Ethiopian Medical Journal 2024, 62(supplement 1)

ISSN 0014-1755 eISSN 2415-2420 Zeleke et al.

Original Article

Association of Birth Weight and Birth-Related Fractures in Neonates Aged 0-15 Days in Resource Limited Setting : A Case Control Study

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Abstract

Background: *The occurrence of birth related fractures is linked to various factors, encompassing maternal aspects, fetal conditions, and the skills of the obstetrician. In this study, our aim was to evaluate the correlation between birth-related fractures and both high and low birth weights.*

Methods: *The study is a case-control study, spanning from August 2019 to August 2023 G.C. The sample size determination relies on birth weight as a variable, considering a type 1 error rate (alpha) of 0.05, a beta of 0.2, and a power of 80%, resulting in a total sample size of 36. After importing the data into a Microsoft Excel file, thorough cleaning procedures were applied. The refined dataset was entered into SPSS 26 for analysis. Statistical significance was assessed using a 95% confidence interval and a p-value threshold of < 0.05.*

Result: *The mean birth weight of neonates with birth related fractures was 3115 grams. Fifty-eight percent of the neonates had fracture of the humerus followed by femur (25%) and clavicle fractures (16.7%). The mean weight of neonates with clavicle fracture, humerus fracture and femur fracture was 3950, 3054 and 2700 grams respectively. Birth weight and breech presentation correlations were statistically significant for birth related fracture at a p-value of <0.05.*

Conclusion: *The findings of this study indicated that both lower and higher birth weights, along with breech presentation, elevate the risk of birth-related fractures. In light of these results, we recommend optimizing the maneuvers of fetal body extraction through practical training.*

Keywords*: Birth trauma, Birth injury, Birth related fractures, Birth weight , Neonatal fractures*

Citation : *Zeleke B, Daniel E, Wamisho BL Association of Birth Weight and Birth Related Fractures in Neonates Aged 0-15 Days in a Resource Limited setting. Ethiop Med J 62 (2) 33-37*

Submission date : *1 November 2023 Accepted: 20 January 2024 Published: April 2024*

Introduction

Neonatal birth injuries are defined as physical impairments that newborns experience during labour and delivery (1-3). Clinical findings such as swelling, crepitus, and mostly the newborn's discomfort are used to identify fractures. The primary clinical indicator is the restricted Moro reaction sign, which displays the affected arm's decreased abduction and external rotation in response to the sense of falling (Moro (startle) reflex) (3). Birth-related fractures can result from injuries sustained during labor and delivery both of which are preventable and unavoidable. The occurrence of these fractures is associated with various parameters, such as maternal, fetal, and obstetrician competence. There have been reports of 2 to 7 cases per 1000 live births (4-5).

Less than 1% of live deliveries result in birth trauma (6). If a fracture is discovered within the first week of a newborn's life and there is no documented postnatal trauma, the fracture is regarded as a birth fracture (7). Fractures in neonates have been linked to difficult births needing significant traction (8).

Despite advancements in obstetric and perinatal care, particularly in developing countries, obstetric fractures can result in a marked rise in neonatal morbidity. (9). Although any bone may be affected, the most frequently broken bones are the clavicle, humerus, femur and other long bones. High birth weight, a challenging delivery, an unusual fetal presentation, the inaccessibility of hospital facilities, the accompanying healthcare providers' abilities, and other factors may be risk factors. It's unclear if caesarean sections are beneficial in lowering these birth traumas. Parents may believe that birth fractures are preventable, and this could lead to litigation (10-11).

A birth fractures is a common quality control indicator used by many hospitals. Neonatal birth fractures have most often occurred in the clavicle, with the middle part

of the clavicle being the most typical site of injury (11-13). There could be risk of fractures or birth injuries due to the predisposing conditions. According to a study conducted by Nasser et al., neonates with a mean birth weight of more than 4500 grams had a 7.7% incidence of birth injuries (14).
Our hypothesis is that both higher and smaller birth weights increase the risk of birth related fractures.

Methods and Materials
The study design was a case control study. The study was conducted from August 2019-August 2023G.C.The study population was all neonates age from 0-15 days. These neonates were grouped into two groups [cases and controls]. The case groups were those that had birth related fractures of tibia, femur, humerus, forearm and clavicle who came to Tikur Anbessa Specialized Hospital as a referral case or directly from maternity ward to neonatal intensive care unit. The control groups were those neonates born with out any fractures in the specified time frame at Ghandi Memorial Hospital. For sample size calculation, an online sample size calculator from the link https://clincalc.com/stats/SampleSize.aspx, was used. The sample size was calculated based on birth weight as a variable with type 1error rate alpha of 0.05, beta of 0.2 and a power of 80%. Two groups of patients used as a variable for sample size calculation was heavier (increased birth weight) babies with a mean weight of 3800 ± 500 gram and normal birth weight babies with a mean weight of 3300 gram. By this calculation , a total sample of size 36 was required. Out of this participants 12 were those that had birth related fracture and 24 were those that did not have birth related fracture. The control groups were picked randomly.

After ethical approval from the department and Informed verbal consent was taken from the newborns legal guardians by phone; data were collected with a structured questionnaire by a research assistant and Principal investigator. The data were checked for cleanness and completeness and imported into a Microsoft excel file and further cleaning was done. The refined data were entered to SPSS for analysis. The data were analyzed by odds ratio, 95% confidence interval and a p value of < 0.05 was used to asses statistical significance. Means and percentage were used for nominal variables. Chi square test was used to assess association between dependent and independent variables.

Results
Demographic characteristics of birth related trauma
In this study, 12 cases and 24 controls with a total of 36 participants were enrolled participants. Majority (52.8%) of the study participants was female and 97.2% were delivered at term. Eighty-six percent of the study participants were delivered vaginally and 83.3% were a vertex presentation. Eighty-three percent of the study participants of the neonate had a normal birth weight (table 1).

Table 1. Demographic characteristics of the study participants

Variable	Frequency	Percent
Sex		
Female	19	52.8
Male	17	47.2
Gestational age at delivery		
Preterm	1	2.8
Term	35	97.2
Mode of delivery		
Vaginally	31	86.1
Caesarean section	5	13.9
Fetal presentation		
Vertex	30	83.3
Breech	6	16.7
Birth weight		
<2500	4	11.1
2500-3999	30	83.3
≥4000	2	5.6

Characteristics of birth related fracture
In this study, 66.7% of the study participants were present in the hospital within 24 hours of delivery and 58.3% of them had humerus bone fracture followed by femur (25%) and clavicle (16.7%). Two-third (66.7%) of the fractures were in the left side, while 1/3 of the fracture was in the right side (table 2).

The association of birth related fracture and independent variables
The case control ratio revealed that, 58.3% of the case were female while it was 50% in the control group. Ninety two percent of the cases were delivered at term and 8.3% were delivered at preterm period while all the control group were delivered at term period of gestational age. Seventy-five percent of the study participants were delivered vaginally and the breech to vertex presentation ratio was equal in the case group. With regard to the case group's birth weight; 66.6 percent (n=8) was in normal birth weight range 16.7 percent (n=2) had low birth weight and 16.7% (n=2) had big baby (table 3). The determinant factors of birth related fracture was assessed using chi-square test. Accordingly, study participant whose fetal

presentation and birth weight had a statistically signifi- cant association with the presence of birth related

Table 2: Study participants birth related fracture characteristics

Frequency	Frequency	Percent
Age at presentation in hours		
≤24	8	66.7
>24	4	33.3
Types fractured bone		
Humerus	7	58.3
Clavicle	2	16.7
Femur	3	25
Hand side of fracture		
Left	8	66.7
Right	4	33.3

Table 3: The association of birth related fracture and independent variable

Variable	case	control	X^2 test
Sex			0.637
Female	7(58.3)	12(50)	
Male	5(41.7)	12(50)	
Gestational age at delivery			0.151
preterm	1(8.3)	0	
Term	11(91.7)	24(100)	
Mode of delivery			0.173
Vaginally	9(75)	22(91.7)	
Caesarean section	3(25)	2(8.3)	
Fetal presentation			0.000
Vertex	6(50)	24(100)	
Breech	6(50)	0	
Birth weight			0.048
<2500	2(16.7)	2(8.3)	
2500-3999	8(66.6)	22(91.7)	
≥4000	2(16.7	0	

The mean weight of the birth weight among birth related fracture

The mean weight of neonates with birth related fracture was 3115 gram, while that of the control group was 3025 grams. From those of the fractured bone, the mean weight of clavicle fracture, humerus and femur were 3950, 3054 and 2700 grams respectively (table 4).

Table 4. the mean and SD of birth weight among birth related fracture.

Birth related fracture	N	Mean	± SD
Yes	12	3115	858.4
No	24	3025	387.0
Types of bone fractured (n=12)			
Humerus	7	3054	947.2
Clavicle	2	3950	494.9
Femur	3	2700	519.6

Discussion

Birth related fracture is one of the obstetric related complications and it is stated as part of poor perinatal outcome. In this study, we assessed the association of fetal birth weight and birth related neonatal fractures using a case control study. The finding of this study showed that the mean birth weight of the fractured neonate was 3115gram, Which was higher than the control means birth weight (3025gm). This finding is consistent with that of study done in Nigeria (19). This similarity may be due to the impact of selecting criteria for the control group. In this study, the control group were randomly chosen from those of non-fractured neonate.

The finding of the mean birth weight of the fractured neonates was lower than the study done by Nasab S, et al (3735gm) (18). This was may be due to the current fracture was not associated with only birth weight, but also with breech presentation and may also be affected by maternal pelvic, and skill of the provider attending the labor and delivery.

In this study, majority of the left side fractures were in breech presentation and majority of the right fracture were in the vertex presentation. This finding was not supported in the literature due to the limitation of study in the area. This might have occurred as a result of the mother's pelvis' anatomical impact or the way the newborn was handled during delivery.

In this study, 58.3% of the neonate had humerus bone fracture followed by femur (25%) and clavicle (16.7%). This finding is not supported by the majority of literatures which indicate that the clavicle is the most often fractured bone in birth traumas. This raises a question if clavicular fractures were missed in our study population and warrants shoulder examination for high risk newborns. The mean weight of clavicle fracture, humerus and femur were 3950, 3054 and 2700 grams respectively. The finding implies that the mean weight of the clavicle was 3950 gram which was a border of big weight. Majority of the clavicle fracture may be related with shoulder dystocia as they have occurred in larger birth weight babies.

The study participants whose fetal presentation was breech were statistically significant for birth-related fractures, according to the chi-square test. The results also showed that participants with breech presentations had a higher likelihood of experiencing a birth-related fracture than those with normal birth weights. This might have been brought on by a poorly executed extraction maneuver during delivery.

The finding of the study also revealed that birth weight was a statistically significant for birth related neonatal fractures at a p- value of <0.05. This finding was supported with the study done in Tertiary Care Hospital in Thailand (16), Nigerian tertiary health facilities (19), Sweden (20) and Northeast Ethiopia (21). This may be because as birth weight increase it might be hard for fetus to pass through the maternal pelvic easily and pressure may be used by provider to expel the fetus. The fracture might have occurred with those providers who used only power at emergency rather than an obstetric maneuver.

Conclusion and Recommendation

The findings of this study suggest that there is an increased risk of birth-related fractures associated with both high and low neonatal birth weights. Moreover, breach presentation contributes to an increased likelihood of birth -related fractures. We propose incorporating training sessions utilizing simulations for maneuvers involved in fetal body extraction during challenging deliveries. Additionally, we also suggest implementing routine shoulder examinations for high-risk newborns, considering the possibility of overlooking clavicle fractures. It is advisable to conduct further research with a larger sample size to explore additional determining factors for birth-related fractures.

Limitation of the study

This study was conducted in small sample size which made it difficult to assess the associated risk of birth weight and birth related fractures in newborns using odds ratio by logistic regression.

Acknowledgment

The authors would like to extend their gratitude to the department of Orthopedics and trauma surgery at Tikur Anbessa Specialized Hospital.

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