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Research Article

Magnitude of Birth Injuries and Associated Factors Among Newborns Delivered in Public Hospitals of North Shewa Zone, Oromia, Ethiopia, 2023: Cross-Sectional Study

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Abstract

Introduction: **-** Birth trauma, often known as birth injuries, is any disability or harm that a newborn sustains during delivery or throughout the entire birth process. According to Ethiopia, birth injuries now contribute to between 28% and 31.6% of neonatal deaths, making them the major cause of mortality and morbidity. Although research on the extent and risk factors was conducted in Ethiopia, it did not cover all aspects, such as medical factors (smoking) and professional factors that were proven to be predictors of birth injury in other nations. *Methods:* An institutional-based cross-sectional study was employed for three months from June 1, 2023, to August 30, 2023. A semi-structured interview-administered questionnaire was used to collect data. Data were entered into Epi Data version 4.6 and exported to Statistical Package for Social Science software version 26 for analysis. Descriptive statistical analysis was done, and an association between dependent variables and independent variables was examined in logistic regression models. *Results:* The overall magnitude of neonatal birth injuries was 22.68% (95% CI: 18.5, 27.5). Age of the mother from 15-19 and 20-24 (AOR: 0.006, 95% CI:0.000, 0.131, and AOR: 0.017, 95% CI:0.001, 0.320), instrumental delivery (AOR:3.882, 95% CI:1.402, 10.780), cesarean section (AOR: 0.1449, 95% CI:0.027, 0.779), rural residence (AOR: 3.188, 95% CI:1.283, 7.923), cephalo-pelvic disproportion (AOR: 8.171, 95% CI:3.871, 17.248), induced labor (AOR: 4.009, 95% CI:1.832, 8.773), and prolonged duration of labor (AOR: 5.262, 95% CI:2.222, 12.461) were risk factors of birth injury. *Conclusion and Recommendation:* The rate of birth injuries was found to be higher than expected. The age of the mother, instrumental and cesarean section delivery, prolonged labor, induced labor, CPD, and rural residence were predictors of birth injury. The Ministry of Health and the regional and local healthcare systems should give attention to maternal health services.

Keywords

Birth Injury, Fiche, North Shewa, Oromia

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1. Background

Birth injuries account for 10% of deaths in children under five years old, making them one of the top three causes of newborn mortality globally [1]. An estimated 60 million women still deliver at home, of whom over 85% deliver without a skilled birth attendant present [2]. The incidence of neonatal birth trauma varies worldwide based on the mode of delivery, fetal presentation, and fetal position and is reported to be between 0.2 and 41.2 per 1,000 births [3]. The leading preventable cause of newborn mortality and morbidity globally is birth injuries [4].

Birth injury rates vary by location and are primarily influenced by the quality of obstetric care that is offered. Birth trauma occurs in 20 to 37 out of every 1000 live births in wealthy nations like the US [5].

According to a report from Egypt, the prevalence of birth injuries was 17% [8], although the rates in African nations (Mali and Morocco) were 0.68% and 0.26%, respectively [6, 7]. According to a different study conducted in Nigeria, the incidence of birth injuries is 0.2 per 37 live births [9].

Around 28% to 31.6% of neonatal deaths in Ethiopia are attributable to birth injuries, making them the primary cause of both morbidity and mortality [2, 10, 11]. An investigation carried out in southwest Ethiopia found that 16.7% of neonatal birth injuries were documented [12].

The majority of mothers may endure unfavorable, traumatic delivery experiences as a result of birth injuries and accompanying complications. Post-traumatic stress disorder (PTSD), poor maternal-neonatal bonding, sexual dysfunction, avoidance of nursing, and low self-esteem can all have an impact on the mother's and the newborn's future lives [13, 14]. Additionally, they are more susceptible to postpartum depression and acute stress reactions [15].

Various factors associated with birth injuries have been identified in the literature, including maternal age, educational status, marital status, pre-pregnancy body max index, maternal weight, maternal height, place of residence, antenatal care follow-up, pregnancy type, parity, maternal diabetes, gestational diabetes, hypertension, smoking, fetal presentation (vertex, breech, face, etc.), duration of labor, obstructed labor, cephalo-pelvic disproportion, mode of delivery, time of birth, sex, birth weight, head circumferences, gestational age, shoulder dystocia, fetal anomaly, fetal macrosomia, multiple gestations, qualification of birth attendant, year of experience, training, delivery material, learning guidelines, and parthograph utilization [2, 14, 16-21].

Birth injuries have become less common in industrialized nations as a result of advancements in obstetric care and practice. However, in developing nations, it is estimated that only 25% of deliveries are attended by trained birth attendants, increasing the risk of delivery injuries. With risk assessment and proactive management, the majority of them may be preventable [22].

Ethiopia's Federal Ministry of Health created and executed high-impact interventions in 2015 to reduce under-five mortality by two-thirds. These interventions included skilled birth services, postnatal care, focused antenatal care, and a comprehensive National Child Survival Strategy (2015–2020) [23, 24]. In Ethiopia, a significant proportion of newborn deaths is attributed to delivery injuries and associated complications, notwithstanding these efforts. Therefore, it is crucial to investigate birth injuries since this could reveal potential contributing variables and stop them from happening.

Besides, whether or not these related aspects are the same in our scenario has not been thoroughly investigated. Knowing the circumstances as well as the probable contributing factors to neonatal birth injuries should raise awareness among caregivers and enhance care for pregnant women and their infants, as well as the identification of high-risk deliveries by fetal and perinatal ultrasound before labor, the use of less harmful obstetrical instruments and techniques, and timely cesarean sections (C/S), which are becoming more and more accepted ways of preventing birth injuries. Even though some research was done in Ethiopia on the magnitude and risk factors, it was limited because it did not include all variables like medical factors (smoking) and professional factors (lack of delivery materials, lack of learning guidelines, lack of training, and partograph utilization) that were found to be predictors of birth injury in other countries.

The magnitude and associated factors of birth injury in North *Shewa* Zone, Oromia, are not known yet. Due to these reasons, this study was carried out to assess the magnitude of birth injuries and associated factors among newborns delivered in government hospitals in North *Shewa* Zone, Oromia, Ethiopia, in 2023.

2. Methods and Materials

2.1. Study Area and Period

The North Shewa zone is located in the Oromia regional state of Ethiopia, 112 kilometers northwest of the capital city, Addis Ababa. The zone has a total population of about 1,639,586, of which 717,552 and 922,034 were men and women, respectively, with a majority of the population (89.75%) residing in rural areas [25]. There are about 71 public health facilities (64 health centers and seven governmental hospitals (one comprehensive specialized hospital, one general hospital, and five primary hospitals)) and 30 private medium clinics providing service to the community. Four hospitals (Salale University Comprehensive Specialized Hospital, Kuyu, Muka Turi, and Dera Gunde Meskel Hospital) were selected for this study.

In a three-month report, the chosen hospital oversees 1861 deliveries. Salale University Comprehensive Specialized Hospital is located in Fiche town, the capital city of the North Shewa zone, and performs more than 621 deliveries in

three months, with 96 of those being attended through cesarean section. Kuyu General Hospital is located in Garba Guracha town, 43 km from Fiche town. It provides services for two adjacent woredas and oversees around 501 deliveries in its three-month report, of which 72 were conducted with cesarean sections. Similarly, Muka Turi and Dera Gunde Meskel Primary Hospital oversee 411 and 327 deliveries in three-month reports, with 57 and 63 deliveries conducted through cesarean sections, respectively. From June 1 to August 30, 2023, newborns delivered at North Shewa Zone in four selected public hospitals (one comprehensive specialized hospital, one general hospital, and two primary hospitals) were studied.

2.2. Study Population

All mother-neonate pairs were delivered in selected public hospitals of North Shewa Zone, Ethiopia, during the study period, fulfilling the inclusion criteria. All mother-neonate pairs delivered in selected public hospitals with gestational ages of $\geq$ 28 weeks were included. Moms who were truly sick and incapable of replying to the address were prohibited.

2.3. Sample Size Determination

The sample size for this study was calculated using the formula for a single population proportion considering the following assumptions.

$$n = \frac{(z_{\alpha/2})^2 \times p \times (1-P)}{d^2}$$

Where:

n= minimum sample size required for study,

p= prevalence population proportion 24.7% (0.274) [2]

Z $_{\alpha/2}$ = critical value at 95% confidence level of certainty (1.96),

d= margin of error 5% (0.05)

Thus, n is calculated as:

$$n = \frac{Za/2^2 * p * q}{d^2} = \frac{1.96^2 * 0.247 * 0.753}{0.05^2} = 285$$

Thus, the final sample size was 313 after adding 10% of the non-response rate.

2.4. Sampling Technique and Procedure

Four hospitals were chosen by lottery to be part of the study from seven (07) government hospitals. Based on each hospital's three-month delivery data, a proportional size allocation algorithm was used to determine how many research units would be sampled from each chosen hospital. A systematic random sampling technique was used to select the study participants from a list of deliveries in the registration book. Each "K" value was determined by dividing the total

number of deliveries in the hospital's 3-month (June 1-August 30, 2014, E.C.) report by the necessary sample size. For every "k" value, the remaining subjects were included in the study, with the first participant being selected at random.

2.5. Instrument

The tools include: maternal socio-demographic characteristics; medical and obstetrical history; a review of records regarding neonatal birth injury; intrapartum factors; and professional-related factors. It was pre-tested on 5% of the study population before actual data collection and necessary adjustments were made. The data was collected by four trained midwives. The data collector was given training by the principal investigator for two days on objectives, data collection tools and techniques, relevance of the study, confidentiality issues, study participants' rights, consenting, and interview techniques. The data collection was supervised by principal investigators. Errors in the data were corrected on the same day of data collection and approved by the principal investigator.

2.6. Operational Definition

Birth trauma/Birth injury: Any physical harm to neonates during the entire birth process that may be identified by clinical and physical examination, including injuries sustained during labor and delivery that result in a diagnosis of birth trauma by qualified health professionals (midwife, IESO, GP, gynecologist) that has been recorded on the card [2].

A newborn infant, or neonate, is a child under 28 days of age [26].

Cephalo-pelvic disproportion, which means "failure to progress" in labor for mechanical reasons, occurs when the size of the fetal head and the mother's pelvis are not in proportion [27].

Prolonged labor is defined as when the first and second stages of labor last more than 12 hours for primipara mothers or 8 hours for multipara mothers [28].

Obstructed Labor: Despite adequate uterine contractions, the delivery of the baby could not be accomplished timely in a normal, natural fashion, but active intervention by health professionals will be needed. It is taken from diagnosis [29].

2.7. Data Processing and Analysis

After completing data collection, the data were categorized, coded, cleaned, and recoded. The data was entered in EpiData version 4.6 and exported to SPSS version 26. Frequencies, percentages, cross-tabulation, and mean. Bivariate logistic regression analysis was used to check the association between each independent variable and birth injury. Then those variables with a p-value of 0.25 were entered into a multivariable logistic regression model analysis to control the confounding factors. To check the correlation between independent variables, colinearity diagnostic taste was used

to check the value of variance, inflation factors, and tolerance. Hosmer and Lemeshow's goodness of fit test was done to test the fitness of the logistic regression in the final model, and then it was found good (statistically insignificant value, P-value > 0.05). The strength of the association between dependent and independent variables was expressed by using an adjusted odds ratio with a 95% confidence interval and P-value <0.05. Finally, the findings were presented by using text, tables, and graphs.

2.8. Ethical Consideration

The study was conducted after the approval of the Institutional Review Board (IRB) of Salale University College of Health Science. Permission was also sought from each hospital. Study participants were asked for their willingness to participate in the study after explaining the purpose of the study. Then, written informed consent assent was obtained from each participant. The privacy and confidentiality of information were strictly maintained by not writing the names of study participants on the data collection tool.

3. Results

3.1. Socio-demographic Characteristics of the Mothers

In this study, all 313 mothers participated with a response rate of 100%. The mean maternal age was 28.96 ± 1.157 SD years, of whom 105 (33.5%) of mothers belong to age groups of 25-29 years. Of those participants, 201 (64.2%) lived in urban areas. In addition, around 289 (92.3%) of the respondents were married. The mean BMI and height of the mothers were 21.53 ± 1.98 SD kg/m^2 and 155.9 ± 0.312 SD cm, respectively. The majority of the mothers, 237 (75.7%), were classified in the range of normal body mass index (18.5-24.9). Regarding the height of the mothers, about 279 (89.1%) of them had a body height greater than 145 cm. (Table 1).

Table 1. Socio-demographic characteristics of study participants in selected hospitals of North Shewa Zone, Oromia, Ethiopia, 2023. (n = 313).

Variables	Category	Frequency (n)	Percentage (%)
Age of the mother	15-19	33	10.5
	20-24	80	25.6
	25-29	105	33.5
	30-34	58	18.5
	≥35	37	11.8
Level of education	No Formal education	86	27.5
	Primary	73	23.3
	Secondary	94	30.0
	More than secondary	60	19.2
Residence	Urban	201	64.2
	Rural	112	35.8
Marital status	Single	13	4.2
	Married	289	92.3
	Divorced	11	3.5
Pre-pregnancy weight/BMI (Kg/m^2)	<18.5	42	13.4
	18.5-24.9	237	75.7
	25-29.9	31	9.9
	≥30	3	1.0
Height of the mother in cm	<145 cm	34	10.9
	≥145 cm	279	89.1

3.2. Magnitude and Types of Birth Injuries

The current study shows from the total of 313 newborns delivered, 22.68% (95% CI: 18.5, 27.5) have developed birth injuries. (Figure 1).

Cephalo-hematoma and Caput succedaneum account for 24 (33.8%) and 20 (28.17%) of neonatal birth injuries, respectively, followed by sub-gallial hemorrhage 13 (18.3%) and ecchymosis/bluish of the skin 4 (5.63%). (Figure 2)
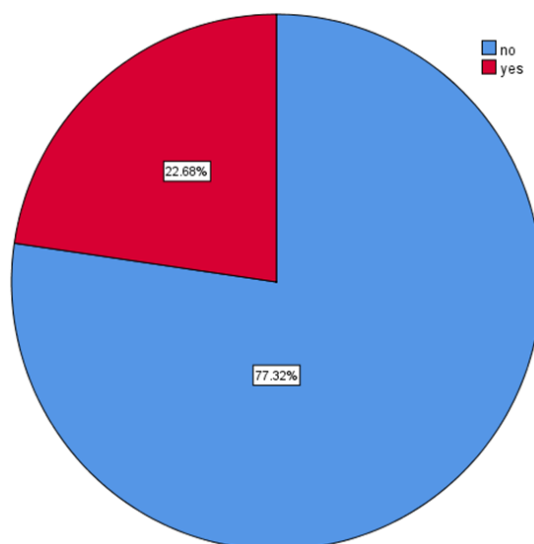

Figure 1. The magnitude of birth injuries among newborns delivered in selected hospitals of North Shewa Zone, Oromia, Ethiopia, 2023 (n = 313).
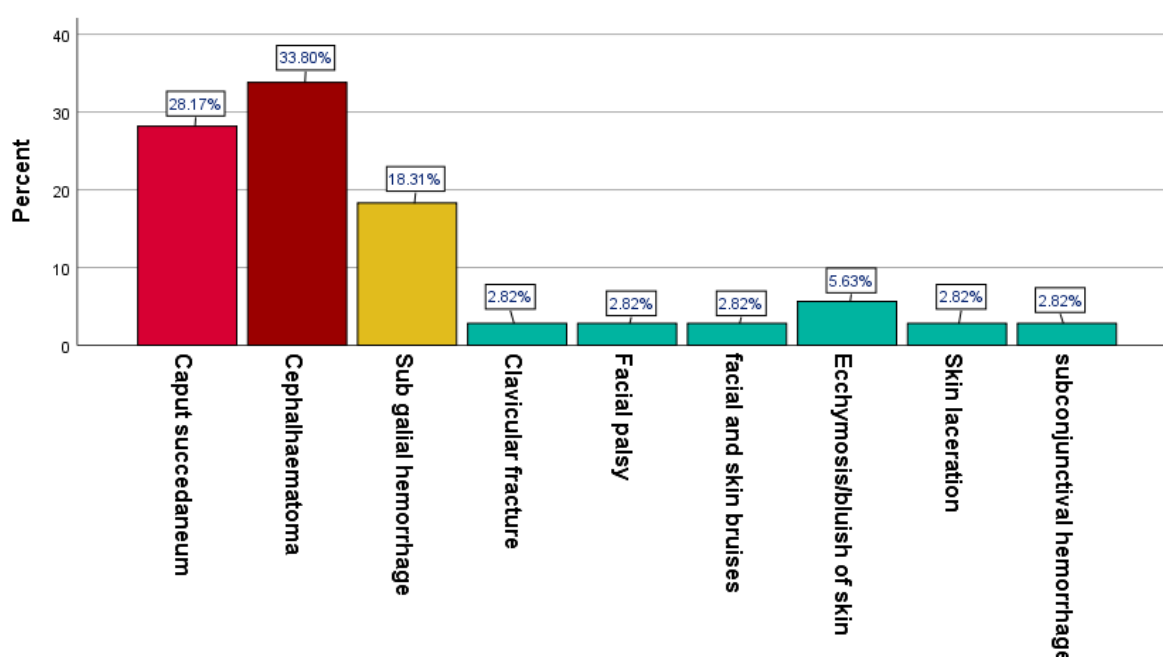

Figure 2. Common types of birth injuries among newborns delivered in selected hospitals of North Shewa Zone, Oromia, Ethiopia, 2023 (n = 313).

3.3. Medical and Obstetric Characteristics of the Mothers

Among 313 study subjects, 296 (94.6%) of mothers attended ANC follow-up during their pregnancy period. Two hundred twenty-two (70.9%) had four or more ANC follow-ups. Of those, 208 (66.5%) of the respondents had ANC follow-ups at government hospitals. The majority of the mothers, 286 (91.4%), had a single type of pregnancy, and 27

(8.6%) of the mothers had twin types of pregnancy. (Table 2)

Table 2. Medical and obstetrics related factors of mothers delivered in selected hospitals of North Shewa Zone, Oromia, Ethiopia, 2023. (n = 313).

Variables	Category	Frequency (n)	Percentage (%)
Having a history of ANC	Yes	296	94.6
	No	17	5.4
Visited health services for ANC	<4 follow-up	74	23.6
	4 and above	222	70.9
	No follow up	17	5.5
Facilities for ANC	Health center	88	28.1
	Governmental hospital	208	66.5
Parity	Primipara	109	34.8
	Multipara	204	65.2
Gravidity	Primigravida	109	34.8
	Multigravida	204	65.2
Pregnancy-induced hypertension	Yes	17	5.4
	No	296	94.6
Smoking cigarette	Yes	7	2.2
	No	306	97.8
Type of pregnancy	Single	286	91.4
	Twine	27	8.6
Vaginal bleeding during pregnancy	Yes	44	14.1
	No	269	85.9

3.4. Intrapartum Related Factors

According to the results of this study, 257 (82.1%) of the fetus/pregnancy were at vertex presentation. Among the total number of mothers who participated, 225 (71.9%) and 77 (24.6%) had spontaneous and induced onsets of labor, respectively. Among the total number of mothers who participated, 199 (63.6%), 91 (29.1%), and 23 (7.3%) of the newborns were delivered by spontaneous vaginal delivery, instrumental delivery, and cesarean section, respectively. -pelvic disproportion accounts for 72 (22.7%) of total labor. Among the total number of mothers who participated, 193 (61.7%) and 120 (38.3%) of the neonates were delivered during daytime and nighttime, respectively. (Table 3)

Table 3. Intrapartum-related factors for newborns delivered in selected hospitals of North Shewa Zone, Oromia, Ethiopia, 2023. (n = 313).

| Variables | Category | Birth injury | |
		No	Yes
Fetal presentation	Vertex presentation	204(79.4%)	53(20.6%)
	Breech presentation	18(75%)	53(25%)

Variables	Category	Birth injury	
		No	Yes
	Face presentation	12(85.7%)	2(14.3%)
	Brow presentation	8(50%)	8(50%)
	Shoulder presentation	0	2(100%)
Cephalo-pelvic disproportion	No	210(87.1%)	31(12.9%)
	Yes	32(44.4%)	40(55.6%)
Did labor start at term?	No	28(84.8%)	5(15.2%)
	Yes	214(76.4%)	66(23.6%)
Conditions of labor	Spontaneous	195(86.7%)	30(13.7%)
	Induced	36(46.8%)	56(48.3%)
Duration of labor	>12hr(prolonged)	60(51.7%)	56(48.3%)
	<12hr(non-prolonged)	171(91.9%)	15(8.1%)
Mode of delivery	Spontaneous vaginal delivery	180(90.5%)	19(8.1%)
	Instrumental delivery	45(49.5%)	46(50.5%)
	Cesarean section	17(73.9%)	6(26.1%)
Time of birth	Day time birth	146(75.6%)	47(24.4%)
	Night time birth	96(80%)	24(20%)

3.5. Neonatal-related Factors

Of the total number, 220 (70.3%) newborns were male. At birth, more than a quarter of 271 (86.6%) of the newborns were between 37 and 42 weeks of gestational age. At the time of birth, the average gestational age was 39 weeks (SD: 0.345). In addition, 249 (79.6%) of the participants had normal birth weights (between 2500 and 3999 grams). Of the subjects, 278 (95.8%) had normal head circumferences (between 33 and 38 cm). (Table 4)

Table 4. Neonatal related factors of newborns delivered in selected hospitals of North Shewa Zone, Oromia, Ethiopia, 2023. (n = 313).

Variables	Category	Frequency (n)	Percentage (%)
Sex	Male	220	70.3
	Female	93	29.7
Gestational age	<37wk	42	13.4
	37wk-42wk	271	86.6
Weight	<2500 gram	54	17.3
	2500-3999 gram	249	79.6
	≥4000 gram	10	3.2
Head circumference	<33 cm	23	7.3
	33-38 cm	278	88.8
	>38 cm	12	3.2

3.6. Health Professionals Related Factors

The majority of labor and delivery 222 (70.9%) were attended by midwifery. (Table 5)

Table 5. Professional related factors of newborns delivered in selected hospitals of North Shewa Zone, Oromia, Ethiopia, 2023. (n = 313).

Variable	Category	Birth injury	
		No	Yes
Qualification of birth attendant	Gynecologist	14(43.8%)	18(56.3%)
	General practitioner	8(44.4%)	10(55.6%)
	Midwifery	197(88.7%)	25(11.3%)
	IESO	23(56.1%)	18(43.9%)
Year of experience	<3	63(67.7%)	30(32.3%)
	4-5	133(82.6%)	28(17.4%)
	≥6	46(78%)	13(22%)
Given special training	No	83(76.1%)	26(23.9%)
	Yes	159(77.9%)	45(22.1%)
Fully availability of delivery materials	No	44(78.6%)	12(21.4%)
	Yes	198(77%)	59(23%)
Availability of different guidelines	No	21(91.3%)	2(8.7%)
	Yes	221(76.2%)	69(23.8)
Parthograph utilization	No	11(84.6%)	2(15.4%)
	Yes	230(76.9%)	69(23.1%)

3.7. The Associated Factors of Birth Injuries

In binary logistic regression analyses, the factors associated with neonatal birth injury were: Age of the mother, Residence, Marital status, BMI of the mother, height of the mother, pregnancy-induced hypertension, fetal presentation, cephalo-pelvic disproportion, condition of labor, duration of labor, mode of delivery, baby sex, gestational age, birth weight, head circumference, qualification of birth attendant, year of experience and lack of different guidelines.

In multivariate logistic regression: age of the mother from 15–19 and 20–24 (AOR: 0.006, 95% CI: 0.000, 0.131, and AOR: 0.017, 95% CI: 0.001, 0.320), instrumental delivery (AOR: 3.882, 95% CI: 1.402, 10.780), cesarean section (AOR: 0.1449, 95% CI: 0.027, 0.779), rural residence (AOR: 3.188, 95% CI: 1.283, 7.923), cephalo-pelvic disproportion (AOR: 8.171, 95% CI: 3.871,17.248), induced labor (AOR: 4.009, 95% CI: 1.832, 8.773), and prolonged duration of labor (AOR: 5.262, 95% CI: 2.222-12.461) were found as independent associated risk factors for birth injury after controlling for multiple potential confounders.

Instrumental delivery was nearly four times (AOR: 3.882, 95% CI: 1.402, 10.780) more likely to cause a birth injury as compared to a cesarean section and spontaneous vaginal delivery. Neonates of mothers who came from rural residences were three times (AOR: 3.188, 95% CI: 1.283, 7.923) more likely to develop birth injuries as compared to those from urban residences. Mothers who have cephalo-pelvic disproportion were eight times (AOR: 8.171, 95% CI: 3.871, 17.248), more likely to develop birth injuries as compared to those who have no cephalo-pelvic disproportion. Neonates born from mothers who had prolonged labor were 5.262 times (AOR: 5.262, 95% CI: 2.222-12.461) more likely to develop a birth injury when compared to those born from mothers with a normal duration of labor. Induced labor was four times (AOR: 4.009, 95% CI: 1.832, 8.773) more likely to develop a birth injury as compared to spontaneous labor. (Table 6)

Table 6. Bivariable and multivariable analysis of factors associated with birth injuries in selected hospitals of North Shewa Zone, Oromia, Ethiopia, 2023. (n = 313).

Variables	Category	Birth injury		COR (95%CI)	AOR (95%CI)	P value
		Yes	No			
Age of the mother	15-19	11	22	0.222((0.079-0.621)	0.006(0.000-0.131)*	0.001
	20-24	8	72	0.561(0.238-0.964)	0.017(0.001-0.320)*	0.000
	≥35	11	26	1	1	1
Fetal presentation	Vertex presentation	53	204	1	1	1
	Breech presentation	6	18	1.283(0.485-3.392)	2.004(0.515-7.795)	0.316
	Face presentation	2	12	0.642(0.139-2.954)	0.255(0.027-2.455)	0.237
	Brow presentation	8	8	3.849(1.380-10.773)	0.513(0.124-4.016)	0.567
Qualification of birth attendant	Gynecologist	18	14	1	1	1
	General practitioner	10	8	0.972(0.304-3.110)	0.229(0.035-1.500)	0.124
	Midwifery	25	197	0.99(0.044-0.223)	2.380(0.396-14.302)	0.343
	IESO	18	23	0.609(0.240-1.546)	0.462(0.137-1.556)	0.213
Pre-pregnancy weight/BMI	<18.5	12	30	1	1	1
	18.5-24.9	44	193	0.570(0.271-1.201)	0.511(0.172-1.517)	0.227
	25-29.9	12	19	1.579(0.590-4.229)	2.501(0.659-9.493)	0.178
Year of professional experience	<3	30	63	1	1	1
	4-5	28	133	0.442(0.244-0.802)	1.462(0.388-5.506)	0.575
	>6	13	46	0.593(0.279-1.2610	0.489(0.144-1.661)	0.251
Marital status	Single	2	11	1	1	1
	Married	64	225	1.564(0.338-7.239)	3.388(0.392-29.299)	0.268
	Divorced	5	6	4.583(0.673-31.198)	7.842(0.542-113.560)	0.131
Head circumference	<33 cm	4	19	1	1	1
	33-38 cm	55	233	1.172(0.383-3.583)	0.355(0.072-1.751)	0.203
Mode of delivery	Normal vaginal delivery	19	180	1	1	1
	Instrumental delivery	46	45	9.684(5.176-18.118)	3.882(1.402-10.780)*	0.009
	Cesarean section	6	17	3.344(1.177-9.497)	0.1449(0.027-0.779)*	0.024
Weight	<2500 gram	8	46	1	1	1
	2500-3999 gram	53	196	1.555(0.692-3.494)	2.469(0.776-7.849)	0.126
Residence	Urban	36	165	1	1	1
	Rural	35	77	2.083(1.216-3.569)	3.188(1.283-7.923)*	0.013
Height	<145 cm	14	20	1	1	1
	≥145 cm	57	222	0.367(0.175-0.771)	0.615(0.130-2.915)	0.540
Pregnancy-induced hypertension	Yes	7	10	0.394(0.144-1.076)	0.445(0.050-3.982)	0.469
	No	64	232	1	1	1
Cephalo-pelvic disproportion	Yes	40	31	8.468(4.654-15.407)	8.171(3.871-17.248)*	0.000
	No	31	211	1	1	1

Variables	Category	Birth injury		COR (95%CI)	AOR (95%CI)	P value
		Yes	No			
Conditions of labor	Spontaneous	30	195	1	1	1
	Induced	41	36	7.403(4.103-13.355)	4.009(1.832-8.773)*	0.001
Gestational age	<37wk	6	36	1	1	1
	37wk-42wk	65	206	0.528(0.213-1.310)	0.301(0.042-2.151)	0.231
Baby sex	Male	58	162	0.454(0.235-0.877)	0.562(0.195-1.621)	0.287
	Female	13	80	1	1	1
Availability of different guide-lines	Yes	69	221	0.305(0.070-1.334)	0.021(0.000-2.961)	0.126
	No	2	21	1	1	1
Duration of labor in hours	>12hr(prolonged)	56	60	10.640(5.603-20.204)	5.262(2.222-12.461)*	0.000
	<12hr(non-prolonged)	15	171	1	1	1

* = Statistically significant at p-value <0.05 with 95% CI, COR= Crude Odd Ration, AOR= Adjusted Odd Ratio

4. Discussion

In this study, 22.68% (95% CI: 18.5, 27.5) of newborns had birth injuries. The outcomes were similar to the study done in Addis Ababa, Ethiopia, where 24% of newborns had birth injuries [2]. However, the finding was higher than the study in Nigeria [30], and Iran, 2.7% [4]. The possible justification for the variations might be differences in the sample size, study setting, infrastructure of health care facilities, maternal and neonatal health services, skills of birth attendants to attend labor and delivery processes, and duration of the study period.

In this study, 33.8% of the reported birth injury was cephalo-hematoma. The finding was comparable to a study in India (38.7%) [31], but lower than a study in Iran (57.2%) [32]. The discrepancy might be related to the availability and accessibility of quality obstetrics care and the continuum of maternal care across the nation. Moreover, 28.17% of the reported birth injuries were caput succedaneum. The finding was higher than in Nigeria [30] but lower than a study in Iran (82%) [33]. The discrepancy might be related to the availability and accessibility of quality obstetrics care and the continuum of maternal care across the nation.

This study showed that 14.03% of the reported birth injuries were soft tissue injuries. The finding was lower than a study in Nigeria (60.7%) [6] And 18.3% of the reported birth injuries were sub-galeal hemorrhages. The finding was higher than a study in India (2.08%) [34], but in line with a study done in Dhaka, Bangladesh (22%) [35] and Ethiopia (20%) [2]. The discrepancy might be due to the variation in delivery and neonatal services in study settings as well as differences associated with the risk factors for birth injuries.

Induced labor was four times more likely to develop birth injuries when compared to C/S and spontaneous delivery. This result was comparable to the study reported in southeast Brazil [36], Maiduguri North-Eastern Nigeria [6], and South East Nigeria [37]. This might be due to the effect of oxytocin or other induction drugs, which may lead to birth injury or trauma.

Mothers who came from rural residences were 3.2 times more likely to develop birth injuries compared to those from urban residences. This result is supported by a previous study conducted in the Netherlands [38] Jimma [20] and Addis Ababa [2]. This may be because mothers who live in rural areas are less likely to have health-seeking behavior, have low practice of birth preparedness and complication readiness, have poor knowledge of danger signs of labor and childbirth, have less access to transportation, and may experience delays in reaching a health facility, all of which put them at risk for labor complications and prevent them from receiving timely treatment, increasing the likelihood of birth injuries.

Mothers who had a cephalo-pelvic disproportion were eight times more likely to develop birth injury compared to those who had no cephalo-pelvic disproportion. This study is supported by a study done in Iran [4], India [39] and Nigeria [40]. This might be because the pelvis and pelvic muscles of mothers were contracted and tight enough [41], which could 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.

The risk of a birth injury was 5.262 times higher for infants born to mothers who experienced extended labor than for those whose labor lasted a typical amount of time. Studies conducted at Bombay Hospital [31], India [42], and Nige-

ria [6] corroborated this conclusion. This is because women may become exhausted throughout extended labor and find it difficult to continue the labor. Thus, a vacuum or forceps may be used by the delivery attendant to aid in labor to avoid fetal distress. This could result in birth damage.

Neonatal birth injuries were also shown to be substantially correlated with maternal age. The results of this study were also found to be in line with research done in nations with low and intermediate incomes [43]. This outcome could be explained by the fact that mothers' pelvis and pelvic muscles were sufficiently stiff and constricted when they were young [3].

This study found a strong correlation between neonatal birth injuries and the technique of delivery. According to reports, infants who are delivered instrumentally—using vacuums or forceps—are more likely to sustain injuries. The results were comparable to those of studies conducted in Cameroon [45]. India [5], and Indonesia [44]. Additionally, research done in Addis Ababa, Ethiopia, supports it [21]. This could be because of differences in the study design, study settings, obstetric care standards, and improper use of the instrument during labor, or the medical profession's incapacity to apply instrumental delivery to the head. If the instrument is pulled forcefully, it could harm the scalp or the head as well as the underlying soft tissues.

5. Conclusion

The magnitude of neonatal birth injuries in selected hospitals in the North Shewa Zone is higher (22.68%) than previous studies conducted in developing countries. Maternal age, cephalo-pelvic disproportion, mode of delivery (instrumental and c/s), rural residence, prolonged labor, and induced labor are significant statistical associations with neonatal birth injury.

6. Recommendation

The increasing magnitude of birth injury can be reduced by active participation of the following concerned bodies in order to improve the quality of newborns health.

For health care provider:-

It is better to give education to strengthen birth preparedness and complication readiness among rural mothers. Following the mother strictly during labor to avoid the complications of prolonged labor. Training of staffs on safe instrumental delivery and early neonatal assessment is crucial to minimize the prevalence and severity of birth trauma.

Careful use of instruments (forceps and vacuums) during delivery to avoid traumatizing newborns is recommended.

For Institutions:-

The hospital administration should increase the frequency of staff training as well as improve the supervision of the staff for quality care.

For the researchers:-

Conducting further research to identify other risk factors by using other study design. Independently studies are being conducted on the various types of birth injuries.

Abbreviations

AOR	Adjusted Odd Ratio
ANC	Antenatal Care
BMI	Body Mass Index
BT	Birth Trauma
CI	Confident Interval
CPD	Cephalo-pelvic Disproportion
C/S	Caesarian Section
CDC	Centers for Disease Control
COR	Crude Odd Ratio
IESO	Integrated Emergency Surgical Officers
IRB	Institutional Review Board
NGO	Non- Governmental Organization
PI	Principal Investigator

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Ethics Clearance and Participant Consent

The Salale University-College of Health Science ethical review committee granted ethical clearance on 06/10/2015 E.C., and a formal letter was sent to each hospital that was chosen to request their consent to participate in the study at their facility as well as their potential cooperation. It was not possible to get individual patient informed consent because this study was a retrospective record review. However, written consent from the three chosen hospitals' administrations was required to view the records. To maintain anonymity, personal identifiers were also excluded from the final data set.

Consent for Publication

Not applicable.

Availability of Data and Materials

All data supporting this manuscript are available in this published article.

Author Contributions

Teferi Tasew was responsible for data management, statistical analysis, and interpretation, and wrote the original manuscript draft. Dejene Hailu and Melese Wagaye interpreted and supervised the statistical analysis. Gadisa Berhanu and Henok Abebayehu critically revised the manuscript. All authors approved the final version of the manuscript.

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Conflicts of Interest

The authors declare no conflicts of interest.

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