ORIGINAL ARTICLE

Clinical Subtypes, Etiology and Associated Comorbidities in Children with Cerebral Palsy: A Single Center Experience from Southern Region of Saudi Arabia

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Pak Pediatr J 2026; **50(2-3):** 143-149

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DOI:
https://doi.org/10.66347/ppj.v50i2&3.718

ABSTRACT

Objective: To study cerebral palsy subtypes and associated complications.
Study design: Retrospective cross-sectional study.
Place & duration of study: Study conducted in Pediatric Neurology Department, King Fahad Armed Forces Hospital Southern Region, Khamis Mushait, Kingdom of Saudi Arabia – a tertiary referral center, and utilized record from 1st April 2023 to 31st March 2026.
Methodology: We enrolled patients aged 1 to 14 years of age with cerebral palsy and collected demographic, clinical, imaging data and related comorbidities.
Results: We studied 106 patients of which 55.7% were female and 44.3% were male. 70.75% had spastic cerebral palsy with quadriplegia being the most common subtype. Largest proportion was between 5-10 years (46.2%). Prematurity and hypoxic ischemic encephalopathy (HIE) were frequent diagnoses as seen in 25 cases each (23.58%). 83.96% patients experienced seizures, while intellectual disability was recognized in 75.47%. 66.03% patients were bedridden (GMFCS-V). 85% had MRI findings characterized by global volume loss with structural malformation, while behavioral issues were evident in 30 (28.30%).
Conclusion: Spastic cerebral palsy with quadriplegia is the most common subtype with majority experiencing seizures and intellectual disability, while behavioral issues evident in significant proportion. Prematurity and HIE were the most common cause and periventricular leukomalacia being the common MRI finding.
Key words: *Cerebral palsy, comorbidities, hypoxic ischemic encephalopathy, prematurity, neuroimaging*.

INTRODUCTION

Cerebral palsy (CP) is the most common physical disability in Pediatric population.[1] Cerebral palsy is described as a group of permanent disorder of movement and posture causing activity limitation, that is attributed to non-progressive disturbances in

the developing fetal or infant brain.[2] Cerebral palsy has a worldwide prevalence. Its prevalence varies with 1.5-3/1,000 in developed countries, with higher range of 2-10/1,000 live births in the developing countries.[3] The etiology over the recent ecades has a paradigm shift towards prematurity from birth asphyxia.[4]

Some studies focused on gross motor abilities of child with CP (Gross Motor Function Classification System – GMFCS) and classify them to level I (minimal limitation) to level V (maximal limitation).[5] Some of research showed that spastic hemiplegic subtype was mostly classified in level I & II of the GMFCS, while children with diplegia and quadriplegia subtypes were mostly classified to level IV & V of GMFCF.[6] In addition to motor disorder, various disturbances of sensation, cognition, communication and behavior, as well as varying co-morbidities are usually witnessed in such children.[7]

Our purpose was to study the cerebral palsy subtypes and their severity and to investigate the common associated complications in children living in southern region of Kingdom of Saudi Arabia. Moreover, there is a limited published literature available in regard to the prevalent characteristics of cerebral palsy in Saudi Arabia.

MATERIAL AND METHODS

This study is a retrospective cohort review of electronic medical records of pediatric patients with cerebral palsy (CP) who were under regular follow-up between 1 to 14 years of age and had a diagnosis of cerebral palsy. Data was collected for patients under follow-up in Pediatric Neurology during the preceding 3 years from 1st April 2023 to 31st March 2026 at the Armed Forces Hospitals Southern Region (AFHSR) in Khamis Mushait, Saudi Arabia, which serves as a tertiary referral center. Due permission was sought from local Research Ethics Committee (REC certificate number AFHSRMREC/2025/Department of Pediatrics/803). Informed consent was not required as there were no direct and face-to-face interactions with the study subjects, and no laboratory tests or treatments were involved. Confidentiality was cinched at all tiers and access to the data was limited to the individual institutional investigators and the designated statisticians. Patients with neurodegenerative disorders, CNS tumors, or peripheral nervous system disorders were excluded from the study.

Our study being a retrospective in design, the limitation to data collection was negotiated with thorough examination of medical archives. Detailed information from hospital electronic medical system of such children with cerebral palsy was gathered. The hospital possesses robust information and medical data management systems including archives system that aided in data collection needs for this study. A well-structured data collection proforma was integrated for collecting information on demographic, clinical, and imaging data, including comorbidities such as epilepsy, behavioral issues, cognitive impairment, sleep disorder, visual and hearing impairment, and constipation. The data was analytically evaluated for descriptive statistics, like frequency, mean and standard deviation to outline demographic data, clinical presentations and comorbids. P value ≤0.05 regarded as significant.

RESULTS

The study included 106 patients with cerebral palsy, of which 55.7% were female and 44.3% were male. The majority of patients had spastic cerebral palsy (75 cases signifying 70.75%), with quadriplegia being the most common subtype (58 patients). Hypotonic and ataxic cerebral palsy were less common (16% and 6.6% respectively), while athetoid / extrapyramidal were rare. In terms of age, the largest proportion of patients were between 5-10 years old (46.2%), followed by those between 2-4 years old (33.0%) and those over 10 years old (20.8%). The majority of patients had a gestational age of 34-36 weeks (60.34%) and a birth weight over 2500 grams (73.58%). Only 5.7% of patients had a birth weight less than 1500 grams, and two (1.98%) patients had a gestational age less than 28 weeks or a birth weight less than 1000 grams. Table-I presents the distribution of patients with cerebral palsy based on age, gender, cerebral palsy subtype, gestational age and birth weight.

Table-1: Demographic factors and baseline characteristics of the patients with cerebral palsy (n=106).

Patient's characteristics		No of patients	
		N	%
Age	2-4 years	35	33.00%
	5-10 years	49	46.20%
	> 10 years	22	20.80%
Gender	Female	59	55.70%
	Male	47	44.30%
CP type	A) Spastic	75	70.75%
	1) Quadriplegia	58	54.72%
	2) Hemiplegia	6	5.66%
	3) Diplegia	6	5.66%
	4) Paraplegia	4	3.77%
	B) Hypotonic	17	16.00%
	C) Ataxic	7	6.60%
	D) Athetoid/Extrapyramidal	4	3.77%
	E) Mixed	3	2.80%
Gestational age	< 28 weeks	2	1.89%
	29-31 weeks	8	7.54%
	32-33 weeks	6	5.66%
	34-36 weeks	64	60.34%
	37^{+} weeks	26	24.53%
Birth weight	> 2500 g	78	73.58%
	< 2500 g	20	18.87%
	< 1500 g	6	5.70%
	< 1000 g	2	1.89%

The most frequent diagnoses associated with cerebral palsy were prematurity (23.58%), hypoxic ischemic encephalopathy (HIE) (23.58%), and congenital underlying causes (52.83%). 88 patients were associated with epilepsy (83.0%), and generalized tonic clonic seizures were most common type of seizures, followed by focal seizures (25%), infantile spasms (6.8%) and mixed seizures (6.81%). The age of onset of seizures varied, with the largest percentage of patients (36.36%) experiencing their first seizure between 1-5 years of age. More than half of the patients (70.75%) had spasticity, while quadriplegic CP was most prevalent (77.33%). The majority of patients (86.79%) had global developmental delay in milestones, and 75.5% were delayed in cognition. The 66.03% patients were bedridden (GMFCS-V). Table-II displays the distribution of diagnoses in the study population, along with prevalent seizures.

Table-2: Clinical characteristics of the study population of pediatric patients with cerebral palsy (n=106).

Clinical characteristics		No of patients	
		N	%
IVH	Yes	7	6.60%
	No	99	93.40%
HIE	Yes	25	23.58%
	No	81	76.40%
Prematurity related brain injury (PVL, IVH)	Yes	25	23.58%
	No	81	76.41%
Prenatal or congenital causes		56	52.83%
Seizures	Yes	88	83.00%
	No	18	17.00%
Types of Seizures	GTC	56/88	63.63%
	Infantile spasm	Jun-88	6.80%
	Focal	20/88	25.00%
	Mixed	Jun-88	6.81%
Age of onset of seizures	At birth	14/88	15.96%
	< month	Apr-88	4.54%
	Month to 6 months	17/88	19.31%
	6-12 month	Dec-88	13.63%

	1-5 years	32/88	36.36%
	> 5 years	Sep-88	10.22%

Regarding feeding, 77.4% of patients could eat orally, while 22.6% required gastrostomy feeding. 4.72% required fundoplication. Only a small percentage of patients (5.7%) had gastroesophageal reflux disease (GERD). Regarding vision, 58.5% of patients had normal vision, while 41.5% had abnormal vision. Squint was present in 11.3% of patients. The majority of patients (75.5%) had intellectual disability. In terms of motor movement, the largest proportion of patients (66.0%) were bedridden, followed by those who used a wheelchair (20.8%) and those with normal gait (13.2%). Regarding psychiatric illnesses, 28.3% of patients had behavioral issues, 5.66% had ASD (autism spectrum disorder) and 3.77% had ADHD (attention deficit hyperactivity disorder). Table-III provides insight about the complications and disabilities of the study population with cerebral palsy.

Table-3: Complications / disabilities associated with cerebral palsy (n=106).

Complications / disabilities		No of patients	
		n	%
Feeding			
Oral	Yes	82	77.36%
	No	24	22.64%
Gastrostomy	Yes	23	21.69%
	No	83	78.30%
Fundoplication	Yes	5	4.72%
	No	100	95.28%
Other Complications			
GERD	Yes	6	5.75%
	No	100	94.30%
Vision	Normal	62	58.50%
	Abnormal	44	41.50%
Strabismus	Yes	12	11.30%
	No	94	88.70%
Intellectual disability	Yes	80	75.50%
	No	26	24.50%
Underlying Causes	HIE	25	23.58%
	IVH	5	4.70%
	CNS Infections	8	7.54%
	Neonatal jaundice	6	5.66%
	Hydrocephalus	20	18.86%
	Unknown causes	42	39.62%
Motor Movement	Bed ridden	70	66.00%
	Wheel chair bound	22	20.80%
	Normal gait	14	13.20%
Psychiatric disorders	Behavioral issues	30	28.30%
	ADHD	4	3.77%
	ASD	6	5.66%

Out of 106 patients, MRI brain was performed in 90.57% cases and 10.42% had unremarkable findings. The most common MRI findings were periventricular leukomalacia (18.75%) and encephalomalacia (9.37%), followed by corpus callosum agenesis, IVH and thin corpus callosum. Table-IV provides information on the MRI findings of pediatric patients with cerebral palsy.

Table-4: Findings on MRI Brain in patients of cerebral palsy (n=96).

Findings on MRI Brain	No of patients	
	N	%
Periventricular leukomalacia	18	18.75%
Encephalomalacia	9	9.37%
Corpus callosum agenesis (CCA)	8	8.33%
IVH	7	7.29%
Middle cerebral artery thrombosis / HIE	6	6.25%
Thin Corpus callosum with hydrocephalus	6	6.25%
Basal ganglia calcification	6	6.25%
Lissencephaly	5	5.21%

Arnold Chiari malformation type 1	4	4.16%
Colpocephaly	4	4.16%
Multiple brain abscess	2	2.00%
Semi-lobar Holoprosencephaly	2	2.00%
Demyelination	2	2.00%
Unremarkable	10	10.42%

DISCUSSION

Cerebral palsy (CP) is described as a group of permanent disorder of movement and posture enthralling on a non-progressive damage to the developing brain.[8] Although the initial neuropathologic lesion is non-progressive, such children may acquire quite varying secondary conditions over time with significant limitations in functional abilities.[2] Causes of cerebral palsy include hypoxia ischemic encephalopathy (HIE), complications of prematurity, infections, and genetic abnormalities, all of which interfere with normal brain development and function, resulting in a neurological disease that impairs movement and coordination.[9] Cerebral palsy exhibits a worldwide prevalence with recent trends shifting from birth asphyxia to prematurity related complications.[10] The clinical spectrum of cerebral palsy (CP) can differ in various places depending upon knowledge of the people and available resources for prevention, diagnosis and therapeutics.[7] We carried out this research to compare the trends prevailing in our region against other world territories. Management of cerebral palsy necessitates multidisciplinary integration as it entails various comorbidities including affected vision and hearing, intellectual disability, motor movement issues, feeding difficulties with varying psychiatric illnesses.[11]

HIE and prematurity are leading cause of cerebral palsy. Lack of oxygen and decreased blood flow to the brain results in HIE, which can happen at any time during pregnancy or delivery.[12] White matter damage is linked to impairments in motor functions.[3] In our study group, the most frequent diagnoses associated with cerebral palsy were prematurity (23.58%), hypoxic-ischemic encephalopathy (HIE) (23.58%), and congenital underlying causes (52.83%). Chaudhary et al had reported perinatal asphyxia in 35.45%, prematurity in 20.90%, while 25.45% having postnatal infections as causative entity.[13]

The majority of our patients had spastic cerebral palsy (70.75%), with quadriplegia being the most common subtype (54.7% cases). Hypotonic and ataxic cerebral palsy were less common (16% and 6.6% respectively). Saleh et al have published identical results in Jordan as 74.1% of the children with cerebral palsy were noted to have spasticity.[3] Likewise, Al-Jabri et al while carrying out a study in Jeddah, identified 74.8% had spastic CP subtype and 54.8% having quadriplegia.[2] However, contrary data is reported by Chaudhary et al who identified spastic quadralegia in 44.44% cases.[13]

While many patients do well with oral nutrition, a sizeable number need gastrostomy feeding.[14] Gastrostomy tube feeding was adopted in 22.6% of our patients. It was much less as compared to Al-Jabri et al who fed 44.9% of patients via gastrostomy.[2]

83% of our cases were associated with epilepsy with generalized tonic clonic seizures being most common. Al-Jabri et al found seizures in 68.1%, while Chaudhary et al reported epilepsy in 66.36% patients of cerebral palsy.[2,13] Hollung et al have documented 95% cases of cerebral palsy in Norway have comorbidities.[15]

CP primarily being a clinical diagnosis, magnetic resonance imaging (MRI) is indicated to delineate the extent of brain lesions and to identify any congenital brain malformations.[4] In our study cohort, most common MRI finding was periventricular leukomalacia (18.75%), followed by encephalomalacia, corpus callosum agenesis and IVH. Previous research reporting anomalies in the corpus callosum and structural malformation in children with cerebral palsy is consistent with these findings.[15]

Cerebral palsy frequently occurs alongside intellectual disability as damages to developing brain impact various regions of the brain important for cognitive function. It carries a significant negative influence on patient's quality of life because of impaired communication, learning and

social engagement.[8] Consistent with earlier research, the study indicated that the vast majority of patients had intellectual disability (75.5%). Novak et al, while doing a meta-analysis, documented two in three individuals with cerebral palsy will walk, three in four will talk and one in two will have normal intelligence.[11] Moreover, children with cerebral palsy sometimes experience additional behavioral symptoms like anxiety, hyperactivity, and irritability. Environmental stressors such social isolation, limited mobility, and communication challenges have been postulated towards emergence of behavioral issues.[10] 28.3% of our patients exhibited behavioral issues. This significant prevalence of behavioral problems in such children is consistent with earlier investigations.[11]

Due to the possibility of weak muscles in the gastrointestinal tract, GERD is a common comorbidity in cerebral palsy. In contrary to the higher incidence of GERD reported in previous studies, a small percentage of GERD (5.7%) in our study sample is at odds with those findings.[11]

In conclusion, this analysis emphasizes some key clinical aspects of cerebral palsy. Consistent with previous studies, HIE and complications of prematurity were identified as the leading cause of cerebral palsy. Patients with cerebral palsy were also shown to exhibit a significant prevalence of intellectual disability, which is consistent with earlier research. Although GERD was lower in our study sample, physicians should be mindful of the potential impact of GERD. Consistent with previous findings, MRI revealed brain atrophies and structural malformation anomalies of brain. However, our observations revealed cerebral palsy are disproportionately affected by behavioral issues

CONCLUSION

Children with cerebral palsy bear a considerably higher burden of medical, neurological and behavioural disorders. The findings suggest that spastic cerebral palsy with quadriplegia is the most common subtype, with the majority of patients experiencing seizures and intellectual disability. Prematurity and HIE were the most common cause of cerebral palsy and periventricular leukomalacia was the most common MRI finding. Behavioral issues were evident in significant proportion of our patients. In lieu of continued improving survival for children with extreme prematurity, this information will not only aide healthcare professionals in improving diagnostics and therapeutics, but can steer in planning for dedicated services for individuals with cerebral palsy. Such centres can serve in optimizing infant motor and cognitive plasticity, prevent secondary complications and enhance caregiver well-being.

Source of funding: None
Conflict of interest: None

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Author's Contribution
MS: Writing draft, Critical review and revision the manuscript, Methodology, Data analysis and interpretation.
MNS: Methodology, Data analysis and interpretation.
MHHS: Proofreading, Methodology, critical review.
AMT: Writing draft, data analysis.

All the authors have approved the final manuscript draft and accept the responsibility of research integrity