Caspian Journal of Pediatrics
Babol University of Medical Sciences
e-ISSN: 2383-3106

Prevalence of Birth Trauma and its Risk Factors in a Medical College Hospital-A Cross-Sectional Study

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Article Info.

Article type:
Research Article

Received: 7 July 2024
Revised: 6 Sep. 2024
Accepted: 15 Sep. 2024
Published: 30 Sep 2024

Keywords:
Birth Injuries, Delivery Obstetric, Femoral Fractures, Newborn

ABSTRACT

Background and Objective: Birth trauma refers to injury sustained by the newborn due to mechanical forces during the birth process. It's associated with increased mortality and morbidity. The aim of this study was to determine the incidence of birth trauma in various modes of delivery and to analyze the risk factors for birth trauma.

Methods: This cross-sectional study was conducted from March-October 2021 in a medical college hospital in Chennai-India. All live-born singleton term neonates delivered in the hospital during the study period were screened for birth trauma through a detailed clinical examination and relevant investigations. The risk factors contributing to birth trauma were investigated. The frequency of birth trauma was compared in various modes of delivery. Univariate and multivariate analysis was done for the risk factors. Results were expressed as odds ratio (95% confidence interval). P-value<0.05 was considered statistically significant.

Findings: Among the 2300 live births screened, there were 22 neonates who developed birth trauma, which corresponds to an incidence of 9.5/1000 live births. Birth trauma occurred more frequently in instrumental delivery. The most common birth trauma was subgaleal hemorrhage followed by cephalhaematoma. Risk factors such as short stature, abnormal fetal presentation, abnormal birth weight and maternal illnesses were significant determinants of birth trauma.

Conclusion: The results of this study showed that when pregnancy is complicated by factors such as maternal short stature, maternal illness, abnormal fetal presentation, and abnormal birth weight, the risk of birth trauma is increased.

Cite this Article: Shrimathy MS, Devimeenakshi K. Prevalence of Birth Trauma and its Risk Factors in a Medical College Hospital-A Cross-Sectional Study. *Caspian J Pediatrs* March 2024; 10: e10.

[Downloaded from caspianjp.ir on 2026-11-18]

[DOI: 10.22088/CJP.BUMS.10.0.10]

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Introduction

Birth trauma refers to injuries that the newborn suffers as a result of mechanical forces like pressure and traction during the birth process [1, 2].It is associated with an increase in mortality and morbidity [3, 4, 5]. Birth trauma and asphyxia remain preventable causes of neonatal death, accounting for about half of all under-five mortality [6]. The 2019 Global Burden of Disease Study revealed that in resource-limited countries, neonatal encephalopathy caused by birth trauma is a leading cause ofneonatal mortality ranging from 5.4% to 96.4% [7]. Woldegeorgis BZ et al. found in a systematic review that the cumulative incidence of neonatal birth trauma in Africa was 52.9 per 1,000 live births (95% CI 46.5 to 59.4), which was more than twice as high as in the Middle East with 24.9 per 1,000 live births (95% CI 17.6 to 32.3) and about three times as high as in Asia and the Pacific countries with 18 per 1,000 live births (95% CI 12 to 23.9. In low- and middle-income countries, estimates from individual studies suggest that the cumulative incidence of birth-related trauma ranges from an estimated 3 per 1,000 live births to 869 per 1,000 live births in Africa, 3 per 1,000 live births to 4.7 per 1,000 live births in Asia and the Pacific, and 6.7 per 1,000 live births to 87.3 per 1,000 live births in the Middle East [8]. Despite careful prenatal care, birth trauma occurs, especially in prolonged or difficult labor or in cases of fetal malpresentation [9].

The term birth injury encompasses all systemic damages incurred during delivery (hypoxic, toxic, biochemical, infectious factors, etc.), whereas birth trauma focuses largely on mechanical damage [10]. Birth trauma includes a wide range of mild to severe injuries during labor and delivery [11]. According to the International Statistical Classification of Diseases ICD 10, birth trauma is classified into intracranial laceration and hemorrhage, central nervous system injury, scalp injury, skeletal injury, peripheral nervous system injury, organ injuries, facial injury, muscle injury and eye injury [12].

Although they are more common in the context of existing feto-maternal risk factors, their occurrence can be unpredictable and occur in the absence of any risk factors [13]. Although they are often superficial and transient, functional and cosmetic sequelae, disability or even death can result from birth injuries [14].

Fetal macrosomia, malpresentation, protracted labor, instrumentation (forceps/vacuum), shoulder dystocia, maternal pelvic anomalies and primiparity are risk factors for birth trauma that have been previously reported [15]. With advances in obstetrics and prenatal diagnostics, the prevalence of birth trauma has reduced over time [16]. The decline in the number of instrumental deliveries such as forceps and vacuum-assisted deliveries and the increased use of cesarean sections for dystocia or difficult vaginal deliveries are also responsible for the reduction in the prevalence of birth trauma over the last three decades [11, 17]. Severe birth trauma decreased from 5.44 to 4.67 per 1000 hospital births due to the decrease in clavicle fractures, brachial plexus injuries and intracranial haemorrhage [18]. However, the problem of birth trauma is still prevalent in low- and middle-income countries [8]. The aim of this study was to determine the incidence of birth trauma in various modes of delivery and to identify risk factors for birth trauma.

Methods

Study design and sample

All live-born singleton term neonates delivered in a Medical College Hospital in Chennai, Tamil Nadu, India from March 2021 to October 2021 were included. The neonates were enrolled after obtaining informed consent from their parents.

Sample size

The sample size was calculated based on the incidence of birth trauma of 15 in 1000 reported by Ray S et al. [19] with an error margin of 0.05 % and 95% confidence interval using the formula. The required sample size was calculated to be 2271 and it was planned to study 2300 babies.

Data collection

Data were collected on sociodemographic factors and risk factors for birth trauma. The maternal risk factors like maternal obesity, short stature, gestational diabetes, gestational hypertension, parity, intrapartum risk factors such

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[DOI: 10.22088/CJP.BUMS.10.0.10]

as mode of delivery, oligohydramnios and neonatal factors like macrosomia were studied. Types of birth trauma studied included subdural and cerebral hemorrhage, scalp injury: Cephalhematoma, subgaleal hemorrhage, clavicle fractures, fractures of the long bones (femur, humerus), skull fractures, brachial plexus palsy (Erb's and Klumpke's), eye injuries, scalpel wounds, etc. The birth trauma was diagnosed by the pediatrician based on the clinical examination at the time of delivery. Examinations such as X-rays and ultrasounds were only performed on selected newborns to confirm birth trauma. Neonates with major congenital anomalies were excluded. The incidence of birth trauma was compared in various modes of delivery.

Statistical analysis

Data was analyzed using SPSS 24. The incidence was reported as a proportion with a 95% confidence interval. The incidence of birth trauma was compared among the various modes of delivery. Univariate and multivariate analysis was done for the risk factors. The results were expressed as odds ratios (95% confidence interval). A p-value < 0.05 was considered statistically significant.

Results

Among the 2300 live births examined during the study period, there were 22 newborns who developed birth injuries, corresponding to an incidence of 9.5/1000 live births. Males and females were equally distributed in the study population. Although the majority of neonates 1725 (75%) were appropriate for gestational age, 67 babies (4%) were large for gestational age. About 734(31%) babies were delivered vaginally, 1019 (44%) were delivered by cesarean section, 373 (16%) by forceps and the remaining 174(7.5%) newborns by vacuum-assisted mode of delivery. In the current study, there were 169 (7.3%) mothers with short stature and 71(3%) were tall. Among the maternal factors studied, it was observed that in the maternal weight category, 1069(46%) mothers were overweight as compared to 122(5.3%) obese mothers.

In the present study, it was found that about 1844(80%) births were cephalic presentation, 215(9%) were breech presentation, 163(7%) shoulder presentation and about 78(3%) were other non-cephalic presentations. Birth trauma was observed in 9(0.5%) neonates with cephalic presentation, in 7(3.5%) newborns with breech presentation and in 4 (2.5%) neonates with shoulder presentation. In the ongoing study, there were 7(2.5%) neonates with birth trauma among 276 mothers (12%) with gestational diabetes mellitus, 4(0.8%) newborns with birth trauma among 477 (20.7%) with gestational hypertension, and 4(4.2%) neonates with birth trauma among 95(4.1%) with oligohydramnios. The different types of birth trauma that occurred during the study period were cephalhematoma in 2 neonates, subgaleal hemorrhage in 13 newborns, femoral fracture in 2 neonates, Erb's palsy in 2 newborns and 3 neonates with scalpel injuries. The most common birth injury was scalp hemorrhage (68.2%) of which subgaleal hemorrhage (59.1%) was the most common, followed by cephalhematoma (9.1%). Femoral fractures accounted for 9.1% of birth traumas.

In the current study, birth trauma was observed in 5(0.6%) newborns delivered vaginally/ spontaneously, in 5(0.5%) neonates delivered by cesarean section, in 9(2.4%) newborns delivered vaginally/ via forceps and in 3(1.7%) neonates delivered vaginally /vacuum-assisted. The incidence of neonatal birth trauma was found to be higher in vaginal/ forceps delivery than in vaginal spontaneous delivery (3.91/1000 live births versus 2.17/1000 live births). The incidence of birth trauma in vaginal delivery without the use of instruments was similar to (2.17/1000 live births) that of a cesarean section (Table 1). The odds of birth trauma were 3.60 and 2.56 for vaginal/ forceps delivery and vaginal/vacuum-assisted delivery, respectively, compared to spontaneous vaginal delivery (Table 2).

Of the 2060 neonates born to normal stature mothers, 10 (0.48%) had birth trauma. 9(5.3%) newborns born to short stature mothers had birth trauma, while of the neonates born to tall stature mothers, 3 (4.2%) had birth trauma, and this was statistically significant ($P < 0.001$). In the present study, birth trauma was observed in 9 (0.4%) infants with cephalic presentation, 7(3.2%) neonates with

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breech presentation and 4(2.4%) newborns with shoulder presentation, and this was statistically significant showing that birth trauma was more common in non-cephalic presentations than in cephalic presentations (P<0.001). About 13(1.1%) newborns born to mothers with normal BMI had birth trauma, while 2(0.1%) neonates born to overweight mothers and 7(5.7%) infants born to obese mothers had birth trauma, indicating that obesity is clearly a risk factor that significantly affects the incidence of birth trauma (P<0.001). Among newborns born to mothers with pregnancy complications, 15 (1.7%) had birth trauma, which was statistically significant. Birth trauma was observed in 6(0.3%) newborns who were appropriate for gestational age (AGA), in 9(1.8%) neonates who were small for gestational age (SGA) and in 7(9.4%) infants who were large for gestational age (LGA), and this was statistically significant (Table 2).

Multivariate logistic regression indicated that the adjusted odds ratio for birth trauma was 5.04 in short stature mothers compared with normal stature mothers. The odds of birth trauma were 11.36 (CI: 2.71, 47.60) and 9.17 (CI: 1.54, 54.53) when the baby was born in the breech and shoulder presentations, respectively, compared to the cephalic presentation. The odds of birth trauma were 6.48 in mothers with oligohydramnios compared to mothers without risk factors. The odds of birth trauma were 4.53 and 116.27 in small for gestational age and large for gestational age infants, respectively, compared to infants ~~of~~ appropriate for gestational age (Table 3).

Table 1. Incidence of birth trauma in different modes of delivery

Mode of delivery	Number of deliveries	Number of Birth trauma	Incidence of birth trauma
Spontaneous Vaginal delivery	734	5	2.17
Cesarean section	1019	5	2.17
Vaginal/Forceps delivery	373	9	3.91
Vaginal/Vacuum delivery	174	3	1.30

Table 2. Bivariate analysis of risk factors for birth trauma

Risk factor	Category	With birth trauma	Without birth trauma	Odds Ratio	95% confidence interval		P-Value
					Upper	Lower	
Mode of delivery	Vaginal/spontaneous	5 (0.7%)	729 (99.3%)	3.21	0.22	2.99	0.006*
	vaginal/forceps	9 (2.4%)	364 (97.6%)	3.60	1.20	10.83	
	Vaginal/vacuum	3 (1.7%)	171 (98.3%)	2.56	0.61	10.81	
	cesarean	5 (0.5%)	1014 (99.5%)	0.72	0.21	2.49	
Maternal height	normal	10 (0.5%)	2050 (99.5%)	10.72	5.18	32.76	<0.001*
	short	9 (5.3%)	160 (94.7%)	11.53	4.62	28.79	
	tall	3 (4.2%)	68 (95.8%)	9.04	2.43	33.61	
Presentation	cephalic	9 (0.5%)	1835 (99.5%)	8.32	3.32	22.13	<0.001*
	breech	7 (3.3%)	208 (96.7%)	6.86	2.53	18.62	
	shoulder	4 (2.5%)	159 (97.5%)	5.13	1.56	16.84	
	others	2 (2.6%)	76 (97.4%)	5.37	1.14	25.26	
Maternal BMI	normal	13 (1.2%)	1096 (98.8%)	7.62	3.3	12.92	<0.001*
	overweight	2 (0.2%)	1067 (99.8%)	0.16	0.04	0.70	
	obese	7 (5.7%)	115 (94.3%)	5.13	2	13.12	
Maternal illness	nil	7 (0.5%)	1444 (99.5%)	15.12	1.65	18.12	<0.001*
	diabetes	7 (2.5%)	269 (97.5%)	5.37	1.87	15.43	
	hypertension	4 (0.8%)	473 (99.2%)	1.74	0.51	5.99	
	oligohydramnios	4 (4.2%)	91 (95.8%)	9.07	2.61	31.54	
Baby gender	male	11 (1%)	1063 (99%)	1.14	0.49	2.65	0.76
	female	11 (0.9%)	1215 (99.1%)				
Baby weight category	AGA	6 (0.3%)	1725 (99.7%)	4.13	1.56	13.34	<0.001*
	SGA	9 (1.8%)	486 (98.2%)	5.32	1.89	15.03	
	LGA	7 (9.5%)	67 (91.5%)	30.04	9.83	91.82	

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Table 3. Multivariate analysis of risk factors for birth trauma

Risk factor	Category	Adjusted Odds Ratio	95%confidence interval		P-value
			Upper	Lower	
Maternal height	Short stature	5.04	1.00	25.31	0.049*
	Tall stature	5.69	0.98	33.18	0.053
BMI	Overweight	0.06	0.01	0.50	0.010*
	Obese	1.48	0.24	9.25	0.677
Mode of delivery	Vaginal/Forceps	0.74	0.17	3.25	0.689
	Vaginal /Vacuum	0.35	0.04	2.89	0.331
	Cesarean	0.25	0.06	1.09	0.065
Presentation	Breech	11.36	2.71	47.60	<0.001*
	Shoulder	9.17	1.54	54.53	0.015*
	others	4.32	0.55	33.66	0.163
Maternal illness	diabetes	2.26	0.50	10.12	0.287
	hypertension	0.99	0.20	4.78	0.988
	oligohydramnios	6.48	1.41	29.84	0.016*
Baby weight category	SGA	4.53	1.32	15.52	0.016*
	LGA	116.27	15.89	851.08	<0.001*

Discussion

In the present study, birth trauma was observed in 22 out of 2300 infants, which corresponds to an incidence of 9.5/1000 live births. Among the individual types of birth trauma, it was found that 2(9.1%) neonates had Erb's palsy and 2(9.1%) newborns had femoral fractures. The most common birth trauma was scalp hemorrhage (68.2%), with subgaleal hemorrhage (59.1%) being the most common, followed by cepalhematoma (9.1%). No soft tissue injuries were observed in the current study.

In previous studies in India, birth trauma was observed in 11.6% [20] in Bijapur and 15.4/1000 births (95% CI: 11.9-18.9) in Kolkata, [19] while it was 13.13% (95% CI: 10.30 to 16.00), 16.9% (95% CI: 13.7-20.5) and 24.7% in the studies of Biset et al., [21] Tolosa Get al. [5] and Tibebu EA et al., [22] conducted in Ethiopia,respectively. Analysis of annual trends showed an increase in birth injury by 23% (from 25.3 to 31.1 per 1000 hospital births) [18]. Very low rates of birth injuries of 2.2 % were found in Iran and Cameroon (1.84%) [23, 24].

The higher rates of birth trauma compared to the current study were due to the inclusion of preterm infants [5, 22], home births [5] and the study in a reference hospital where more complicated cases were treated, [22] whereas the ongoing study was limited to term newborns. The low rates were due to the higher incidence of cesarean section, no use of vacuum and forceps and no vaginal delivery in non-vertex presentation [23], very early discharge after delivery and minimal use of forceps due to lack of equipment and experience [24].

Overall, 9.1% of the infants in the present study had Erb's palsy. Similar rates (8.78%) were observed in Iran [25]. A very high incidence of brachial plexus palsy (70.6%) was observed by Mah EM et al. [24] as most of the deliveries were conducted by persons who had less experience in obstetrics, with a low rate of cesarean section and a higher rate of macrosomic babies (41.7%) [24] compared to the ongoing study (3.2%). Nagrik RD et al. (4.5%) and Tolosa G et al. (3.6%) [2, 5]found lower rates due to fewer macrosomic babies as the majority of newborns were in the vertex presentation (78.7%) and had normal birth weight (60.8%) [5].

In the present study, subgaleal hemorrhage (59.1%) was more common than cepalhematoma (9.1%). In the current study, 547 neonates had vaginal instrumental deliveries which may increase the risk of subgaleal hemorrhage. Some of the neonates were delivered by cesarean section after forceps and /or vacuum failure. In contrast to our observations, several studies have observed that cephalhematomas occur more frequently [2, 5, 20, 23, 25]. Analysis of annual trends in birth trauma revealed an increase from 19.87 to 26.46 per 1000 hospital births. [18] Lower rates of cephalhematoma (13.6%)

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were found in the study by Linder N et al. [26]. Hameed NN et al. in their study found that caput succedaneum (68%) was more common than cephalhematoma (12%) [1].

In the present study bony injuries (femoral fracture) were seen in 2 neonates (9.1%). Higher rates of bone injury were reported by Linder N et al. (32.1%), [26] Borna H et al. (37.8 %) [25] and Mah EM et al. (22.5%) [24].Other studies have observed bone injuries in 1 % [3] and 1 to 2 per 1000 live births [19]. Humeral fractures were observed in 4.8% of neonates [24].No clavicle fractures were detected in the current study. This could be due to the fact that not all neonates delivered with shoulder dystocia were routinely x-rayed, which could have resulted in missed cases of clavicle fractures.

Although no soft tissue injuries were observed in the present study, they were found in 18 (21%) neonates in the study of Tolossa G. [5] similar observations were made in another study [20]. Soft tissue injuries were the most common form of birth trauma with an incidence of 5.91(3.73 - 8.09) per 1000 live births [19]. In the ongoing study, there were 3 (13.6%) neonates with a scalpel injury. In a previous study by Nagrik RD et al., scalpel injuries were observed in about 3.5% [2].

In the present study, there were no neonates with facial palsy, while Tolossa G et al. observed it in 5 (6%) neonates [5]. Similar rates of nerve injury were observed in 14 (5%) neonates [3].Factors like malpresentation, instrumental deliveries and macrosomia were responsible [3, 5].

No intracranial hemorrhage was observed in the present study, while Borna H et al. found cerebral hemorrhage in 1 (0.67%) neonate in their study [25].

In the ongoing study, birth trauma was more common in newborns delivered vaginally/with forceps, followed by vaginally/with vacuum. This was similar to the observations made in other studies worldwide [3, 5, 11, 14, 21, 22, 24, 25, 27, 28]. During the labor process, compressive and traction forces due to uterine contractions, cephalopelvic disproportion, dystocia, and the use of instruments may increase the risk of birth trauma [13]. An abnormal birth presentation [1, 3, 5, 11] and the duration of labor [1, 21, 22] were risk factors for birth trauma. When comparing different modes of delivery, vaginal delivery was found to be associated with an increased risk of birth trauma [23, 25]. However, the current study suggested that the incidence of birth trauma in vaginal delivery without the use of instruments did not differ from that of cesarean delivery (2.17/1000 live births).

Among the risk factors studied, maternal age was found to be associated with an increased risk of birth trauma [19, 24]. A study by Osinaike et al. indicated that the mean maternal age was lower in the birth trauma group (29.6±5.5 years versus 30.2±5.3 years).[29] If the mother is very young or if she is an older primipara, the baby squeezing through the rigid birth canal results in injury [20]. In the present study, 32% of birth injuries occurred in neonates born to mothers with gestational diabetes ($p<0.001$). Previous studies have made similar observations [1, 11, 14, 22, 27] which may be due to macrosomia and shoulder dystocia.

In the current study, it was observed that the odds of birth trauma were higher in mothers with short stature than in mothers with normal stature [AOR 5.04(95% CI: 1-25.31)]. Previous studies have made similar observations regarding maternal stature [3, 11, 19].

Among the neonatal risk factors, birth weight was found to be associated with birth trauma [8, 23, 25, 27] Neonates with macrosomia were found to have an increased risk of birth trauma [1, 3, 5, 11, 14, 24]. However, Nagrik et al observed more birth injuries in newborns with normal birth weight (53.5%) [2]. Neonates with birth trauma were found to have a higher mean birth weight (3220 ± 835.3 versus 3040.9±626.3 g) [29]. Macrosomia was a predominant risk factor for extracranial skeletal fractures such as fractures of the clavicle, humerus, and femur [13].

Birth trauma has been observed more frequently in male neonates [2, 5, 16, 20, 21, 23, 24, 29].In the present study, male neonates and female neonates were equally distributed. The present study did not compare the incidence of birth trauma at different gestational ages, whereas other studies have found gestational age to be a risk factor for birth trauma and an increased risk in preterm neonates [1, 5, 11, 25].

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Limitations

The present study was conducted in a single center with a small sample size. Rates of birth trauma after emergency cesarean section and deliveries during high-risk hours were not analyzed separately. As the number of deliveries with shoulder dystocia was very low, it was not analyzed separately as a risk factor. Premature neonates were not included so that the influence of gestational age as a risk factor could not be investigated. Routine X-rays were not taken for all causes of difficult deliveries, so bony injuries such as clavicle fractures may have been overlooked.

Conclusion

Birth trauma was more common in instrumental deliveries than in vaginal deliveries, and forceps deliveries were more likely to cause birth trauma than vacuum deliveries. The most common birth injury was hemorrhage, of which subgaleal hemorrhage was the most common followed by cephalhematoma. Risk factors such as maternal short stature, fetal presentation, abnormal birth weight (SGA, LGA) and maternal disease remained important risk factors and determinants of birth trauma which were also statistically significant. The assessment of the risk of birth trauma is very important for the decision on the mode of delivery.

Definition

- Normal weight: BMI (body mass index)= 18.5 to 24.9
- Overweight: BMI= 25 to 29.9
- Obesity: BMI ≥30
- Short stature: Height <145 cm
- Tall stature: Height >165 cm
- Gestational diabetes: Any degree of glucose intolerance with onset or first detection during pregnancy, as evidenced by two two-hour oral glucose tolerance tests with a blood glucose of 140 mg/dl
- Gestational hypertension: Blood pressure ≥140 mmHg systolic or 90 mmHg diastolic on 2 separate occasions at least 4 hours apart after 20 weeks of pregnancy if previous blood pressure was normal.

Acknowledgments

The authors would like to thank the Department of Obstetrics and Gynaecology, Government Kilpauk Medical College, Chennai for their valuable support in the conduct of the study.

Ethical Considerations

This cross-sectional study was commenced after approval from the Institutional Ethics Committee (protocol ID 482/2021, meeting on 17-03-2021).

Funding

There was no financial support for this research.

Conflict of interest

There is no conflict of interest.

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[DOI: 10.22088/CJP.BUMS.10.0.10]