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(RESEARCH ARTICLE)

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# Causes, types and clinical outcomes in children with cerebral palsy: A retrospective study

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## Abstract

**Background:** Cerebral palsy (CP) is the most common motor disability in childhood, presenting in diverse clinical forms, including spastic, dyskinetic, ataxic, and mixed types. Understanding its epidemiological patterns, etiological factors, and clinical outcomes is essential for improving management strategies.

**Objectives**: This study examined the demographic profiles, underlying causes, clinical features, and outcomes of CP patients treated at El-Shamal Specialized Hospital between December 2023 and February 2024.

**Methods**: A retrospective analysis was conducted on 45 patients diagnosed with CP. Data were collected on sex, age, residence, etiology, motor subtype, associated impairments (including intellectual disability, speech delay, and epilepsy), severity, and clinical outcomes.

**Results**: Most patients were male (64.4%) and aged 0–5 years (55.6%), with the majority residing in the Northern State (71.1%). Perinatal factors were the leading cause of CP (64.4%), followed by prenatal (20%) and postnatal (15.6%) causes. Spastic CP was the most common subtype (62.2%), followed by hypotonic (15.5%) and dyskinetic (13.3%) types; among dyskinetic cases, dystonic features were more common than athetoid. Ataxic CP was rare (4.4%). Comorbidities were common, including milestone delays (97.8%), speech delays (88.9%), and intellectual disability (84.4%). Epilepsy was present in 26.7% of patients, and no cases of hearing impairment were reported. Regarding severity, 48.9% were classified as severe. Clinical improvement was observed in 57.8% of patients, and no mortality was recorded.

**Conclusion**: The findings reflect global CP patterns while highlighting regional differences, particularly the predominance of perinatal causes and spastic subtypes. The high burden of comorbidities underscores the need for early, multidisciplinary interventions. Further large-scale studies are recommended to validate these findings and guide local management strategies.

**Keywords:** Cerebral Palsy; Motor Disability; Perinatal Factors; Clinical Outcomes.

## 1. Introduction

Cerebral palsy (CP) is the most common physical disability in childhood, with a global prevalence ranging from 1.5 to 4 per 1,000 live births [1]. It is defined as a group of permanent disorders of movement and posture caused by non-progressive disturbances in the developing fetal or infant brain [2]. The clinical spectrum includes spastic (70–80%), dyskinetic (10–15%), ataxic (5%), and mixed types [3], with considerable variation in the severity of motor impairment

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and associated comorbidities such as intellectual disability (30–50%), speech delay (40–60%), and epilepsy (25–45%) [4].

CP can result from prenatal (e.g., congenital infections, genetic disorders), perinatal (e.g., hypoxic-ischemic encephalopathy, prematurity), or postnatal (e.g., meningitis, traumatic brain injury) insults [5]. In low-resource settings, perinatal complications—particularly birth asphyxia and prematurity—account for 50–60% of cases [6], while prenatal factors are more predominant in high-income countries [7].

Despite advances in neonatal care, CP remains a leading cause of childhood disability, with a reported male predominance (male-to-female ratio of 1.2:1) [8]. Early diagnosis and intervention are crucial, as motor and cognitive impairments often persist into adulthood, significantly affecting quality of life [9]. Outcomes vary widely: while some children achieve functional independence, others—particularly those with severe spastic or dyskinetic subtypes—require lifelong care [10].

This study investigates the demographic distribution, etiological patterns, clinical subtypes, and outcomes of CP in a clinical cohort from El-Shamal Specialized Hospital, Northern State, Sudan, along with associated comorbidities. By analyzing these factors, we aim to contribute to a region-specific CP profile that can guide early intervention strategies and inform resource allocation.

## 2. Methodology

### 2.1. Study Design

This study was designed as a retrospective, hospital-based chart review conducted at El-Shamal Specialized Hospital, located in the Northern State, Sudan. The hospital serves as a referral center for pediatric neurological cases across the region. The study covered the period from December 2023 to February 2024, during which medical records of children diagnosed with cerebral palsy (CP) were reviewed. A total of 45 patients who met the eligibility criteria were included in the final analysis.

### 2.2. Inclusion Criteria

Patients were included in the study based on the following criteria:

- A confirmed diagnosis of cerebral palsy, established through comprehensive clinical and neurological evaluations by a pediatrician or neurologist.
- Availability of complete and detailed medical records, allowing for the extraction of all relevant variables.
- Age between 0 and 18 years at the time of diagnosis or treatment.

### 2.3. Exclusion Criteria

Patients were excluded from the study if they met any of the following conditions:

- Incomplete or missing medical records that prevented accurate data analysis.
- A diagnosis of other motor disorders or progressive neurological conditions not classified under cerebral palsy.

### 2.4. Data Collection

Relevant data were systematically extracted from patients' medical records using a pre-designed data collection form. The following variables were recorded:

- Demographic information: age at presentation, sex, and geographic residence.
- Etiological factors: categorized based on the presumed timing of the insult into prenatal (e.g., congenital anomalies, intrauterine infections), perinatal (e.g., birth asphyxia, prematurity), or postnatal (e.g., CNS infections, head trauma).
- Clinical characteristics: including CP subtypes (spastic, dyskinetic, hypotonic, ataxic, and mixed forms) and associated comorbidities such as developmental delays, epilepsy, speech impairment, and intellectual disability.
- Severity classification: categorized as mild, moderate, or severe based on motor function, cognitive ability, and the level of assistance required for daily activities.

- Outcome assessment: based on follow-up notes and clinical progression, outcomes were classified as improved, improving, static, or worsening.

### 2.5. Statistical Analysis

The collected data were entered into a structured database and analyzed using descriptive statistical methods. Categorical variables—such as sex, CP subtype, etiological categories, severity, and outcome—were presented as frequencies and percentages. No inferential statistics were applied due to the observational and descriptive nature of the study, as well as the relatively small sample size. Data were analyzed manually.

### 2.6. Ethical Considerations

Ethical approval was obtained from the administration of El-Shamal Specialized Hospital. Patient confidentiality, anonymity, and data protection were strictly maintained throughout the study.

## 3. Results

This study included 45 patients diagnosed with cerebral palsy (CP), providing insights into their demographic characteristics, etiological factors, clinical subtypes, associated comorbidities, and outcomes, as observed at El-Shamal Specialized Hospital, Northern State, Sudan.

### 3.1. Demographic Profile

A clear male predominance was noted, with 64.4% of patients being male (n = 29), compared to 35.6% female (n = 16), reflecting a male-to-female ratio of approximately 1.8:1 (Figure 1). The majority of cases (55.6%, n = 25) were within the 0–5 years age group, indicating early onset and diagnosis of CP. Children aged 6–10 years comprised 31.1% (n = 14), while those aged 11–15 years and over 15 years accounted for 8.9% (n = 4) and 4.4% (n = 2), respectively (Figure 2). A substantial proportion of the cohort (71.1%, n = 32) resided in the Northern State, consistent with the hospital's catchment area (Figure 3).

### 3.2. Etiological Patterns

Perinatal events were the most common contributors to CP, accounting for 64.4% (n = 29) of cases. These included complications such as birth asphyxia, prematurity, and neonatal infections. Prenatal factors—such as congenital anomalies and intrauterine insults—accounted for 20% (n = 9), while postnatal causes, including central nervous system infections, trauma, and other acquired conditions, were identified in 15.6% (n = 7) (Figure 4).

### 3.3. Clinical Subtypes

Spastic CP was the most frequently encountered subtype, affecting 62.2% (n = 28) of the cohort. Although sub-classification into diplegia, hemiplegia, and quadriplegia was noted, it was not detailed in the current dataset. Hypotonic CP was observed in 15.5% (n = 7), followed by dyskinetic CP in 13.3% (n = 6). Ataxic and mixed types were the least common, each accounting for 4.4% (n = 2) of cases (Figure 5).

### 3.4. Associated Comorbidities

Developmental comorbidities were highly prevalent in the study population. Nearly all patients (97.8%, n = 44) exhibited global developmental delay, with specific speech and communication delays reported in 88.9% (n = 40). Intellectual disability was also common, affecting 84.4% (n = 38). Epilepsy was present in over a quarter of patients (26.7%, n = 12), underscoring the neurological complexity of CP. Interestingly, no cases of hearing impairment were documented, which may reflect either a true absence or possible underassessment (Figure 6).

### 3.5. Severity and Clinical Outcomes

In terms of functional severity, patients were categorized into three groups: severe (48.9%, n = 22), moderate (33.3%, n = 15), and mild (17.8%, n = 8), based on clinical judgment and functional status (Figure 7). With ongoing care and rehabilitation, clinical improvement was observed in 57.8% (n = 26) of cases, primarily in gross motor and communication skills. The remaining 42.2% (n = 19) showed static clinical progress, with no documented regression. Importantly, no mortality was reported during the study period, indicating a relatively stable clinical course for the cohort under review.

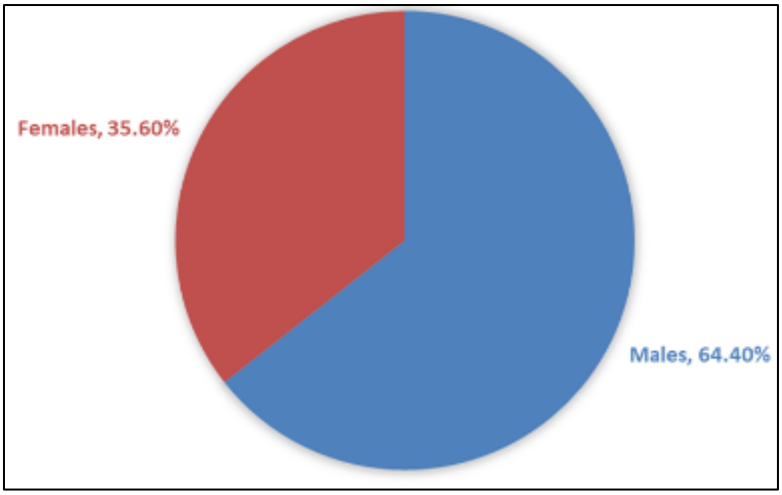


**Figure 1** Distribution of patients according to sex

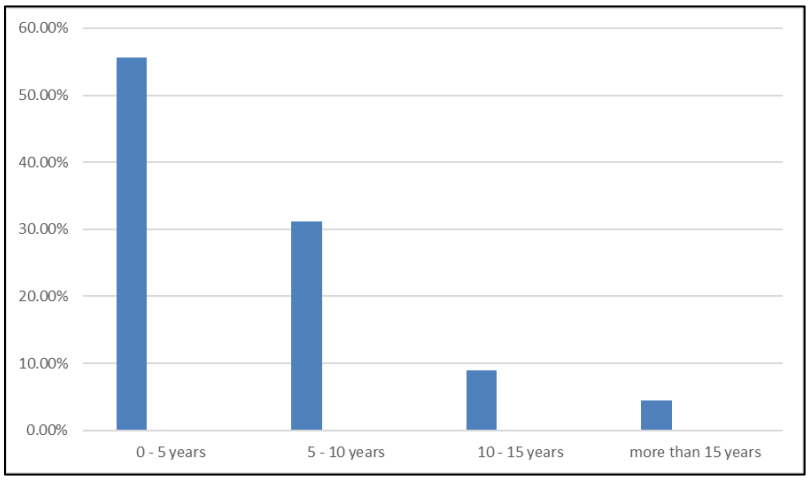


**Figure 2** Distribution of patients according to age

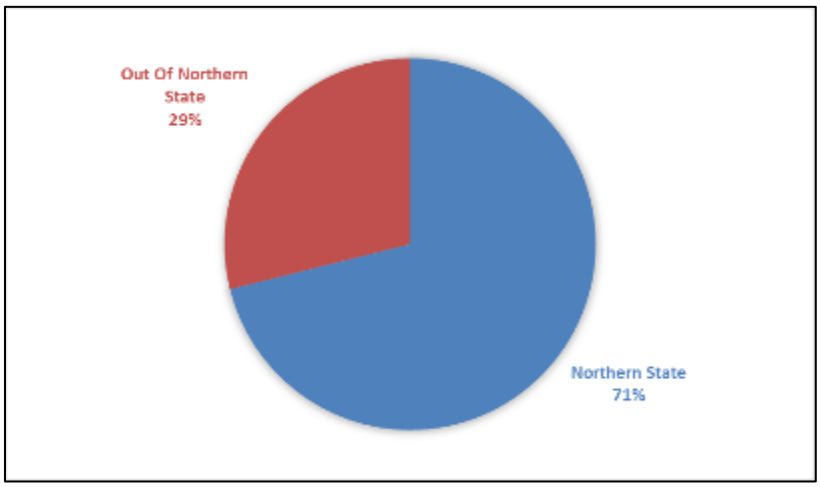


**Figure 3** Distribution of patients according to their residence

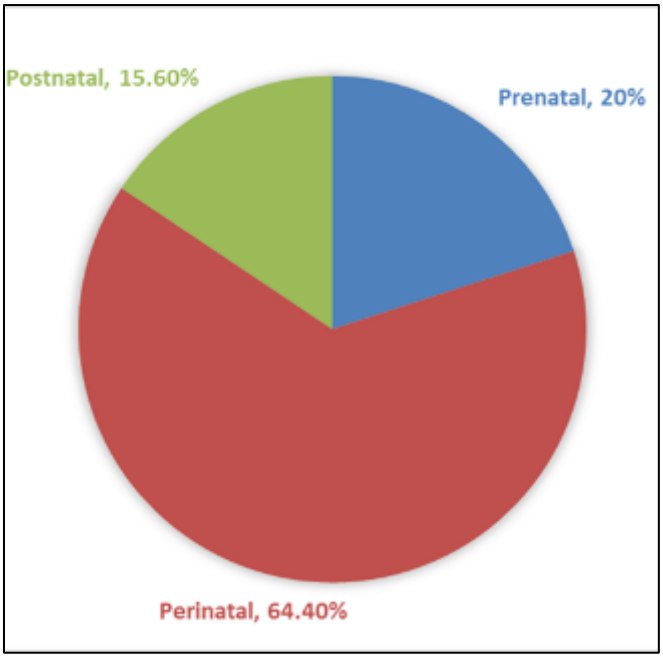


**Figure 4** Distribution of patients according to the etiology

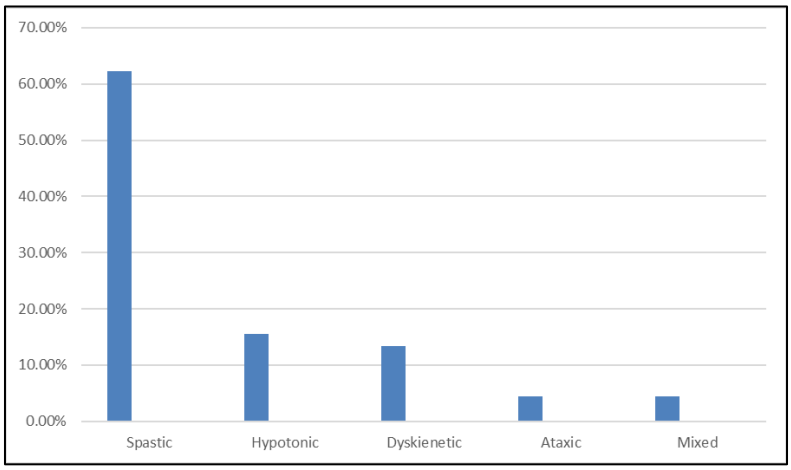


**Figure 5** Distribution of patients according to CP type

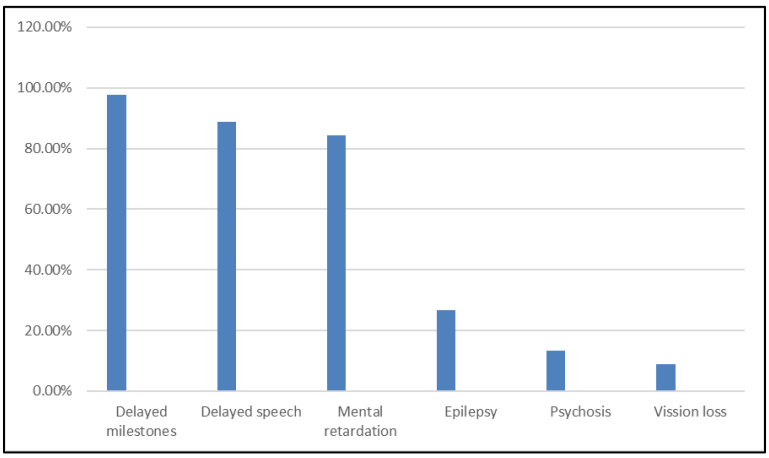


**Figure 6** Distribution of patients according to clinical presentation

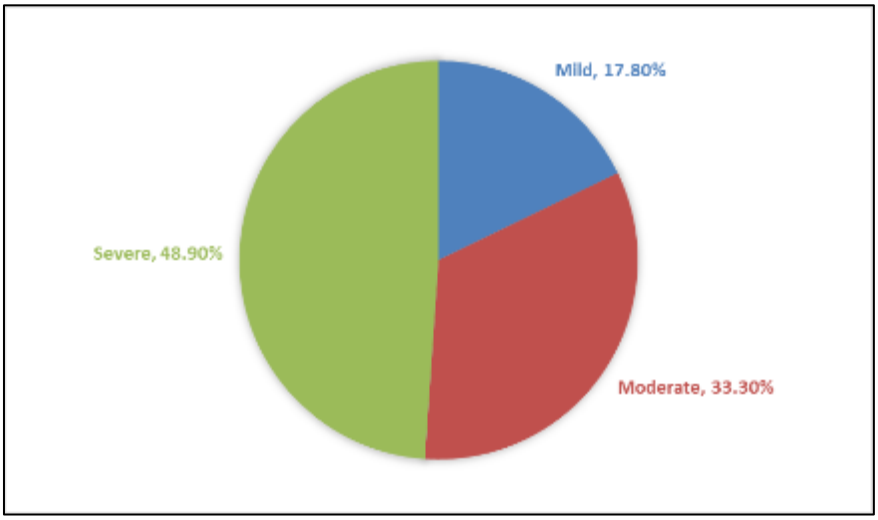


**Figure 7** Distribution of patients according to severity of CP

## 4. Discussion

This retrospective study of 45 patients with cerebral palsy (CP) provides valuable insights into the demographic, etiological, and clinical characteristics of CP within our population. The findings are largely consistent with existing literature and contribute to the growing body of evidence while highlighting areas for further investigation.

### 4.1. Demographic Patterns

The male predominance (64.4%) observed in our cohort aligns with global trends, where CP is reported to be 1.2–1.5 times more common in males [11]. This disparity may be attributed to biological factors, including increased male vulnerability to perinatal brain injury and complications related to preterm birth [12]. The high proportion of patients in the 0–5-year age group (55.6%) reflects typical diagnostic timelines, as motor impairments often become evident in early childhood [13].

### 4.2. Etiological Factors

Perinatal causes accounted for the majority of cases (64.4%), reinforcing existing evidence that this period is the most critical window for CP development [14]. This finding underscores the need for continued improvements in obstetric and neonatal care to reduce CP risk [15]. The prenatal causation rate (20%) is consistent with reports from high-income countries [16], while the relatively low postnatal rate (15.6%) may reflect advancements in post-neonatal care, particularly in preventing infection-related brain injuries [17].

### 4.3. Clinical Characteristics

Spastic CP (62.2%) was the most prevalent subtype, consistent with global data indicating that spastic forms constitute 70–80% of all CP cases [18]. The high prevalence of developmental comorbidities—particularly motor milestone delay (97.8%) and speech delay (88.9%)—highlights the multisystem nature of CP and reinforces the importance of early, multidisciplinary intervention [19]. The absence of hearing impairment in our cohort contrasts with Western studies reporting a 10–20% prevalence [20], possibly due to differences in etiological profiles, small sample size, or limitations in diagnostic assessments.

### 4.4. Severity and Outcomes

Nearly half of the patients (48.9%) had severe CP, which likely reflects the tertiary care setting, where more complex cases are typically managed [21]. The observed improvement rate (57.8%) should be interpreted cautiously due to the subjective nature of retrospective assessments. The absence of mortality aligns with global trends indicating improved survival rates in CP over recent decades [22], although it is important to note that functional outcomes often plateau during adolescence [23].

### 4.5. Limitations

This study has several limitations. Its retrospective design may introduce selection and reporting biases. The relatively small sample size and single-center scope may limit the generalizability of findings to broader populations. Additionally, outcome assessments were based on clinical documentation rather than standardized functional scales, which may affect the reliability and objectivity of reported improvements.

## 5. Conclusion

Our findings reinforce global CP patterns while revealing regional variations, particularly in perinatal causes and spastic subtypes. The high comorbidity burden underscores the need for early, multidisciplinary care. Future larger studies should validate these findings to optimize local management strategies.

### *Recommendations*

**T**o improve outcomes for individuals with cerebral palsy, we recommend enhancing perinatal care, implementing early screening programs, and adopting multidisciplinary rehabilitation approaches. Establishing regional registries would support monitoring trends and optimizing resource allocation. Future research should focus on developing cost-effective, tailored interventions adaptable to diverse healthcare settings.

## Compliance with ethical standards

### *Acknowledgments*

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### *Disclosure of conflict of interest*

No conflict of interest to be disclosed.

### *Statement of informed consent*

Informed consent was obtained from all individual participants included in the study.

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