

THE MAGNITUDE OF BIRTH INJURIES AND ASSOCIATED FACTORS AMONG NEONATES ADMITTED TO NEONATAL INTENSIVE CARE UNITS OF SELECTED PUBLIC HOSPITALS IN CENTRAL ETHIOPIA

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ABSTRACT

BACKGROUND: Approximately half of the birth injuries are avoidable if appropriate and timely evidence based measures are taken. However, there is a paucity of studies in Ethiopia. Therefore, this study aimed to assess the magnitude of birth injuries and associated factors among neonates delivered in Central Ethiopia.

METHODS: Multi-center facility-based cross-sectional study was conducted from March to April 2021. Systematic sampling method was used to select 344 mother-neonate pairs admitted to neonatal intensive care units in the included hospitals. Data were collected using face-to-face interview and review of medical records. Epi-info version 4.1 was used to enter data and SPSS version-25 for analysis. Descriptive statistics, binary and multivariable logistic regressions analyses with 95% CI were done. A cut off value of p-value < 0.05 was used to declare the statistical significance of variables.

RESULTS: The magnitude of birth injuries was 24.7% (95% CI=24.7% - 24.8%). The majority 71.6 % of the neonates had soft tissue injuries while 16.6 % of them had birth asphyxia. Both birth asphyxia and physical trauma were encountered in 2.9 % of the neonates. Fetal mal-presentation (AOR=29.69, 95% CI =10.61 - 43.09), ANC follow-up less than four (AOR=3.2, 95% CI, 1.21-8.33), assisted childbirth (AOR =3.33, 95 % CI=1.003 -11.044) and short maternal height (AOR=4.85, 95% CI, (1.26-20) were significantly associated with birth injuries.

CONCLUSION: The magnitude of birth injuries was higher than other similar studies in Ethiopia. Fetal mal-presentation, antenatal care follow-up less than four, and short maternal height were significantly associated with birth injuries. Thus, promotion of full antenatal care follow-up, close monitoring of mothers during intrapartum period and timely clinical decision of labor and childbirth process of mal-presented children are recommended.

KEYWORDS: Birth trauma, birth injuries, mechanical birth trauma, neonates, newborn, perinatal asphyxia

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INTRODUCTION

Birth injuries are defined as damage of the newborn's body structure or function due to adverse outcomes of the birth processes¹. Birth injuries can be due to oxygen insufficiency for tissues (birth asphyxia) or physical trauma (birth trauma) during labor or delivery². Despite how much adequate prenatal care is provided, birth injuries could occur due to unavoidable risks such as long and/or difficult labor or fetal mal-presentations³.

The incidence of birth injuries varies based on the type of delivery, fetal presentations, and type of injury². The spectrum of birth injuries ranges from superficial injury to the skin which is the most common type of injury to the more severe damages of the central nervous system and other soft tissues⁴. Birth injuries can significantly be reduced with the use of appropriate methods of obstetric care to monitor the prognosis of the labor, the fetal status, and by making the timely decision for Cesarean Section (C/S) delivery⁴⁻⁶.

Skull injury (subgaleal hemorrhage, Caput succedaneum, Cephalohematoma), soft tissue injuries (bruises, petechial and subcutaneous fat necrosis), intra-abdominal (hepatic and splenic injuries), and central nervous system (intracranial hemorrhage, facial nerve palsy injuries), bone (humeral fracture, femoral fracture, and clavicular fracture injuries) and systemic injuries including perinatal asphyxia are the commonest types of birth injuries occurring during the birth process^{7,8}.

An estimated 7-9 per 1000 live births birth injuries happen each year worldwide, while from the total neonatal deaths, about 99% of them take place in developing countries⁴. Perinatal asphyxia alone contributes to 42 million disability-adjusted neonatal life years lost and 23% of the deaths^{9,10}. Approximately 3% of the 130 million newborns delivered each year globally develop severe consequences of birth injuries such as epilepsy, cerebral palsy, and developmental delay¹¹.

Evidence shows larger than the average birth weight of the fetus, small pelvis, small maternal stature,

maternal obesity, and presence of maternal pelvic anomalies are the common maternal-related risk factors for birth injuries. Fetal macrosomia, pre-term or post-term delivery, and fetal mal-presentation are neonatal-related risk factors for birth injuries. Induction of labor, shoulder dystocia, and operative childbirth are the intrapartum-related risk factors of birth injuries^{10,12}.

Ethiopia achieved the millennium development goals for under-five death two years earlier than planned but it is less successful in reducing neonatal deaths. Limited studies in Ethiopia show, childbirth-related complications and/or birth injuries are among the major and direct causes of neonatal deaths^{8,13}. However, there is a dearth of studies in this aspect. Therefore, this study aimed to assess the magnitude of neonatal birth injuries and their associated factors in public hospitals of Silte Zone, Central Ethiopia.

Materials and methods

Study area, population, study design, and period
The study was conducted in Silte Zone which is located in the Central Ethiopia. The Zone has 10 Districts and 3 administrative towns. Based on the information obtained from the Silte Zone Health Department, the population of the Silte Zone is estimated to be 1,033,954 in 2019. All women regardless of the mode of delivery and their neonates in Silte Zone were the source population and all women and neonates delivered at the included hospitals were taken as the study population. Neonates with major congenital malformations referred to the included hospitals during the data collection period were excluded. The multicenter facility-based cross-sectional study design was conducted from March to April 2021.

Sample size determination of the study

By using the single population proportion formula and considering the following sample size calculation assumptions: confidence level of $Z_{\alpha/2}$ of 95%, marginal of error 4%, a reasonable estimate for the proportion of birth injury from the study result of Jima, Southwest Ethiopia ($P=0.154$)¹⁴ the sample size was calculated as follows:

$$n = (Z_{\alpha/2})^2 * P (1-P) = (1.96)^2 * 0.154 (1-0.154) = 313$$

d2

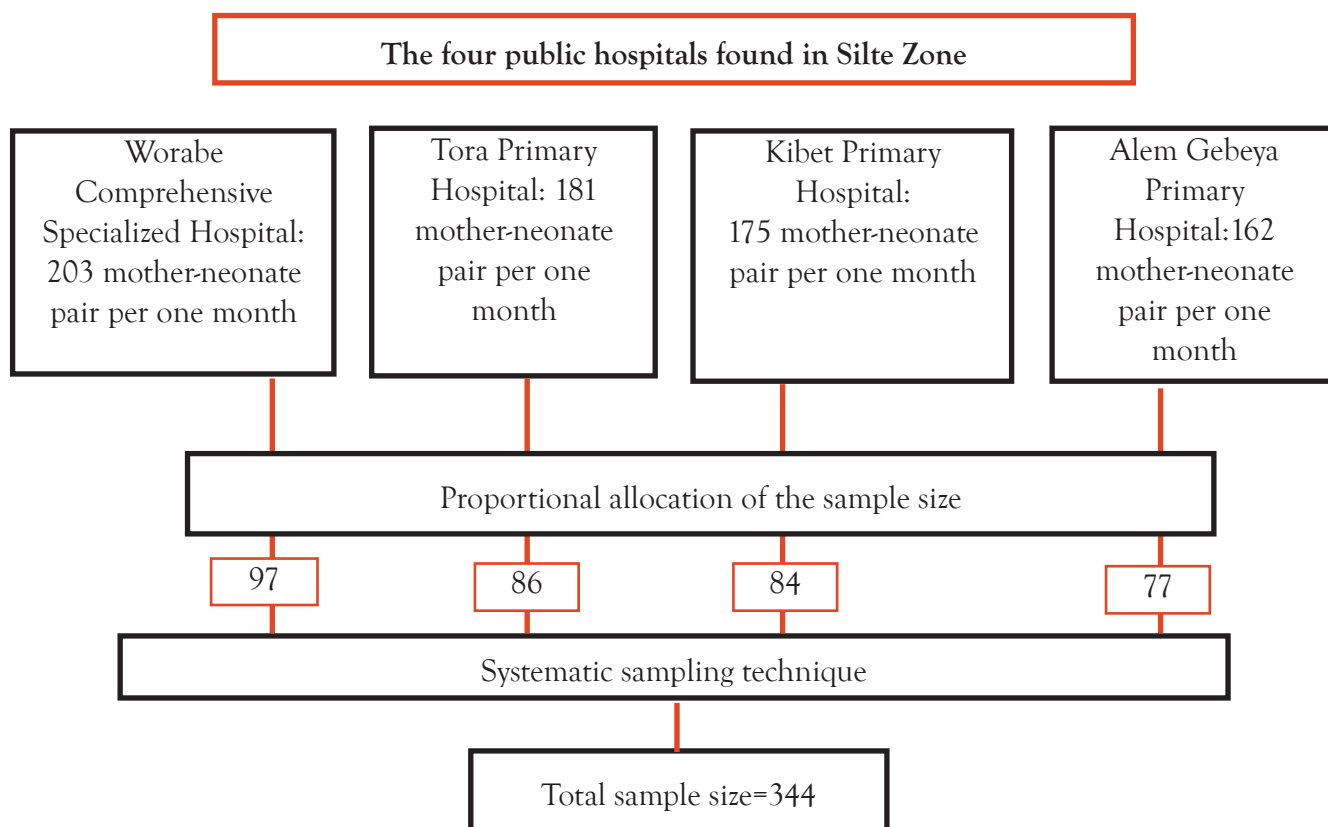
(0.04)²

After adding 10% non-response, the final sample size was 344 mother-neonate pairs were included in the study.

The sampling procedure

All four public hospitals in the Silte Zone Worabe Comprehensive Specialized Hospital (WCSH), Kibet Primary Hospital (KPH), Tora Primary Hospital (TPH), and Alem Gebeya Primary Hospital (AGPH) were included in the study. Then proportionally allocation of the required calculated total sample

size for each hospital was done considering the average number of labor and delivery service visits of one month before data collection: WCSH=203 per month, KPH=175 per month, TPH=181 per month, and AGPH=162 per month with a total of 721 per month in the four hospitals included. After proportionally allocating the required sample size to each hospital: WCSH=344x203/721=97, AGPH= 344x162/721=77, TPH=344x181/721=86, and KPH = 344x175/721=84 and a systematic sampling technique with the sampling interval of two (721/344=2) was applied to select mother-neonate pairs 'Figure 1'.



Variables of the Study

Dependent variable: Birth injury on the neonates during childbirth.

Independent variables:

Maternal socio-demographic characteristics: age, educational status, residence, occupation, marital status

Maternal obstetrics and reproductive

characteristics: gravidity, parity, the onset of labor, mode of delivery and ANC follow-up

Medical disorders and infection on the mother: chronic medical conditions like, Diabetes Mellitus (DM), cardiac disease

Maternal physical and lifestyle characteristics: Mid Upper Arm circumference (MUAC), substance use, physical activity

Neonatal factors: sex of the neonate, neonatal weight, fetal presentation, Apgar score

Data collection tool and procedures

Data were collected by face-to-face interviewer-administered and structured questionnaires, anthropometric measurements, and by reviewing the mother-neonate pair medical records to identify the type of birth injury encountered using checklists. The questionnaire consisting of information on sociodemographic and reproductive characteristics, morbidity status, different chronic maternal medical disorders, gynecologic and obstetric factors, and neonatal-related factors, and others were extracted from the literature review and used 'Supplementary files: Supplementary questionnaire 1'. The questionnaire was constructed in English and translated to the Amharic language and back to English to keep its consistency and equivalency. Six Midwifery professionals and 6 neonatal nurse professionals collected the required data.

Data quality management

The tool was evaluated and validated by senior researchers and subjects experts. Two days of training were given for data collectors. The pre-test was employed on 5% of the sample size in Halaba Kulito general hospital. Based on the pre-test result modification of the sequence of questions was done and vague terminologies were replaced with simple common words. Daily evaluation of the data collection process was monitored by the researchers. Data completeness and problems encountered during data collection were followed each day and the necessary correction was done accordingly.

Data processing and analysis

The completeness of the questionnaire was rechecked preceding data entry. Following this, data coding, entry, cleaning, recording, and analysis were accomplished by using SPSS version 25. Descriptive statistics were computed. Bivariable logistic regression analysis was done after dichotomizing the dependent variables with coding 1 for Yes and 0 for No. CORs and AOR were computed to assess the presence and degree of association between the dependent and independent variables. In the bivariable logistic regression analysis, the

variables with P-value <0.25 were entered into a multivariable logistic regression analysis model to control confounding variables and to check the independent and significant association. A P-value of <0.05 with a 95% CI was used to express the strength and statistical association of the variables. The results were presented using text descriptions, tables, and graphs.

Operational definitions

Birth injury: a neonate who has been diagnosed with oxygen insufficiency for tissue (perinatal asphyxia/ birth asphyxia), mechanical birth trauma, or both encountered during childbirth.

Mechanical birth trauma: the presence of mechanical (physical) trauma of the soft tissue or organs of the newly borne neonate during labor and/or childbirth.

Perinatal asphyxia (birth asphyxia): a diagnosis made according to NICU management protocol of Ethiopia based on the failure to initiate and sustain breathing at birth, impairment of placental or pulmonary gas exchange leading to hypoxemia and hypercarbia (persistence of an APGAR score of less than 3 at 10th minute and evidence of multi-organ (the brain, heart, lung, kidney, liver) dysfunction immediately following childbirth⁸.

Results

Socio-demographic and economic characteristics of the study participant

A total of 344 (100%) response rate study respondents participated in the study. The mean age of respondents was 28 years, ranging from 17 to 43 years. More than 81% of the mothers were 20-35 years of age while 14.2% of them were aged greater than or equal to 35 years. The median family size of the respondents was 5. More than half of the respondents, 208 (60.5%) were rural residents and (48%) had no formal education. The majority, 319 (92.7%) were Muslims followed by Orthodox, 19 (5.5%). All of the study participants 344 (100%), were married and the majority 164 (47.7%) were housewives while 8 (2.3%) were merchants (Table 1).

Table 1: Socio-Demographic and Economic Characteristics of Study Participants in Silte Zone Public Hospitals, Central Ethiopia

Variables (n=344)	Frequency		
	Number	%	
Age	<20 Years	16	4.7
	20-35 Years	279	81.1
	>=35 Years	49	14.2
Religion	Muslim	319	92.7
	Orthodox	19	5.5
	Protestant	6	1.7
Occupation	Housewife	164	47.7
	Government employee	45	13.1
	Self-employed	37	10.8
	Merchant	78	22.7
	Farmer	20	5.8
Education status	Not attend formal education	165	48
	Attend primary education	95	27.6
	Attend secondary education	40	11.6
	Attend more than 2ry education	44	12.8
Marital status	Single/not married	27	6.4
	Married	372	88.2
	Divorced/ Widowed	11	2.6
Ethnicity	Silte	322	93.6
	Gurage	10	2.9
	Hadiya	7	2
	Amhara	5	1.5
Residence	Urban	136	39.5
	Rural	208	60.5
	< 5 members	168	48.8
	≥5 members	176	51.2

Maternal obstetrics and reproductive characteristics

The majority of mothers 265 (77%) were multiparous and the rest 79 (23%) were primiparous. More than half (54.9 %) of the participants had less than 4 ANC follow-up care visits by healthcare professionals. Approximately 21.2% of mothers were diagnosed with mal-presentation of the fetus. About 23 % of the study participants had complications during their previous childbirth.

Mode of delivery of the study participants

The majority of mothers 70.6% childbirth was Spontaneous Vaginal Delivery (SVD), 14.5% of them by Cesarean Section (C/S), and the remaining 14.8 % gave childbirth was assisted SVD 'Figure 2'.

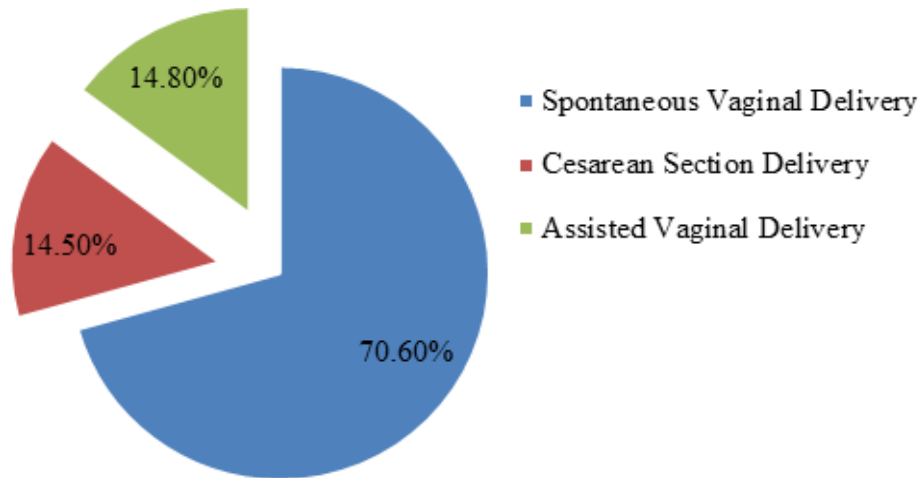


Figure 2

The neonatal characteristics

The majority 61% of the neonates were males. Low birth weight was observed in 9% of the neonates and 1.2% were macrocosmic. The proportion of preterm babies was 13.1% and post-term accounted 2.9%. Nearly twenty-three (22.7 %) of neonates had low (0-3), 18.9% had moderate (4-6) and the remaining 58.4 % had mild APGAR score.

The magnitude of birth injuries

The magnitude of birth injuries in the current study was found to be 24.7% (95% CI=24.7%-24.8%). Approximately 2.9 % of neonates had birth asphyxia and physical trauma while 16.6 % of the neonates had birth asphyxia (perinatal asphyxia). The majority 71.6 % and 6 % of the neonates had been affected with soft tissues and scalp injuries respectively while 3.6 % of them had fractures 'Figure 3'.

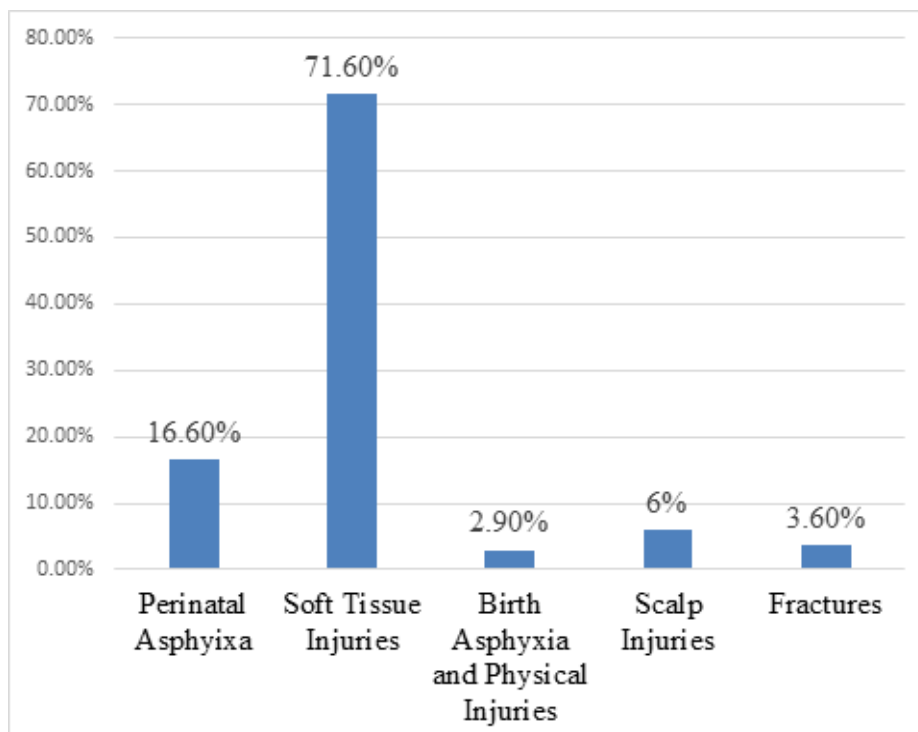


Figure 3

Factors associated with birth injury in selected public hospitals of Silte Zone, Central Ethiopia.

Bivariable logistic regression analysis was conducted to identify the possible associated factors with birth injury. In the current study, residence (COR=2.64, 95% CI= 1.51-4.61), (source of referral (COR=0.72 , 95% CI= 0.44-1.20), history of pre-term (COR=13.82, 95% CI=3.72-51.2), gestational age (COR=0.603, 95% CI = 0.30-1.20), ANC follow-up (COR=1.944, 95% CI=1.13-3.33), mode of delivery (COR=0.51, 95% CI =0.88-2.87), history of obstetric complications (COR=0.2.16 ,95% CI =1.25-3.74), maternal height (COR=5.63, 95%

CI=2.43-12.5), birth weight (COR=0.06 ,95% CI=0.03-0.13) , fetal presentation (COR=17.86, 95% CI=9.57-33.33) were associated with birth injury in the binary logistic regression analysis.

ANC follow-up by health professionals less than four (AOR=3.2, 95% CI = 1.21-8.33), short maternal height (AOR=4.85,95% CI= 1.26-20), assisted childbirth (AOR =3.33, 95 % CI=1.003 -11.044) and fetal mal-presentations (AOR=29.69, 95% CI =10.61 -43.09) were significantly and independently associated with birth injury in multivariable logistic regression analysis (Table 2).

Table 2: Bivariate and Multivariate Analysis of Birth Injury with Maternal, Pregnancy, and Labor Related Factors In Silte Zone Public Hospitals, June 2021.

Variables		Birth Injury		COR 95%CI	AOR 95%CI
		No	Yes		
Residence	Urban	116 (85.3%)	20 (14.7%)	1	1
	Rural	143 (68.8%)	65 (31.3%)	2.64 (1.51-4.61)	2.47(0.936-6.556)
Source of Referral	Self	141 (72.7%)	53 (27.3%)	1	
	Other HF	118 (78.7%)	32 (21.3%)	0.72(0.44-1.20)	0.732(0.289-1.849)
History of Preterm birth	No	211 (79%)	56 (21%)	1	1
	Yes	3 (21.4%)	11 (78.6%)	13.82(3.73-51.2)	5.143(0/673-39.312)
Gestational age(weeks)	<37	30 (66.7%)	15 (33.3%)	0.603(0.30-1.20)	0.902(0.258-3.148)
	37-40	199 (76.8%)	60 (23.2%)	1	1
	41-42	30 (75%)	10 (25%)	0.67(0.26-1.72)	0.429(0.065-2.853)
ANC follow up	>=4	117 (82.4%)	25 (17.6%)	1	1
	<4	130 (70%)	54 (29.3%)	1.944 (1.13-3.33)	3.2 (1.21-8.33)
Mode of delivery currnt birth	SVD	137 (79.2%)	36 (20.8%)	1	1
	Assisted	50 (71.4%)	20 (28.6%)	1.52(0.81-2.87)	3.33(1.003-11.044)
	C/S	72 (71.3%)	29 (28.7%)	1.53(0.87-2.7)	2.212(0.768-6.371)
History of obstetric complication	No	211 (78.7%)	57 (21.3%)	1	1
	Yes	48 (63.2%)	28 (36.8%)	2.16(1.25-3.74)	1.478(0.528-4.139)
Maternal height	>154cm	248 (78.5%)	68 (21.5%)	1	1
	<154cm	11 (39.3%)	17 (60.7%)	5.63 (2.43-12.5)	4.85 (1.26-20)
Birth weight	<2500gm	11 (25.6%)	32 (74.4%)	0.06(0.03-0.13)	0.46(0.013-0.16)
	2500 -3999gm	234 (85.1%)	41 (14.9%)	1	1
	>=4000gm	14 (53.8%)	12 (46.2%)	0.295(0.11-0.83)	0.308(0.058-1.623)
Fetal presentation	Vertex	238 (87.8%)	33 (12.2%)	1	1
	Non-vertex	21 (28.8%)	52 (71.2%)	17.86(9.57-33.33)	29.69(10.61-83.09)

Footnote: COR=Crude Odds Ratio, AOR=Adjusted Odds Ratio, CI=Confidence Interval, HF=Heart Failure

DISCUSSION

The magnitude of birth injury in the current study is 24.7% (95% CI=24.7%-24.8%) in this study is higher than the study reports of some developing countries^{13,15,16} including the study done in Jimma University specialized hospital and tertiary hospitals of Addis Ababa, Ethiopia where 15.4 % and 12.3 % of the neonates had birth injuries respectively^{14,17}. The possible reason for this variation might be due to the differences in the competency and experience of health professionals, local intrapartum management protocols, routine immediate neonatal examination protocols (policies), sample size, study design, and the time-lapse between the studies.

Perinatal asphyxia or birth asphyxia alone in the current study contributed to 16.6 % of birth injuries. This finding is higher than the study report of Jimma University specialized hospital where 8.1 % of the neonates sustained birth asphyxia from the total birth injuries of 15.4%¹⁴. This result is also higher than the study reports of New Delhi 3.6 %⁹ and, Uganda referral hospital 12.8 %^{6,18}. The dissimilarities of the findings might be due to the differences in the socio-demographic and socio-economic factors, quality of the service delivered during prenatal, labor, and childbirth, and the availability, accessibility, and affordability of maternal service, competency and experience of health professionals, local intrapartum management protocols, routine immediate neonatal examination protocols (policies).

In the current study birth trauma accounts for 71.6% of the reported total birth injuries. The finding was unacceptably high when compared to a systematic review and meta analysis result in Ethiopia where neonatal birth trauma among newborns in Ethiopia was 15%¹⁹. The possible reason for the variation might be the type and the scope of the studies

The previous finding of the recent study is lower than the study finding of Zambia where perinatal asphyxia magnitude of 23 %²⁰. The discrepancies might be due to the differences in the characteristics of the study population, sample size, the time lapse between the two studies, and the study settings.

The present study confirmed that neonates who were born from mothers of ANC follow-up less than four (AOR=3.2, 95% CI = 1.21-8.33) had a higher risk of encountering a birth injury than their counterparts. This finding was similar to the study findings from Hungary²¹, but not with the study finding of Jimma University specialized hospital, and tertiary hospitals of Addis Ababa, Ethiopia where ANC follow up less than four times was not reported to have association with birth injuries^{14,17,22,23}.

Neonates borne by assisted vaginal childbirth had a 3.3 (AOR=3.3, 95% CI=1.003-11.044) times the high risk of getting injury than those delivered spontaneously. This finding is similar to the study done in Dessie town, Ethiopia²⁴. Neonates borne from mothers who had a history of obstetric complications had 1.5 times (AOR=1.5, 95% CI=0.528-4.139) more chance of sustaining birth injuries than those mothers without obstetric complications. This finding is congruent to the study finding of Chennai, India¹⁵.

According to this study, a short maternal height of <154 cm (AOR=4.85, 95% CI= 1.26-20) was more risk for birth injury of the neonates than their counterparts. A similar report was found in the study done in Dessie town, Ethiopia, and the study in tertiary care hospitals of Chennai, India, and Nigeria^{15,24,25}.

The risk of birth injury was also significantly high among neonates of assisted childbirth (AOR =3.33, 95 % CI=1.003 -11.044) and fetal mal-presentation (AOR =5.78, 95 % CI=1.99 -16.78). These results are reported similarly in the studies conducted in Jimma university specialized hospital, Ethiopia and a prospective study done in Chennai, India^{14,15}. Unlike many other studies from low and middle-income countries, in this study, length of labor, primiparity, sex of the neonates, maternal weight, and MUAC had no association with a birth injury^{2,22,24,26,27}.

LIMITATIONS

The limitations of the present study include the result of the current study might not be

generalized to the whole population since this study was conducted at the health care facilities level. Additionally, this was done using only the quantitative approach, it would have been more informative if it included a qualitative approach. Finally, as the study was conducted in primary and referral hospitals most of the childbirth might be referral cases and this might be the reason for the slightly increased magnitude of birth injury relative to other studies in Ethiopia.

CONCLUSIONS

The magnitude of birth injury in this study was higher than other similar studies done in developing countries. Birth injuries were significantly high among neonates of mothers who attended less than four ANC follow-up visits, assisted birth / instrumental deliveries, neonates of mothers with short maternal height, and neonates with fetal malpresentations. Therefore; efforts should be made to improve the quality of prenatal and intrapartum care services to prevent birth injuries. Improving the referral system and strengthening the capacity of health professionals are recommended.

Abbreviations

ANC: Antenatal Care,
AGPH: AlemGebeya Primary Hospital,
APH: Ante Partum Hemorrhage,
C/S: Cesarean Section,
DM: Diabetic Mellitus,
KPH: Kibet Primary Hospital,
MUAC: Mid-Upper Arm Circumference,
NICU: Neonatal Intensive Care Unit,
SVD: Spontaneous Vaginal Delivery,
TPH: Tora Primary Hospital,
WHO: World Health Organization and
WCSH: Worabe Comprehensive Specialized Hospital

Ethical Consideration

This study was conducted following the declaration of Helsinki for studies involving human participants. Ethics approval was obtained from the Institutional Review Board (IRB) of Wolaita Sodo University. Permission was secured from Silte Zone Health Department, District Health Offices, and the leaders of respective Hospitals sequentially. The

purpose and procedure of the study were explained to respective health officials “Supplementary files: Supplementary information 1”. After getting permission from the medical director, obstetrics and gynecologic and pediatric departments of the hospitals, they have been requested to confirm the applicability of this study and to write a letter of cooperation to the delivery case team and NICU, and medical record office of the respective hospital. Finally, the researchers obtained informed written consent from all mothers/guardians after an agreement has been reached to participate in the study “Supplementary files: Supplementary information 2”.

Consent for Publication: Not applicable

Data availability: The dataset analyzed for the findings of this particular study is available with the corresponding author and can be accessed upon reasonable request.

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Competing interests: The authors declared that they have no competing interests

Authors contribution

All authors equally contributed to this work beginning from the conception, study design, execution, acquisition of data, analysis, and interpretation. Authors of this work took part in the drafting, revising, and/or critically reviewing of the article and finally agreed on the journal to which the article was submitted. All authors are also reviewed and agreed on all versions of the article before submission, during revision, and the final version is accepted for publication and agreed to be accountable for all aspects of the work.

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REFERENCES

1. Darmstadt GL, Hussein MH, Winch PJ, Haws RA, Gipson R, Santosham M. Practices of rural Egyptian birth attendants during the antenatal, intrapartum and early neonatal periods. *J Health Popul Nutr.* 2008;26(1):36-45.
2. Abedzadeh-Kalahroudi M, Talebian A, Jahangiri M, Mesdaghinia E, Mohammadzadeh M. Incidence of Neonatal Birth Injuries and Related Factors in Kashan, Iran. *Arch Trauma Res.* 2015;4(1):e22831.
3. Njokanma OF, Kehinde O. Mechanical Birth Trauma - An Evaluation of Predisposing Factors at the Ogun State University Teaching Hospital, Sagamu. *Nigerian Journal of Paediatrics.* 2002;29.
4. Wen Q, Muraca GM, Ting J, Coad S, Lim KI, Lisonkova S. Temporal trends in severe maternal and neonatal trauma during childbirth: a population-based observational study. *BMJ Open.* 2018;8(3):e020578.
5. Dalal EA, Bodar NL. A Study on Birth Asphyxia at Tertiary Health Centre. *The Journal of medical research.* 2013;3:374-376.
6. Costello AM, Manandhar DS. Perinatal asphyxia in less developed countries. *Archives of disease in childhood. Fetal and neonatal edition.* 1994;71(1):F1-3.
7. Kluwer W. Manual of neonatal care. Seventh Edition ed: LIPPINCOTT WILLIAMS & WILKINS, a WOLTERS KLUWER business; 2012.
8. Health FdroEMo. Neonatal Intensive Care Unit (NICU) Management Protocol:Ethiopia. Addis Ababa2021.
9. Lawn JE, Bahl R, Bergstrom S, et al. Setting research priorities to reduce almost one million deaths from birth asphyxia by 2015. *PLoS Med.* 2011;8(1):e1000389-e1000389.
10. Federal democratic republic of Ethiopia Ministry of Health. BEMOC NCLRP:Best practice in maternal and newborn care Maternal Death Surveillance and Response. 2013.
11. Lee ACC, Kozuki N, Blencowe H, et al. Intrapartum-related neonatal encephalopathy incidence and impairment at regional and global levels for 2010 with trends from 1990. *Pediatric Research.* 2013;74(1):50-72.
12. WHO. Basic Newborn Resuscitation: A practical guide, Maternal and Newborn Health/safe motherhood unit division of reproductive health. WHO, Geneva2009.
13. services USdohah. National Healthcare Quality Report, Statics about birth injury,. USA2012.
14. Workneh Tesfaye NWaEG. Birth Injury and Associated Factors in Jimma University Specialized Hospital, Southwest Ethiopia Ethiop. *J.Pediatr. Child Health.* 2016.
15. Prabhu RS SM, Anandan H. Incidence and Predisposing Factors of Birth Trauma in a Tertiary Care Hospital in Chennai, India: A Prospective Study. *Int J Sci Stud* 2017; 4(10):29-33.
16. Rabelo NN, Matushita H, Cardeal DD. Traumatic brain lesions in newborns. *Arquivos de neuro-psiquiatria.* 2017;75(3):180-188.
17. Lalisa Chewaka. Preventable Cause of Neonatal Mortality and Associated Factors Among Neonates Admitted To Neonatal Intensive Care Units of Addis Ababa Government Hospitals, Addis Ababa, Ethiopia. 2016.
18. Warke C, Malik S, Chokhandre M, Saboo A. Birth Injuries -A Review of Incidence, Perinatal Risk Factors and Outcome. *The Bombay Hospital journal.* 2012;54.
19. Balis B, Diriba Hunde A, Lami M. Prevalence and Patterns of Neonatal Birth Trauma in Ethiopia: Systematic Review and Meta-Analysis. *Global pediatric health.* 2023;10:2333794x231191982.
20. Halloran DR, McClure E, Chakraborty H, Chomba E, Wright LL, Carlo WA. Birth asphyxia survivors in a developing country. *Journal of perinatology : official journal of the California Perinatal Association.* 2009;29(3):243-249.
21. A F. Birth and Neonatal Care Injuries: A Special Aspect of Newborn Surgery. *Pediat Therapeutic.* 2012;2:132.
22. Hailu D, Worku B. Birth trauma among live born term neonates at a referral hospital in Addis Ababa, Ethiopia. *Ethiopian medical journal.* 2006;44(3):231-236.
23. Naik JD KR, Mathurkar MP, Jain SR, Jailkhani S, Thakur MS. Socio-demographic determinants of pregnancy outcome: a hospital-based study. *International Journal of Medical Science and Public Health.* 2016;5(9).
24. Hailu G YKaKA. Determinants of Birth-Asphyxia among Newborns in Dessie Town Hospitals, North-Central Ethiopia. *Int J Sex Health Repro Health.* 2018;1(1):1-12.
25. Njokanma OF, Kehinde O. Mechanical Birth Trauma - An Evaluation of Predisposing Factors at the Ogun State University Teaching Hospital, Sagamu. *Nigerian Journal of Paediatrics.* 2002;29.
26. Shireen N, Nahar N, Mollah AH. Risk Factors and Short-Term Outcome of Birth Asphyxiated Babies in Dhaka Medical College Hospital. *Bangladesh Journal of Child Health.* 2010;33.
27. Collins KA, Popek E. Birth Injury: Birth Asphyxia and Birth Trauma. *Acad Forensic Pathol.* 2018;8(4):788-864.