Research Article

Evaluation of risk factors of cerebral palsy in a tertiary health facility, Nnewi, Nigeria: a case–control study

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Abstract

Background: Cerebral palsy is the most commonly diagnosed condition in children presenting with disability. This could be attributed to the lack of awareness on the quantifiable and largely preventable risk factors associated with it and poor knowledge of simple public health measures against these factors.

Objective: To evaluate the risk factors associated with cerebral palsy in Nnamdi Azikwe University Teaching Hospital, Nnewi, Anambra state, Nigeria.

Materials and Methods: This is a case–control study carried out with 40 case study population of children diagnosed with cerebral palsy and 80 control group of children who do not have cerebral palsy. The study was carried out using a pro forma to access and collect relevant data from the records (folders) of these individuals.

Result: There is a statistically significant relationship between cerebral palsy and the following risk factors—birth asphyxia ($\chi^2 = 18.98$; $P < 0.01$; OR = 7.71), neonatal jaundice ($\chi^2 = 5.958$; $P < 0.05$; OR = 3.33), and postnatal infection ($\chi^2 = 5.86$; $P < 0.05$; OR = 3.02). However, the relationship between cerebral palsy and intrauterine infection was not statistically significant.

Conclusion: Birth asphyxia is the strongest risk factor associated with cerebral palsy, followed by neonatal jaundice and postnatal infection, and then intrauterine infection. Adequate prevention targeting these factors will hopefully reduce the incidence of cerebral palsy among children in Nigeria.

KEY WORDS: Cerebral palsy, tertiary health facility, risk factors, odds ratio

Introduction

Cerebral palsy (CP) is a chronic disorder, predominantly, of the motor function, which occurs in children as a result of nonprogressive insult to the immature brain.[1] The primary manifestation in CP is the disorder of the motor function.

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CP contributes significantly to the poor health status of children in Nigeria. The incidence of CP varies significantly across different geographical zones, although the Centers for Disease Control and Prevention (CDC) study found that the average prevalence of CP in 2004 was 3.3 per 1,000 live births. The prevalence was significantly higher in boys than girls (male/female ratio 1.4:1).[2] It is one of the commonest causes of motor disabilities in childhood. While there has been controversies regarding the alterations in the rates over time, studies in recent days have reported a prevalence of 2–3 per 1,000 live births.[3] This comes about owing to a poor understanding of the associated risk factors and application of necessary preventive measures. In UNICEF 2011 annual report for Zimbabwe, it was stated that the total number of children with disabilities presenting for the first time had tripled

from 114 in 2005 to 346 in 2010. CP was the most commonly diagnosed condition, which resulted from preventable causes such as birth asphyxia and jaundice.[4]

Sigmund Freud postulated in 1897 that CP may be the result of intrauterine factors affecting fetal neurological development.[5] The causes of CP are numerous. In Nigeria, birth asphyxia (causing hypoxic ischemic encephalopathy), severe neonatal jaundice (NNJ), (causing bilirubin encephalopathy), and prematurity appear to be the most important factors associated with CP. Other causes include hypoglycemia, intrauterine infection, meningitis, and encephalitis.[1] In a significant proportion of children with CP, no obvious cause could be determined.[6]

The WHO in the update on December 6, 2010 on "the meningitis vaccine project" stated that "20% of survivors have serious permanent health problem as a result of the disease including CP, mental retardation, epilepsy and deafness."[7] Other reports by the WHO reflect this, including WHO world health report 2005 on "Make Every Mother and Child Count," which states that "while data are limited, it is estimated that each year over a million children who survive birth asphyxia develop problem such as CP, learning difficulties and other disabilities."[8] CP is classified based on the nature of manifestation of the disease. CP poses a high degree of burden on the family. In a preliminary study done by Wang et al.[9] including caregivers of 319 patients in 2003 reported that the average life time burden of new CP cases in China was US $67,044. The productivity costs are responsible for 93% of the total economic loss and direct health care and development costs make-up 3% each. There are several factors that contribute to the extraordinary high economic burden of CP, including productivity loss, reduced life expectancy, and dependency, progressive condition.

The objective of this study is to evaluate the risk factors associated with CP in Nnamdi Azikiwe University Teaching Hospital (NAUTH) Neurology Clinic. Moreover, the study aimed at determining the association between the CP and some identified risk factors viz.: birth asphyxia, NNJ, intrauterine infection, and postnatal infection (PNI).

Materials and Methods

Study Design and Area

This case–control study was conducted at Nnamdi Azikwe University Teaching Hospital (NAUTH), Nnewi, Nigeria. It is located at the urban part of Nnewi town. NAUTH is a tertiary health-care institution, an outstation of Nnamdi Azikwe University, Awka. The major specialty includes surgery, internal medicine, community medicine, pediatrics, obstetrics, and gynecology.

The pediatrics department has about nine specialists with two professors, including a specialist in neurology. The neurology clinic runs every Tuesday conducted by the specialist or a senior registrar.

Nnewi is located in Anambra state in the southeastern part of Nigeria, east of River Niger and about 22km southeast of Onitsha. Nnewi is the second largest city in Anambra state and occupies an area of approximately 1,076.9 square miles (2,789 km^2) with an estimated population of 391, 227.[10,11]

Study Population

The case study population consisted of children diagnosed with CP, while the control population consisted of children not diagnosed with CP or similar neurological illness. The control population was selected to be of the same sex and age range of ±2 years with the case study population.

Selection Criteria for Subjects

Inclusion criteria for the case group included (1) children diagnosed with CP, (2) children older than 2 years of age, and (3) children with complete data on the risk factors under evaluation. Inclusion criteria for the control group included: (1) children free of CP, (2) children of the same sex as the case subject, and (3) children within the age range of ±2 years for the case subject.

Exclusion criteria included: (1) children not yet diagnosed but rather observing (i.e., "at-risk of CP cases" and (2) children without records on the risk factors under evaluation.

Sample Size Determination

$$X = \frac{U\sqrt{[\pi 1(1-\pi 1)+\pi 2(1-\pi 2)]}+\sqrt{[\pi(1-\pi)]}}{(\pi 1-\pi 2)^2}$$

where,
U = 1.28 (where power is 90%).
V = 1.96 (where significance level = 5%).
$\pi 1$ = Proportion of control exposed.
$\pi 2$ = Proportion of cases exposed.
It can also be calculated from,

$$\pi 2 = \frac{\pi 1 \mathrm{OR}}{(1+\pi 1(\mathrm{OR}-1))}$$

where OR = odds ratio (OR); $\pi 1 = 0.1$; $\pi 2 = 0.25$.
$X = 57.30 \approx 60$; minimum sample size = $2X = 120$.

Sampling Method

A convenience sampling method was used to collect data for the calculated sample size. The folders of 40 patients diagnosed of CP were assessed through the neurology clinic register. With the folder number, the folders were taken by the record department staffs. Vital information required for the research was collected.

The control group consisted of patients of similar sex and age attending the nephrology clinic. The folders of 80 patients were assessed, and the vital information required in the research was collected.

Tool for Data Collection

The data were collected using a pro forma. This was used collect information on the relevant risk factors in both the case

and the control groups. Moreover, data on relevant sociodemographic characteristics were accessed and collected.

Data Analysis

The data obtained were analyzed using the software Microsoft Excel Descriptive summary statistics such as mean were presented as frequency tables. OR was calculated for the risk factors under evaluation. The association between the variables was calculated using appropriate statistical test and the level of significance set at $P \leq 0.05$.

Limitations

Some limitations were encountered in the course of the study, and they include—few researches on the subject of study with consequent available literature; strike action by health workers, which prolonged the time spent for data collection; and inadequate records keeping.

Ethical Consideration

Ethical approval for the project was obtained from the NAUTH Ethics Committee through the office of the Head of Department, Community Medicine and PHC, Nnamdi Azikwe University Teaching Hospital, Nnewi, Nigeria. Appropriate permission was also obtained from the heads of various sections of the records department. The nature of the study was clearly explained to them before obtaining the approval. Adequate confidentiality was maintained during the use of the patient's folder.

Result

A total of 120 folders of 40 cases of CP and 80 controls were assessed. The study population (cases) and control group were very similar in terms of age ($P > 0.05$). Hence, the case and control groups were age matched as shown in Table 1.

In Table 2, the distribution of the subjects' parents' educational levels and occupations are displayed. From available records, more than 25% of the mothers and fathers of these babies attained secondary level of education and above.

Figures 1 and 2 indicate that majority of the subjects are of Anambra state origin (58%) and reside in the urban area (42%).

Table 3 shows that significantly higher proportion of CP cases revealed birth asphyxia than in the control group ($\chi^2 = 18.98$, $P < 0.001$). The odd of CP occurring among babies with birth asphyxia was about eight times more than would occur among those without birth asphyxia (OR = 7.71). Similarly, NNJ and PNI are significantly associated with CP ($\chi^2 = 5.96$, $P < 0.05$; $\chi^2 = 5.86$, $P < 0.05$, respectively). The chances of CP occurring among babies with these conditions (NNJ and PNI) are about 3–4 times more, when compared with the likelihood among those without these conditions (OR = 3.33; OR = 3.03, respectively). However, intrauterine infection is not significantly associated with CP ($\chi^2 = 2.295$, $P > 0.05$; OR = 1.89).

Discussion

This study analyzed some common risk factors associated with CP. The risk factors under analysis included birth asphyxia, NNJ, intrauterine infection, and PNI. Birth asphyxia is the leading associated risk factor, which was seen in 42.5% of cases. This agreed with similar studies carried out by Frank-Briggs and Alikor[4] in Port Harcourt, Southern Nigeria, Ogunseli et al.[12] in Sagamu Western Nigeria, and Belonwu et al.[13] in Kano Northern Nigeria in which birth asphyxia was associated with 27.94%, 57.6%, and 45.7% of cases, respectively. The lower value obtained in the study by Frank-Briggs and Alikor [4] could be because the study was done entirely in the urban part of the country where people are enlightened and sufficiently equipped to adopt preventive measures readily.

In this study, the mean age of cases was found to be 3.4 ± 2.01 years. This contrasts with the results of a similar study done in El-Kharga district New Valley Egypt, North Africa, by El-Tallawy et al.,[14] in which the mean age was 7.17 ± 4.38 years.[14] The difference could have been owing to a better enlightenment and an earlier presentation of cases in the western part of Africa. The prevalence of CP was significantly higher in male than female subjects with male/female ratio of 1.7:1. This agrees with the results of a study done by CDC and Okike et al.[15] in Federal Medical Center (FMC), Asaba, with the male/female ratio of 1.4:1and 1.1:1, respectively.[3]

Further analysis revealed a significant relationship between CP and birth asphyxia ($P < 0.01$) and OR of 7.71. This agreed with the results of the studies done in Port Harcourt, Nigeria[4]; Sagamu, Western Nigeria[12]; Kano, Northern Nigeria[13]; and El-Kharga district, New Valley Egypt. [14]

Moreover, in a two-year study by Okike et al.[15] on CP among children seen in the neurologic clinic of FMC, Asaba, birth asphyxia was the commonest risk factor for the development of CP. Similar studies in Northern Nigeria by Ogunseli et al.[12] on socioclinical issues in CP in Sagamu, Nigeria, revealed that, of 92 patients attending the pediatric neurology clinic at Olabisi, Onabanjo University Teaching Hospital, Sagamu, Nigeria, between the periods of 2000 and 2006, birth asphyxia was associated with 57.6% cases, being the leading cause, kernicterus, 36.9%, and central nervous system infection, 21.7%. These three are the leading associations with CP in Sagamu, Nigeria. Another study by Erkin et al.[16] in Turkey on the risk factors and clinical profiles in Turkish children with CP showed that, in 625 cases of CP in pediatric rehabilitation clinic between 2000 and 2004, birth asphyxia accounted for 34.6% cases.

In our study, NNJ was the second leading risk factor associated with CP, although almost at par with PNI. This agrees with the result of a similar study done by Frank-Briggs and Alikor[4] in Port Harcourt Nigeria, Ogunseli et al.[12] in Sagamu Nigeria, and Belonwu et al.[13] in Kano, Nigeria, in which NNJ accounted for 26.26%, 36.9%, and 12.6% of cases, respectively. Another review on CP in Kano, Northern Nigeria, by Belonwu et al.[13] showed that, using hospital records of pediatric neurology clinic between January 1998 and December 2005,

Table 1: Age and sex distribution of the subjects

Age group (years)	Case			Control		
	Male subjects	Female subjects	Total	Male subjects	Female subjects	Total
<5	23	13	36	46	26	72
6–10	0	2	2	0	4	4
11–15	2	0	2	4	0	4
Total	25	15	40	50	30	80
Mean		3.40			3.60	
SD		2.10			2.80	
Z-test			0.447			
p			0.05			

Table 2: Distribution of subjects by other sociodemographic characteristics

Variable	Frequency	Percentage
Educational level of mothers		
No formal education	0	0
Primary education	6	5
Secondary education	33	27.5
Tertiary education	43	35.8
Missing data	38	31.7
Total	120	100
Educational level of fathers		
No formal education	0	0
Primary education	22	18.3
Secondary education	35	29.2
Tertiary education	19	15.8
Missing data	44	36.7
Total	120	100
Occupation of mothers		
Professionals	18	15
Technicians	1	0.8
Clerical workers	15	12.5
Service and sales workers	46	38.3
Housewives	21	17.5
Missing data	19	15.8
Total	120	100
Occupation of fathers		
Professionals	11	9.2
Clerical workers	9	7.5
Service and sales workers	66	55
Agricultural workers	2	1.7
Craft workers	9	7.5
Machine operators	1	0.8
Missing data	20	16.6
Elementary occupation	2	1.7
Total	120	100

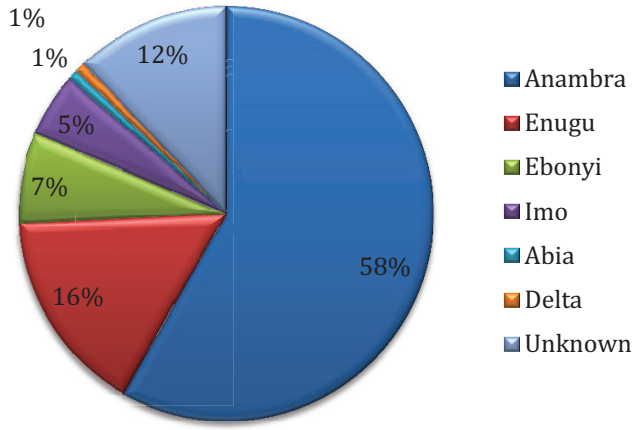

Figure 1: Distribution of subjects by state of origin.

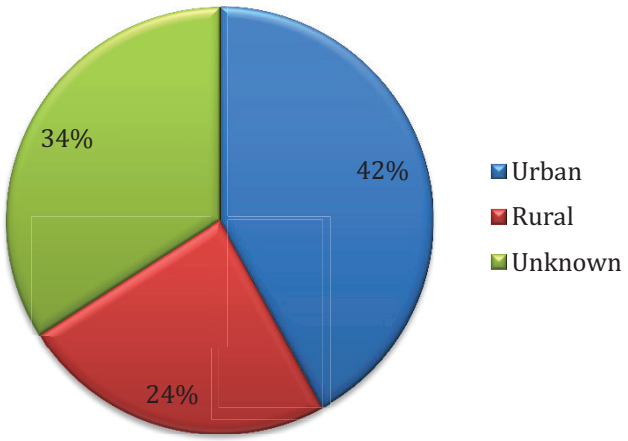

Figure 2: Distribution of subjects by the area of residence.

birth asphyxia was the leading cause of CP associated with 45.7%, followed by NNJ associated with 12.6%, PNI associated with 10.6%, and unknown etiology found in 13.2% of cases.

In this study, intrauterine infection was slightly associated with 25% of cases ($P > 0.05$, OR = 1.89). This agrees with the results of the study done by Wu et al.[17] in Denmark with

Table 3: Relationship between cerebral palsy and the common risk factors

CP risk factors	Case, *?* (%)	Control, *?* (%)	Total	*Á*	OR
Birth asphyxia	17 (42.5)	7 (8.75)	2,418.98	<0.001*	7.71
Neonatal jaundice	13 (32.5)	10 (12.5)	235.96	<0.05*	3.33
Intrauterine infection	10 (25)	12 (15)	222.295	>0.05	1.89
PNI	13 (32.5)	11 (13.75)	245.86	<0.05*	3.02

*Statistically significant.

adjusted hazard ratio of 1.63 but disagrees with a similar study done by Abdullahi et al.[18] in Khartoum Sudan ($P < 0.05$, OR = 8.4). The significant finding in the Sudan study could be attributed to delays in seeking medical help by febrile pregnant women, principally, because they may be ignorant of the connotations and severe health consequences to the fetus.

PNI was significantly associated with 32.5% of CP (OR = 3.02). This agrees with the results of a similar study done by Frank-Briggs and Alikor [4] in Port Harcourt, Nigeria; Ogunseli et al.[12] in Sagamu, Nigeria; and Belonwu et al.[13] in Kano, Nigeria, in which PNI accounted for 15.95%, 21.7%, and 10.6% of cases, respectively. The lower values in study by Frank-Biggs et al.[4] and Ogunseli et al.[12] are probably because only central nervous system infection was considered. Our study focused on all PNIs because most infectious diseases in children result in septicemia, which eventually involve the brain.[4,12,13] Similarly, our finding is comparable with the results of another study done by Gibson et al.[19] in South Australia (OR = 2.22). The reason for the little difference could be owing to the confirmation of the presence of infection with highly sensitive PCR in the Australian study.[19] Moreover, a population-based case–control study at California, USA, by Gilbert et al.[20] on adverse obstetrical events that are associated with a significant risk of CP, which showed that, among 7,242 children with CP, maternal infection was seen in 15.1% cases versus 6.6% in the control.

Conclusion

This study has shown that a significant relationship exists between CP and the following risk factors—birth asphyxia, NNJ, and PNIs. The relationship between CP and intrauterine infection was not statistically significant. The respective ORs are indications of the strength of association between the studied risk factors and CP viz., that babies with birth asphyxia, NNJ, PNI, and intrauterine infections, which are about sevenfolds, threefolds, threefolds, and twofolds, respectively, more likely to develop CP than those without the stated risk factors.

Recommendation

The result of the study has obvious public health implications, and, so, the following strategies are recommended in order to decrease the incidence of CP among children:

1. Aggressive health education of the general public on the nature of CP emphasizing that it is the cause of major disability in children. This will raise people's awareness to adopt adequate preventive measure against this debilitating illness by taking their pregnant women to well-equipped health facilities for antenatal care and delivery.
2. Education of nonprofessionals involved in child delivery on appropriate interventions to adopt when difficulty is encountered during delivery and on how to manage birth asphyxia adequately. This will go a long way to reducing the number of birth asphyxia and, thus, CP.
3. Education of pregnant women, in particular, during antenatal clinic (in the third trimester) on the nature of NNJ and the implications of inadequate treatment.
4. Routine and regular screening for infections among pregnant women will lead to early diagnosis and prompt and adequate treatment of perinatal infections, and this will hopefully nip CP in the bud. Moreover, identification of the infant who is at high risk is important. Such children should be seen and examined frequently.
5. Early assessment and treatment is essential for the prevention of deformities and the provision of experiences required for normal development.

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