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An Evaluation of Risk Factors for Cerebral Palsy in Children in Jos, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author EUE contributed to the concept, design, literature search, data collection and analysis, manuscript preparation, editing and review. Authors AOE, CJ and BOT contributed to manuscript editing and review. Author ESY contributed to literature search, data collection and analysis, manuscript editing and review. All authors read and approved the final manuscript.

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ABSTRACT

Aim: To evaluate the incidence of risk factors for cerebral palsy (CP) in children at Jos University Teaching Hospital, Jos, North-Central Nigeria.
Study Design: This was a case control study.
Place and Duration of Study: Pediatric neurology clinic, Jos University Teaching Hospital, Nigeria between January 2015 and October 2016.
Methodology: We recruited consecutive children with CP attending the pediatric neurology clinic of Jos University Teaching Hospital as cases and children without CP attending the general pediatric out-patient clinic of the hospital as controls. We used structured questionnaires and hospital records to document all relevant information of the patients and their parents. We also conducted detailed physical examination for each patient and performed specialized examinations and investigations if necessary. Data obtained was analysed with Stata software version 14. Ethical approval for this study was obtained from the Health Research Ethical Committee of Jos

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University Teaching Hospital. Informed consent was obtained from the parent/guardian of each participant.

Results: Majority of the study subjects were males (156, 55.8%) and aged 1-5 years (244, 87.2%). Risk factors that were significantly associated with cerebral palsy were home delivery, birth asphyxia, neonatal jaundice and central nervous system infections. Children with history of home delivery, birth asphyxia, neonatal jaundice and central nervous system infections were more likely than controls to develop CP: adjusted odds ratio (AOR)=3.26 (1.68-5.21), p<0.001; AOR=6.78 (3.52-13.37), p<0.001; AOR=1.87 (1.07-3.29), p=0.03 and AOR=2.69 (1.08-7.16), p=0.03 respectively.

Conclusion: CP in the majority of children in our study was associated with potentially preventable risk factors. Improvement in basic healthcare especially maternal and newborn care will help reduce the incidence of CP.

Keywords: Cerebral palsy; risk factors; children; Jos; Nigeria.

1. INTRODUCTION

Cerebral palsy (CP) is a chronic motor disorder involving posture, tone and movement that results from an injury to the developing brain. It is the most common chronic motor disorder in children. Although described as a non progressive disease, the features could change with time as the brain matures and the child acquires new motor skills [1].

The prevalence of CP in developed countries is 2-3 per 1000 live births [2-4]. There is paucity of information on the prevalence in developing counties. CP is a chronic disorder with no known cure. Long term management of CP is very expensive in terms of human and material resources. Wang et al [5] reported in 2003 that the average life time burden of new CP cases in China was US $67,044. The productivity costs were responsible for 93% of the total economic loss while direct health care and development costs were 3% each.

CP can be classified into spastic, athetoid, ataxic and mixed types. Spastic CP can be further sub-classified into spastic hemiplegic, spastic diplegic, and spastic quadriplegic types [1]. Infants with spastic hemiplegia have decreased spontaneous movements on the affected side and show hand preference at a very early age. The upper limb is often more involved than the lower limb and difficulty in hand manipulation is obvious by 1 year of age. In spastic diplegic CP, spasticity is worse on the lower limbs compared to the upper limbs. Examination of the child reveals spasticity in the legs with brisk reflexes, ankle clonus, and a bilateral Babinski sign. Spastic quadriplegic CP is the most severe form of CP because of marked motor impairment of all extremities and the high association with intellectual disability and seizures. Neurologic examination shows increased tone and spasticity in all extremities, decreased spontaneous movements, brisk reflexes, and plantar extensor responses. Athetoid CP is less common than spastic cerebral palsy. Affected infants are characteristically hypotonic with poor head control and marked head lag and develop increased variable tone with rigidity and dystonia over several years. Ataxic CP is the least common type. It is usually associated with hypotonia which usually persists into early childhood. Common features include delayed motor development, dysarthria, intention tremor, ataxic stance & gait disorders [1].

CP is caused by a broad group of developmental, genetic, metabolic, ischemic, infectious, and other acquired aetiologies that produce a common group of neurologic manifestations [1]. The injury to the developing brain may occur during the antenatal, perinatal or postnatal periods. Though most of the risk factors for CP have been reported previously, they could vary from one region of the world to another depending on the availability and utilization of healthcare services. In developed countries the major causes are antenatal factors causing abnormal brain development and prematurity/low birth weight leading to intra-cerebral hemorrhage and periventricular leukomalacia [6-9].

However in developing countries, some studies reported that preventable and treatable perinatal and postnatal factors like birth asphyxia, neonatal jaundice (NNJ) and infections of the central nervous system (CNS) were the major causes [10-17]. The difference in the risk factors of CP between developed and developing countries may be related to availability and utilization of basic antenatal, perinatal and newborn care services; advances in perinatology

and increased survival of preterm infants; and availability of diagnostic and therapeutic equipments. Therefore in developing countries, many cases of CP could have been prevented. Identifying the risk factors for CP in our region will help in designing interventions that will help reduce the incidence of the disease. The aim of this study was to evaluate the incidence of risk factors for CP in children at Jos university teaching hospital, Jos, North-Central Nigeria.

2. MATERIALS AND METHODS

2.1 Background of Study Area

Jos, the capital of Plateau state of Nigeria, is located in the north central zone of the country. The Jos University Teaching Hospital is one of the three teaching hospitals in the zone. The population of the state was estimated at 3,206,531 in the 2006 census, with the state capital having a population of approximately 900,000 [18]. Children constitute about 45% of the total population.

2.2 Study Site

This study was carried out in the pediatric neurology clinic of Jos university teaching hospital, Jos. The clinic runs every Monday at the pediatric out-patient department (POPD) of the hospital. It receives referrals from the general pediatric out-patient clinic, general out-patient department, other pediatric specialist clinics, surgical units and from other hospitals in different parts of the state and neighbouring states. It also serves as a follow-up clinic for children that were admitted for neurologic diseases in the hospital. It attends to about 40 patients every clinic day.

2.3 Study Population

Subjects of the study were children with clinical diagnosis of cerebral palsy (CP). Age and sex matched children without CP was recruited from the general pediatric out-patient clinic as controls.

2.4 Study Design

This was a case control study.

2.5 Sample Size

The sample size was calculated using the formula proposed by Charan and Biswas [19].

$$\text{Sample size} = \frac{r + 1\ (p^*)\ (1-p^*)(Z_\beta + Z_{\alpha/2})^2}{r\ (p_1 - p_2)^2}$$

Where,

r = Ratio of control to cases.
p* = Average proportion exposed.
Z_β = Standard normal variate for power set at 80% = 0.84.
$Z_{\alpha/2}$ = Standard normal variate for level of significance set at 95% = 1.96.
p_1-p_2 = Effect size or difference in proportion expected.

Minimum sample size = 139.

We recruited 140 cases and 140 controls for the study.

2.6 Inclusion Criteria

All children aged <18 years with cerebral palsy attending the pediatric neurology clinic of JUTH were recruited as cases for the study. Age and sex matched children without CP was recruited from the general pediatric out-patient clinic as controls.

2.7 Exclusion Criteria

Children with other neurologic disorders and those whose parents or guardians did not give consent were excluded from the study.

2.8 Data Collection

Consecutive patients who met the inclusion criteria that presented at the pediatric neurology clinic from January 2015 to October 2016 were recruited. Age and sex matched children without CP or any other neurologic disorder were recruited during the study period from the general pediatric out-patient clinic as controls. We used a structured questionnaire and hospital records to document all relevant information of each patient. Information collected included biodata, detailed medical history: present illness, pregnancy, delivery and perinatal history, past medical history, and developmental history. We also conducted a detailed physical examination for each patient with particular emphasis on general and central nervous system (CNS) examination. We also performed specialized examinations and investigations to exclude other pathologies and to identify some risk factors and the severity of brain damage.

2.9 Data Analysis

Data obtained was analysed with STATA software version 14 (StataCorps, Texas, USA). Chi-square test was used to test significance of associations. Bivariate logistic regression analysis was used to determine whether the independent variables were associated with the dependent variable, the results were expressed as odds ratios (OR) with their 95% confidence intervals (CIs). Variables that were associated with cerebral palsy in the bivariate model at *P* <0.05 were fit into a multivariate logistic regression model and the results were expressed as adjusted odds ratio. *P* value <0.05 was considered significant.

2.10 Ethical Consideration

Ethical approval for this study was obtained from the Health Research Ethical Committee (HREC) of Jos University Teaching Hospital. Informed consent was obtained from the parent or guardian of each participant.

3. RESULTS AND DISCUSSION

3.1 Results

A total of 280 children were recruited within the study period (140 cases and 140 controls), 156 (55.8%) were males while 124 (44.2%) were females. Two hundred and forty four (87.2%) were aged 1-5 years, 24 (8.6%) were aged 6-12 years, while 12 (4.2%) were aged 13-18 years. Table 1 shows the demographic characteristics of the subjects.

The frequency distribution of types of CP seen during the study period showed that spastic CP was the commonest type; 90 (64.3%) had spastic CP, 44 (31.4%) had athetoid CP, 2 (1.4%) had ataxic CP while 4 (2.9%) had mixed type of CP. In the spastic type, 59 (42.1%) had spastic hemiplegia, 26 (18.6%) had spastic quadriplegia while 5 (3.6%) had spastic diplegia.

The commonest maternal risk factors identified were home delivery (43.6%), prolonged obstructed labor (26.4%), ante-partum hemorrhage (10.0%), and chronic maternal illnesses (8.6%) (Table 2). Chronic maternal illnesses identified included sickle cell disease, hypertension, chronic kidney disease, maternal malnutrition, and diabetes mellitus. The commonest child risk factors were birth asphyxia (38.6%), neonatal jaundice (NNJ) (33.6%), CNS infection (15.0%), and prematurity/LBW (6.4%) (Table 3). Some children had multiple risk factors while in 16 (11.4%) no risk factor was identified.

In the multivariate analysis, risk factors that were significantly associated with CP were home delivery (P <0.001), birth asphyxia (P <0.001), NNJ (P <0.05), exchange blood transfusion (EBT) (P <0.05), and CNS infections (P <0.05). Children delivered at home were about 3 times more likely than controls to develop CP (AOR=3.26). Similarly children with history of birth asphyxia, NNJ, EBT and CNS infections were respectively about 7 times, 2 times, 6 times and 3 times more likely than controls to develop CP (AOR=6.78, 1.87, 6.52 and 2.69 respectively) (Table 4).

3.2 Discussion

In this study, we investigated the risk factors associated with cerebral palsy in our hospital. The significant risk factors identified were home delivery, birth asphyxia, NNJ, and CNS infections. We did not find any previous reports on long term neurologic outcome of children delivered at home. Women that delivered at home may not have benefitted from the services of skilled birth attendants and may have suffered the consequences of poorly conducted labor and delivery. Also if their newborns had birth asphyxia, they were unlikely to have had proper newborn resuscitation. In addition women that delivered at home were not likely to have received antenatal care and would have missed out on basic healthcare messages and proper supervision of pregnancy. All these would have resulted in increased morbidity and mortality among those women and their children.

Studies have shown that many women in developing countries still continue to deliver at home [20-26]. Factors responsible for this include poverty, ignorance, traditional and cultural beliefs and practices, far distance to and high cost of health facilities, and inadequate transportation services. Improving economic situation of families, female education, provision of basic healthcare facilities with skilled birth attendants within reach of most people, and community support will help reduce the number of women that deliver at home.

Table 1. Demographic characteristics of subjects

	Cases number (%)	Controls number (%)	Total number (%)	P value
Sex				0.27
Male	78 (27.9)	78 (27.9)	156 (55.8)	
Female	62 (22.1)	62 (22.1)	124 (44.2)	
Age				0.01
1-5 years	122 (43.6)	122 (43.6)	244 (87.2)	
6-12 years	12 (4.3)	12 (4.3)	24 (8.6)	
13-18 years	6 (2.1)	6 (2.1)	12 (4.2)	

Table 2. Maternal risk factors associated with cerebral palsy

Risk factors	Cases	Controls	Total	X^2	P value
Home delivery				17.87	0.00
Yes	61 (43.6)	28 (20.0)	89 (31.8)		
No	79 (56.4)	112 (80.0)	191 (68.2)		
Prolonged labor				20.32	0.00
Yes	37 (26.4)	9 (6.4)	46 (16.4)		
No	103 (73.6)	131 (93.6)	234 (83.6)		
APH				0.33	0.56
Yes	14 (10.0)	17 (12.1)	31 (11.1)		
No	126 (90.0)	123 (87.9)	249 (88.9)		
Chronic maternal illness				0.46	0.49
Yes	12 (8.6)	9 (6.4)	21 (7.5)		
No	128 (91.4)	131 (93.6)	259 (92.5)		
Pre-eclampsia/PIH				1.93	0.16
Yes	7 (5.0)	13 (9.3)	20 (7.1)		
No	133 (95.0)	127 (90.7)	260 (92.9)		
Instrumental delivery				1.83	0.37
Yes	4 (2.9)	1 (0.7)	5 (1.8)		
No	136 (97.1)	139 (99.3)	275 (98.2)		
Chorioamnionitis				0.20	1.00
Yes	3 (2.1)	2 (1.4)	5 (1.8)		
No	137 (97.9)	138 (98.6)	275 (98.2)		
Abdominal trauma				1.83	0.37
Yes	1 (0.7)	4 (2.9)	5 (1.8)		
No	139 (99.3)	136 (97.1)	275 (98.2)		

APH antepartum hemorrhage; PIH pregnancy-induced hypertension

Prolonged obstructed labor which was associated with CP in the bivariate analysis was not a significant risk factor in the multivariate model. This suggests that there was a relationship between prolonged obstructed labor and other risk factors like birth asphyxia. Prolonged obstructed labor especially in the second stage could compromise blood and oxygen delivery to the fetus and lead to birth asphyxia. This further buttresses the need for proper supervision of pregnancy and delivery by skilled birth attendants.

The most significant risk factor associated with CP in our study was birth asphyxia. This agrees with previous reports from developing countries [10-17]. Birth asphyxia is a leading cause of neurologic diseases like CP and seizure disorder in children in developing countries [27-29]. Birth asphyxia is inadequate intake of oxygen by the baby before, during or just after birth. Decreased oxygen intake can result in chemical changes in the body which includes hypoxemia and acidosis. Hypoxic damage can occur to most of the infant's organs, but brain damage is of most concern and perhaps the least likely to quickly or completely recover. Birth asphyxia could compromise oxygen delivery to the brain leading to hypoxic ischemic encephalopathy (HIE) with consequent brain dysfunction, poor development and long term neurologic sequelae. Supervision of pregnancy, delivery by skilled birth attendants and proper newborn resuscitation will help reduce the number of children that will develop birth asphyxia and HIE and ultimately reduce the incidence of CP and other neurologic disorders.

Another factor that was significantly associated with cerebral palsy in our study was NNJ. This also agrees with previous reports from developing countries [10-17]. Because of the immaturity of newborn bilirubin conjugation system and the blood brain barrier, unconjugated bilirubin can cross into the brain leading to bilirubin encephalopathy [30,31]. This usually occurs in children with high levels of unconjugated bilirubin. In developing countries, EBT is still used in treating high levels of unconjugated bilirubinemia that are unresponsive to phototherapy. However in this study, 15 (88%) of 17 children that had EBT for NNJ developed CP. Perhaps they had already developed bilirubin encephalopathy before EBT was done. Studies have shown that many children that had EBT for NNJ still developed bilirubin encephalopathy [32-34]. This could be as a result of three phases of delay in care-seeking pathways proposed by Thaddeus and Maine [35]: the decision to seek appropriate care, reaching an appropriate health facility, and receiving adequate/appropriate care that could occur in infants with NNJ in developing countries.

Severe hyperbilirubinemia portends significant risks of avoidable mortality and severe long-term neurodevelopmental sequelae in developing countries [36]. Each country must therefore target efforts towards improved public and antenatal education on the potential dangers of NNJ, timely detection of high-risk infants, adequate resourcing of special care baby units in all referral-level hospitals, as well as the development and active promotion of pragmatic and contextually relevant clinical practice guidelines [36]. The need for use of intensive phototherapy in the treatment of NNJ in developing countries cannot be overemphasized.

Table 3. Child risk factors associated with cerebral palsy

Risk factors	Cases	Controls	Total	X^2	P value
Birth asphyxia					
Yes	54 (38.6)	12 (8.8)	66 (23.6)	34.97	0.00
No	86 (61.4)	128 (91.2)	214 (76.4)		
Neonatal jaundice					
Yes	47 (33.6)	29 (20.7)	76 (27.1)	5.85	0.02
No	93 (66.4)	111 (79.3)	204 (72.9)		
EBT*					
Yes	15 (31.9)	2 (6.9)	17 (22.4)	6.38	0.01
No	32 (68.1)	27 (93.1)	59 (77.6)		
CNS infection					
Yes	21 (15.0)	8 (5.7)	29 (10.4)	6.48	0.01
No	119 (85.0)	132 (94.3)	251 (89.6)		
Prematurity/LBW					
Yes	9 (6.4%)	13 (9.3)	22 (7.9)	0.79	0.38
No	131 (93.6)	127 (90.7)	258 (92.1)		
Neonatal Hypoglycemia					
Yes	6 (4.3)	4 (2.9)	10 (3.6)	0.41	0.52
No	134 (95.7)	136 97.1)	270 (96.4)		
Head injury					
Yes	6 (4.3)	8 (5.7)	14 (5.0)	0.30	0.58
No	134 (95.7)	132 (94.3)	266 (95.0)		
Congenital CNS malfor.					
Yes	5 (3.6)	2 (1.4)	7 (2.50)	1.31	0.44
No	135 (96.4)	138 (98.6)	273 (97.5)		
Birth trauma					
Yes	2 (1.4)	6 (4.3)	8 (2.9)	2.05	0.28
No	138 (98.6)	134 (95.7)	132 (97.1)		
Congenital infection				1.01	0.62
Yes	1 (0.7)	3 (2.1)	4 (1.4)		
No	139 (99.3)	137 (97.9)	276 (98.6)		

EBT exchange blood transfusion; CNS central nervous system; LBW low birth weight mal for. Malformation
**Sub-set of those that had neonatal jaundice*

Table 4. Multivariate analysis of risk factors associated with cerebral palsy

Factor	Bivariate crude OR (95% CI)	P Value	Multivariate adjusted OR (95% CI)	P Value
Home delivery				
No	1.00 (Ref)		1.00 (Ref)	
Yes	3.09 (1.76-5.45)	0.00	3.26 (1.68-5.21)	0.00
Prolonged labor				
No	1.00 (Ref)		1.00 (Ref)	
Yes	5.23 (2.30-12.24)	0.00	1.02 (0.67-1.85)	0.08
Birth asphyxia				
No	1.00 (Ref)		1.00 (Ref)	
Yes	6.70 (3.24-14.09)	0.00	6.78 (3.52-13.37	0.00
NNJ				
No	1.00 (Ref)		1.00 (Ref)	
Yes	1.93 (1.09-3.44)	0.02	1.87 1.07-3.29)	0.03
EBT				
No	1.00 (Ref)		1.00 (Ref)	
Yes	6.33 (1.21-44.09)	0.01	6.52 (1.76-28.06)	0.00
CNS infection				
No	1.00 (Ref)		1.00 (Ref)	
Yes	2.91 (1.17-7.46)	0.01	2.69 (1.08-7.16)	0.03

OR odds ratio; NNJ neonatal jaundice; EBT exchange blood transfusion; CNS central nervous system

CNS infections were also significantly associated with CP in our study. This is similar to previous reports from developing countries [14-17]. Poorly treated meningitis could result in brain damage leading to long-term neurologic sequelae. Studies have shown that a significant number of children that had meningitis in developing countries developed moderate to severe neurodevelopmental impairment [37-39]. Early diagnosis and appropriate treatment of meningitis is therefore very important if we are to mitigate the adverse effect meningitis has on neurodevelopment in children.

Contrary to findings in developed countries [7-9]. prematurity was not significantly associated with CP in our study. This could be as a result of differences in survival of preterm babies between developed and developing countries. While extremely preterm babies survive in developed countries, they usually don't survive in developing countries because of inadequate neonatal intensive care services. Each year 15 million babies are born preterm and their survival chances vary dramatically around the world [40]. South Asia and sub-Saharan Africa account for almost two-thirds of the world's preterm babies and over three-quarters of the world's newborn deaths due to preterm birth complications [40,41].

We didn't identify any risk factor in 11% of children with CP in our study. This is similar to 13% of children with CP with unidentifiable risk factor reported in India [10]. These may be children with CP from genetic abnormalities and mitochondrial defects which we do not have the facilities to diagnose. A growing body of evidence suggests that cerebral palsy is probably caused by multiple genetic factors [42-46].

A lot of research gaps still exist in the area of risk factors for cerebral palsy in developing countries. Genetic studies are needed to identify children that developed CP because of genetic abnormalities and mitochondrial defects. Genomic studies are also needed to ascertain why some children develop bilirubin encephalopathy at lower serum bilirubin levels while others with high bilirubin levels don't develop bilirubin encephalopathy. We also need genomic studies to ascertain why some children with severe birth asphyxia develop CP while others don't.

4. CONCLUSION AND RECOMMENDA-TION

4.1 Conclusion

We observed that majority of children with CP in our study had identifiable risk factors which are potentially preventable. Improvement in basic healthcare especially maternal and newborn care will help reduce the incidence of CP.

4.2 Recommendation

We therefore make the following recommendations to the government:

1. Establishment of primary healthcare centres with basic facilities for safe conduct of labor and newborn resuscitation, and skilled birth attendants within reach of all communities in the region.
2. Educating pregnant women and their family members on danger signs in newborns and infants.
3. Introduction of Measles, Mumps and Rubella (MMR) vaccines to the immunization programme of women of child-bearing age.
4. Introduction of routine screening for glucose-6-phosphate dehydrogenase (G6PD) deficiency for all newborn.
5. Establishment of well equipped neonatal intensive care unit (NICU) at all referral level hospitals.
6. Provision of intensive phototherapy units at all referral level hospitals.
7. Training and re-training of all cadres of healthcare workers.

We also make the following recommendations to the communities:

1. All pregnant women should attend antenatal care (ANC).
2. Home delivery should be actively discouraged.
3. Seek immediate care at the clinic when you notice any problem with your child like yellowness of the eyes, fever or poor sucking.
4. Treatment of neonatal jaundice with glucose water and early morning sunlight should be discouraged.

5. LIMITATIONS

This study had some limitations. Firstly we relied on the ability of parents or guardians to recall events that happened in the past in assessing the risk factors. This could have led to recall bias and therefore an over or underestimation of the risk factors.

Secondly because of lack of appropriate facilities and manpower we were unable to identify the presence of genetic abnormalities and mitochondrial defects that could have been responsible for CP in some children.

CONSENT

As per international standard or university standard, patient's written consent has been collected and preserved by the authors.

ETHICAL APPROVAL

As per international standard or university standard, written approval of Ethics committee has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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QUESTIONNAIRE

An Evaluation of Risk Factors for Cerebral Palsy in Children at Jos University Teaching Hospital, Jos, Nigeria.

Questionnaire/Case Record Form

Hosp No _____

How old is your child? _____

Age group

<1Year _____ 1-5 years_____
6-12 years _____ 13-18 years _____

Is your child male or female?

Male _____ Female _____

Cerebral Palsy

Yes _____ No _____

Where did you deliver this child?

Home _____ PHC _____
Maternity _____ Private hosp _____
Secondary facility _____ Tertiary facility _____
Church/Mosque _____ Others (specify) _____

Did you have any of these during pregnancy or labour/delivery?

Prolonged obstructed labour Yes _____ No _____
Bleeding before delivery Yes _____ No _____
Chronic illness Yes _____ No _____

If yes specify _____

Fever with skin rash Yes _____ No _____

If yes at what gestational age (wks)? _____

Fever with foul-smelling vaginal discharge Yes _____ No _____
Leg swelling with High blood pressure Yes _____ No _____
Trauma to the abdomen Yes _____ No _____
Abdominal irradiation Yes _____ No _____

How was the child delivered?

SVD _____ Elective CS _____
Emergency CS _____ Instrumental delivery _____
Assisted breech delivery _____
Others _____ Specify _____

At what gestational age did you deliver your child (weeks) _____

Is your child a product of multiple gestation? Yes _____ No _____

If yes how many were they _____
What position was this child? _____

Did your child have any injuries during delivery? Yes _____ No _____

If yes what type of injury? _____

APGAR score at 5 minutes ≤3 _____ >3 _____

Source of APGAR score Hospital record _____ Parents _____

Did your child cry immediately after birth Yes _____ No _____

If no how long did it take for your child to cry ≤5 mins >5 mins
What was done before your child cried? _____

Was your child admitted in the hospital after delivery Yes _____ No _____

If yes why _____
For how long (days) _____

Did you notice any problem with your child after delivery Yes _____ No _____

If yes what did you notice? _____

When did you start feeding your child (hours)? _____

If longer than 1 hour why? _____

Did your child have jitteriness or seizure in the first 1 wk of life Yes _____ No _____

Did your child have yellowish discolouration of the eyes after birth Yes _____ No _____

If yes at what age _____
What was done _____

Did your child have exchange blood transfusion? Yes _____ No _____

If yes at what age _____
How long was your child admitted in the hospital (days)? _____

Has your child ever been admitted in the hospital? Yes _____ No _____

If yes for what condition _____

Has your child ever had fever with convulsion? Yes _____ No _____

If yes how many times? _____
At what age(s) _____
What was done? _____

Has your child ever had a head injury? Yes _____ No _____

If yes how many times? _____
At what age(s) _____
What was the nature of the injury? _____

Has your child had any other problems in the past? Yes _____ No _____

If yes what was the nature of the problem? _____
_____

Anthropometry

Weight (kg) _____
Height/Length (cm) _____
OFC (cm) _____

Neurological examination findings

1. _____
2. _____
3. _____
4. _____
5. _____

Investigation

CT Scan Yes _____ No _____

If Yes Report _____
_____
_____

MRI Yes _____ No _____

If Yes Report _____
_____
_____

Other Investigations with result

a. _____
b. _____
c. _____
d. _____

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