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CC –BY **Incidence and characteristics of neonatal birth injuries in Maiduguri North-Eastern Nigeria**

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**Abstract:** *Background:* Birth injury is defined as impairment of neonate's body function that occur due to mechanical forces during the process of delivery. Incidence of birth injury varies from place to place, with place of delivery, experience of birth attendants, and mode of delivery.

*Objective:* To determine the incidence, characteristics of birth injury in the Special Care Baby Unit of the University of Maiduguri Teaching Hospital (UMTH).

*Subjects and methods:* This is a prospective observational study that was conducted in a Special Care Baby Unit (SCBU) of the University of Maiduguri Teaching Hospital. The subjects were recruited between 1st January, 2016 and 31st December, 2016. Neonatal birth injury was diagnosed based on paediatrician or senior registrar examination. Demographic variables: maternal age, maternal weight, and height, reproductive and labour variables: prenatal care, parity, gestational age, presence and duration of PROM, duration of labour, type of delivery, and skill of delivery attendance, while neonatal variables, includes: neonatal age, sex, birth weight, length, Apgar score, and type of birth injury. The treatment administered to the patients were either medical management such exchange blood transfusion in case of severe Jaundice complicating cephalhaematoma and/or simple transfusion for anaemia without complication, phototherapy, antibiotics, among others, or surgical/orthopaedic treatment in the presence of surgical injury. Statistical analysis was done using SPSS version 16 (SPSS Inc., Illinois, Chicago USA). A P-value

<0.05 was considered statistically significant.

*Results:* Sixty one out of 1078 admitted to SCBU during the 12 months period of the study had different types of birth injuries giving an incidence of 5.7/1000 live births,  $p < 0.0001$ . Soft tissue injury constituted the majority accounting for 37/61 (60.7%), closely followed by subconjunctival haemorrhages 25/61 (41.0%). Severe perinatal asphyxia also constituted significant proportion of the birth injury 24/61 (39.3%). Other central nervous system (CNS) birth injuries includes facial nerve palsy and Erb's palsy 13.1% each. The commonest of the fractures was femoral bone fracture 9/61 (14.8%), followed by clavicular fracture 5/61 (8.2%). It was revealed that urea 2.5 mmol/L, total serum bilirubin (TSB) 12.4  $\mu\text{mol/L}$  and random blood sugar 2.6mmol/L were deranged in those neonates with three or more birth injuries and all the three parameters were statistically significant  $p < 0.05$ . The common complications encountered in these patients were jaundice, anaemia and sepsis though were not statistically significant  $P > 0.05$ . Four patients died, two with internal organ injury were, of which one with splenic rupture and the other one with liver damage in addition to severe perinatal asphyxia died while the remaining two patients with severe perinatal asphyxia also died with mortality rate of 6.6%.

*Conclusion:* The incidence of birth injury has decreased overtime especially in the affluent economy where obstetric and perinatal diagnosis has remarkably improved, but in the developing economy like ours as demonstrated in this study

such an improvement is yet to be achieved. However education of the general populace especially the pregnant women so that they attend antenatal care and deliver at health facility with skilled health

personnel will remarkably reduce birth injury.

**Keywords:** Neonatal, birth injury, incidence, Maiduguri

## Introduction

Birth injuries are defined as impairment of neonatal body function due to adverse

Events that occur at birth and can be avoidable and unavoidable. Despite meticulous and prompt prenatal care, birth injuries usually occur particularly in prolonged and difficult labour or foetal malpresentation.<sup>1</sup>

In literature, the common types of birth injuries includes soft tissue injuries (bruises, petechiae, subcutaneous fat necroses, ulceration and perforation), bleeding into subcutaneous tissues (cephalhaematoma, caput succedaneum, subgaleal haemorrhage), intra-cranial haemorrhages, central nervous system injuries (spinal cord injury, facial nerve palsy, brachial plexus injury such as Erb's palsy and Klumpke's paralyses), musculoskeletal injury (long bone and clavicular fracture and torticollis), and hypoxic-ischaemic injury.<sup>2-6</sup>

The incidence of birth injuries varies widely from the developed western countries to that of developing countries. The incidence has decreased overtime in those affluent societies due to improved obstetric care and perinatal diagnosis. In United States, the incidence of birth injury varies from 0.2-37/1000 live birth,<sup>7-9</sup> while the incidence reported from India ranged from 3.2-15.4/1000 livebirth.<sup>10</sup> In Africa, statistics on birth injuries are scarce, however studies done in some African countries like Mali and Morocco revealed frequencies of 0.68% and 0.26% respectively, while report from Egypt showed prevalence of up to 17%.<sup>11, 12</sup> Just like other African countries, study on birth injuries from Nigeria is scarce, one study by Adegbehingbe and co-workers,<sup>13</sup> from Ile-Ife South-Western Nigeria reported birth injuries by types and frequencies as follows; commonest types were skeletal fractures 50(58.8%), brachial plexus injury 33(38.8%) and cerebral palsy 2(2.4%). Fracture of the clavicle were 23(46%); femur 12(24%), humerus 11(22%) and radius/ulnar fracture 4(8%), others were brachial injuries which includes Erb's palsy 31(93.9%) and Klumpke's palsy 2(6.1%).

Shorter maternal height, higher birth weight (weight > 4 kg), instrumental delivery, malpresentations, prolonged labour, and obstructed labour and maternal age < 16 or > 35 years have been identified as common risk factors of birth injuries.<sup>10, 14-17</sup> While it is true that the overall incidence of birth injuries has declined with improvements in obstetrical care and prenatal diagnosis in most affluent societies, such cannot be attested to in developing countries like Nigeria, also to the best of our knowledge such as study has not been reported in the last decade in Nigeria and none has ever been undertaken in this sub-region of the country. This informed the reason to undertake this study in order to determine the incidence, characteristics of neonatal birth injuries and to identify

gaps in knowledge that can be improved upon.

## Subjects and methods

This was a prospective observational study that was conducted in the Special Care Baby Unit (SCBU) of the University of Maiduguri Teaching Hospital, Maiduguri, Borno state Nigeria. The SCBU admits newborns as referrals from other hospitals in addition to newborns delivered at the centre and admitted for neonatal birth injuries and other various illnesses. The SCBU is 30 bed capacity run by two consultants, a senior registrar, two registrars, two interns and at least three nursing staffs on every shift.

The subjects were recruited over a one year period between 1<sup>st</sup> January, 2016 and 31<sup>st</sup> December, 2016. Ethical clearance was obtained from the hospital research and ethical committee. An informed consent both written and verbal was obtained from the parents of each baby before they were enrolled. One of the researcher attended to the patients and information was obtained on the demographic variables: maternal age, maternal weight, and height, reproductive and labour variables: prenatal care, parity, gestational age, prolong rupture of amniotic membrane (PROM) > 18 hours, duration of PROM, induction of labour, shoulder dystocia, breech presentation, prolong /obstructed labour, mode of delivery, and skill of delivery attendants, while neonatal variables, included: age, sex, birth weight, length, head circumference, Apgar score, and types of birth injuries. After full physical examination by the researchers concerned, diagnosis of neonatal birth injury was made supported by ultrasonographic and radiologic investigation among others where necessary. Neonatal asphyxia was diagnosed based on clinical evidence (low Apgar score at 1 and 5 minute, need for resuscitation, hypotonia, seizure, Acidosis) and radiological evidence where suspicion of skeletal injuries were entertained. The treatment administered to the patients were either purely medical management such exchange blood transfusion in case of severe cephalhaematoma and/or simple blood transfusion for moderate anaemia, phototherapy, antibiotics, intravenous fluid and oxygen therapy among others, or in the presence of surgical/or orthopaedic injuries such as lacerations were stitched and fractures/dislocations had application of hip spicer cast, skin traction and/or plaster of Paris (POP) as appropriate treatment, see photograph H below. Outcome of the patients such as whether patients got well and discharged home, left against medical advice or died were all documented. The study was also conducted in strict compliance with 1945 Helsinki declaration on study involving human subjects.

### Statistical analysis

Statistical analysis was done using SPSS version 16 (SPSS Inc., Illinois, Chicago USA). Tables and charts were used to present simple descriptive statistics, Student t-test was used to compare mean values between groups and Chi squared test was used for testing association between categorical variables. A P-value <0.05 was considered statistically significant.

### Results

The total number of neonates admitted into the special care baby unit (SCBU) over the one year study period was 1078. The Total number of neonates with birth injury accounted for 61. The incidence of birth injury following mode of birth were; 4.3%, following vaginal deliveries (including vacuum and forceps) and 1.4% following caesarean sections. The overall incidence in this study was 5.7/1000 live birth,  $p=0.0001$ , this is as shown in figure 1. There was a predominance of male sex of 40 versus 21 female giving a ratio of 1.9:1. Twenty three of the patients (38.0%) were brought from following home deliveries or referred from private health facilities, primary health care or from general hospital, while the remaining 38 patients (62.3%) were delivered at tertiary health facility where the study was conducted. Of these patients 20/38 (52.6%) were referred to the labour ward of the study centre in second stage of labour as difficult/obstructed labour. The gestational age ranged between 30 weeks to 43 weeks with mean of  $38.1 \pm 2.4$  weeks, the weight ranged between 900g to 5700g with mean of  $3000 \pm 898.2$ g. Of all the patients only 5 (8.2%) had weight greater 4000g while 46 patients (75.4%) the weight was within normal range, two third of the patients had 3 birth injuries. Figures A-H show pictures of clinical images of the various types of birth injuries sustained and management during the period of the study.

Table 2: Shows the frequency and types of birth injuries. Soft tissue injury constitute the majority accounting for 37/61 (60.7%), closely followed by sub-conjunctival haemorrhage 25/61 (41.0%). Severe perinatal asphyxia also constituted significant proportion of the birth injuries 24/61 (39.3%). Other central nervous system (CNS) injuries included facial nerve palsy and Erb's palsy each constituting 13.1%. The commonest of the fractures was femoral 9/61 (14.8%), followed by clavicular fracture 5/61 (8.2%). Four patients died, two with internal organ injury were, of which one with splenic rupture and the other one with liver damage in addition to severe perinatal asphyxia died while the remaining two patients with severe perinatal asphyxia also died with mortality rate of 6.6%.

**Table 1:** Distribution and characteristics of birth injuries

Neonatal variables	Number	% of birth injuries
<i>Gestational Age (weeks)</i>		
< 37	7	11.5
	53	86.9
> 42	1	1.6
<i>Infant Weight (gm)</i>		
< 1000	1	1.6
1000-1499	3	4.9
1500-2499	7	11.5
2500-4000	45	73.8
>4000	5	8.2
<i>Mode of Delivery</i>		
SVD	36	59.0
CS	14	23.0
Vacuum/Forceps	11	18.0
<i>Place of Delivery</i>		
Home	3	4.9
PHC	10	16.4
Private Health Facility	1	1.6
GH	9	14.8
Teaching Hospital	38	62.3
<i>Delivery Attendants</i>		
TBA	1	1.6
Mid-wife/Nurse	35	57.4
CHEW	12	19.7
Obstetric Residents	3	4.9
Consultants	10	16.4
<i>Duration of Admission (days)</i>		
< 7	4	6.6
7-13	21	34.4
14-21	13	21.3
>21	23	37.7

SVD=spontaneous vaginal delivery, CS=caesarean section, PHC=primary health care, GH=general hospital, TBA=traditional birth attendants, CHEW=community health extension workers

**Table 2:** Types and frequencies of birth injury

Types of birth injury	Frequency*	% of all injuries
<i>Soft tissue trauma</i>		
Facial and skin bruises	37	60.7
Sub conjunctival haemorrhage	25	41.0
Ecchymoses (bluish discoloration of skin)	15	24.6
Fat necrosis	10	16.4
Skin laceration	7	11.5
Scrotal/Labial trauma	4	6.6
Cephalhaematoma	10	16.4
Caput succedenum	23	37.7
Subgeleal haemorrhage	8	13.1
Ischaemic-Hypoxic trauma		
Asphyxia	24	39.3
CNS trauma		
Facial nerve palsy	8	13.1
Erb's palsy	8	13.1
Klumpke's paralysis	2	3.3
<i>Fractures</i>		
Mandibular fracture	1	1.6
Clavicular fracture	5	8.2
Femoral fracture	9	14.8
Humeral fracture	4	6.6
Skull fracture	1	1.6
<i>Internal Organ injury</i>		
Liver rupture	1	1.6
Splenic rupture	1	1.6

\*some patients had multiple birth injuries

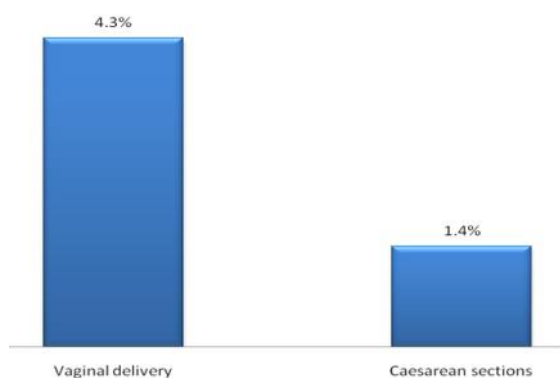
Table 3. Shows common laboratory and metabolic profiles of the patients with less than two birth injuries were compared with those greater than two birth injuries. It shown that urea 2.5 mmol/L, total serum bilirubin (TSB) 12.4  $\mu$ mol/L and random blood sugar 2.6mmol/L were deranged in those neonates with three or more birth injuries and all the three parameters were statistically significant  $p < 0.05$ . The other complications encountered in these patients were jaundice, anaemia and sepsis though not statistically significant  $P > 0.05$ . The pictures (A-H) photographed below that shown various types of birth injuries treated by the research team with 93.4% success.

**Table 3:** Laboratory profiles and complications associated with birth injuries

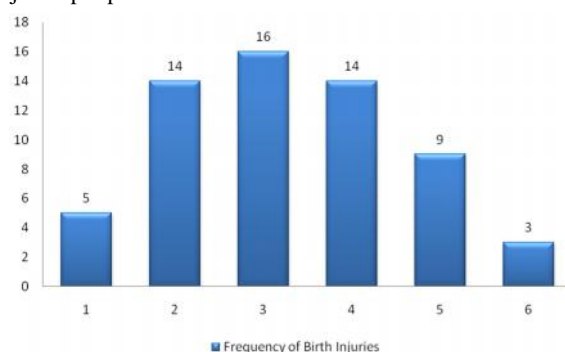
Number of birth injuries sustained by the patients				
Variables	1-2 birth injury	3 birth injury	t-test	p-value
<i>Metabolic derangement</i>				
Urea (mmol/L)	4.1	6.5	1.449	0.038*
Creatinine ( $\mu$ mol/L)	99.8	109.8	0.693	0.211
Calcium (mg/dL)	3.0	2.8	0.978	0.358
TSB ( $\mu$ mol/L)	8.9	12.4	1.391	0.014*
Conjugated SB ( $\mu$ mol/L)	4.8	6.4	0.285	0.461
PCV (%)	46.7	50.7	1.643	0.383
<i>Complications associated with birth injury</i>				
Hypoglycaemia (RBS <2.6mmol/L)	8 (42.1)	18 (40.6)	1.016	0.027*
Anaemia (PCV <35%)	8 (42.1)	22 (52.4)	0.553	0.457
Jaundice (>10mg/dL)	9 (47.4)	26 (61.9)	1.130	0.288
Convulsion	3 (15.8)	16 (38.1)	3.035	0.081
Sepsis	8 (42.1)	27 (64.3)	2.632	0.105

\*p-value <0.05, PCV=packed cell volume, TSB=total serum bilirubin, RBS=random blood sugar

**Fig 1:** Incidence of Birth injury by birth method



**Fig 2:** Frequencies of birth injury with increase in number of injuries per patients.



A. Lt parietal scalp ulceration due forcep delivery



B. Lt humeral fracture on X-ray



C. Bilateral femoral fracture



D. Facial bruises



G. Rt parietal cephalhaematoma



H. Neonate with Both femoral fracture on gallore's traction



## Discussion

Birth injury incidence varies widely, while the morbidity and mortality from birth injury has fallen to as low as 2% of neonatal mortality and 3% of neonatal morbidity in the affluent societies which reflects the technological advancement of their Obstetric care. The incidence ranges from as low as 3.16/1000 live birth as reported by Solanen and co-workers from Finland.<sup>18</sup> In the developing countries the incidence is still relatively high as exemplified by report of 41.16/1000 live birth from Iran by Hagiehe et al.<sup>15</sup>

In this study the overall incidence was 5.7/1000 live birth, while the incidence based on mode of delivery were: spontaneous vaginal delivery 4.3/1000 live birth, and that by operative/assisted birth was 1.4/1000 live birth  $p < 0.001$ , this was significantly lower than the report by Hagiehe *et al* from Iran, however this was still higher than report from Finland. This marked difference between our finding and that of Hagiehe *et al* was probably because their study was conducted over three year period while ours was over one year which was smaller than their study population. The incidence in our study was also lower than that by Abedzadeh-Kalahroudi *et al*<sup>1</sup> who reported 22/1000 live birth, but this finding was higher than 3.26 per 1000 live birth as report by Wrake *et al*<sup>19</sup> from Indian Hospital. The incidence in this study was still higher than the incidences reported from Maliand Morocco found 0.68% , 0.26% and that from Cameroon respectively.<sup>11,20</sup>

We report in this study that birth injuries occur among term neonates in 86.9% of cases and among those who weigh between 2500-4000 grams this was in contrast to the report by Borna *et al*<sup>15</sup> who reported birth injury among post term and those with larger weight at birth, however it conforms to the report by Keita *et al*.<sup>21</sup> Birth injury was more among neonates delivered vaginally and those attended to by Mid-wives/Nurses, and was higher among those delivered in study centre compared to those delivered at peripheral health facilities. The reason probably is because most of the patients delivered at the study facility were referred cases of complicated labour and attempted vaginal delivery by mid-wife before intervention was made. This is similar to the report by Mosavat *et al*<sup>3</sup> and Warke *et al*<sup>19</sup> who also reported that birth injuries were related to place of delivery, education of the birth attendants, mode of delivery among others.

In our study many women especially those who are unbooked decline operative delivery such C/S, vacuum, forceps due fear from cultural believe and they prefer trail of labour and in most instances it gets complicated before intervention is employed. The neonates most often had suffered birth injury as is seen in many developing countries with poorly equipped health facilities.<sup>13</sup> Also in this study a substantial number of birth injuries were mainly among those delivered to mothers referred to the centre due to difficult second stage or complicated labour. This may be the reason why we

observed high incidence in our teaching hospital compare to peripheral hospitals.

In our study centre, the spectrum of common types of birth injuries were soft tissue injuries which includes facial and skin bruises (60.7%), subconjunctival haemorrhage (41.0%), caput succedenum (37.7%) and other birth injuries considered as part of soft tissue injuries which includes cephalhaematoma (16.4%) and subgaleal haemorrhage (13.1%). These were largely in conformity with the findings by Linder *et al*<sup>22</sup> and Hailu *et al*.<sup>23</sup> Unlike other reports, intra-cranial bleeding was not encountered. Hypoxic-ischaemic (encephalopathy) injury due to severe perinatal asphyxia (39.1%) was high in this study, much higher than most of the reported cases from other studies.<sup>1,15,24</sup> We speculate probably the high incidence of hypoxic-ischaemic injury in our study is because most of the patients were delivered by mid-wife/nurse, though they were referred from peripheral health facilities due to complication.

Birth injuries involving the nervous system in this study include the facial nerve palsy (7<sup>th</sup> cranial injury) in (13.1%), brachial plexus injuries including Erb's palsy 8 (13.1%) and Klumpke's paralysis 2 (3.3%). This finding is similar to that reported by Warke *et al*<sup>19</sup> and is said to result from pressure due to forceps application for delivery causing facial asymmetry and weakness on the affected side of the face; brachial plexus injury resulting from shoulder dystocia, breech extraction, or hyper abduction on the neck in cephalic presentation.<sup>25</sup> Fractures of femur and humerus is said to be rare in literature,<sup>19</sup> while clavicular fracture was the commonest.<sup>26,27</sup> However in this study, femoral fracture was the commonest (14.8%), followed by clavicular fracture (8.2%) and humeral fracture was 6.6%, this is lower in comparison to other reports.<sup>8,28,29</sup> In our study there was each a case of liver and splenic rupture with intra-abdominal haemorrhage which were diagnosed by abdominal ultrasound scan, both patients were referred from a primary health care centre and in addition both had hypoxic-ischaemic encephalopathy and expired shortly after admission, this conforms similar report in literature especially in difficult breech deliveries.<sup>30</sup>

The common metabolic derangement encountered in this study were azotaemia, urea of (6.5mmol/L), in those patients with more than two birth injuries ( $p = 0.038$ ), elevated serum bilirubin among neonates with birth injuries 3 or more this was also statistically significant ( $p = 0.014$ ). Other complications were; hypoglycaemia (RBS  $< 2.1$ mmol/l), which was also statistically significant, ( $p < 0.027$ ). Others were jaundice (61.9%), anaemia (52.4%), sepsis (42.1%) and convulsions (15.8%), but were not statistically significant ( $p > 0.05$ ). This report is inconsonance with the report by Andreas<sup>30</sup> and Madan *et al*.<sup>25</sup> These complications were not unexpected especially in those neonates that had birth asphyxia, cephalhaematoma and septicemia. Out of 61 patients studied 4 died, which constituted 6.6 % of the cases, while 93.4% were discharged home with no apparent complication, as at the second follow up at 3 months of life.

## Conclusion

The incidence of birth injury has decreased overtime especially in the affluent societies where obstetric and perinatal care has remarkably improved, but in the developing societies like ours, as has been demonstrated in this study such improvement is yet to be achieved. In the same vein birth injuries may be unavoidable even in the optimal condition of standard obstetric care and diagnosis, and in the absence of apparent risk factors. Issues of birth injuries should be high in the minds of obstetricians, neonatologists, mid-wives who conduct deliveries and the general public especially the pregnant women be educated on antenatal care clinic attendance and delivery

at health facilities that can handle high risk pregnancies that may result in birth injuries.

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