



WESTERN NIGERIA JOURNAL OF MEDICAL SCIENCES (WNJMS)

**PREVALENCE, PATTERN AND TREATMENT OUTCOME OF NEWBORN BIRTH
INJURIES AMONG NEONATAL UNIT ADMISSIONS IN A TEACHING HOSPITAL IN
SOUTH-WESTERN NIGERIA**

PREVALENCE, PATTERN AND TREATMENT OUTCOME OF NEWBORN BIRTH INJURIES AMONG NEONATAL UNIT ADMISSIONS IN A TEACHING HOSPITAL IN SOUTH-WESTERN NIGERIA

Abiodun MO¹, Bola-Oyebamiji SB¹, Olarewaju SO², Olagunju FA³, Adedire A⁴

1. Obstetrics & Gynaecology Department, Osun State University, Osogbo, Nigeria
2. Community Medicine Department, Osun State University, Osogbo, Nigeria
3. Paediatrics Department, Osun State University, Osogbo, Nigeria
4. Surgery Department, Osun State University, Osogbo, Nigeria.

Correspondence to: Bola-Oyebamiji SB, Obstetrics & Gynaecology Department, Osun State University, Osogbo, Nigeria. E-mail: sekinah.bola-oyebamiji@uniosun.edu.ng. **Telephone:**+2348033238808.

ABSTRACT

Introduction: Neonatal birth injuries (NBI) are a diverse set of mechanical traumas from tractions and compressions affecting neonates during delivery, and these range from minor bruises and lacerations to significant injuries such as obstetric fractures and nerve injuries. This study aimed to determine the prevalence, pattern, and outcome of newborn birth injuries seen at UNIOSUN Teaching Hospital (UTH), Osogbo.

Methods: This retrospective descriptive study was conducted at UTH, Osogbo, in Osun State, South-Western Nigeria. The data of the 190 neonates with birth injuries attended to in the hospital's neonatal unit over 11 years from 1st January 2012 to 31st December 2022 were collected. The data were analyzed using the IBM Statistical Package for Social Sciences version 23 (SPSS 23).

Results: The prevalence rate of NBI was 100.2/1000 NU admission (10%). The most common type of birth injury was caput succedaneum, accounting for 71.6% of the cases. Perinatal asphyxia was the dominant associated co-morbidities (79.5%). Most (98.9%) had favorable outcomes, while 1.1% were referred on account of residual deformity. The mode of delivery, place, and duration between delivery were significantly associated with treatment outcomes (p-value <0.001, 0.003).

Conclusion: The prevalence of neonatal birth injuries was high in our study. Caput succedaneum was the predominant NBI in our survey.

Keywords: Neonatal Birth injuries, Newborn, Prevalence, Caput Succedaneum, Perinatal care.

INTRODUCTION

Birth injuries are a diverse set of mechanical traumas from tractions and compressions affecting newborns during delivery and range from minor bruises and lacerations to significant injuries such as obstetric fractures and nerve injuries.¹ The type and degree of injury relate to the route and mode of delivery. Though the prognosis is good, the impact of these injuries depends on the part of the body affected and the therapeutic actions taken.

Neonatal birth trauma (NBT) prevalence is reported to be 25.3-31.1/1000 live births in the United Kingdom.¹ A systematic review of NBT in Low- and Middle-Income Countries (LMICs) reported a pooled prevalence of 34/1000 live births.² In Nigeria, neonatal birth injuries of 31.1-110.1/1000 live births have been reported.³⁻⁷ Bruises and lacerations make up to 80% of injuries, while fractures constitute about 5%.¹ Globally, Obstetric fractures are the most severe neonatal birth injuries, and these are predominantly

clavicular fractures.⁸ Obstetric fractures are associated with neural injuries such as brachial plexus injury (Erb's palsy and Klumpke's palsy) and facial nerve injury. Perhaps the most sinister of the injuries is intracranial haemorrhage. Hypoxic Ischaemic Encephalopathy (HIE) could complicate severe birth injuries. Despite being common globally, birth injuries account for less than 2% of neonatal deaths.¹

The significant determinants of injury and its severity are fetal birth weight and mode of delivery. It is more common with caesarean sections, assisted breech, and instrumental delivery.⁹ The incidence of clavicular fractures is associated with the mode of delivery, irrespective of birth weight.¹⁰ Fetal macrosomia and shoulder dystocia remain the significant risk factors for long bone injuries.⁸ Survivors of shoulder dystocia who had internal manoeuvres were more likely to develop brachial plexus injury.¹¹ Maternal factors such as extreme maternal age, primigravida, short maternal stature, and pelvic abnormalities predispose a fetus to injury at birth.¹⁰ Furthermore, the skill of the birth attendant and the quality of care available immediately after delivery significantly impact on the outcome.¹²

Birth injuries contribute to the abysmal perinatal morbidity and mortality in Nigeria and Sub-Saharan Africa. Moreover, management of these conditions constitutes a significant financial burden on the parents of these neonates and may lead to substantial morbidities such as brain injury and motor dysfunction.² Despite the importance of this subject, there is a paucity of literature on the pattern of injuries as well as its impact on perinatal morbidity and mortality in our environment. Hence, we carried out this study to determine the prevalence, pattern, and outcome of newborn birth injuries seen at a referral tertiary hospital in Southwest Nigeria over an 11-year period.

METHODS

Study Population

Neonates with birth injuries who were attended to in the neonatal unit of UNIOSUN (formerly LAUTECH) Teaching Hospital, Osogbo, Nigeria over 11 years from 1st January 2012 to 31st December 2022.

Study Design

This retrospective descriptive study was conducted at UNIOSUN Teaching Hospital in Osun State, South-Western Nigeria. We reviewed all available case notes to document all birth injuries identified at resuscitation or admission, irrespective of the attending physician's diagnosis.

Inclusion Criteria

All babies (0-28 days old) diagnosed with birth injuries who were delivered or referred to UTH over the study period.

Exclusion Criteria

We excluded neonatal admission cases where birth injuries were not documented.

Data Collection and Procedures

Data was retrieved from all the case notes of neonates with birth injuries attended to in the neonatal unit of the hospital over 11 years from 1st January 2012 to 31st December 2022. The total number of newborn admissions during the period was 1,896, out of which 190 had newborn birth injuries. Information concerning the socio-demographic and obstetric characteristics of the mother, neonatal parameters such as birth weight, mode of delivery, Apgar score (or presence or absence of history suggestive of asphyxia where Apgar score was not documented), nature and type of injuries, and treatment outcome were extracted from the neonatal unit records for analysis.

Neonates who were discharged home with full recovery were categorized as having favorable outcomes, while babies who died had unfavorable outcomes.

Statistical Analysis

The data obtained were analyzed using the IBM Statistical Package for Social Sciences

(SPSS) version 23.0. Univariate analysis was done and presented with frequency distribution tables. Bivariate analysis was also done using chi-square to check for association between categorical variables. P-value of <0.05 was considered statistically significant.

Ethical considerations

Ethical approval for this study was obtained from the Osun State University Research Ethics Committee (UNIOSUNHREC 2023/0800). Permission for the study was also obtained from the UTH authority. Data was anonymized to ensure participants' confidentiality.

RESULTS

There were 1,896 admissions over the study period, and 190 neonates were admitted to the neonatal unit (NU) on account of birth injuries. This gives a prevalence rate of 100.2/1000 (10%) of NU admissions. The mean age at diagnosis was 4 ± 2.7 hours. Table 1 provides an overview of the participants' demographics and other parameters. Most (85.8%) were diagnosed within 24 hours, and most (62.6%) babies were males. Most babies had a normal birth weight range of 2.50-3.99 kg, accounting for 77.9% of neonates, while 6.8% were macrosomic (91.6% of these babies had neonatal asphyxia). Among the mothers, 77.4% were in the 18-30 age group, while 22.6% were in the 31-43 age group. The mean age of mothers was 27 ± 4.9 years. Furthermore, 99.5% of the mothers had fewer than five previous pregnancies.

Table 2 presents the types and frequency of newborn birth injuries observed in the study. Among the recorded cases, the most common type of birth injury was caput succedaneum, accounting for 71.6%. Other birth injuries reported include facial oedema, erythematous plaque, and shoulder subluxation.

Table 3 presents the factors associated with newborn birth injuries. The table displays the frequency and percentage distribution of variables such as mode of delivery, gestational age at delivery, history of prolonged labor, abnormal traction at delivery, liquor drainage before delivery, presenting part at delivery, place of delivery,

Table 1: Socio-demographics Parameters of the newborn and mother

Variable	Frequency	Percentage
Baby parameter		
Age at Diagnosis		
<24hrs	163	85.8
24-72hrs	17	8.9
>72hrs-7 days	3	1.6
>7days	7	3.7
Sex		
Male	119	62.6
Female	71	37.4
Birth weight (kg)		
1.00-1.49	4	2.1
1.50-2.49	25	13.2
2.50-3.99	148	77.9
≥ 4.00	13	6.8
APGAR Score		
Normal	16	8.4
Asphyxia	174	91.6
Maternal Parameters		
Age		
18-34 years	168	88.4
>34 years	22	11.6
Mean age= 27.91 ± 4.9		
Occupation		
Professional	42	22.1
Non-professional	121	63.7
Unemployed	19	10.0
Student	8	4.2
Parity		
1	115	60.5
2-4	70	36.8
>4	5	2.6
Gestation type		
Singleton	183	96.3
Multiple	7	3.7
Pregnancy term		
Preterm (<37 weeks)	23	12.1
Term (≥ 37 weeks)	167	87.9

Table 2: Types and frequency of newborn birth injuries

Newborn birth injuries	Frequency	Percentage
Caput Succedaneum	136	71.6
Subconjunctival haemorrhage	12	6.3
Cephalhematoma	12	6.3
Fractures of scalp bone, humerus, femur, clavicle	9	4.7
Laceration	5	2.6
Abrasion	3	1.6
Erb's Palsy	3	1.6
Others	10	5.3

Table 3: Factors associated with newborn birth injuries

Variable	Frequency	Percentage
Mode of delivery		
Spontaneous Vaginal Delivery	100	52.6
Caesarean Section	87	45.8
Assisted breech	2	1.1
Instrumental delivery (Vacuum)	1	0.5
Pregnancy term		
Preterm (<37 weeks)	23	12.1
Term (\geq 37 weeks)	167	87.9
History of Prolonged Labour		
Yes	108	56.8
No	82	43.2
History of abnormal or excessive traction at delivery		
Yes	19	10.0
No	171	90.0
History of liquor drainage before delivery		
Yes	44	23.2
No	146	76.8
Presenting part at delivery		
Cephalic	180	94.7
Breech	10	5.3
Place of delivery		
Home	5	2.6
Mission	2	1
Primary Health Centers	5	2.6
Public hospitals (UTH and general hospitals)	150	78.9
Private hospital	28	14.7
Features of congenital anomalies		
Yes	5	2.6
No	185	97.4
Any associated co-morbidities		
Yes	185	97.4
No	5	2.6
Duration between delivery and diagnosis		
<24hours	163	85.8
24-72hours	17	8.9
>72hours-7days	3	1.6
>7days	7	3.7

presence of congenital anomalies, associated co-morbidities and duration between delivery and diagnosis. Findings indicate that 52.6% of births were through spontaneous vaginal delivery (SVD), 45.8% were via cesarean section (CS), 1.1% were assisted breech deliveries, and only one was by vacuum delivery. Most deliveries occurred in public hospitals (78.9%).

Most (97.4%) of the babies did not have features of congenital anomalies, while 97.4% had associated co-morbidities. Table 4 shows associated co-morbidities and clinical outcomes. Perinatal asphyxia was the dominant associated co-morbidities (79.5%). A majority (98.9%) of them had a favorable outcome (complete resolution or discharged with follow-up at the clinic), while two babies (1.1%) were either referred or had a residual deformity.

Table 5 shows the distribution of the mode and place of delivery with treatment outcomes. Fischer's exact test was used to show association since there were only two mortalities (unfavourable outcome): p-value < 0.001 and 0.003.

Table 4: Co-morbidities and Clinical Outcome of the newborns

Variable	Frequency	Percentage
Associated co-morbidities		
Perinatal asphyxia	151	79.5
Neonate jaundice	8	4.2
Sepsis	13	6.8
Prematurity	13	6.8
Others (acute bilirubin encephalopathy, chromosomal anomaly, and hypoglycemia)	5	2.6
Clinical outcome		
Favorable	188	98.9
Unfavorable	2	1.1

Table 5: Factors associated with newborn birth injuries and treatment outcome

Variable	Treatment outcome		
	Favorable (188)(%)	Unfavorable (2)(%)	p-value (Fischer's exact test)
Mode of delivery			
Spontaneous Vaginal Delivery	99(52.1)	1(0.5)	<0.001
Caesarean Section	87(45.8)	0(0)	
Assisted breech	1(0.5)	1(0.5)	
Instrumental delivery (Vacuum)	1(0.5)	0(0)	
Pregnancy Duration			
Preterm	23(12.1)	0(0)	1.00
Term	165(86.8)	2(1.0)	
History of Prolonged Labour			
Yes	107(56.3)	1(0.5)	
No	81(42.6)	1(0.5)	1.00
History of excessive traction at delivery			
Yes	18(9.5)	1(0.5)	
No	170(89.5)	1(0.5)	
Presenting part at delivery			
Cephalic	179 (94.2)	1(0.5)	0.209
Breech	9(4.7%)	1(0.5)	
Place of delivery			
Home	5(2.6)	0(0)	
Mission	2(1.0)	0(0)	0.003
Primary Health Centers	4(2.1)	2(1.0)	
Public hospitals (UTH, general hospitals)	149(78.4)	0(0)	
Private hospital	28(14.7)	0(0)	

DISCUSSION

We reported a prevalence rate of 100.2/1000 hospital admissions (10%) of NBI among the neonatal unit admissions over the study period. This is similar to the 15% pooled prevalence rate Balis et al. reported in Ethiopia.¹³ This is, however, higher than the 34/1000 live birth pooled incidence reported in a systematic review of birth traumas conducted in LMICs by Woldegeorgis et al.² and 6.9/1000 live births reported by West et al. in Southeast Nigeria,⁵ as well as other studies from Nigeria.^{3,4,6} This is probably because over 70% of our participants had caput succedaneum, a mild NBT. Most of the earlier studies only reported severe neonatal birth injuries.^{4-7,8} Underreporting of birth

injuries may also account for this difference.¹⁴ Previous studies have reported that most neonatal birth injuries are not documented or are underreported.^{8,14}

The majority (85.8%) of NBT were diagnosed within 24 hours. This probably explains the good outcomes recorded in most of our study population. This agrees with Herskind et al., who stated that early intervention in infants with injuries leads to better perinatal outcomes.¹⁵ Early diagnosis and intervention can improve perinatal outcomes in line with the Sustainable Development Goals.¹⁶

Most of the affected neonates were males (62.6%). This finding raised questions on potential gender-related vulnerabilities or

differences in injury patterns across genders. Tibebe et al.¹⁷ and West here in Nigeria also reported a male preponderance in their studies on NBT.⁵ However, this has not been proven to be of clinical significance.¹⁴ Furthermore, the observation that most babies with birth injuries fall within the average birth weight range of 2.5-3.5 kg underscores the complexity of factors contributing to birth injuries beyond birth weight alone. Such factors include maternal height, intrapartum fetal distress, cord prolapse, tight nuchal cord, and skills of resident birth attendants.^{13,17}

The most prevalent birth injury identified was caput succedaneum (71.6%); this is in tandem with earlier reports on NBT that about 80% are due to caput succedaneum.^{1,8} However, most studies report scalp lacerations as the predominant injuries.^{15,18} Laceration injuries were more predominant following Caesarean deliveries.¹⁷ Caput succedaneum is underreported as some authors do not consider it a birth injury.¹³ Furthermore, most studies on the subject only reviewed severe birth injuries, thereby excluding caput succedaneum.^{14,15,19} Furthermore, caput succedaneum is usually managed by reassurance and does not require admission.

Spontaneous vaginal delivery and delivery at term were more frequently associated with birth traumas in our study. This corroborates the study by Alghafor et al. which highlighted the risk factors related to birth injuries, such as delivery at term and mechanism of delivery.²⁰ This, however, differs from earlier reports where assisted vaginal breech deliveries and instrumental deliveries were significantly associated with NBT.^{13,15} The low rate of instrumental deliveries in our study may be responsible for the differences.

Perinatal asphyxia was identified as the dominant co-morbidity, with a rate of 79.5%. Perinatal asphyxia often complicates NBI if proper neonatal resuscitation is not done or may occur in shoulder dystocia irrespective of the birth attendants' skill.¹⁸ This can be mitigated by adequate neonatal resuscitation. This finding aligns with previous literature, which consistently reported perinatal asphyxia as a leading complication of

NBI.^{5,18,21} The high incidence observed in our study underscores the critical need for skilled birth attendants to provide neonatal resuscitation, thereby improving perinatal outcomes and reducing long-term complications.

Our study identified other significant co-morbidities, including neonatal jaundice and sepsis, in addition to perinatal asphyxia. These findings are consistent with those reported by Mamo et al., who noted similar co-morbidities in neonates with birth injuries.²¹ Neonatal jaundice can arise following cephalhaematoma, which was diagnosed in 12(6.3%) of our study population. This finding has been corroborated by earlier studies.^{3,15}

A notable aspect of our findings is the favorable clinical outcomes observed in most cases. Specifically, 97.4% of the neonates achieved complete resolution of their conditions or were discharged with follow-up plans at the clinic. The high rate of favorable outcomes may be attributed to the prompt and adequate medical interventions administered and the dedicated follow-up care provided. These results agree with those reported by Lin et al., who documented high recovery rates with similar co-morbidities.²² However, it is essential to note that two babies (1.1%) required referral to specialized centers for residual deformities. This low rate of severe morbidity differs from earlier reports of serious and potentially life-threatening morbidities reported mainly in LMICs and mothers with medical conditions such as gestational diabetes mellitus.^{18,23} Severe NBI cases often require follow-up to assess the attainment of developmental milestones and the complete resolution of symptoms.

Delivery by caesarean section (CS) was associated with favorable outcomes among all the babies, while the unfavorable outcomes were from SVD and assisted vaginal breech deliveries. This is in tandem with an earlier study in Ethiopia.²⁴ This could be because CS is usually performed in an environment with sufficient resources, including health expertise, neonatal resuscitation facilities, and surgical interventions, all contributing to

favorable treatment outcomes. Studies have found CS to be protective of birth injuries compared to other modes of delivery, particularly in cases of fetal macrosomia and breech presentation.^{25,26} However, Luca et al. reported a contrary finding that CS was not protective against birth injuries, probably because most of the injuries they reported were scalp lacerations, which are more prevalent with Caesarean deliveries.²⁷ In this study, the instrumental deliveries were insufficient to make a categorical statement on their specific contribution to neonatal birth injury.

An unfavorable outcome was recorded in two neonates delivered in primary health centers. This could be due to the difference in the availability of skilled birth attendants in primary health centers, which are manned mainly by Community health extension workers (CHEWs). Tertiary and secondary care hospital resources have access to specialists and a consultant cadre of health care providers, which translates to the improved quality of care despite the myriads of infrastructural deficits they suffer.^{6,28,29,30} The high number of cases of birth injuries reported in deliveries in public hospitals, including UTH and general hospitals, in this study is probably because they are referral centers for prolonged labor and other such cases that are associated with a higher risk of neonatal birth injuries.

LIMITATIONS

This study used hospital-based data that may differ from that in the community.

The impact of perinatal asphyxia was not determined. This may be addressed by a prospective cohort study as a long follow-up period is required for this.

CONCLUSION

The prevalence of neonatal birth injuries was high in our study. Caput succedaneum was the predominant NBI in our survey. NBI occurred predominantly in males and average-sized neonates. Place of delivery significantly

impacted the treatment outcome, which was favorable in most of our study population.

RECOMMENDATION

Strategic interventions to train health workers in prompt diagnosis and early treatment are encouraged to limit morbidity following neonatal birth injuries.

ACKNOWLEDGMENT

We acknowledge UNIOSUN Teaching Hospital's permission to carry out this study in the hospital.

CONFLICT OF INTEREST

All authors declare that we have no conflict of interest that could have inappropriately influenced the study and the manuscript preparation.

REFERENCES

1. Gupta R, Cabacungan ET. Neonatal birth trauma: analysis of yearly trends, risk factors, and outcomes. *The Journal of Pediatrics*. 2021; 238:174–180. pmid:34242670 .
2. Woldegeorgis BZ, Gebrekidan AY, Kassie GA, Azeze GA, Asgedom YS, Alemu HB, et al. Neonatal birth trauma and associated factors in low and middle-income countries: A systematic review and meta-analysis. *PLoS One*. 2024; 19(3):e0298519. doi: 10.1371/journal.pone.0298519. PMID: 38512995; PMCID: PMC10957092.
3. Ekwochi U, Osuorah DIC, Asinobi IN. Birth injuries in newborn: A prospective study of deliveries in South-East Nigeria. *African Journal of Medical and Health Sciences*. 2021; 20(4): 41–46
4. Pius S, Ibrahim HA, Ibrahim BA, Farouk AG, Machoko Y, Bello M. Incidence and characteristics of neonatal birth injuries in Maiduguri North-Eastern Nigeria. *Nigerian Journal of Paediatrics*. 2018; 45(2):99-105.
5. West BA, Okari T. Incidence, Pattern and Outcome of Birth Injuries as Seen

- in a Tertiary Hospital in Southern Nigeria. *International Journal of Research and Review*. 2021; 8(6):8–17.
6. Emeka CK, Uchenna E, Tochukwu EJ, Chukwuebuka NO, Chikaodili ET, Chigozie IC. Profile of birth injuries in a tertiary hospital in Enugu, Nigeria. *American Journal of Biomedical and Life Sciences*. 2019; 7(5):99-103.
7. Okoro PE, Oriji VK. Spectrum of birth trauma and predisposing factors. Experience in two Nigerian tertiary health facilities. *East African Medical Journal*. 2018; 95(6):1672–1679.
8. Rehm A, Promod P, Ogilvy-Stuart A. Obstetric neonatal brachial plexus and facial nerve injuries: A 17 years single tertiary maternity hospital experience. *Eur J Obstet Gynecol Reprod Biol*. 2019; 243:57–62.
9. Perlow JH, Wigton T, Hart J, Strassner HT, Nageotte MP, Wolk BM. Birth trauma. A five-year review of incidence and associated perinatal factors. *The Journal of reproductive medicine*. 1996; 41(10):754-760.
10. Ulici A, Herdea A, Dragomirescu MCLC. Obstetric fractures in caesarean delivery and risk factors as evaluated by paediatric surgeons. *Int Orthop*. 2022; 46(11):2611–2617.
11. Elmas B, Ercan N, Ersak DT, Ozdemir EU, Çelik IH, Tapisiz OL, et al. Risk factors for brachial plexus injury and permanent sequelae due to shoulder dystocia. *Nigerian Journal of Clinical Practice*. 2022; 25(12):2016-2023.
12. Buchmann EJ, Stones W, Thomas N. Preventing deaths from complications of labour and delivery. *Best Pr Res Clin Obs*. 2016; 36:103–115.
13. Balis B, Diriba Hunde A, Lami M. Prevalence and Patterns of Neonatal Birth Trauma in Ethiopia: Systematic Review and Meta-Analysis. *Glob Pediatr Health*. 2023; 10:2333794X231191982. doi: 10.1177/2333794X231191982. PMID: 37602141; PMCID: PMC10434842.
14. Osinaike BO, Akinseye LO, Akiyode OR, Anyaebunam C, Kushimo O. Prevalence and predictive factors of birth traumas in neonates presenting to the children emergency center of a tertiary center in Southwest, Nigeria. *Journal of Clinical Sciences*. 2017; 14(4):167-172.
15. Herskind A, Greisen G, Nielsen JB. Early identification and intervention in cerebral palsy. *Developmental Medicine & Child Neurology*. 2015 Jan;57(1):29-36.
16. Halisçelik E, Soytaş MA. Sustainable development from millennium 2015 to Sustainable Development Goals 2030. *Sustainable Development*. 2019; 27(4):545-572.
17. Tibebu EA, Desta KW, Ashagre FM, Jemberu AA. Prevalence of birth injuries and associated factors among newborns delivered in public hospitals Addis Ababa, Ethiopia, 2021. *Crosssectional study. PloS one*. 2023; 18(1):e0281066.
18. Kekki M, Tihtonen K, Salonen A, Koukkula T, Gissler M, Laivuori H, et al. Severe birth injuries in neonates and associated risk factors for injury in mothers with different types of diabetes in Finland. *International Journal of Gynecology & Obstetrics*. 2022; 159(1):195-203.
19. Tolosa G, Assefa N, Keneni M, Lonsako AA, Desalew A. Neonatal birth trauma and its predisposing factors among newborns admitted to public hospitals in Eastern Ethiopia: a cross-sectional study. *Global Pediatric Health*. 2023; 10:2333794X231183814.4
20. Alghafoor I, Saadoon H. Fetal and Maternal Risk Factors Associated With Birth Trauma. *American Academic Scientific Research Journal for Engineering, Technology, and Sciences [Internet]*. 2019; 53(1):97-104.
21. Mamo SA, Teshome GS, Tesfaye T, Goshu AT. Perinatal asphyxia and associated factors among neonates admitted to a specialized public hospital in South Central Ethiopia: A retrospective cross-sectional study.

- PloS one. 2022 Jan 13;17(1):e0262619.
22. Lin Y, Davis TJ, Zorrilla-Vaca A, Wojcik BM, Miyamoto SD, Everitt MD, et al. Neonatal heart transplant outcomes: a single institutional experience. *The Journal of thoracic and cardiovascular surgery*. 2021; 162(5):1361-8.
23. Phuengphaeng A, Sirisomboon R. Incidence and risk factors of major neonatal birth injuries in a tertiary care hospital in Thailand: a retrospective cohort study. *Pacific Rim International Journal of Nursing Research*. 2022; 26(2):243-53.
24. Biset G, Mihret S, Mekonen AM, Workie A. Magnitude of birth trauma and its associated factors in South Wollo public hospitals, northeast Ethiopia, August 2021: Institutional-Based Cross-Sectional Study. *BMJ open*. 2022; 12(9):e057567.
25. Tiwary R, Tiwary MK. Cesarean section with breech presentation and shaft femur fracture in newborn: a rare case report. *Int J Reprod Contraception, Obstet Gynecol*. 2022; 12(1):246-248. DOI: <https://dx.doi.org/10.18203/2320-1770.ijrcog20223503>
26. Niles K, Barrett J, Ladhani N. Comparison of cesarean versus vaginal delivery of extremely preterm gestations in breech presentation: retrospective cohort study. *J Matern Neonatal Med*. 2019; 32:1142–1147.
27. Luca A, Vinturache A, Ilea C, Avasiloiu A, Paduraru L, Carauleanu A, et al. Birth trauma in preterm spontaneous vaginal and cesarean section deliveries: A 10-years retrospective study. *PloS one*. 2022; 17(10):e0275726.
28. Mahmood K, Saleh A. Barriers and facilitators influencing access to and utilization of primary healthcare services in Kurdistan-region, Iraq: a cross-sectional study. *Ann Med Surg*. 2023;85:3409–3417.
29. Bel G, Esteve M. Is Private Production of Hospital Services Cheaper than Public Production? A Meta-Regression of Public Versus Private Costs and Efficiency for Hospitals. *Int Public Manag J*. 2020; 23:1–24.
30. Sharma J, Leslie HH, Regan M, Nambiar D, Kruk ME. Can India's primary care facilities deliver? A cross-sectional assessment of the Indian public health system's capacity for basic delivery and newborn services. *BMJ Open*. 2018; 8(6):e020532.