that the maternal, neonatal and delivery-related factors were associated with an increased incidence of birth trauma.[22–26] Small maternal stature, maternal pelvic anomalies, parity and maternal medical condition were associated with an increased risk of birth injuries.[25 27] Similarly, prolonged labour, obstructed labour and instrumental delivery were risk factors for birth traumas.[25] In addition, neonatal-related factors like macrosomia, shoulder dystocia, large gestational age and malpresentation were the contributing factors to birth trauma.[23 24] However, there is limited evidence regarding the magnitude and risk factors of birth trauma in Ethiopia. Therefore, this study was designed to assess the magnitude and associated factors of birth trauma in South Wollo public hospitals, northeast Ethiopia.

METHODOLOGY AND MATERIALS
Study setting and study participants
The institutional-based cross-sectional study design was employed among 612 mother-newborn pairs in South Wollo public hospitals from 1 March 2021 to 30 June 2021. The study participants were selected by applying a simple random sampling technique in each study hospital after proportional allocation of the total sample populations to each study hospital. All live newborns who were delivered during the study period were included, whereas stillborn, neonates born with major congenital malformation and newborns whose mothers died during the birth process were excluded. In the cases of multiple births, one neonate was included from the multiple births by using a lottery method. Birth trauma was assessed immediately after delivery in each sampled neonate on a daily basis from the starting date of data collection (1 March 2021) to the end of data collection (30 June 2021).

Patient and public involvement
Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Sample size determination
The sample size was determined using a single population proportion formula considering the assumptions $Z\alpha/2$=critical value for normal distribution at 95% confidence level, which equals 1.96 (z value at α=0.05), the estimated proportion of 15.4%[17] and absolute precision or margin of error 3% (d=0.03).

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

$$n = \frac{(1.96)^2 \times 0.154(0.846)}{(0.03)^2}$$

n=556

Then, adding 10% to compensate for the non-respondents, the final sample size was 612 mother-newborn pairs. Where n=required sample size, $Z\alpha/2$=critical value for normal distribution at 95% confidence level (1.96), p=proportion of birth trauma from the previous study and d=margin of error.

Sampling procedure
Four hospitals, Dessie Referral Hospital, Tenta General Hospital, Akesta General Hospital and Mekaneselam General Hospital, were selected randomly from 13 public hospitals. The total sample size was proportionally allocated to the study hospitals based on the number of their source populations. Then, the study participants were selected by applying a simple random sampling method from the daily delivered mothers in each hospital until the desired sample was reached.

Data collection instrument and procedure
A structured questionnaire and data extraction tool were adopted from different literature and prepared in the context of the local situation and the objective of the study. Questionnaires were prepared in English and then translated to the local language Amharic and back to English to see their consistency. Data were collected using the Amharic version questionnaire on a daily basis by interviewing the labouring mothers, interviewing the healthcare professionals who attend the delivery, diagnosis of newborns for birth trauma and reviewing the maternal and neonatal charts.

Data quality control
Prior to the data collection time, a pretest was done on 5% of the samples (31 newborns) in a separate hospital, Haik Primary Hospital. Two days of training were given for data collectors and supervisors regarding the data collection instrument and data collection procedures. Strict supervision was held throughout the data collection period by the principal investigators and supervisors. The completeness and clarity of the data were checked on a daily basis by supervisors and principal investigators.

Data processing and analysis
Data were verified, coded and entered to EpiData Software V.3.1 and was exported to SPSS V.24 Software for analysis. The magnitude of birth trauma was described in terms of the frequency with its 95% CI, which was performed using the bootstrap method. Other descriptive statistics were done and the result was presented using texts, tables and cross-tabulations. The maternal, neonatal and delivery-related factors were the independent variables included in the bivariate analysis. Variables with a p value <0.2 in the bivariate analysis, clinical importance and absence of multicollinearity were considered in the final model. Model fitness for

the logistic regression analysis was assessed using the Hosmer-Lemeshow goodness-of-fit test and the model fits best with a p value of 0.062. Multivariable logistic regression analysis was done to control potential confounders and to identify the factors associated with birth trauma. Finally, a statistical significance level was declared at a p value of <0.05.

Study variables
Dependent variable
Birth traumas/Birth injuries (yes/no).

Independent variable
Maternal-related variables including place of residence, maternal age, maternal stature, parity/gravidity, maternal obesity, antenatal care (ANC); newborn-related variables like gestational age, birth weight, fetal presentation, fetal position; multiple pregnancies; delivery-related factors like prolonged labour, mode of delivery and instrumental delivery and the health professional-related factors like profession, special training and work experience.

Operational definitions
Birth trauma/Birth injury
Any physical trauma to any parts of the newborn identified or diagnosed clinically and/or by imaging studies (CT scan, ultrasound) at birth; and the diagnosis depends on the types of birth trauma and the level and specialisation of study hospitals.

Full delivery materials
According to the Ethiopian hospital standard, hospitals with a minimum of the following materials are considered as having full materials for delivery: delivery couches, delivery kit, linens, towels, intravenous stand, medications, vacuum, forceps, trolley, neonatal resuscitation kit and newborn care table.[28]

RESULT
Maternal characteristics
A total of 594 mother-newborn pairs were involved with a response rate of 97%. The minimum and the maximum age of the participants were 18 and 40 years, respectively. The mean age of the participants was 28.89 years with

Table 1 Maternal-related variables in the public hospital of South Wollo, northeast Ethiopia, August 2021

Variable	Category	Frequency (n=594)	Percentage (%)
Maternal age (years)	<25	246	41.41
	25–35	277	46.63
	>35	71	11.96
Place of residence	Rural	214	36.00
	Urban	380	64.00
Educational status	No formal education	82	13.80
	Primary education	208	35.01
	Secondary education	175	29.46
	College and above	129	21.73
Disease during pregnancy	Yes	95	15.99
	No	499	84.01
Number of pregnancy	≤2	444	74.75
	>2	150	25.25
Number of delivery	≤2	529	89.06
	>2	65	10.94
Duration of labour (second stage)	Normal (≤1 hour)	425	71.55
	Prolonged (>1 hour)	169	28.45
Number of ANC follow-up	<4 follow-up	73	12.29
	4 and above	521	87.71
Iron/Folic supplementation	Yes	554	93.27
	No	40	6.73
Previous obstetric complication	Yes	16	2.69
	No	578	97.31

ANC, antenatal care.

an SD of 5.48 years. Two-thirds of the participants 380 (64.00%) were urban dwellers. The majority of the participants (87.71%) have attended ANC follow-up for more than four visits (table 1).

Neonatal characteristics

Three hundred and sixty newborns (60.61%) were males. The majority of the newborns 529 (89.06%) were term and 470 (79.12%) newborns had normal birth weight (2.50–4.00 kg) (table 2).

Health services-related variables

The majority of labour and delivery 323 (54.38%) were attended by midwifery professionals. Five hundred and eighty-three (98.15%) of the healthcare workers had taken special training on labour and delivery. Five hundred healthcare workers (84.18%) use partograph while attending labour and delivery (table 3).

The magnitude of birth trauma

In this study, 78 (13.13%) newborns had experienced birth trauma. The major birth traumas identified were soft tissue injury 15 (19.23%), cephalohematoma 18 (23.08%), caput succedaneum 26 (33.33%), subgaleal haemorrhage 12 (15.39%) and other forms of birth traumas 7 (8.97%).

Factors of birth trauma

The odds of birth trauma were almost 6 times (adjusted OR (AOR): 5.78, 95% CI: 3.00 to 11.15) higher among prolonged deliveries compared with their counterparts. Newborns with birth weight >4 kg were 9 times (AOR: 9.18, 95% CI: 3.92 to 21.50) more likely to experience birth trauma compared with newborns with a birth weight of 2.50–4.00 kg. Newborns delivered by vacuum were 6 times (AOR: 6.74, 95% CI: 2.01 to 22.56) more likely to experience birth trauma compared with newborns delivered by caesarean section. Similarly, newborns delivered by forceps were 7 times (AOR: 7.36, 95% CI: 1.96 to 27.58) more likely to develop birth trauma compared with newborns delivered by caesarean section. Newborns with shoulder dystocia were 9 times (AOR: 9.83, 95% CI: 4.13 to 23.50) more likely to experience birth trauma compared with newborns with no shoulder dystocia (table 4).

DISCUSSION

In this study, 13.13% (95% CI: 10.30 to 16.00) newborns had experienced birth trauma. The finding was similar to a study in Ethiopia, 15.4% of newborns had birth injuries.[17] The reason could be similarities in the study populations or similarities in maternal and delivery services in the study hospitals. However, the finding was lower than the study in Nigeria, 67.2% of neonates presented with birth trauma,[8] but higher than the study in Cameroon, 1.84% of newborns

Table 2	Newborn-related variables in the public hospitals of South Wollo, northeast Ethiopia, August 2021		
Variable	**Category**	**Frequency (n=594)**	**Percentage (%)**
Baby sex	Male	360	60.61
	Female	234	39.39
Gestational age (weeks)	Post-term (>42)	15	2.53
	Preterm (<37)	50	8.42
	Term (37–42)	529	89.06
Birth weight (kg)	Low birth weight (<2.50)	75	12.63
	Large birth weight (>4.00)	49	8.25
	Normal birth weight (2.50–4.00)	470	79.12
Mode of delivery	Spontaneous vaginal delivery	436	73.40
	Vacuum delivery	71	11.95
	Forceps delivery	36	6.06
	Delivery by caesarean section	51	8.59
Fetal presentation (n=588)	Cephalic	539	91.70
	Not cephalic	49	8.30
Fetal position	Vertex (occipital)	495	83.33
	Not vertex	99	16.67
Shoulder dystocia	Yes	52	8.75
	No	542	91.25

The sum of percentages does not provide 100% because of rounding the decimals.

Table 3 Professional, health setting and health service-related characteristics in public hospitals of South Wollo, northeast Ethiopia, August 2021

Variable	Category	Frequency (n=594)	Percentage (%)
Healthcare worker attending labour and delivery	Nurse	13	2.19
	Midwifery	323	54.38
	General practitioner/Intern	120	20.20
	Residence	76	12.79
	Specialist	62	10.44
Years of experience	≤3	113	19.02
	4–5	357	60.10
	≥6	124	20.88
Received special training	Yes	583	98.15
	No	11	1.85
Full delivery material	Yes	578	97.31
	No	16	2.69
Availability of learning guide	Yes	577	97.14
	No	17	2.86
Partograph utilisation to follow labour	Use	500	84.18
	Not use	94	15.82

had birth trauma,[22] a study in Iran, 2.2% of newborns had birth trauma.[19] The discrepancy could be due to the differences in the maternal and neonatal health services in the study countries. The discrepancy could also be due to the difference in the diagnostic tools used or it might be due to a problem in the definition of birth trauma across studies.

Table 4 Bivariable and multivariable results showing the association of independent variable with birth trauma in the public hospital of South Wollo, northeast Ethiopia, August 2021

Variables	Category	Birth trauma		COR	AOR	
		Yes	No	(95% CI)	(95% CI)	P value
Duration of labour	Prolonged/≥1 hour	47	122	4.90 (2.98 to 8.05)	**5.78 (3 to 11.15)**	**<0.0001**
	Normal/<1 hour (ref)	31	394	1	1	1
Antenatal follow-up	<4 follow-up	6	67	0.56 (0.23 to 1.34)	0.92 (0.27 to 3.19)	0.9
	4 and above (ref)	72	449	1	1	1
Birth weight (BW)	Low BW <2.50 kg	13	62	2.08 (1.06 to 4.09)	2.36 (0.91 to 6.11)	0.08
	Large BW (≥4 kg)	22	27	8.09 (4.25 to 15.41)	**9.18 (3.92 to 21.50)**	**<0.0001**
	Normal BW (2.50–4 kg) (ref)	43	427	1	1	1
Fetal presentation	Cephalic	67	472	0.49 (0.24 to 1.01)	0.62 (0.15 to 2.66)	0.52
	Not cephalic (ref)	11	38	1	1	1
Fetal position	Vertex (occipital)	61	434	0.68 (0.38 to 1.22)	0.55 (0.24 to 1.27)	0.164
	Not vertex (ref)	17	82	1	1	1
Mode of delivery	Spontaneous vaginal delivery	25	411	0.46 (0.18 to 1.17)	0.43 (0.14 to 1.34)	0.15
	Vacuum	31	40	5.81 (2.20 to 15.37)	**6.74 (2.01 to 22.56)**	**0.002**
	Forceps	16	20	6.00 (2.05 to 17.60)	**7.36 (1.96 to 27.58)**	**0.003**
	Caesarean section (ref)	6	45	1	1	1
Shoulder dystocia	Yes	24	28	7.75 (4.20 to 14.31)	**9.83 (4.13 to 23.50)**	**<0.0001**
	No (ref)	54	488	1	1	1

AOR, adjusted OR; COR, crude OR.

In this study, 15.39% of the reported birth trauma was subgaleal haemorrhage. The finding was lower than a study in Ethiopia (20%)[17] but higher than a study in India (2.08%).[18] Moreover, 23.08% of the reported birth trauma was cephalohematoma. The finding was comparable to a study in India (25%)[18] but lower than a study in Iran (57.2%)[19] and a study in India (38.7%),[20] however, the finding is higher than a study in Baghdad (6%).[21] Additionally, 33.33% of the reported birth trauma was caput succedaneum. The finding was higher than a study in Nigeria (22.2%)[8] but lower than a study in Baghdad (82%).[21] This study showed that 19.23% of the reported birth trauma was soft tissue injury. The finding was lower than a study in Nigeria (60.7%).[14] The difference might be due to the variation in the delivery and neonatal services in study settings. The difference might also be associated with the difference in the risk factors of birth traumas. For example, vacuum delivery might cause trauma to the head whereas shoulder dystocia might cause soft tissue injuries and fractures.

Neonates born with a long duration of labour were 5 times more likely to develop birth trauma compared with newborns born with a normal duration of labour. The finding was similar to the study in India,[25] a study in Nigeria[8] and another study in Baghdad.[21] This could be the fact that the longer the duration of labour the more likely the newborn might experience birth trauma. Similarly, shoulder dystocia was a risk factor for birth trauma. The finding was similar to a study in India,[20] a study in Baghdad[21] and another study in India.[19] The reason could be when the large neonatal shoulder passes through the birth canal, it could impact the maternal pelvis, which might cause laceration, compression of the nerves and other related trauma to the newborn.

Forceps delivery was a risk factor for birth trauma. The finding was similar to a study in Indonesia,[15] a study in India,[20] a study in Cameroon[22] and another study in Mumbai, India.[25] This could be the fact that forceps might compress the head causing trauma to the head, brain, soft tissues and nerves. Similarly, vacuum delivery was a risk factor of birth trauma. The finding was similar to a study in Indonesia,[15] a study in India,[20] a study in Cameroon[22] and another study in Mumbai, India.[25] This could be when vacuums are applied to the head and pulled forcefully, it might damage the underlying soft tissues and the scalp or the head.

Additionally, a higher birth weight (macrosomia) (>4.00 kg) was a risk factor for birth trauma. The finding was similar to a study in Mumbai, India,[20] a study in Indonesia,[15] a study in Baghdad,[21] a study in Cameroon[22] and another study in India.[25] The reason could be when a macrosomic baby pass through the maternal birth canal (pelvis), there might be cephalopelvic disproportions which in turn result in compression of the neonate's body by the narrowed or small maternal pelvis that can damage the neonate's body and cause trauma to the newborn.

CONCLUSION

Birth trauma was found to be higher than the expected rate. The prolonged second stage of labour, shoulder dystocia, macrosomia, forceps extraction and vacuum delivery were the risk factors for birth trauma. The ministry of health and the regional and local healthcare system should give attention to the maternal health services.

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