

A Clinicoepidemiological Study of Cerebral Palsy among Children Attending Medical Rehabilitation and Rheumatology Center

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Abstract

Background: Cerebral palsy (CP) is an umbrella term used to accurately describe a group of permanent movement and posture disorders that cause activity limitations and are caused by nonprogressive disturbances in the developing fetal or infant's brain. **Objective:** This study aimed to evaluate the risk factors, comorbidities, and associated clinical problems with CP. **Materials and Methods:** A cross-sectional study was conducted among children with CP who attended the Medical Rehabilitation and Rheumatology Center for the first time. A random sample of 76 children aged ≤1 to 5 years who were clinically diagnosed with CP was enrolled in this study. The data were collected between January 2021 and December 2021. Sociodemographics, etiology, risk factors associated with the neonatal period, factors related to obstetric histories, and CP classification were typically gathered from a questionnaire designed for this purpose. **Results:** The majority of participants were males, 63.2%, compared with females; 47.3% of infants were born at a low birth weight <2500 g. Two-thirds of children, 64.5%, were diagnosed with CP before 1 year. Neonatal jaundice was present in 56.6% of newborns. Hypoxic-ischemic encephalopathy, 47.4%, is the most significant perinatal risk factor for CP. First-degree consanguineous marriage was observed in 35.5% of the studied sample. The mothers of 70, 92.2%, children with CP were multiparous. Most of the patients, 72.4%, had spastic CP, and quadriplegia was primarily reported in 51.3% of them. **Conclusions:** CP cannot be prevented in most cases, but the risk factors can be reduced. Early diagnosis gives the multidisciplinary team the opportunity for early intervention and rehabilitation.

Keywords: Cerebral palsy, comorbidities, epidemiology, etiologies, risk factors

INTRODUCTION

Cerebral palsy (CP) is an umbrella term used to describe a group of permanent movement and posture disorders that cause activity limitations and are caused by nonprogressive disturbances in the developing fetal or infant's brain. The movement disorder of CP is frequently accompanied by disturbances in sensation, comprehension, cognition, communication, and behavior; seizures or convulsions, and secondary musculoskeletal difficulties.^[1] According to population-based studies conducted all over the world, it is estimated that there are 1 to >4 cases of CP for every thousand live births or children of a specific age group. CP affects approximately two per 1000 live birth.^[2] In triplets and quadruplets, the prevalence of CP was significantly higher than in twins.^[3] It is noteworthy that out of every thousand live births, there is a rise

from 40 to 100 in children born very early and with low birth weight.^[4] With an increasing gestational age, a significant decrease was reported in the prevalence of CP, and gestational ages from 27 weeks onward recorded an exciting reduction in occurrence.^[5] CP is attributed to a wide variety of etiologies and factors. Approximately 75% of all CP cases are thought to be caused by prenatal factors. In comparison, 6%–8% are supposed to be caused by neonatal asphyxia, and 10%–18% are thought to be caused by postnatal factors.^[6]

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MATERIALS AND METHODS

A cross-sectional study was conducted at the Pediatric Rehabilitation Department in Medical Rehabilitation and Rheumatology Center (Baghdad) from January 2021 to December 2021. A random sample of 76 children aged between less than 1 year and more than 5 years was recruited in the current study and was clinically diagnosed with CP by a pediatric neurologist. All the study samples attended the center for the first time. The data were obtained through a direct interview with the patient's parents or caregivers. The design of the survey form included many aspects; the collected information included sociodemographic characteristics of the child, such as age, sex, weight at birth, method of feeding, fetal presentation at birth, etc.; risk factors associated with the neonate include the age at which the parents were married, pregnancy histories, consanguinity of the parents, gestational age, disease, and taking medication during pregnancy, etc. Factors related to obstetric histories, including perinatal, prenatal, postnatal, and congenital abnormalities, were recorded. All the CP patients with nonprogressive neurologic defects were included in this study. The surveillance of cerebral palsy and physiological and topographic classifications were used to classify CP. Associated impairments, for instance, deafness, visual problems, speech disorder, and seizures, are also included in this study. A rheumatologist did a clinical examination and assessment of each child. Some medical reports on visual problems and hearing

impairment were obtained from ophthalmologists, audiologists, and speech-language pathologists. We used statistical SPSS commercial software v26 to analyze the findings. Observed frequencies in the attributive characteristics were compared to the expected values via the χ^2 test; categorical variables were compared using a one-sample chi-square test and a binomial test. P value < 0.05 was set as a significance level.

Ethical approval

The research was carried out according to the ethical principles outlined in the Helsinki Declaration. Before taking the sample, verbal approval was taken from the mothers of the children involved in the study. The Research and Development Committee in Baghdad's Al-Rusafa Health Directorate reviewed the study protocol before taking the fundamental approvals to conduct the research. The study protocol and the subject information and consent form were reviewed and approved by a local ethics committee according to the document number 411 in 18/8/2022 to get this approval.

RESULTS

By the end of the data collection, as can be seen in Table 1, out of 76 participants, 63.2% were male and 36.8% were female. The majority of children, i.e., 27.6%, belonged to the age group of 2–3 years, 47.3% of children had a low birth weight (<2500 g), and almost two-thirds of the participants, 64.5%, were diagnosed with CP before they

Table 1: Study sample distribution based on sociodemographic characteristic variables and weight at birth (kg) with significant comparisons

Children's sociodemographic characteristics and weight at birth	Classes	No.	%	CS*, P value
Gender	Male	48	63.2	$P = 0.029$ (S)
	Female	28	36.8	
Age groups (years)	<1	6	7.9	$\chi^2 = 11.632$ $P = 0.040$ (S)
	1–2	16	21.1	
	2–3	21	27.6	
	3–4	13	17.1	
	4–5	8	10.5	
	>5	12	15.8	
Weight at birth (kg)	Less than 1.5	15	19.7	$\chi^2 = 13.447$ $P = 0.001$ (HS)
	1.5 to <2.5	21	27.6	
	2.5 and more	40	52.6	
Age of diagnosis—CP	Less than 1 year	49	64.5	$\chi^2 = 74.947$ $P = 0.000$ (HS)
	At the first year	21	27.6	
	At the second year	5	6.6	
	At the fourth year	1	1.3	
Feeding method after birth	Breast feeding	23	30.3	$\chi^2 = 12.658$ $P = 0.002$ (HS)
	Formula feeding	39	51.3	
	Mixed feedings	14	18.4	
Neonatal jaundice	Yes	43	56.6	$P = 0.302$ (NS)
	No	33	43.4	

CS = comparison significant, HS = highly significant at $P < 0.01$, NS = nonsignificant at $P > 0.05$, S = significant at $P < 0.05$

*Testing based on one-sample chi-square test and binomial test

turned 1-year-old. More than half of the children were formula feeding after birth, 51.3%, followed by breast fed ($n = 23$, 30.3%) and mixed fed ($n = 14$, 18.4%), and neonatal jaundice was present in 56.6% of newborns. The study included 39 (51.3%) children with CP who were bottle-fed.

Moving to the findings obtained from Table 2, the occurrence of brain damage was classified into prenatal ($n = 10$, 13.1%), perinatal ($n = 57$, 75%), and postnatal ($n = 9$, 11.8%). The most striking result from the data is that the most significant value for the timing of causal brain damage was discovered to be in perinatal. Approximately half of those surveyed reported hypoxic-ischemic encephalopathy ($n = 36$, 47.4%), the presence of a highly significant difference in the distribution of clinical types of CP concerning risk factors ($\chi^2 = 155.263$, $P = 0.000$), whereas the lowest value to be in prenatal and postnatal, respectively.

Table 3 provides an overview of the main characteristics of factors associated with obstetrics information. The age group between 15 and 19 years represented the highest percentage of the mothers when they married (40.8%) and found significant differences ($\chi^2 = 31.895$, $P = 0.000$), and there was a mean age of 20.97 ± 5.13 years for mothers of children with CP; furthermore, no parental consanguinity was observed in more than half of the study sample size ($n = 44$, 57.9%), whereas the first-degree consanguinity was documented in 27 (35.5%) and the second-degree consanguinity in five (6.6%).

More than two-thirds of the mothers in the survey had a normal pregnancy and did not experience any bleeding

($n = 62$, 81.6%). In terms of multiparity, the results show that 1–2 and 3–4 have the highest frequency ($n = 35$, 46.1%). Maternal health care during pregnancy is one of the important factors in lowering the incidence of CP. Therefore, over half of the mothers surveyed reported ($n = 53$, 69.7%) that they were disease-free. Anemia, high blood pressure, diabetes, and asthma affect many pregnant mothers. Furthermore, the percentage of mothers exposed to smoking or passive smoking was higher than that of women who had not, respectively, $n = 48$ (63.2%) and $n = 28$ (36.8%). The results also show that the majority of mothers (60.5%) did not take any medications (antibiotics, corticosteroids, and non-steroidal anti-inflammatory drugs) while pregnant. The cephalic presentation was the fetal presentation at delivery, and it was observed in most of the children in a study sample ($n = 71$, 93.4%). The minority of newborns ($n = 2$, 2.6%) are traumatized at birth or throughout their first year of life. Fortunately, $n = 68$ (89.5%) of children were born in hospitals under qualified medical supervision, and $n = 43$ (56.6%) were full-term gestational age delivered; the difference in distribution is statistically highly significant ($\chi^2 = 30.816$, $P = 0.000$). The children of the study sample were delivered by normal vaginal delivery and by cesarean section in equal percentages ($n = 38$, 50%). Approximately, 46 (60.5%) newborns require admission to a neonatal intensive care unit.

As shown in Table 4, the children with CP who participated in this study were categorized according to physiological and topographical classification of the patients. Among 76 patients, spastic CP was the most common clinical type in the physiological classification of the current study ($n = 55$, 72.4%), and significant differences were found at

Table 2: Study sample distribution based on risk factors associated with neonatal causes of CP with statistically significant comparisons

Natal causes of CP	Classes	No.	%	CS*, P value
Prenatal factors of CP	Nonapplicable	66	86.8	$\chi^2 = 155.263$ $P = 0.000$ (HS)
	Maternal infection during the first and second trimesters (TORCH)	5	6.6	
	Metabolic disorder	2	2.6	
	Genetic syndrome	3	3.9	
Perinatal factors of CP	Nonapplicable	19	25	$\chi^2 = 116.00$ $P = 0.002$ (HS)
	Obstructed labor	4	5.3	
	Antepartum hemorrhage	1	1.3	
	Cord prolapsed	2	2.6	
	Hypoxic-ischemic encephalopathy	36	47.4	
	Severe hypoglycemia	1	1.3	
	Untreated jaundice	12	15.8	
	Severe neonatal infection	1	1.3	
Postnatal factors of CP	Nonapplicable	67	88.2	$\chi^2 = 221.368$ $P = 0.002$ (HS)
	Miscellaneous disorders	2	2.6	
	Meningitis	5	6.6	
	Septicemia	1	1.3	
	Trauma	1	1.3	

CS = comparison significant, HS = highly significant at $P < 0.01$, NS = nonsignificant at $P > 0.05$, S = significant at $P < 0.05$ TORCH = toxoplasmosis, rubella, cytomegalovirus, herpes

*Testing based on one-sample chi-square test and binomial test

Table 3: Distribution of the mother's previous history according to the study sample with statistically significant comparisons

Factors associated with obstetrics information	Classes	No.	%	CS*, P value
Mother's age when married (years)	<15	5	6.6	$\chi^2 = 31.895$ $P = 0.000$ (HS)
	15–19	31	40.8	
	20–24	22	28.9	
	25–29	11	14.5	
	>30	7	9.2	
	Mean $\pm$ SD	20.97 $\pm$ 5.13		
Consanguinity of parents	First degree	27	35.5	$\chi^2 = 30.184$ $P = 0.000$ (HS)
	Second degree	5	6.6	
	There is no consanguinity	44	57.9	
Bleeding during pregnancy (first trimester, second trimester, and third trimester)	No bleeding	62	81.6	$\chi^2 = 132.000$ $P = 0.000$ (HS)
	First trimester	10	13.2	
	Second trimester	2	2.6	
	Third trimester	2	2.6	
Parity	1–2	35	46.1	$\chi^2 = 22.132$ $P = 0.000$ (HS)
	3–4	35	46.1	
	>4	6	7.9	
Mother health during pregnancy	None	53	69.7	$\chi^2 = 5.263$ $P = 0.022$ (S)
	Hypertension	6	7.9	
	Diabetic mellitus	3	3.9	
	Anemia	13	17.1	
	Asthma	1	1.3	
Pregnancy and smoking and passive smoking	Yes	48	63.2	$P = 0.029$ (S)
	No	28	36.8	
Medication during pregnancy (antibiotics, corticosteroid, NSAID)	Yes	30	39.5	$P = 0.085$ (NS)
	No	46	60.5	
Fetal presentation at birth	Cephalic	71	93.4	$\chi^2 = 123.658$ $P = 0.000$ (HS)
	Breech	5	6.6	
Birth trauma	Yes	2	2.6	$P = 0.000$ (HS)
	No	74	97.4	
Delivery mode	Vaginal	38	50	$P = 1.000$ (NS)
	Cesarean section	38	50	
Place of delivery	Hospital	68	89.5	$P = 0.000$ (HS)
	Home	8	10.5	
Gestational age	Full time	43	56.6	$\chi^2 = 30.816$ $P = 0.000$ (HS)
	Preterm	29	38.2	
	Postterm	4	5.3	
Admission to neonatal intensive care unit	Yes	46	60.5	$P = 0.085$ (NS)
	No	30	39.5	

CS = comparison significant, HS = highly significant at $P < 0.01$, NS = nonsignificant at $P > 0.05$, NSAID = non-steroidal anti-inflammatory drug, S = significant at $P < 0.05$, SD = standard deviation

*Testing based on one-sample chi-square test and binomial test

$\chi^2 = 91.895$, $P = 0.000$. In contrast, in the topographic, the quadriplegia type represents more than half of the study sample ($n = 39$, 51.3%).

The primary associated disabilities and problems that CP children complain about were described by their parents or caregivers, as shown in Table 5, which includes visual problems, speech disorders, hearing defects, epilepsy, and other issues. The most frequent visual problems were strabismus, which occurred in $n = 46$, 60.5%, children. Conversely, less than a third of the sample was free from a visual problem ($n = 22$, 28.9%). Speech disorders and communication difficulties have been shown in 40

(52.6%). Epilepsy was observed in only nine (11.8%) of the participants, and three (3.9%) children have a hearing impairment.

DISCUSSION

CP remains a health issue, even though its epidemiology and etiology have been significantly changed in societies with developed healthcare systems. The child's disability frequently causes psychological and social trauma to the parents and the financial burden on the family and society. The current study highlights many aspects and trends in CP. The present study's finding is consistent with other

Table 4: Distribution of the studied sample according to the classification due to child disorders with significant comparisons

Classification due to child disorders	Classes	No.	%	CS*, P value
Physiological classification	Spastic	55	72.4	$\chi^2 = 91.895$ $P = 0.000$ (HS)
	Athetoid	7	9.2	
	Hypotonic	4	5.3	
	Mixed	10	13.2	
Topographic classification	Monoplegia	1	1.3	$\chi^2 = 85.053$ $P = 0.002$ (HS)
	Hemiplegia	5	6.6	
	Diplegia	21	27.6	
	Triplegia	6	7.9	
	Quadriplegia	39	51.3	
	Paraplegia	4	5.3	

CS = comparison significant, HS = highly significant at $P < 0.01$, NS = nonsignificant at $P > 0.05$, S = significant at $P < 0.05$

*Testing based on one-sample chi-square test and binomial test

Table 5: Study sample distribution based on comorbidities of children with CP with significant comparisons

Disorders associated with CP	Classes	No.	%	CS*, P value
Visual disorder	Strabismus	46	60.5	$\chi^2 = 96.763$ $P = 0.000$ (HS)
	Nystagmus	4	5.3	
	Optic atrophy	3	3.9	
	Cataracts	1	1.3	
	None	22	28.9	
Speech disorder	Yes	40	52.6	$P = 0.731$ (NS)
	No	36	47.4	
Hearing impairment	Yes	3	3.9	$P = 0.000$ (HS)
	No	73	96.1	
Epilepsy	Yes	9	11.8	$P = 0.000$ (HS)
	No	67	88.2	

CS = comparison significant, HS = highly significant at $P < 0.01$, NS = nonsignificant at $P > 0.05$, S = significant at $P < 0.05$

*Testing based on one-sample chi-square test and binomial test

research, which found that males are at higher risk of CP than females.^[7] The findings of Makwana *et al.* (2017) was inconsistent with this study in that the highest frequency of the age group was between 2 and 3 years in both genders.^[8] Several recent studies have revealed that the prevalence of CP has been gradually increasing because of an increase in the number of infants with low or very low birth weight.^[9,10] Approximately, 47.3% of the participants in this study had low and very low birth weight, and this can be attributed to many reasons, some of them related to the mother's diseases, for instance, chronic hypertension, anemia, history of previous low weight birth, and educational level, and besides that, the socioeconomic status of the family.^[11] Early diagnosis plays a significant role in treatment and rehabilitation. One issue with very early intervention is the difficulty in diagnosing CP in infants younger than 6 months of age.^[12] The central nervous system has the opportunity to compensate for functional impairment through the first few months of life because of its considerable plasticity. Early rehabilitation will yield faster and more positive outcomes because the child does not yet exhibit many abnormalities and has little experience with abnormal activities.^[13] Our findings show that 64.5% of the babies were diagnosed within the first year of life, which

enhances our knowledge of why early diagnosis is important in rehabilitation. One of the most important risk factors was jaundice at birth. An unanticipated finding was that neonatal jaundice constituted 56.6% of the study sample. A possible explanation for these results may be a lack of ability to diagnose, represented by laboratory materials or deficiency of glucose-6-phosphate dehydrogenase (G6PD) in neonatal^[14] or low birth weight, near term, and delivery by cesarean section.^[15,16] Our findings contradict previous research, which found that 70%–80% of all CP cases occur during pregnancy.^[6] The present study indicates that perinatal events are responsible for about 75% of the causes of CP, and hypoxic-ischemic encephalopathy constitutes 47.4% of the primary reasons. Evidence supports this finding in other studies, which found that CP is highly predicted by hypoxic-ischemic encephalopathy within the perinatal period.^[17,18] The most striking result from the data is the mothers' age at marriage. As illustrated in Table 3, the highest frequency of maternal age when married was the age group of 15–19 years (40.8%). The findings of the current study are consistent with those of Schneider *et al.* (2018), who observed that the prevalence of CP was comprised 19% with a mother aged 35 years or older and 4% with a mother aged less than 20 years.^[19] Consanguineous

marriage is one of the social legacies associated with the prevailing customs and traditions in Arab societies. Several studies have reported an association between consanguineous marriage and CP. A systematic review and meta-analysis by Mushta *et al.* (2022) revealed that 37.7% of the children have CP and are born from consanguine marriages.^[20] Our results were expected and matched those observed in Arab societies (35.5%, $\chi^2 = 30.184$, $P = 0.000$). Children born of multiple pregnancies were significantly more likely to develop CP at term and preterm.^[21] According to our results, in both parity groups 1–2 and 3–4, the majority of mothers of CP children who participated in the survey were multiparous (92.2%), which may explain why these children are at high risk for CP. On the positive side, more than two-thirds of the mothers were healthy.^[22] The present results also support the study of Ren *et al.* (2020) that concluded there is an association between passive smoking and CP.^[23] Macharey *et al.*^[24] found the breech presentation to be a significant risk factor.^[24] Our study found that 6.6% of children with fetal position data have a breech presentation. Meanwhile, cephalic presentation in terms was not associated with a lower risk of CP according to Gray *et al.*^[25] Birth trauma was previously believed to cause approximately 90% of CP cases. At the same time, recent studies have shown no association with birth complications.^[26] Previous studies have reported that emergency C-sections and assisted vaginal labor are significant risk factors for CP.^[27,28] Our finding revealed that no significant differences were observed between the two methods because the outcomes for both modes were equal. On the question of the place of delivery, this study found that hospitals had been the most common place for births, and only 10.5% were delivered at home. These results agree with the findings of other studies, in which hospital deliveries represent the majority of deliveries.^[9,29] Preterm children are 10–50 times more likely than term children to develop CP.^[30] Preterm birth is probably the main factor related to brain deterioration in newborns that causes CP.^[31] Demeši-Drljan *et al.* (2022) concluded that a high risk of CP is associated with premature birth.^[27] The current study found that 29 patients (32.2%) were premature births, which is lower than that found by Krusteva *et al.* (2002) who found that 40.5% of CP cases occur as a result of prematurity,^[32] and Demeši-Drljan *et al.* (2022) found that 54.5% of the study samples were premature.^[27] There are several possible explanations for this result; some of them could be attributed to the difference between countries' CP etiology and obstetric history and management. Furthermore, preterm births in Iraq are caused by a lack of nutrition, infection in the urinary tract, psychological problems such as anxiety, miscarriage, multiple gestations, pet care, hard manual work, and direct abdominal trauma.^[33] More than 60.5% of children were admitted to neonatal intensive care units. This indicates that admission to a neonatal intensive care unit is a significant factor that helps predict neurodevelopmental delay and a greater chance of

survival for neonate.^[9,30] Our study used two kinds of classification for CP physiological and topographical. According to physiological classification, it appears that children with spastic CP made up over two-thirds of the sample, considered the most common type of CP case. A great deal of previous research on this topic has been corroborated by the results of this study, which is consistent with this research.^[27,34] Fetal growth restriction increases the incidence of spastic CP.^[18] The topographical classification shows that quadriplegia represents the majority of the findings in CP children (51.3%), followed by diplegia (27.6%); this is consistent with findings of Mangamba *et al.* (2022) and Makwana *et al.* (2017), which showed that quadriplegia was the most common type of CP (76.75%), followed by diplegia (11.62%).^[8,34] This result is difficult to explain, but there is a possibility that it might be related to the different CP etiologies in different communities and the different sampling techniques. Children with spastic quadriplegia had a higher rate of central nervous system abnormalities than children with diplegia and hemiplegia.^[35] Pediatricians reported problems with vision in only 71% of cases. According to our findings, the majority of children, 60.5%, with visual problems had strabismus. This finding is in agreement with a previous study which shows that 90% of diplegic CP patients had strabismus^[36] and fewer than 10% of children with nystagmus, optic atrophy, and cataracts. Some authors have speculated that strabismus occurs most often in patients with spastic CP and less commonly in athetoid and toxic patients.^[37] In addition to these comorbidities, speech disorders were observed in 52% of the cases. These results relatively correspond with those of Sharma *et al.* (1999), which found that 53.5% of the sample had speech defects.^[38] Among the comorbidities, epilepsy was the most common, and the incidence of epilepsy in CP is around one-third.^[39] This study revealed that 11.8% of children suffer from epilepsy. However, this result is much lower than those that have been previously described in other research.^[8] Our interpretation of this result is, first, the small size of the sample; second, Singhi *et al.* (2003) reported that 60% of seizures started in the first or second year of life, whereas the number of children enrolled in our study who were diagnosed with CP in the first year is six children and in the second year of life is only 16 patients.

CONCLUSIONS

The current study provides an overview of CP's clinical and epidemiological features, reveals several significant findings, and highlights areas for further studies:

1. Evidence from this study suggests that perinatal hypoxic-ischemic encephalopathy was the primary factor causing CP. The incidence of CP can be reduced by improving perinatal care strategies.
2. Most patients were diagnosed before the first year of life, which gave the multidisciplinary team the

opportunity for early intervention and rehabilitation.

- There is a need for more research to gain a better understanding of the disease and its risk factors, strive for early diagnosis, and prioritize perinatal care for effective prevention. We must establish excellent CP registries to generate evidence of CP, epidemiology, and prevention opportunities, and finally, emphasize and improve the quality of life.

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Conflicts of interest

There are no conflicts of interest.

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