"A STUDY ON THE PREVELANCE OF SLEEP DISTURBANCES IN CHILDREN WITH CEREBRAL PALSY- A CROSS SECTIONAL STUDY"

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With reference to the above, we wish to inform you that your proposed research project titled **"A STUDY ON THE PREVELANCE OF SLEEP DISTURBANCES IN CHILDREN WITH CEREBRAL PALSY- A CROSS SECTIONAL STUDY",** is ethical and justifiable. The proposed research project has been cleared by the JNMC Institutional Ethics Committee.

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LIST OF ABBREVIATIONS

AASM	–	American Academy of Sleep Medicine's
ANOVA	–	Analysis of Variance
ASM	–	Anti-Seizure Medications
BIND	–	Bilirubin-Induced Neurological Dysfunction
CFCS	–	Communication Function Classification System
CHL	–	Conductive Hearing Loss
CI	–	Confidence Interval
CNS	–	Central Nervous System
CP	–	Cerebral Palsy
CSA	–	Central Sleep Apnoea
CTRI	–	Clinical Trial Registry of India
CVI	–	Cerebral Visual Impairment
DA	–	Disorders of Arousal
DES	–	Disorders of Excessive Somnolence
DIMS	–	Disorders of Initiating and Maintaining Sleep
DREs	–	Digital Rectal Examinations
EDACS	–	Eating and Drinking Ability Classification System
EEG	–	Electroencephalogram
GERD	–	Gastroesophageal Reflux Disease
GMFCS	–	Gross Motor Functional Classification System
GORD	–	Gastro-oesophageal reflux disease
ICSD	–	International Classification of Sleep Disorders
MACS	–	Manual Ability Classification System
MAS	–	Meconium Aspiration Syndrome

MRI	–	Magnetic resonance imaging
NHBI	–	Neonatal Hypoglycemic Brain Injury
NREM	–	Non Rapid Eye Movement
OPD	–	Out Patient Department
OSA	–	Obstructive Sleep Apnoea
PLMD	–	Periodic Limb Movement Disorder
PROM	–	Prolonged Rupture of Membranes
PVL	–	Periventricular Leukomalacia
QoL	–	Quality of Life
REM	–	Rapid Eye Movement
RLS	–	Restless Legs Syndrome
RMD	–	Rhythmic Movement Disorder
SBD	–	Sleep Breathing Disorders
SCPE	–	Surveillance of Cerebral Palsy in Europe
SDs	–	Sleep disturbances
SDSC	–	Sleep Disturbance Scale for Children
SHY	–	Sleep Hyperhidrosis
SNHL	–	Sensorineural Hearing Loss
SPSS	–	Statistical Package for the Social Sciences
SRMDs	–	Sleep-related movement disorders
SWTD	–	Sleep-Wake Transition Disorders
UNCRC	–	United Nations Convention on the Rights of the Child
VFCS	–	Visual Function Classification System

ABSTRACT

"A STUDY ON THE PREVELANCE OF SLEEP DISTURBANCES IN CHILDREN WITH CEREBRAL PALSY-: A CROSS SECTIONAL STUDY"

Background:

Children with Cerebral Palsy (CP) frequently experience sleep disturbances, which can significantly impact their health, cognitive function, and quality of life (QOL). Sleep problems in CP arise due to motor dysfunction, spasticity, pain, comorbidities such as epilepsy and GERD, and environmental factors. Despite the high prevalence of sleep disturbances in CP, limited research has been conducted in India, particularly in rural and mixed-population settings. This study aimed to assess the prevalence and types of sleep disturbances in children with CP and their correlation with functional severity and QOL.

Objectives:

- **Primary Objective:** To study the frequency and types of parent-reported sleep problems in children with CP aged 2–18 years.

- **Secondary Objectives:**

1. To study the factors affecting sleep in children with cerebral palsy and to correlate the severity with the functional classification of children with cerebral palsy.
2. To study the Quality of Life (QOL) of children with cerebral palsy having sleep disturbances.

Methodology:

A cross-sectional study was conducted on 89 children with CP aged 2–18 years, covering both urban and rural populations from June 2023-July 2024 for a period of one year in KLE's Dr Prabhakar Kore hospital, Karnataka. Sleep disturbances were assessed using standardized sleep disturbance scales, and QOL was evaluated using validated measures. Functional severity was classified using GMFCS, VFCS, CFCS, MACS, and EDACS. Statistical analyses, including ANOVA and Chi-square tests, were performed to determine associations between sleep disturbances, functional classifications, and QOL.

Results:

Our study found a high prevalence (86.52%) of sleep disturbances in children with cerebral palsy (CP), with 52.81% experiencing severe to very severe impairment. DIMS (70.71 ± 19.1) was most common, followed by SWTD (69.22 ± 19.36), DA (66.73 ± 19.46), and DES (64.09 ± 16.13). Sleep disturbances were more frequent and severe in higher GMFCS levels, particularly IV & V, who also had lower QoL scores. Dyskinetic CP (41.57%) and quadriparetic CP (79.78%) were most prevalent, with GMFCS V (34.83%) being most common. Mixed CP had the highest sleep disturbance scores (78.63 ± 18.74), and quadriparetic CP had the most severe cases. Hyperactivity (74.2%) was the most common comorbidity, followed by epilepsy (60.7%) and drooling (55.1%). Greater functional limitations in VFCS, EDACS, and manual ability classifications correlated with increased sleep disturbances, negatively impacting all QoL domains. Sleep disturbances strongly correlated with lower QOL, particularly in psychosocial, communication, and emotional domains, with GMFCS IV–V showing the most significant declines (Total QOL ≤ 40, $p < 0.001$).

Conclusion:

This study highlights the high burden of sleep disturbances in children with CP, particularly among those with severe motor, visual, and feeding impairments. The strong association between sleep disturbances, functional severity, and reduced QOL underscores the need for early screening and targeted interventions, including physiotherapy, parental education, and sleep management strategies, to enhance overall well-being in children with CP.

Keywords: Cerebral Palsy, Sleep Disturbances, Functional Classification, Quality of Life, GMFCS, VFCS, CFCS, MACS, EDACS

CONTENTS

LIST OF TABLES

LIST OF FIGURE

INTRODUCTION

Cerebral Palsy(CP) is a 'group of permanent disorders of the development of movement and posture, that cause activity limitation, are attributed to non-progressive insults to the developing foetal or infant brain'[1,2]. The motor disorders are often accompanied by disturbances to sensation, perception, cognition, communication and behaviour caused by epilepsy and by secondary musculoskeletal problems[3]. There are many risk factors for the development of CP including perinatal asphyxia, prematurity, low birthweight, maternal infections, multiple gestation[3]. The pathophysiology is injury to a developing brain from the prenatal period until two years of age.

In addition to the motor and movement dysfunction associated with CP, various comorbidities commonly including intellectual disability and epilepsy, as well as speech delays, hearing defects, visual impairments, behavioural challenges, constipation, gastroesophageal reflux disease, drooling, dental caries and malnutrition are present[4] . These factors together with restricted movement due to contractures, spasticity and its associated pain, contribute to the development of sleep disturbances (SDs) in children with CP[5]. More than one third of CP children experience a pathological sleep pattern[5].

Sleep is a crucial need for development in childhood and adolescence. Appropriate sleep patterns contribute significantly to positive health, immunity, mental health and academic performance[6] . Chronic insufficiencies in sleep are associated with heightened mortality risks and chronic non-communicable diseases[7]. Healthy sleep encompasses adequate duration, timing, regularity and the absence of

sleep disorders with good quality[7]. It is essential for children to gain sufficient sleep to help promote health and wellbeing while supporting their development.

In high income countries, CP birth prevalence has been estimated to be 1.6 per 1000 live births with trends in middle- and low-income areas unable to be accurately concluded[8]. In India, a systematic review and meta-analysis conducted by A. Chauhan has found that the pooled prevalence of CP per 1000 children survived is 2.95[2].

In the general population, there is a 20 – 30% incidence of children without neurodevelopmental disorders experiencing sleep disturbances[10]. There is increased reporting of sleep disturbances and a decline in sleep duration for normal children[9]. This is a concern as sleep is fundamental to wellbeing and healthy neurophysiological functioning. Sleep disturbances in normal children can be caused by developmental changes, medical conditions (allergies, GERD, asthma), behavioural issues (poor sleep habits, anxiety), and environmental factors (screen exposure, noise, inconsistent routines)[74].Sleep problems mostly affect normal children by interfering with their growth and cognitive functions and resulting in behavioural problems.

Children with CP experience a higher prevalence of sleep disturbances, with more than 40% reported to experience sleep problems[1]. Not only can sleep disturbances have negative consequences for children with CP, they can also be a major source of family stress.

Sleep problems in cerebral palsy are due to muscle spasticity, pain, breathing difficulties, and neurological impairments affecting sleep regulation[2]. Poor sleep worsens motor function, cognitive development, behaviour, and overall quality of life. This leads to increased fatigue, irritability, and challenges in daily activities. Primary caregivers of children with CP are often physically challenged and, additionally, may

also face the effects of sleep disturbances experienced by the child. One-third of parents of children with CP feel sleep-deprived as compared to a quarter of parents of typically developing children[14].

Quality of Life (QoL) is lower in children with CP than in normal children. Sleep disturbances further affect QoL, so it is crucial to understand sleep disturbances in detail, which can help in management and improve outcomes for patients and families.

Despite high prevalence of sleep disturbances in CP, there has been only little research conducted in India especially in rural areas. The studies that have been conducted are from different areas of India, mostly including the urban population, but our study caters to a mixed cohort of both urban and rural areas of Karnataka.

This study aims to identify the prevalence of sleep disorders in children with CP and its potential impact on their quality of life. Early interventions and appropriate treatment strategies can help mitigate the significant impact of sleep disturbances in children with CP, ultimately improving their quality of life.

AIMS AND OBJECTIVES

Aim of the Study

To assess the prevalence, types, and impact of sleep disturbances in children with cerebral palsy and their correlation with functional severity and quality of life.

Objective of the study

Primary objective

To study the frequency and types of parents reported sleep problems in children with cerebral palsy aged 2-18 yrs.

Secondary objective

1. To study the factors affecting sleep in children with cerebral palsy and to correlate the severity with the functional classification of children with cerebral palsy.
2. To study the Quality of Life (QOL) of children with cerebral palsy having sleep disturbances.

REVIEW OF LITERATURE

Cerebral Palsy

Cerebral Palsy (CP) is a neurological disorder that affects movement, muscle tone and posture development[3]. The etiology of CP stems from developing brain injury in the prenatal to neonatal age period[3]. The initial pathological lesion is non-progressive and children may develop secondary conditions and comorbidities with age[3].

Western World accepts any definition of CP which includes following 5 key elements[3]:

1. CP is an umbrella-term for a group of disorders; with static insult
2. CP is permanent, but not unchanging;
3. It arises in the immature/developing brain
4. It is a disorder of movement and/or posture and also of motor function;
5. It results from a non-progressive lesion/abnormality/interference;

The etiology of CP can stem from three main phases in development:

1. Prenatal causes including maternal factors, polyhydramnios, multiple gestations, cerebral dysgenesis, intrauterine infections, intrauterine growth restriction, intrauterine stroke, chromosomal abnormalities, second or third trimester bleeding, toxaemia[17].
2. Perinatal causes including prematurity, low birth weight, multiple births, meconium aspiration, breech, instrumental deliveries, PVL, perinatal stroke, CNS infections, kernicterus, metabolic abnormalities and hypoxic-ischemic

insults such as uterine rupture, placental abruption, cord prolapse, congenital heart disease, stroke[17].

3. Postnatal causes including traumatic brain injury, CNS infections such as meningitis, seizures, hypoglycaemia, respiratory distress syndrome, anoxic insults[17].

There is a heterogeneity in risk factors. A major risk factor for CP is prematurity with shorter pregnancy duration correlating to more severe neurodevelopmental disorders[18]. Furthermore, consanguinity is a risk factor for congenital disability and genetic disorders[19].

Brain asphyxia or an interruption of oxygen supply to the foetus is considered the main factor leading to CP[16]. Periventricular leukomalacia (PVL) is the most common cause of spastic quadriplegia which is present in 20% of children with CP[3].

Congenital malformations leading to CP are considered significantly rarer than environmental causes of CP[16]. White matter in preterm infants whereas grey matter and the brainstem in full-term newborns are mostly injured in those time frames[16].

Classifications of Cerebral Palsy

Cerebral Palsy is commonly classified based on the physiologic type into dyskinetic, spastic, hypotonic, ataxic, and mixed (spastic and dyskinetic) types based on the predominant quality of motor impairment. The topographical classification based on the distribution of involved limbs stratifies CP into quadriplegic (all 4 limbs involved with or without asymmetry), diplegic (both lower limbs affected without appreciable upper limb affection), hemiplegic (one side of the body affected with some difference in upper limb and lower limb permitted) and mono or triplegic involvement of limbs[12].

Physiological Classification

The physiological classification of patients with CP is crucial for management and is typically dependent on the cause and areas of brain damage.

According to the Surveillance for Cerebral Palsy in Europe (SCPE) the CP subtypes are:

I. Spastic Cerebral Palsy - characterized by minimum two of the three:

- Abnormal posture and/or movement pattern
- Hypertonia (need not necessarily be present constantly)
- Pathological reflexes (hyper-reflexia or pyramidal signs such as a Babinski response) It may be bilateral or unilateral (hemiplegia)

Though spastic CP is the predominant type in the Western world due to the high prevalence of prematurity, research conducted by Kamate and Detroja indicates that dyskinetic CP is more common in India, primarily due to perinatal asphyxia, hyperbilirubinemia, and infections[22].

The spastic classification of CP involves tightness and muscle stiffness[22]. It describes increased resistance to muscle stretch or with inappropriate involuntary muscle activity associated with upper motor neuron paralysis[23]. Contractures including shortening and stiffness of tissues leads to stretch resistance and prevention of normal movements[23].

II. Ataxic Cerebral Palsy is by both of

- Abnormal pattern of posture and/or movement
- Loss of orderly muscular co-ordination, so that movements are performed with abnormal force, rhythm and accuracy

Hypotonia results from poor muscle tone which leads to floppiness, it causes decreased resistance with passive joint movement[28]. Generalised hypotonia may present in infants with periventricular leukomalacia (PVL) and it gradually changes into hypertonia mainly in extremities[28].

Ataxic-hypotonic CP describes ataxia and/or hypotonia as the motor manifestation[29].

III. Dyskinesic Cerebral Palsy - which is characterised by both of

- Abnormal pattern of body posture and/or movement
- Involuntary, recurring, uncontrolled and occasionally stereotyped movements occurring in affected body parts

Dyskinesic Cerebral Palsy is classified as follows:

1) Dystonic Cerebral Palsy which is characterized by hypokinesia and hypertonia.

2) Choreo-athetotic Cerebral Palsy, which is characterized by hyperkinesia and hypotonia.

Dyskinetic CP is the next common type of CP following spastic. This is typically caused by non-progressive lesions to basal ganglia or thalamus and leads to abnormal postures or with impaired tone regulation[24]. Dyskinetic CP is the most common physiological type of CP present in India and is typically due to birth-asphyxia, hyperbilirubinemia, hypoglycaemia and infections[22].

In a study done by Detroja and Kamate, the majority of the 103 children [54 (52.4%)] were dyskinetic, followed by 30 (29.1%) with spastic CP and 19 (18.4%) with mixed (dyskinetic and spastic) CP[22].

Dystonia describes fluctuating hypertonia and involuntary movements and postures[25]. This can interfere with motor function, comfort and caregiving[25]. Dystonia rather than choreoathetosis has a higher impact on functional abilities[26]. Choreoathetosis describes rapid or slow involuntary movement of fingers or toes in irregular, nonrhythmic and purposeless motions[27].

IV. Mixed cerebral palsy :

Mixed CP is a physiological classification given to patients when no one type of tone dominates in a child[22].

Topographical Classification

Topographical classification of CP include quadriplegia or tetraplegia, diplegia and hemiplegia. Monoplegia and triplegia is also employed to describe one or three limb involvement[30].

Topographical classification allows CP to be classified into subtypes depending on neurological problems. Quadriplegia or tetraplegia refers to both arms and legs being affected as well as potentially the trunk, face and mouth[31]. Triplegia refers to three affected limbs and diplegia to both legs but to a lesser extent, the arms[31]. Hemiplegia refers to one side of the body being affected by CP[31].

Functional Classification :

Functional Classifications of CP stratify individuals with CP into five categories ranging from level I (most able) to level V (least able). The Gross Motor Function Classification System (GMFCS) is based on the self-initiated ambulatory function and the need for appliances to assist in mobility[13]. The MACS (Manual Ability Classification System) assesses the bimanual performance in activities of daily

living and the need for assistance or adaptation. The capacity to communicate as a sender and/or receiver with familiar and new surroundings forms the basis of the Communication Function Classification System (CFCS). The EDACS (Eating and Drinking Ability Classification System) evaluates efficiency (amount of food spilled and time taken to consume) in addition to safety for eating and drinking (aspiration and choking). A three-point ordinal scale that measures how much help a person requires is added by the EDACS: either independent, in need of help, or reliant on others to eat and drink[14]. Based on visual adaptations and compensating techniques, the Visual Function Classification System (VFCS) evaluates visual capacity[15].

Functional classification of CP assesses mobility, motor function, and activity limitations, helping in treatment planning and personalized interventions. It aids in predicting future needs, setting realistic goals, and improving overall care and support[89].

Gross Motor Functional Classification System

The Gross Motor Function Classification System (GMFCS) is utilised to classify children with CP according to five levels. This classification system's use has been shown globally with numerous studies to establish its validity and reliability[32]. The GMFCS proves beneficial for physicians in physical examinations and extends further to aiding prognosis, intervention and outcome decisions with patients[32].

This classification is based on the patient's daily performance rather than their optimal capacity. It is focussed on self-initiated movement and allows medical practitioners to distinguish between children diagnosed with CP as accounting for the large variability in movement[33].

Children classified at level I can complete typical expected activities at their age level, however, will face challenges with speed, balance and coordination[34]. At the other end, level V children with CP experience difficulty with posture and voluntary movement control[34].

A study has identified that a correlation exists between GMFCS level and QoL of both patients and their mothers[32]. Additionally, this scale provides aid to the need for assistance and physiotherapy in treatment.

Ultimately, the GMFCS is one of the primary classification methods employed by clinicians in determining functional levels in children with CP proving benefit in both research and clinical settings.

Manual Ability Classification System

The Manual Ability Classification System (MACS) was created to distinguish between a child with CP's use of their hands to handle objects in everyday tasks[36]. Similar to the GMFCS, the MACS relies on daily maneuvers rather than their maximal capacity.

It is focussed on age-appropriate activities such as self-feeding, dressing, writing, typing rather than specialised skills[36]. The MACS does not rely on gross motor function with objects being in reach and distinctions being made according to the quantity and quality of performance as well as assistance required[36].

Describing the movement and performance of the upper-extremity is separated into five levels of descriptors with level I showing ease in handling objects. Level V describes the inability to handle objects and with extremely limited ability to complete simple actions[37].

Eating and Drinking Ability Classification System

Children with CP have an estimated 85% prevalence of difficulties with eating and drinking[38]. This classification system allows clinicians and researchers to aptly define the abilities of patients for analysis and outcome identification. Children are classified on a scale of I to V with Levels III to V having an increased risk of aspiration[39].

This scale accounts for safety and efficiency which is assessed by time taken and loss of fluid and food from the mouth[40]. It is complementary to both the GMFCS and MACS.

Eating and drinking abilities can be correlated with insufficient nutrition and hydration as well as aspiration of fluid or food into the lungs[40].

Communication Function Classification System

Communication is a multifactorial skill that involves the rater to understand the patient's communication with both new and usual communication partners[41]. Communication is used to describe the transmission of a message from the sender to a receiver who can understand the message.

For the Communication Function Classification System (CFCS), all modes of communication are utilised including speech, facial expressions, behaviours, etc[41]. Levels I to V are used to describe the child's ability to communicate. Level V is the most severe classification which is used in the context of "seldom effective sender and receiver even with familiar partners"[41].

This classification cannot be utilised to describe any underlying causes of the impaired speech and communication. It proves beneficial in both research and clinical settings.

Visual Function Classification System

The Visual Function Classification System (VFCS) allows clinicians and researchers to identify children with CP's visual abilities. In a research capacity, it can be utilised to form classifications of patients and interpret information. Whereas on a clinical level it can be crucial in identifying a child's current position and future needs.

It has been estimated that up to 50% of children living with CP experience varying degrees of visual impairment[42]. This can be a consequence of a myriad of factors such as brain damage, involvement of peripheral visual structures or more[42].

Mirroring the previous classification systems, the VFCS utilises a five-level classification system. Level I is used to describe a positive measure of visual ability with success in activities utilizing vision. On the other end, Level V describes severe limitations in vision related activities and is often accompanied by the use of the other senses to compensate[42].

Prior to this scale, this element of neurodisabilities including CP has been overlooked to focus more on the associated motor aspect[43]. The VFCS again focuses solely on ability rather than performance and is not to be used as an assessment tool for such conditions but rather as a classification system.

Comorbidities of Cerebral Palsy

There are several comorbidities that can affect the day to day life of children suffering from CP. Each comorbidity can vary in severity and in the impact on the quality of life for all individuals. In patients with CP, the risk of disorders including behavioural, neurological and medical are higher than the extended population[44]. There exist three categories of comorbidities experienced by children living with CP including co-causal, complications of CP itself and co-occurring conditions[44].

Table 1: Classification of Comorbidities in Cerebral Palsy

Category	Description	Examples
Co-causal Comorbidities	Conditions that share a common cause with CP	Preterm birth, Perinatal brain injury, Hypoxia
Complications of CP Itself	Secondary conditions resulting from CP	Muscle contractures, Hip dislocation, Scoliosis, Spasticity, Chronic pain
Co-occurring Conditions	Unrelated conditions that frequently occur with CP	Epilepsy, Sleep disorders, Autism spectrum disorder, Intellectual disability, Vision and hearing, impairments

Epilepsy

Epilepsy is a neurological condition in which there is a predisposition to epileptic seizures with unprovoked seizures and a high risk of future occurrences[20]. Epilepsy is a clinical diagnosis with 0.4 to 0.8% prevalence in the general public whereas in children with CP, the incidence is estimated to be 35% to 41% making it a greatly higher percentage incidence than those who do not suffer from CP[45].

Children with CP who experienced neonatal seizures or during the first year of life, a family history, low birth weight and severe CP have a higher risk of epilepsy[46]. According to K A et al., among children with cerebral palsy (CP) and epilepsy, generalized seizures were the most common seizure type, with a particularly higher prevalence in those with spastic quadriplegia.

Additionally, the study reported that nearly two-thirds of children with CP and epilepsy experienced multiple seizure types, highlighting the complex nature of epilepsy in this population[46].

Epilepsy in this cohort is early-onset and is mainly drug-resistant[46]. Such patients with epilepsy experience higher rates of status epilepticus, a syndrome in which there is ongoing jerking of a body part over an extended period of time[47].

The pathophysiology of epilepsy aligns with that of CP with diffuse brain injuries more likely to cause spastic quadriplegia and epilepsy[20]. Injuries occurring in earlier pregnancy can cause a more severe form of epilepsy. Dystonia and involuntary movements that are clinical features of CP may be mistaken as seizures and hence the evaluation and assessment of epilepsy must be completed with care[20].

According to Patil P and Weber ARB, injuries occurring earlier in pregnancy are associated with more severe forms of epilepsy in children with cerebral palsy (CP). Additionally, the study emphasizes that up to 50% of children with CP and epilepsy may have drug-resistant epilepsy, making accurate diagnosis and tailored management crucial. Furthermore, dystonia and involuntary movements, which are common clinical features of CP, can be mistaken for seizures, underscoring the need for careful evaluation and assessment of epilepsy in this population[20].

Cerebral Visual Impairment

Cerebral Visual Impairment (CVI) is a comorbidity of CP that is cognitive-perceptual dysfunction with a range of clinical manifestations[48]. Both CVI and CP have common pathophysiology for development including hypoxic ischemic encephalopathy and neonatal hypoglycaemia[48].

Insults to the retrogeniculate visual pathway and visual association areas have been described to result in CVI[48]. New research has added that a retrograde trans-synaptic degradation of retinal ganglion cells also results in optic nerve abnormalities[48].

This comorbidity is related to the location of both motor and visual pathways being anatomically close meaning that lesions can impact both pathways as seen in patients with CP[49].

According to Philip SS et al., PVL is present in a significant portion of cases with CVI in children with CP which is strongly associated with damage to the posterior visual pathways, including the optic radiations and occipital cortex. The study highlights that periventricular leukomalacia (PVL) is the most frequently reported brain injury linked to CVI, but other structural abnormalities, such as basal ganglia and thalamic lesions, also contribute to visual dysfunction[50].

The incidence of CVI in children with CP is approximately 60 to 70% making it a common comorbidity experienced by a large proportion of patients[51]. CVI can also contribute to further delays in development for the child with CP[51].

Hearing Defects

Hearing defects are faced by a large percentage of children living with CP[52]. The presence of other comorbidities including intellectual disability, quadriplegia and epilepsy correlated to an increased severity in hearing loss[52].

It has been stated that sensorineural hearing loss (SNHL) is related to asphyxia or neonatal hyperbilirubinemia[53].

According to Sano M et al., in children with CP, the severity of sensorineural hearing loss (SNHL) is linked to kernicterus-related brain damage, particularly in the brainstem's auditory pathways. The study emphasizes that bilateral SNHL is more common in those with severe neonatal jaundice, highlighting the need for early audiological screening in high-risk infants[53].

Sensorineural hearing loss refers to a hearing defect resulting from pathology of the auditory nerve, the central nervous system (CNS) or the cochlea[54]. It is the result of damage to the vestibulocochlear nerve, processing centres in the brain or within the inner ear[54].

Conductive hearing loss (CHL) is the presentation in children with CP where a disruption through the outer and middle ear occurs resulting in a disturbance prior to the sound conduction to the inner ear receptors and cochlea[55].

However, the location of the lesion eventuating in hearing loss has yet to be reliably established[53].

Hyperactivity

Systematic reviews have shown that individuals with CP face increased rates of emotional lability, irritability and behavioural problems[56].

Emotional, peer, social, attentional and dissocial problems have been reported with higher incidences in children with CP continuing on into adulthood[57]. Such psychological problems have been shown to impact parental stress and patient QOL[57].

Clinical and epidemiological studies have shown that hyperactivity has a higher incidence in children with CP as compared to those without[60].

Constipation

In children with neurological conditions, the severity of dysfunction has been associated with increased risk of gastrointestinal problems[61]. Constipation can present as reduced defecation, stool retention, pain with defecation and hard stools which can affect appetite and QOL for children[61].

According to Imanieh MH et al., untreated constipation in children with CP can lead to complications like fecal impaction and increased discomfort, emphasizing the need for early intervention and tailored treatment approaches[61].

The prevalence of constipation among children with CP has been estimated to range from 26% to 74% with differences in the definition and clinical criteria[62]. According to Veugelers R et al., damage to the central nervous system (CNS) such as that present with CP is a risk factor for constipation[62]. This further suggests that neural modulation of colonic motility has some disruptions that contribute to the development of constipation[62]. The detection of constipation in children with severe

disabilities is challenging as they may require nappies, may not be toilet trained and digital rectal examinations (DREs) may be invasive[62].

Drooling

The secretion of saliva is controlled by the autonomic nervous system. Drooling of saliva is typically considered abnormal over the age of 4, however, in children with CP it has a higher occurrence[63]. Sialorrhea may be a result of neurodevelopmental delays which can affect tongue suction, swallowing and lip closure[63]. It has further been hypothesised that there is increased salivary secretion in children who present with dyskinetic CP due to increased oral movements and salivary glands stimulation[63].

Salivary control is typically anterior leading to drooling whereas posterior issues can cause coughing and an increased risk of aspiration[64]. Particular medications used in the management of CP can also result in hypersialia which can contribute to drooling experienced by children with CP[64].

Chronic drooling experienced by some children can cause further challenges including dehydration and skin irritation[21]. Management of drooling is crucial to reducing hygiene challenges, improving self-esteem and alleviating stress[64].

Gastroesophageal Reflux Disease

Gastroesophageal reflux disease (GERD) has a high incidence in patients with CP for a range of reasons related to the decreased motor capacities of children and to medications taken for other comorbidities such as anticonvulsants[65]. Patients with CP often have a chronic supine position, have displaced stomachs from scoliosis and due to spasticity can have raised intra-abdominal pressure[65].

According to Fernando T and Goldman RD, persistent GERD in children with CP can lead to complications like esophagitis, aspiration pneumonia, and failure to thrive, highlighting the need for early diagnosis and appropriate management[65].

Dental Caries

The neuromuscular challenges associated with CP can impact oral hygiene and individuals with CP may face challenges with accessing oral care. One study has identified that children with CP showed higher rates of untreated decay as compared to children with no disabilities[66].

Oral hygiene is typically attributed to dental caries in individuals with CP as paired with increased rates of orofacial motor dysfunction[66]. This can lead to increased dental biofilm formation and retention in children suffering from CP[66].

According to Akhter R et al., the correlation between GMFCS severity and dental caries remains unclear, but poor oral hygiene, dietary factors, and feeding difficulties significantly increase the risk of dental caries in children with CP[66].

Another factor influencing oral hygiene is the child's dependence on a caregiver to complete daily activities including maintaining oral hygiene and eating patterns[67]. Morbidities from oral hygiene can affect the child's QOL.

Furthermore, the high burden of dental caries in low- and middle-income countries may be attributed to limited access, socioeconomic status and education[67].

As a result of reduced manual dexterity, 73.1% of children with CP relied on caregivers for oral hygiene maintenance[68]. It is essential to understand the needs and barriers faced by children with disabilities to help provide preventative and therapeutic treatment[67].

Malnutrition

Due to feeding difficulties experienced by children with CP, malnutrition presents with an increased risk. With increased incidences of gastrointestinal issues, children with CP must be detected earlier to alleviate pressure on nutritional status[69].

More severe neurological dysfunction is associated with increased risk of malnutrition as is lower intelligence quotients[69]. Growth failure is the biggest consequence of malnutrition as followers by decreased cerebral function and potential for impaired immune function, impaired circulation and diminished respiratory muscle[69].

The wellbeing of children with CP is also associated with nutritional content. Decreased nutrition has vast impacts on the body including motor, neurological and psychological function. It can also predispose individuals to congestive heart failure and increase susceptibility to infection[70]. Furthermore, malnutrition as a comorbidity further contributes to the presence of gastroesophageal reflux, impaired wound healing and immunity[70].

This comorbidity can lead to poor prognosis and to increased mortality in children with CP[71].

According to da Silva DCG et al., malnutrition in children with CP is strongly associated with feeding difficulties, impacting growth, immune function, and overall health, highlighting the need for early nutritional assessment and intervention[71].

Sleep

Children with cerebral palsy (CP) are particularly vulnerable to sleep disturbances. Dutt et al. Reviewed current evidence indicating that children with CP

frequently experience insomnia, fragmented sleep, and breathing difficulties, further affecting their quality of life. Environmental modifications and non-pharmacological interventions, such as optimizing sleeping positions and improving bedroom environments, can help mitigate these sleep issues[9]. Addressing sleep disorders in this population is crucial for improving both their physical health and daily functioning.

Parents of children with CP also experience significant sleep disturbances, as caregiving demands often disrupt their sleep cycles. Hulst et al. Found that the sleep problems of these children are strongly correlated with parental stress and fatigue, which can negatively impact overall family well-being[14]. Comprehensive management strategies, including caregiver support and structured sleep interventions, are essential to improving sleep quality for both children and their parents.

Diagnosis and Management

Cerebral palsy diagnosis employs primarily clinical assessment. The treatment of CP must be approached by a multidisciplinary team as there are many associated medical conditions.

Magnetic resonance imaging (MRI), neuromotor assessment and clinical history can be used in combination to diagnose CP at an earlier stage[3]. However, CP diagnosis can occur reliably at the age of 2. MRI can be utilised to examine the extent of brain lesions as well as congenital brain malformations[3].

Normal Sleep

Sleep is defined "as a reversible behavioural state of decreased responsiveness and interaction with the environment"[72]. Infants and younger children sleep for longer

periods of time which suggests that sleep is essential for developing the brain and body[72].

Sleep architecture explains the structural organisation of normal sleep and involves two types: non rapid eye movement (NREM) and rapid eye movement (REM) sleep[73]. These two stages referred to as the ultradian process of the sleep cycle throughout the night. NREM sleep is further classified into four stages.

Stage one of NREM is a transitional stage and typically marks the start of the sleep episode[73]. Stage two sleep involves relatively low-voltage, mixed frequency EEG activity and it constitutes 45 to 55% of the total sleep episode[73]. Stages three and four are called the slow-wave sleep and involves high-voltage, slow-wave activity on EEG[73].

REM sleep involves desynchronised brain wave activity with muscle atonia and bursts of rapid eye movements[73]. Dreaming is associated with this sleep stage and involves loss of muscle tone. During sleep, there are also other physiological changes including cardiovascular, sympathetic nerve activity, respiratory, cerebral blood flow, renal and endocrine[73]. Sleep and wakefulness are regulated by two main processes being the circadian process and the homeostatic process[72]. The circadian process describes an internal clock which incorporates the external environment to regulate timings of sleep based on the light-dark cycle[72]. The homeostatic process drives the body to sleep[72].

Newborns do not have a circadian rhythm but it begins to develop around 10 – 12 weeks of age[74]. Sleep-wake patterns are driven by an interplay of biological processes and environmental, behavioural and social factors[74]. Between 1 to 12 months, the circadian and ultradian processes mature[74]. Optimal sleep is crucial for

growth, development, psychological health and immune function[74]. It is a period of neurological and physiological activity with higher cortical functions[74].

Sleep Disturbances

Sleep disturbances in children and adolescents encompass a range of conditions that impact sleep quality and overall well-being. Common sleep disturbances include disorders of initiating and maintaining sleep, sleep-related breathing disorders, disorders of arousal (such as nightmares), sleep-wake transition disorders, disorders of excessive somnolence, and sleep hyperhidrosis. These disturbances can significantly affect cognitive development, behaviour, and daily functioning.

AASM International Classification of Sleep Disorders - Third Edition, Text Revision (ICSD-3-TR) [59]

1. Insomnia Disorders
2. Sleep-Related Breathing Disorders
3. Central Disorders of Hypersomnolence
4. Circadian Rhythm Sleep-Wake Disorders
5. Parasomnias
6. Sleep-Related Movement Disorders
7. Other specified sleep-wake disorders

This classification provides a structured approach for diagnosing and managing sleep disturbances, helping to implement early interventions and improve the quality of life in affected individuals[59,60].

Insomnia Disorders (Disorders of Initiation and Maintenance of Sleep)

Disorders of initiating and maintaining sleep (DIMS) are frequently associated with insomnias. This category is affected by the ability to remain asleep for a desired time frame, perception of sleep quality and tolerance to environmental factors[76]. Insomnia is associated with the persistent inability to fall asleep or stay asleep.

DIMS involve difficulties in falling asleep and staying asleep more commonly referred to as insomnia[1]. DIMS is either viewed as a problem by the child or caregiver. Spastic quadriplegia and dystonic / dyskinetic classifications of CP are associated with DIMS strongly[15].

Sleep-related breathing disorders (Disruptions in breathing patterns during sleep)

Sleep breathing disorders (SBD) refers to the disruption of usual respiratory patterns and ventilations during periods of sleep[77]. Sleep Breathing Disorders (SBD) are a result of impaired respiratory control with compromised ventilatory and resistive loading[78]. It is a spectrum of conditions that include obstructive sleep apnoea (OSA), hypoventilation and central sleep apnea (CSA)[78]. SBD are categorised through four classifications of increasing severity with the first being primary snoring, followed by upper airway respiratory resistance syndrome, hypoventilation and the most severe being OSA[79].

For patients with CP, structural and functional factors can increase risk of airway obstruction and the subsequent development of SBD[80]. Such examples include adenotonsillar hypertrophy, laryngeal dystonia, hypotonia of palate and constrictor muscle, maxillary hypoplasia and additionally GORD leading to inflammation[80].

Additionally, further predispositions for children with CP result from impaired neuromuscular control of upper airway, lung aspiration, joint contracture and scoliosis and postural disorders resulting from spasticity[80].

Obstructive sleep apnea (OSA) that is chronic and unchecked can lead to metabolic disorders, obesity, cardiovascular disease, hypertension and further developmental disorders. During sleep in patients with OSA, airflow is severely reduced and in some cases blocked leading to reduced sleep quality[77]. OSA can further cause hypertension, increased risk of cardiovascular disease, metabolic disorders, obesity and more[77]. CP increases OSA risk because of palatopharyngeal incoordination and is also a major clinical concern in obese patients[79]. The presence of SBD can impair development or cause an exacerbation of existing chronic diseases[77]. It can also extend to be a major stress source for both children and their families.

Hypersomnolence disorders (Excessive daytime sleepiness despite adequate sleep duration)

Disorders of excessive somnolence (DES) refers to excessive daytime sleepiness including narcolepsy and hypersomnia. Narcolepsy is characterised by irresistible sleepiness and brief duration sleep attacks whereas hypersomnia occurs in longer durations[84]. Such disorders are associated with hypersomnolence, excessive daytime sleepiness, but cannot be attributed to other sleep disorders or abnormalities in circadian rhythms[83]. They are often caused by CNS abnormalities that control the sleep-wake cycle. Epilepsy in patients with CP has the strongest correlation to excessive somnolence [15].

Circadian rhythm sleep-wake disorders (Sleep-wake transition disorders)

Sleep-wake disorders may be persistent or transient and are associated with disturbances in the synchrony between behaviours of sleep and processes of human physiology within the day[10]. Persistent sleep-wake disorders are also associated with the presence of insomnias and disorders of excessive somnolence[76].

Sleep-wake transition disorders (SWTD) involve parasomnias that happen between the transition from wakefulness to sleep or between the stages which may present as abnormal behaviours[10]. The most common of these is somniloquy, commonly referred to as sleep talking. The typical causes occur in two groups with misaligned internal circadian rhythm as compared to the environment and additionally changes in the timing system relative to the surrounding environment[10].

Parasomnia Disorders (Disorders of Arousal)

Disorders of arousal and nightmares are associated with parasomnias. Sleep terrors and nightmares can occur early in the sleep cycle or later with nightmares during the dream cycle[76]. They can be associated with sleepwalking, sleep terrors and dream anxiety attacks. Disorders of Arousal (DOA) refer to non-rapid eye movement (NREM) sleep parasomnias that involve motor and emotional behaviours from incomplete arousals[81].

This set of disorders encompasses three conditions including confusional arousal, sleep terror and sleepwalking[81]. In particular during a sleep terror attack, autonomic hyperactivity is often present for the patient[82]. The clinical criteria include recurrent episodes of incomplete awakening, inappropriate responsiveness, limited or nil dream report and partial or complete amnesia[83].

Sleep-related movement disorders (Abnormal movements that occur during sleep)

Sleep-related movement disorders (SRMDs) encompass conditions characterized by repetitive, involuntary movements that occur during sleep, often leading to sleep fragmentation and impaired rest. These disorders are particularly relevant in children with neurodevelopmental conditions, such as cerebral palsy (CP), due to their underlying motor dysfunction and neuromuscular abnormalities. The most common SRMDs include restless legs syndrome (RLS), periodic limb movement disorder (PLMD), and rhythmic movement disorder (RMD)[93].

RLS is characterized by an uncomfortable urge to move the legs, often worsening at night and temporarily relieved by movement. PLMD involves repetitive limb jerks during sleep, which can cause frequent arousals and non-restorative sleep. RMD includes repetitive movements, such as head banging or body rocking, typically occurring during drowsiness or light sleep, and is more commonly observed in children with developmental disorders. In CP, spasticity and involuntary muscle contractions contribute to sleep disruptions, while medications used for spasticity management, such as baclofen, may exacerbate movement abnormalities. The presence of SRMDs in children with CP has been linked to increased sleep disturbances, excessive daytime sleepiness, and reduced overall quality of life. Understanding and managing these disorders is crucial for improving sleep outcomes in this population[93].

Other specified sleep-wake disorders (Sleep Hyperhidrosis)

Sleep hyperhidrosis (SHY) results from stimulation of eccrine sweat glands and is characterised by excessive sweating beyond thermoregulatory requirements[85]. It is caused typically by sympathetic overactivity during periods of sleep. Hyperhidrosis describes excessive sweating beyond thermoregulatory requirements that has an impact on the patients' quality of life[85]. Excessive eccrine sweat gland stimulation causes this hyperhidrosis[85]. Profuse sweating occurs during sleep and is also referred to as "night sweats". It may cause awakenings in the night[86].

Sleep problem in children with cerebral palsy assessment tools

1. Sleep problems in children with cerebral palsy can be assessed using various tools:
2. Children's Sleep Habits Questionnaire (CSHQ) – A parent-reported survey evaluating sleep behaviours like bedtime resistance and night awakenings[168].
3. Sleep Disturbance Scale for Children (SDSC) – Measures different sleep disorders, including insomnia and breathing difficulties[89].
4. Pittsburgh Sleep Quality Index (PSQI) – Assesses overall sleep quality and disturbances over a month[169].
5. Polysomnography (PSG) – A sleep study that monitors brain activity, breathing patterns, and muscle movements[170].
6. Actigraphy – A wrist-worn device tracking sleep-wake cycles over several days[91].
7. Sleep Diaries – Parents document sleep patterns, awakenings, and disruptions over time[171].

Why We Used the Sleep Disturbance Scale for Children (SDSC) Over Other Scores[88].

1. SDSC is a validated and reliable tool specifically for assessing sleep disorders in children with CP.
2. It evaluates six major sleep disturbances, offering a more comprehensive assessment than other scales.
3. The questionnaire format makes it easy to administer without requiring complex diagnostic tests.
4. It has a clear pathological cut-off score, allowing precise identification of sleep disorders.
5. SDSC correlates sleep disturbances with cerebral palsy severity, which many other scales do not address.

Correlation between Cerebral Palsy and Sleep Disturbances

Sleep disturbances affect up to 85% of children suffering from neurodevelopmental disorders[10]. According to Horwood et al., children with cerebral palsy (CP) experience a significantly higher prevalence of sleep problems compared to normal children, with difficulty initiating and maintaining sleep, nocturnal awakenings, and sleep-disordered breathing being the most commonly reported disturbances[10].

Specifically, children with epilepsy, gastroesophageal reflux disease (GERD), hyperactivity, and visual impairments are at a higher risk of experiencing sleep disruptions[10]. Nocturnal seizures associated with epilepsy may also awaken children[10]. Additionally, visual impairments may also delay the onset of sleep due to decreased light perception which can in turn affect the endogenous circadian rhythm[10].

Quality of Life

Quality of life was previously described through survival factors such as mortality, disease and social problems but has now shifted to incorporate the child's own sense of wellbeing as paralleled in the United Nations Convention on the Rights of the Child (UNCRC)[87]. Quality of life is now more holistic to incorporate both physical and psychosocial variables including functioning, health status, wellbeing, lifestyle, happiness[87].

Children living with CP are likely to experience decreased QoL[15]. QoL of children with CP is impacted by not only the functionality but extends further to psychological and social factors[13].

Additionally, DIMS and functional motor abilities also contribute to lower QOL in children with CP[15]. Patients with diplegia and hemiplegia experienced higher QOL as compared to severely disabled subjects[11]. CP impacts QOL for children and has an impact on caregivers. Being a neurodevelopmental disorder, numerous domains of life are impacted in addition to functional motor skills which can have a significant impact on daily activities.

Sleep disturbances in children with cerebral palsy (CP) are a significant comorbidity, affecting their growth, cognition, behaviour, and overall quality of life (QOL). Conditions like epilepsy, gastroesophageal reflux disease (GERD), hyperactivity, and visual impairments further contribute to sleep disruptions, leading to fatigue, cognitive decline, and behavioral difficulties. Children with severe motor impairments often rely on caregivers for daily activities, mobility, and hygiene, making sleep disturbances even more challenging. This not only impacts the child's functional abilities but also increases caregiver burden, stress, and emotional strain, affecting the entire family's well-being. Addressing sleep as a key comorbidity is crucial in improving both child and caregiver QOL.

Salient Features of Earlier Research on Sleep Disorders in children with Cerebral Palsy

Study	Year	Location	Sample Size	Study Type	Age Group	Questionnaire Type	Phenomenology	Correlation with QoL	Inter-vention	Exclusion Criteria
Kulkarni et al. (88)	2021	Mumbai, India	200	Prospective observational Study	1 – 14yrs	SDSC	DIMS (78.2%) SBD (3.1) DA (44.4) SWTD (44.4) DES (29.8) SHY (32.3)	N/A	N/A	Comorbid conditions including cardiorespiratory system, other illness and epilepsy, GERD. Patients taking sleep-altering medications.
Newman et al. (89)	2006	Dublin, Ireland	173	Prospective observational Study	6 – 12yrs	SDSC	DIMS (24.3%) SBD (14.5%) SWTD (17.9%) DES (11.0%) DA (8.1%) SHY (5.8%)	N/A	N/A	Patients younger than 6 and older than 12. Patients without a diagnosis or a GMFCS level documented.
Zuculo et al. (90)	2014	Marília, Brazil	43 children with CP 35 patients without neurological disorders	Prospective observational Study	4 – 18yrs	General Sleep Habits Questionnaire SDSC Child Health Questionnaire Children's QOL Scale	DIMS (11.6%) DES (2.3%) SBD (25.6%) SHY (34.9%)	Yes	N/A	Individuals outside of 4 – 18yrs and those without a neurodevelopmental disorder.

Sandella et al. (15)	2011	Michigan, USA	41 children with CP and 91 typically developing	Prospective Correlational Study	8 – 12yrs	Pediatric Sleep Questionnaire Sleep-Related Breathing Disorder Scale Pediatric Quality of Life Inventory Scale	SBD (7.3%) Insomnia affects psychological QOL for patients. DES contributes to physical QOL impact. GMFCS level impacts QOL outcomes.	Yes	N/A	Recent changes in medication, history of acquired brain injury, other neurological or psychiatric conditions.
Hulst et al. (14)	2021	Utrecht, Netherlands	90	Cross-sectional Study	0 – 11yrs	24-hour activity checklist	DES (33.3%) DIMS (30%) Early Morning Waking (26.7%)	N/A	N/A	Children older than 11 or with concurrent disability were excluded.

Limitations of Previous Studies

Limitations of previous studies include:

1. There has been only little research on sleep disturbances in children with CP in India, with most studies focusing on urban populations. No studies have been conducted in this region of Karnataka, which includes both urban and rural areas.
2. Small sample sizes in previous research limit the validation of sleep disturbances and hinder the ability to extrapolate data to other settings.
3. Only few studies correlated sleep with QoL

Clinical Implications

The clinical implications of conducting research into sleep disturbances in children with CP are vast, including:

1. Identifying sleep disturbances allows for early treatment and intervention planning, significantly impacting a child's growth and development while improving long-term outcomes through a multidisciplinary approach to CP management.
2. Future research can focus on developing new treatment strategies to enhance the quality of life (QOL) for children with CP.
3. Raising public awareness about the challenges faced by children with CP can contribute to better support systems and education initiatives.
4. Addressing sleep disturbances not only benefits the affected children but also alleviates stress for caregivers and families, ultimately improving their overall well-being.

Need for the Study

1. Understanding the prevalence of sleep disturbances in the community is crucial for developing treatment plans and further intervention.
2. Sleep disturbances have a significant impact on the QOL of children living with CP. The increased presence of sleep disturbances in population will have a significant impact on cognitive development.
3. Understanding the prevalence of sleep disturbances can help facilitate health education for patients and families, enabling early interventions and appropriate care.

MATERIALS AND METHODS

Study Design

This study is a cross-sectional study.

Study Population

Children with cerebral palsy aged 2-18 years old who attended the Paediatric neurology outpatient department and admitted to Paediatric ward at KLE's Dr Prabhakar Kore hospital, Belagavi were enrolled in the study.

Study Period

The study was conducted over a span of one year from June 2023 to May 2024.

Sample Size

The sample size for this study is 89 Cerebral Palsy cases.

Sampling Technique: Data Processing and Statistical Analysis

Sample Size

Single Proportion - Absolute Precision

Expected Proportion = 0.64 (64% with disturbance)

Precision (%) = 10

Desired confidence level (%) = 95

Sample size (n) = 89 screened

Formula [88]

N = (Z^2 * pq) / (d ^2)

Where:

Z = Standard normal variate value (Z=1.96 at 5% alpha error)

d-Margin of error = 9%

p = 64%

q = 100 - 64 = 36%

Inclusion Criteria

Two to eighteen year old children diagnosed with cerebral palsy.

Exclusion Criteria

- Children with acute infections such as viral fever, lower respiratory tract infections
- Children with cerebral palsy taking sleep medications

Study Protocol

Hospital based cross sectional study in cerebral palsy children.

Ethical Clearance

The study received ethical approval from the JNMC Institutional Ethical Committee **(Ref No:**

MDC/JNMCIEC/93) on March 26th , 2023.

C.T.R.I Registration

The study was registered with the Clinical Trial Registry of India (CTRI) before sample collection and received approval under the registration number CTRI/2023/05/053045.

Data Collection

After procuring the ethical committee's approval and consent from the parent or guardian, children with cerebral palsy aged 2 - 18 years attending the paediatric neurology outpatient department and admitted to paediatric ward at KLE's Dr Prabhakar Kore hospital were enrolled into the study.

An accurate history and clinical examination were performed following a standard CP proforma. The patient demographic data and previous/current medications were collected and reviewed.

Children with CP were classified according to their functional abilities using the Gross Motor Functional Classification System (GMFCS), Manual Ability Classification System (MACS), Communication Functional Classification System (CFCS), Visual Function Classification (VFCS) and Eating and Drinking Ability Classification System (EDACS).

The sleep disturbance scale for children (SDSC) was administered to all enrolled patients. Detailed responses given by parents / guardians on sleep disturbance questionnaires were recorded.

The SDSC assesses sleep quality and disturbances in children within the last six months[91]. It contains 26 items in a 5-point Likert scale and covers six general and common sleeping disorders in children[91]:

1. Disorders of Initiation and Maintenance of Sleep (DIMS)
2. Sleep Breathing Disorders (SBD)
3. Disorders of Arousal (DA)
4. Sleep-Wake Transition Disorders (SWTD)

5. Disorders of Excessive Somnolence (DES)
6. Sleep Hyperhidrosis (SHY)

Parents used a five-point, Likert-type scale to indicate how frequently certain behaviours are exhibited by their children:

1 indicates 'never'

5 indicates 'always (daily)'

Respondents also offer estimates of sleep quantity and onset time. The total sleep score as well as individual disorder score were calculated.

Total score and scores of individual SD were categorised into pathological and normal based on normative data from the scale used. Higher scores indicate more acute sleep disturbances.

Sleep disturbance severity was categorized based on T-scores:

- No Disturbance : T Score - 38-50
- Mild : T Score - 51-65
- Moderate : T Score - 66-71
- Severe : T Score - 72-92
- Very Severe : T Score - 93-100+

Quality of Life was assessed using the Cerebral Palsy-Quality of Life (CP-QOL) questionnaire[92]. The CP-QOLD measures the following seven areas of a child's life[92]:

- Domain 1(D1) - Social well-being and acceptance
- Domain 2(D2) - Feelings about functioning
- Domain 3(D3) - Participation and physical health

- Domain 4(D4) - Emotional wellbeing and self-esteem
- Domain 5(D5) - Access to service
- Domain 6(D6) - Pain and impact of disability
- Domain 7(D7) - Family health

0-0.3-Weak correlation,0.3-.07-Moderate correlation,>0.7-Strong correlation

Negative sign indicates Negative correlation .

Higher sleep disturbance scores are associated with lower QOL scores.

Statistical Analysis and Methods

Quantitative statistics were presented as mean and standard deviation for quantitative variables and as frequency and proportion for categorical variables. Data visualization included bar charts, pie charts, and box plots.

ANOVA was used to assess the relationship between quantitative variables and categorical outcomes (>2 groups). Pearson's correlation was applied to evaluate associations between two quantitative variables.

A p-value < 0.05 was considered statistically significant. Statistical analysis was conducted using IBM SPSS Statistics version 22. IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.

RESULTS

Table 2: Quantitative analysis of Age (years) in the study population (N=89)

Parameter	Mean ± SD	Median	Minimum	Maximum	95% C.I	
					Lower	Upper
Age (years)	7.82 ± 4.05	7.00	2.10	18.00	6.96	8.67

The mean age of the study population (N = 89) was 7.82 ± 4.05 years, with a median age of 7.00 years. The minimum and maximum ages observed were 2.10 years and 18.00 years, respectively. The 95% confidence interval (CI) for the mean age ranged from 6.96 to 8.67 years.

Table 2a: Quantitative analysis of demographic parameter in the study population (N=89)

Demographic Parameter	No. Of Cases	Percentages
Age Group (Years)		
2-5	30	33.71%
6-10	39	43.82%
11-15	12	13.48%
15-18	8	8.99%
Gender		
Male	51	57.30%
Female	38	42.70%

In the study population (N = 89), most participants were in the 6–10 years age group (39, 43.82%), followed by the 2–5 years age group (30, 33.71%). Participants aged 11–15 years and 15–18 years accounted for 12 (13.48%) and 8 (8.99%), respectively. Fifty-one (57.30%) participants were male, while 38 (42.70%) were female.

Figure 1: Bar chart of age group (years) in the study population (N=89)

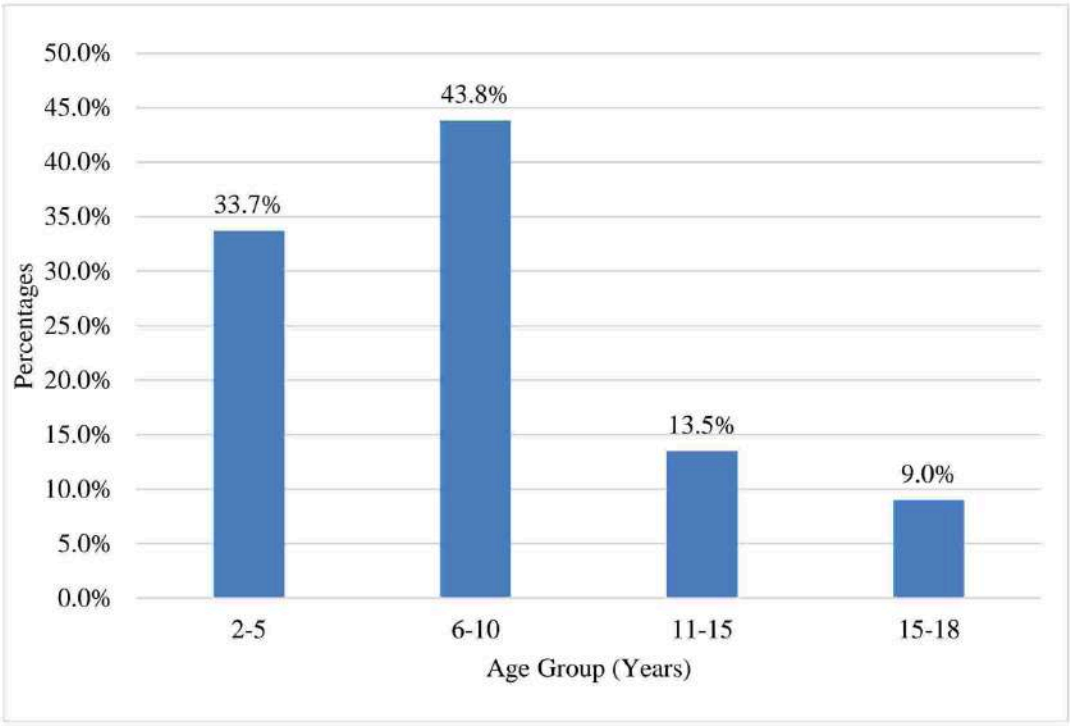

Figure 2: Pie chart of Gender in the study population (N=89)

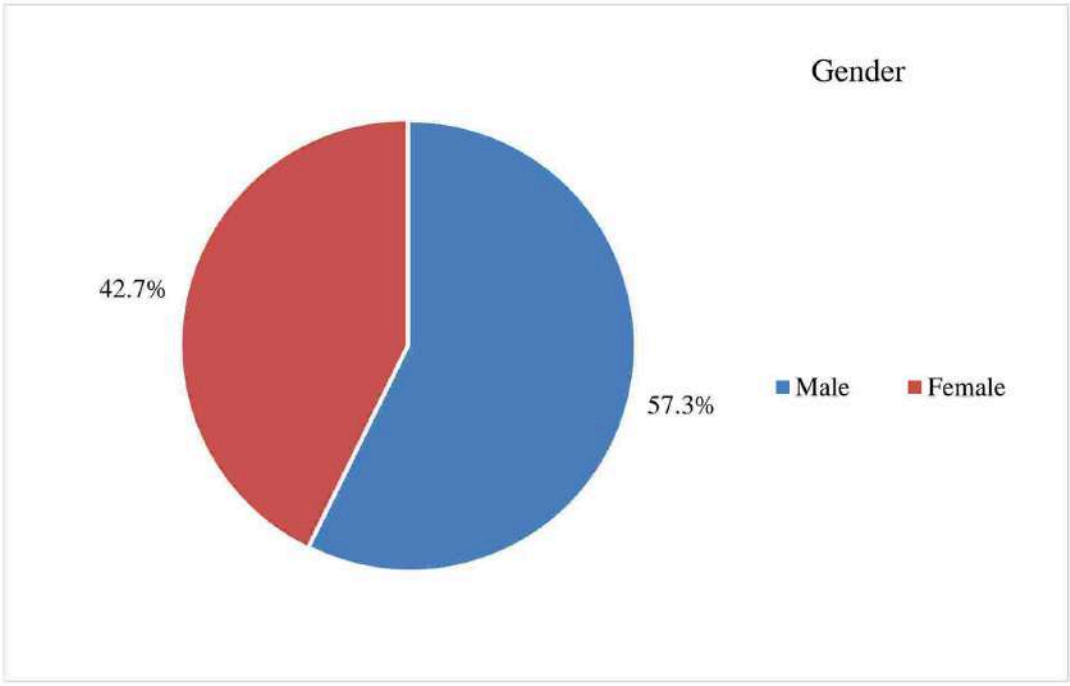

Table 3: Quantitative analysis of etiology of cerebral palsy in the study population (N=89)

Etiology	No. Of Cases	Percentages
Acquired	81	91.01%
Genetic	8	8.99%
Acquired Etiologies (N=81)		
Perinatal Asphyxia	41	50.62%
NHBI	17	20.99%
Prematurity	8	9.88%
Postnatal Sepsis/Meningitis	8	9.88%
BIND	6	7.41%
PROM	5	6.17%
MAS	5	6.17%

The analysis shows an acquired etiology in 91.01% and genetic cause in 8.99% of cerebral palsy cases. Among acquired causes, perinatal asphyxia (50.62%) is the most common, followed by NHBI (20.99%), prematurity (9.88%), and postnatal sepsis/meningitis (9.88%). Among the other acquired causes, BIND accounted for 7.41%, PROM and MAS accounted for 6.17 % each respectively.

Figure 3: Pie chart of etiology in the study population (N=89)

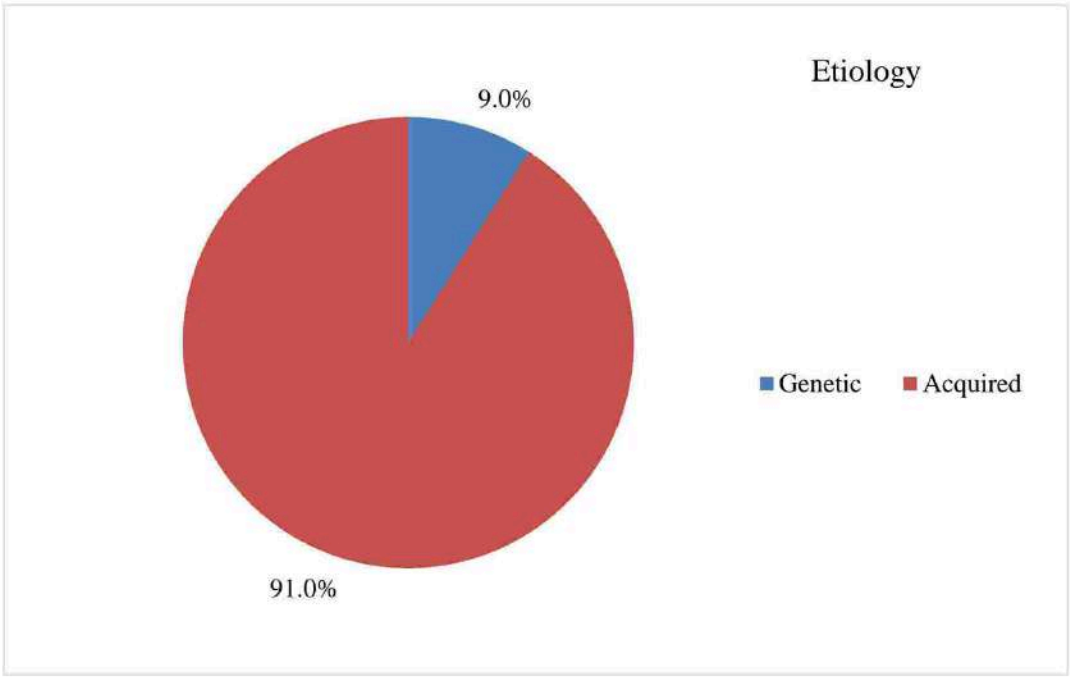

Figure 4: Bar chart of Acquired Etiologies in the study population (N=89)

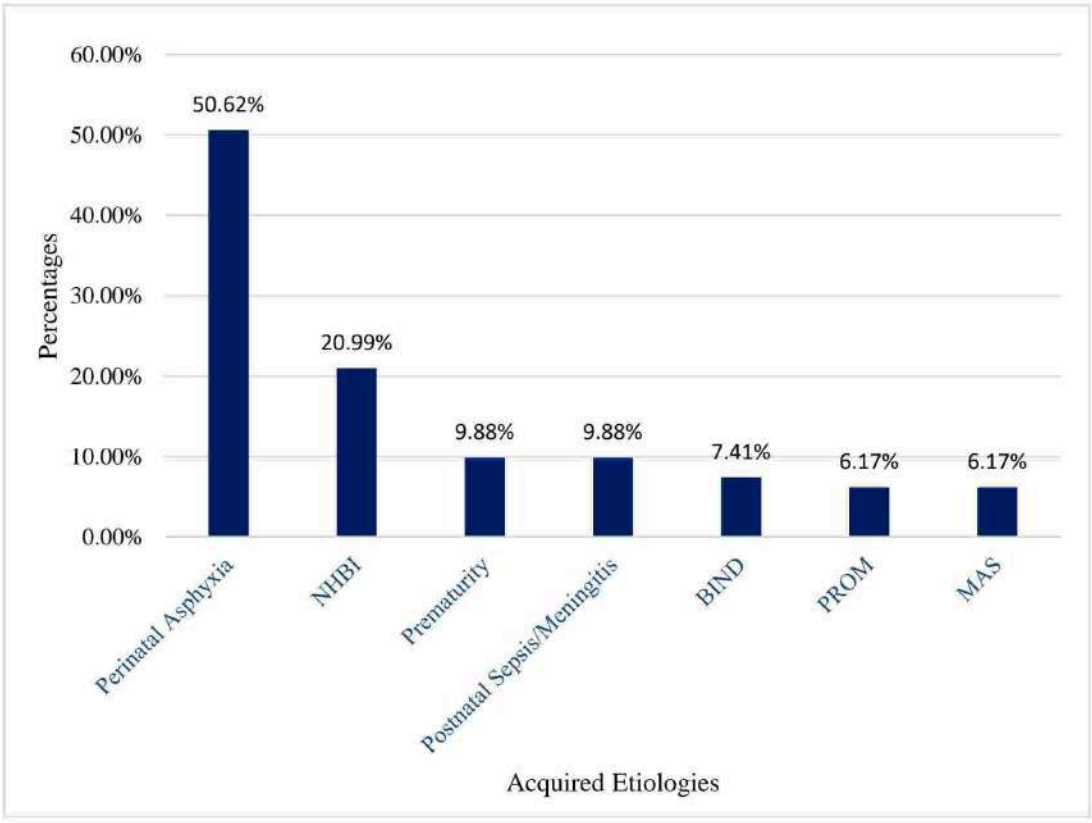

Table 4: Quantitative analysis of Physiological and Topographical Classification of CP in the study population (N=89)

Classification	No.of Cases	Percentages
Physiological		
Dyskinetic	37	41.57%
Mixed	30	33.71%
Spastic	22	24.72%
Topographical		
Quadriparetic	71	79.78%
Diplegic	11	12.36%
Hemiparetic	7	7.87%

The analysis shows the most common physiological type of CP is dyskinetic CP (41.57%) followed by mixed CP (33.71%) and spastic CP (24.72%). In topographical classification, quadriparetic CP (79.78%) accounts for majority of the cases followed by diplegic CP (12.36%) and hemiparetic CP (7.87%).

Figure 5: Pie chart of Physiological Classification of CP in the study population (N=89)

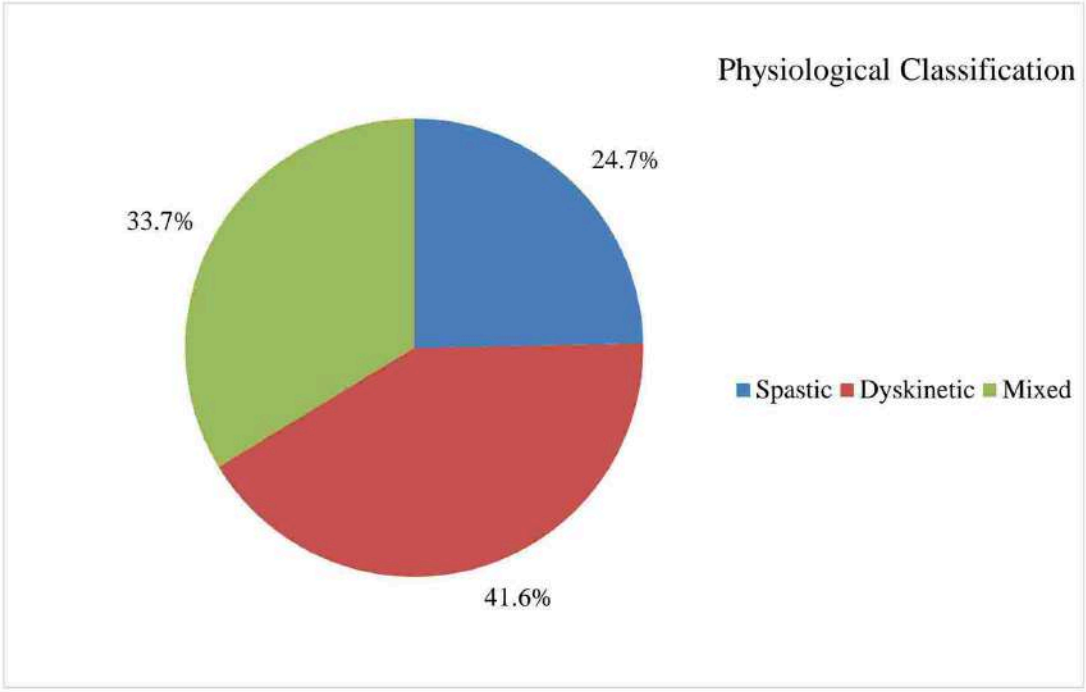

Figure 6: Pie chart of Topographical Classification of CP in the study population (N=89)

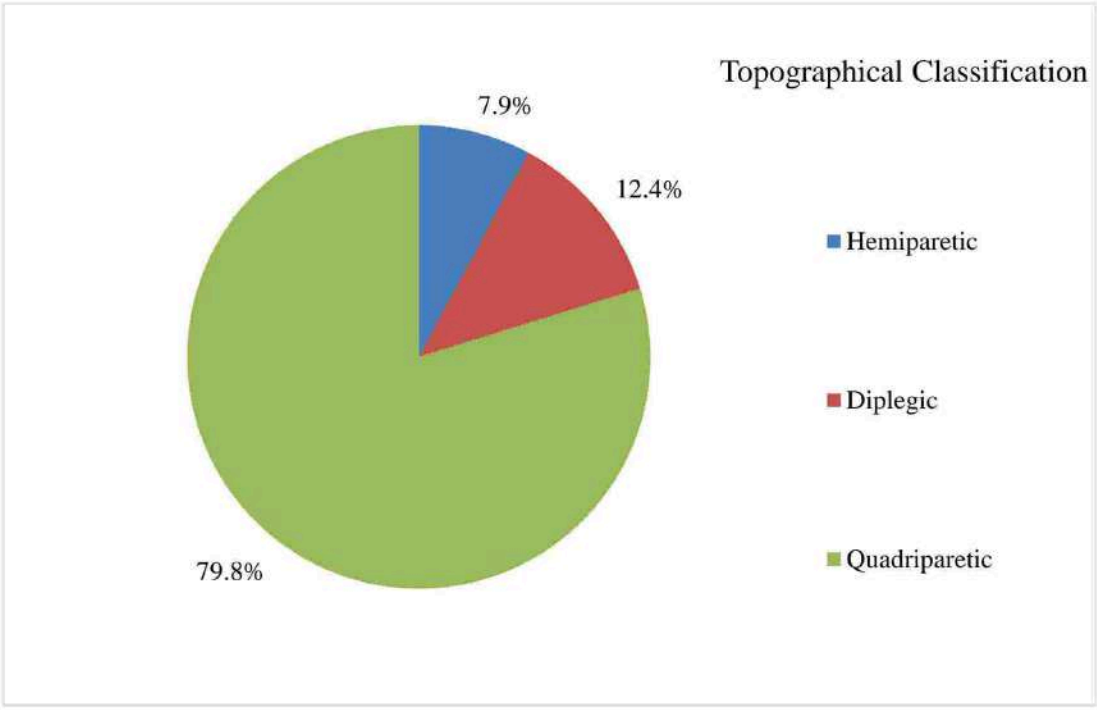

Table 5: Quantitative analysis of GMFCS of CP in the study population (N=89)

GMFCS	No. Of Cases	Percentages
I	7	7.87%
II	23	25.84%
III	14	15.73%
IV	14	15.73%
V	31	34.83%

The Analysis shows GMFCS Level V (34.83%) as the most common, followed by Levels II (25.84%) , III/IV (15.73% each) and Level I (7.87%)

Figure 7: Bar chart of GMFCS of CP in the study population (N=89)

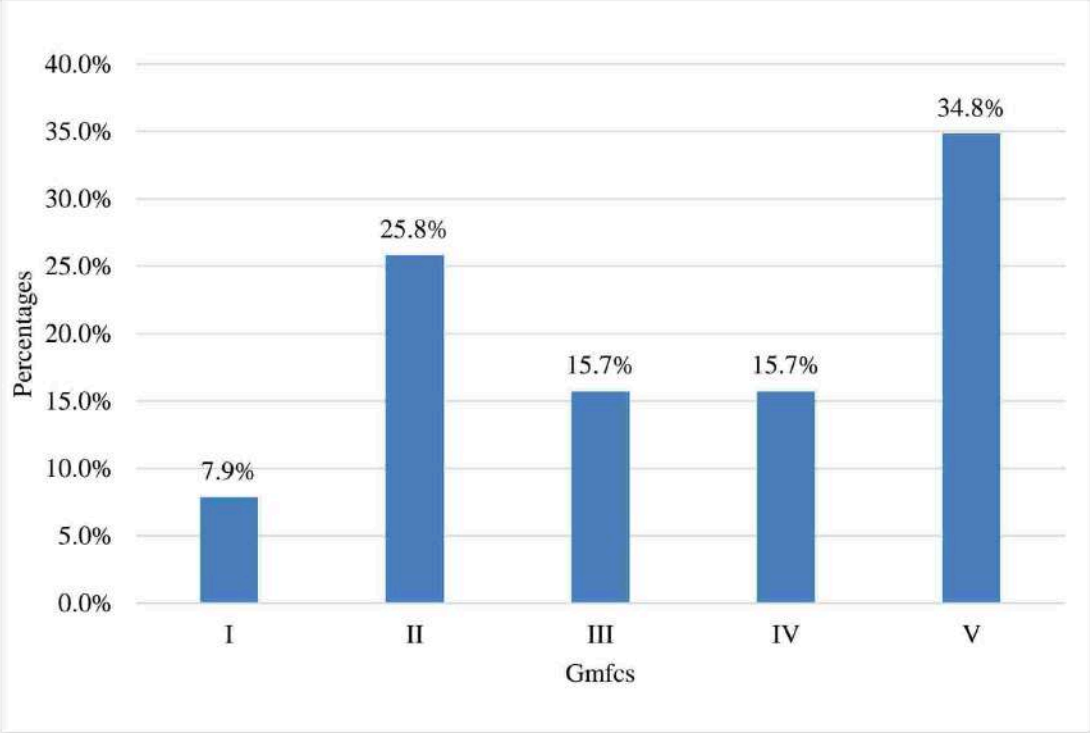

Table 6: Quantitative analysis of MACS of CP in the study population (N=89)

MACS	No. Of Cases	Percentages
I	7	7.87%
II	30	33.71%
III	14	15.73%
IV	17	19.10%
V	21	23.60%

The Analysis shows MACS Level II (33.71%) as the most common, followed by Levels V (23.60%), IV (19.10%), III (15.73%), and I (7.87%).

Figure 8: Bar chart of MACS of CP in the study population (N=89)

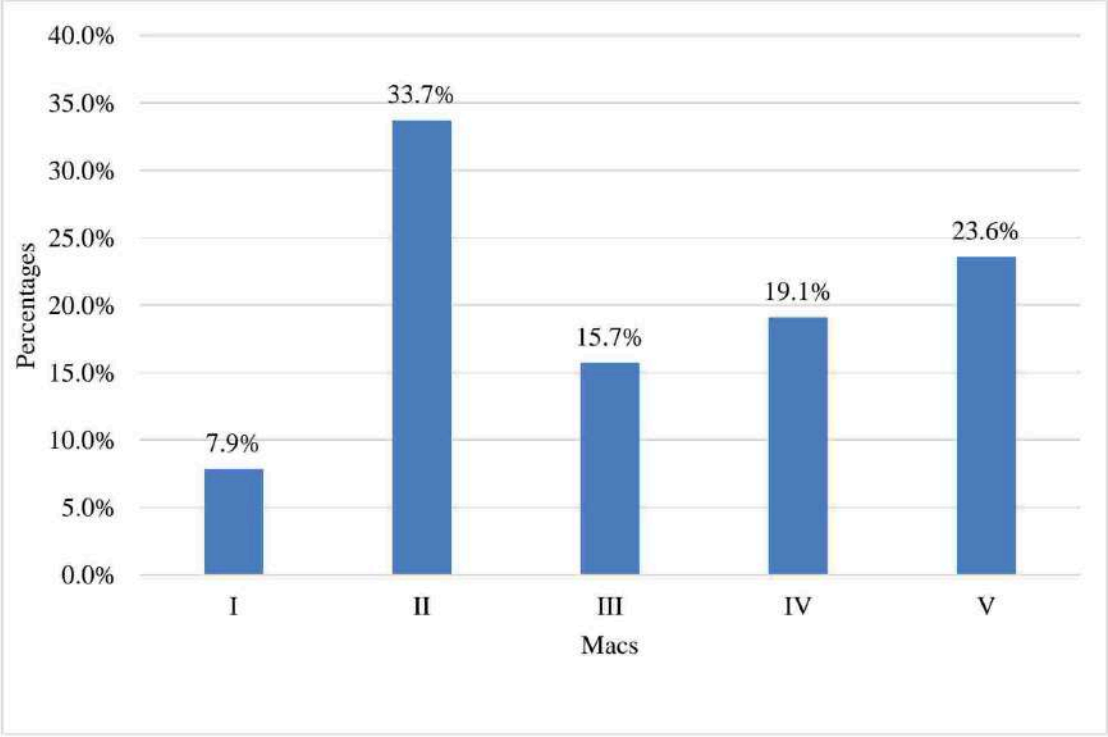

Table 7: Quantitative analysis of EDACS of CP in the study population (N=89)

EDACS	No. Of Cases	**Percentages**
I	12	13.48%
II	30	33.71%
III	21	23.60%
IV	14	15.73%
V	12	13.48%

The Analysis shows EDACS Level II (33.71%) as the most common, followed by Levels III (23.60%), IV (15.73%), and I/V (13.48% each).

Figure 9: Bar chart of EDACS of CP in the study population (N=89)

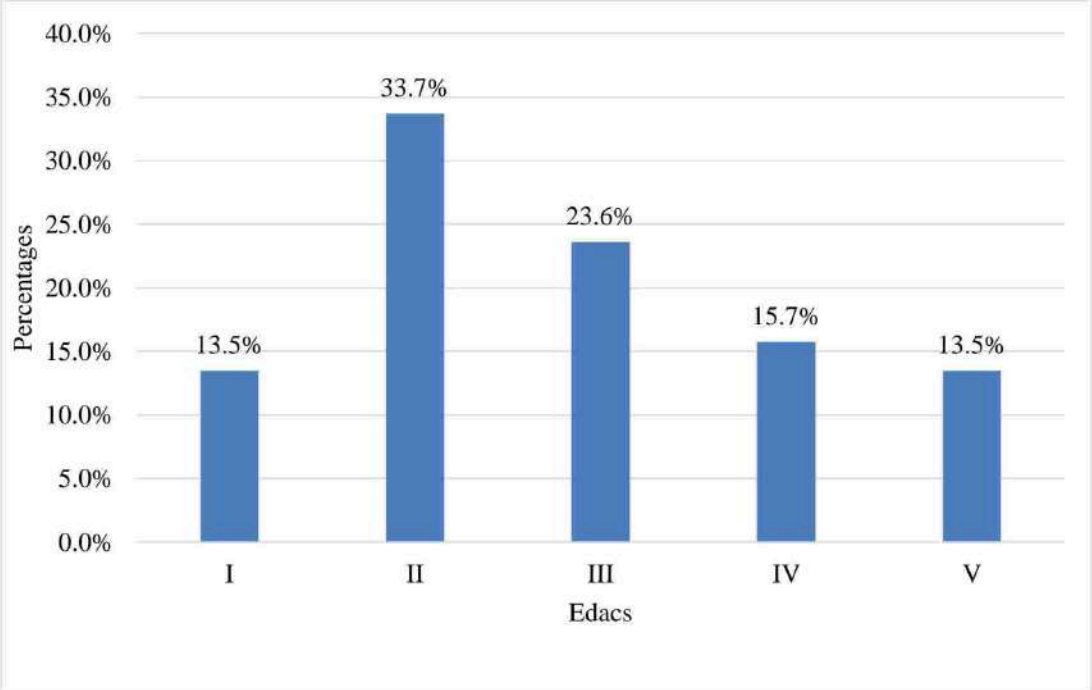

Table 8: Quantitative analysis of CFCS of CP in the study population (N=89)

CFCS	No. Of Cases	**Percentages**
I	10	11.24%
II	23	25.84%
III	22	24.72%
IV	12	13.48%
V	22	24.72%

The Analysis shows CFCS Level II (25.84%) as the most common, followed by Levels III/V (24.72% each), IV (13.48%), and I (11.24%).

Figure 10: Bar chart of CFCS of CP in the study population (N=89)

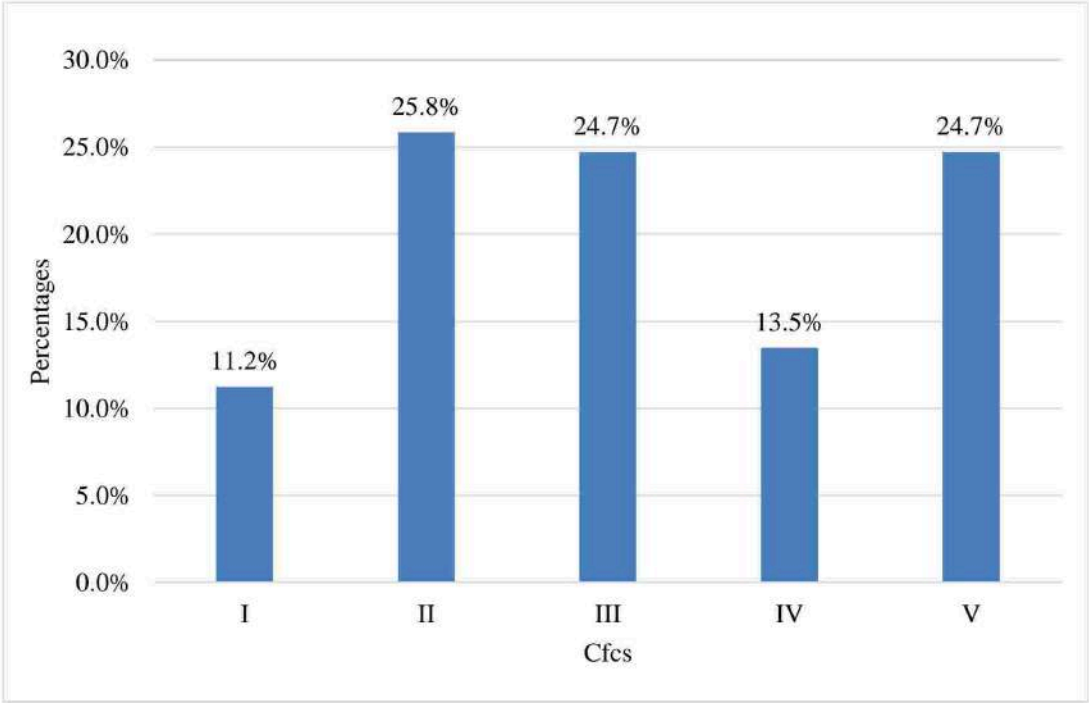

Table 9: Quantitative analysis of VFCS of CP in the study population (N=89)

VFCS	No. Of Cases	**Percentages**
I	14	15.73%
II	27	30.34%
III	10	11.24%
IV	21	23.60%
V	17	19.10%

The Analysis shows VFCS Level II (30.34%) as the most common, followed by Levels IV (23.60%), V (19.10%), I (15.73%), and III (11.24%).

Figure 11: Bar chart of VFCS of CP in the study population (N=89)

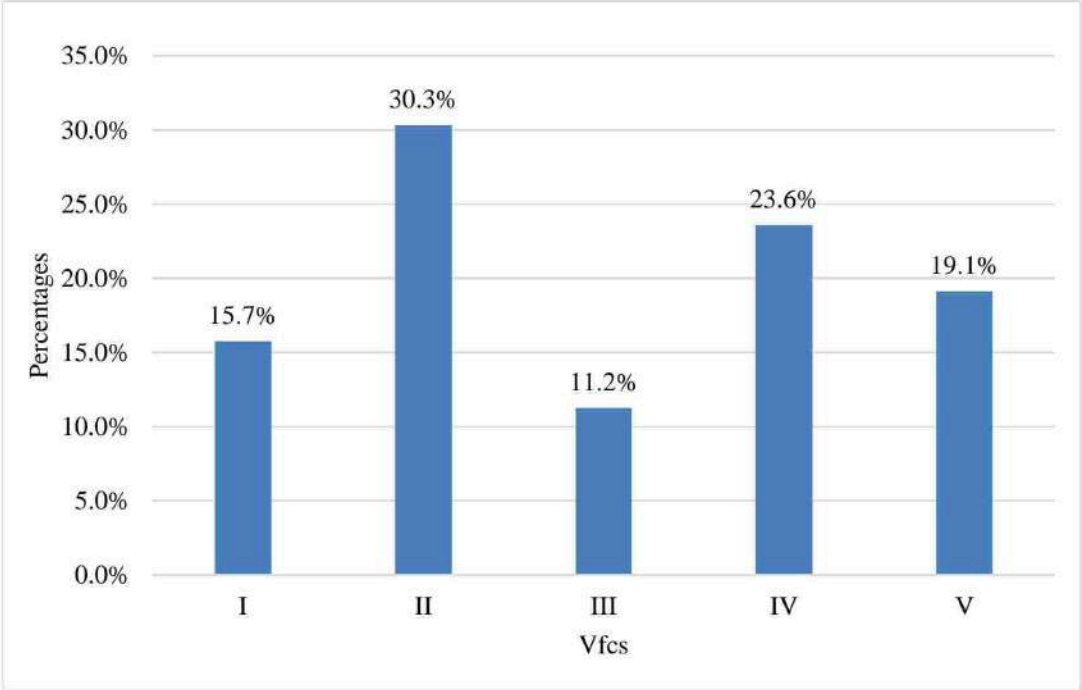

Table 10: Quantitative analysis of comorbidities associated with CP in the study population (N=89)

Comorbidities	No. Of Cases	Percentages
Hyperactivity	66	74.2%
Epilepsy	54	60.7%
Drooling	49	55.1%
CVI	36	40.5%
Dental caries	36	40.4%
GERD	31	34.8%
Constipation	31	34.8%
Malnutrition	23	25.8%
Hearing defects	6	6.7%

Analysis shows hyperactivity (74.2%) as the most common comorbidity, followed by epilepsy (60.7%), drooling (55.1%), CVI and dental caries were 40% each. GERD and constipation were reported in 34.8% each, followed by malnutrition (25.8%) and hearing defects (6.7%).

Figure 12: Bar chart of comorbidities in the study population (N=89)

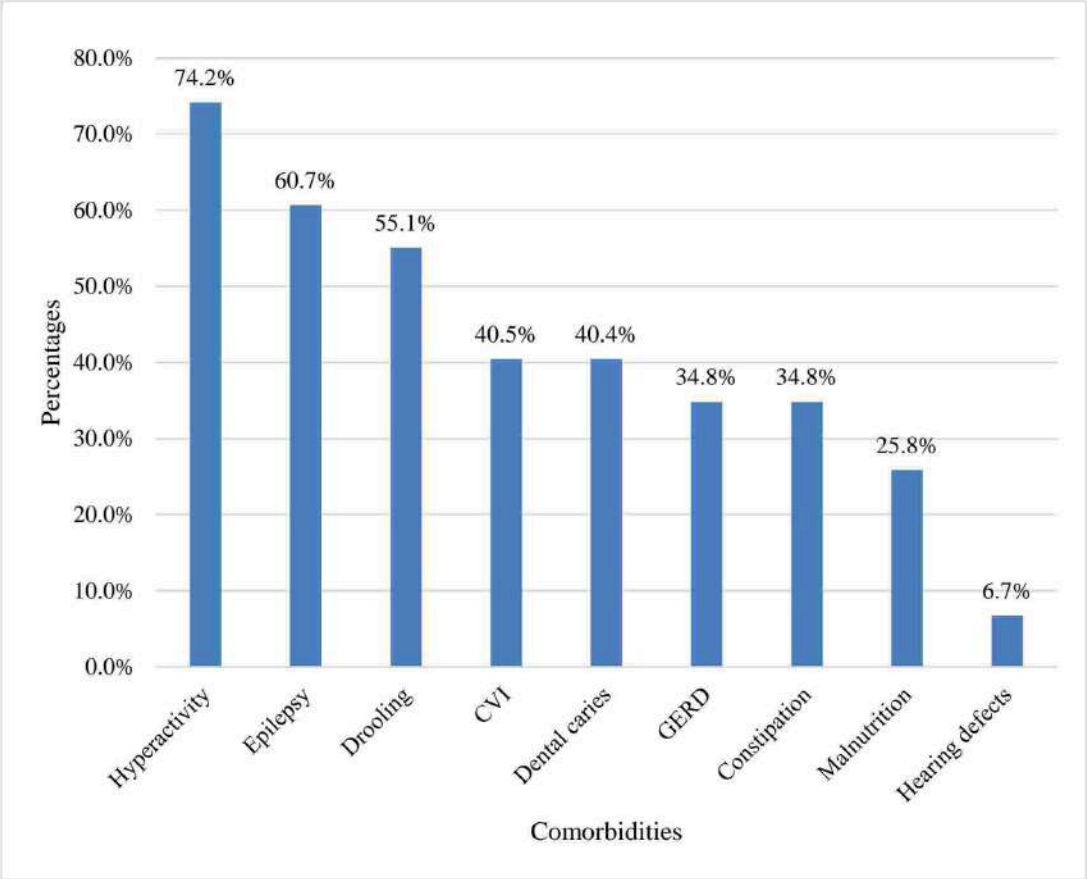

Table 11: Quantitative analysis of Sleep disturbances in the study population (N=89)

Sleep Disturbances	No. of cases	Percentages
No Disturbances (38-50)	12	13.48%
Mild (51-65)	27	30.34%
Moderate (66-71)	3	3.37%
Severe (72-92)	21	23.60%
Very Severe (92-100+)	26	29.21%

In the study, 86.52% of children with CP exhibited sleep disturbances, with 52.81% experiencing severe (23.6%) to very severe (29.21%) disturbances. Mild disturbances were observed in 30.34%, while 3.37% had moderate disturbances. 13.48% of the population showed no sleep disturbances.

Figure 13: Bar chart of sleep disturbances based Total -T score in the study population (N=89)

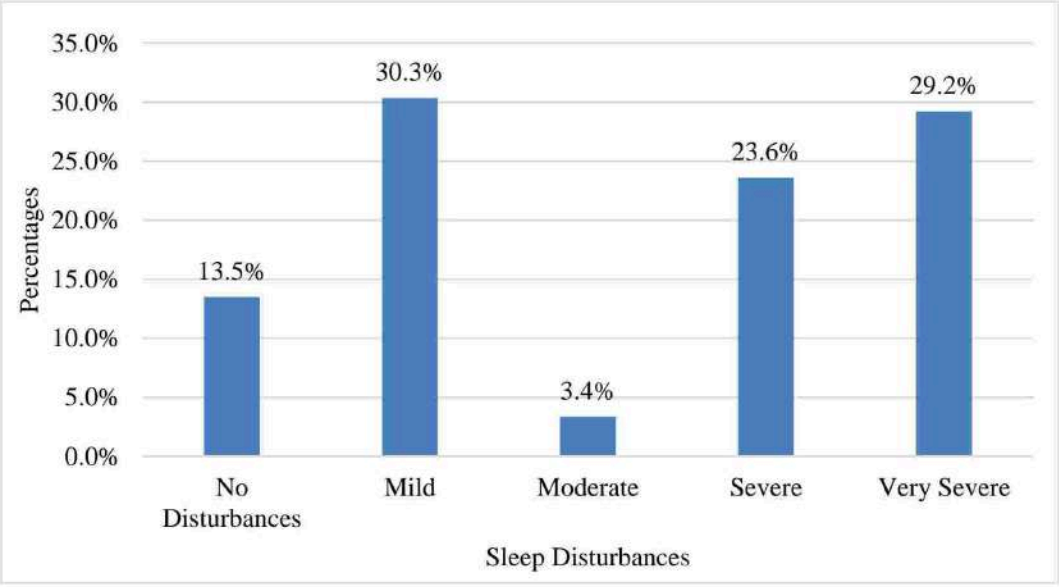

Table 12: Quantitative analysis of Sleep Disturbance Scale (T-Score) in the study population (N=89)

T-Score	Mean ± SD	Median	Minimum	Maximum	95% C.I	
					Lower	Upper
DIMS Score	70.71 ± 19.1	70.0	41.0	100.0	66.7	74.7
SBD Score	60.91 ± 17.22	58.0	45.0	100.0	57.3	64.5
DA Score	66.73 ± 19.46	58.0	40.0	100.0	62.6	70.8
SWTD Score	69.22 ± 19.36	66.0	25.0	100.0	65.2	73.3
DES Score	64.09 ± 16.13	62.0	42.0	100.0	60.7	67.5
SHY Score	59.15 ± 12.36	58.0	36.0	86.0	56.5	61.8
Total Score	73.69 ± 20	72.0	42.0	100.0	69.5	77.9

In the study population (N = 89), the mean Total Sleep Disturbance T Score was 73.69 ± 20.00, with a median of 72.0 and a range of 42.0 to 100.0. The 95% confidence interval (CI) for the mean total score ranged from 69.5 to 77.9.

Among the subscales, the highest mean scores were observed in DIMS (70.71 ± 19.1) and SWTD (69.22 ± 19.36), followed by DA (66.73 ± 19.46) and DES (64.09 ± 16.13). SBD had a mean score of 60.91 ± 17.22, followed by SHY with a mean score of 59.15 ± 12.36.

Table 13: Quantitative analysis of Mean T scores of sleep disturbance scale for Children in the study population (N=89)

Type of Sleep Disturbance	No. of cases	Percentages
DIMS T-Score		
No Disturbances (38-50)	20	22.47%
Mild (51-65)	21	23.60%
Moderate (66-71)	5	5.62%
Severe (72-92)	26	29.21%
Very Severe (92-100+)	17	19.10%
SBD T-Score		
No Disturbances (38-50)	28	31.46%
Mild (51-65)	37	41.57%
Severe (72-92)	16	17.98%
Very Severe (92-100+)	8	8.99%
DA T-Score		
No Disturbances (38-50)	28	31.46%
Mild (51-65)	21	23.60%
Moderate (66-71)	14	15.73%
Severe (72-92)	8	8.99%
Very Severe (92-100+)	18	20.22%
SWTD T-Score		
No Disturbances (38-50)	21	23.60%
Mild (51-65)	22	24.72%
Moderate (66-71)	10	11.24%
Severe (72-92)	17	19.10%
Very Severe (92-100+)	19	21.35%

DES T-Score		
No Disturbances (38-50)	29	32.58%
Mild (51-65)	25	28.09%
Moderate (66-71)	8	8.99%
Severe (72-92)	18	20.22%
Very Severe (92-100+)	9	10.11%
Shy T-Score		
No Disturbances (38-50)	23	25.84%
Mild (51-65)	39	43.82%
Moderate (66-71)	12	13.48%
Severe (72-92)	15	16.85%

The analysis of mean T-scores from the Sleep Disturbance Scale for Children in the study population (N=89) showed that for DIMS T-score, 20 (22.47%) had no disturbances, 21 (23.60%) had mild, 5 (5.62%) had moderate, 26 (29.21%) had severe, and 17 (19.10%) had very severe disturbances. For SBD T-score, 28 (31.46%) had no disturbances, 37 (41.57%) had mild, 16 (17.98%) had severe, and 8 (8.99%) had very severe disturbances. In DA T-score, 28 (31.46%) had no disturbances, 21 (23.60%) had mild, 14 (15.73%) had moderate, 8 (8.99%) had severe, and 18 (20.22%) had very severe disturbances. The SWTD T-score showed 21 (23.60%) with no disturbances, 22 (24.72%) with mild, 10 (11.24%) with moderate, 17 (19.10%) with severe, and 19 (21.35%) with very severe disturbances. For DES T-score, 29 (32.58%) had no disturbances, 25 (28.09%) had mild, 8 (8.99%) had moderate, 18 (20.22%) had severe, and 9 (10.11%) had very severe disturbances. In SHY T-score, 23 (25.84%) had no disturbances, 39 (43.82%) had mild, 12 (13.48%) had moderate, and 15 (16.85%) had severe disturbances.

Figure 14: Bar chart of DIMS t-score in the study population (N=89)

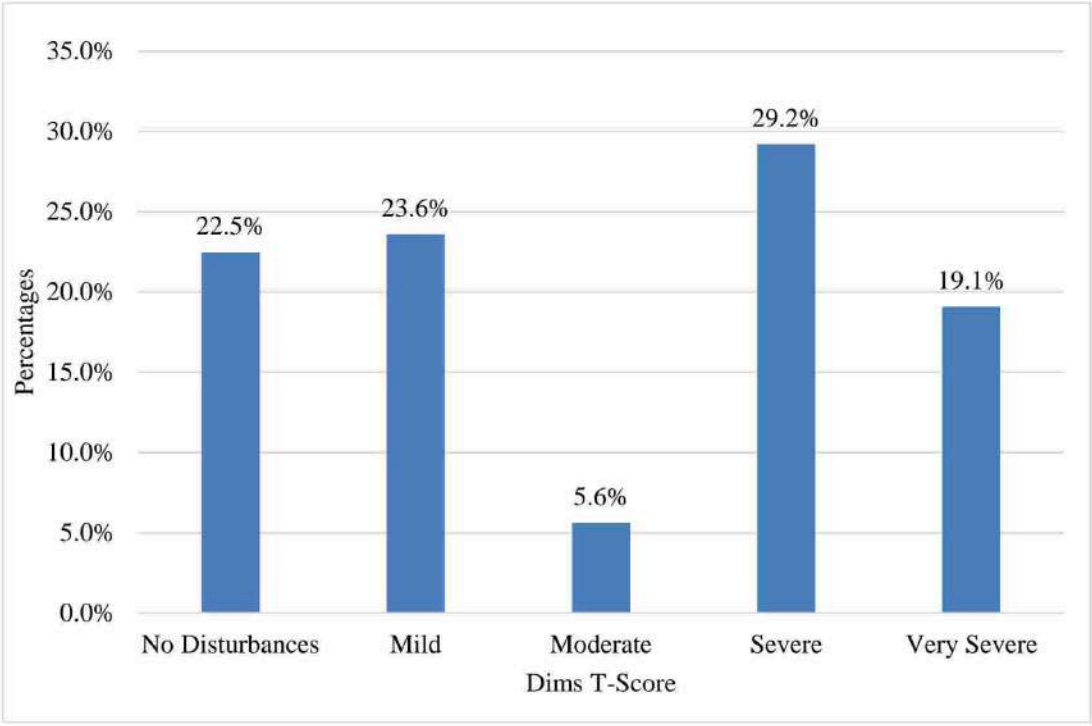

Figure 15: Bar chart of SBD T-score in the study population (N=89)

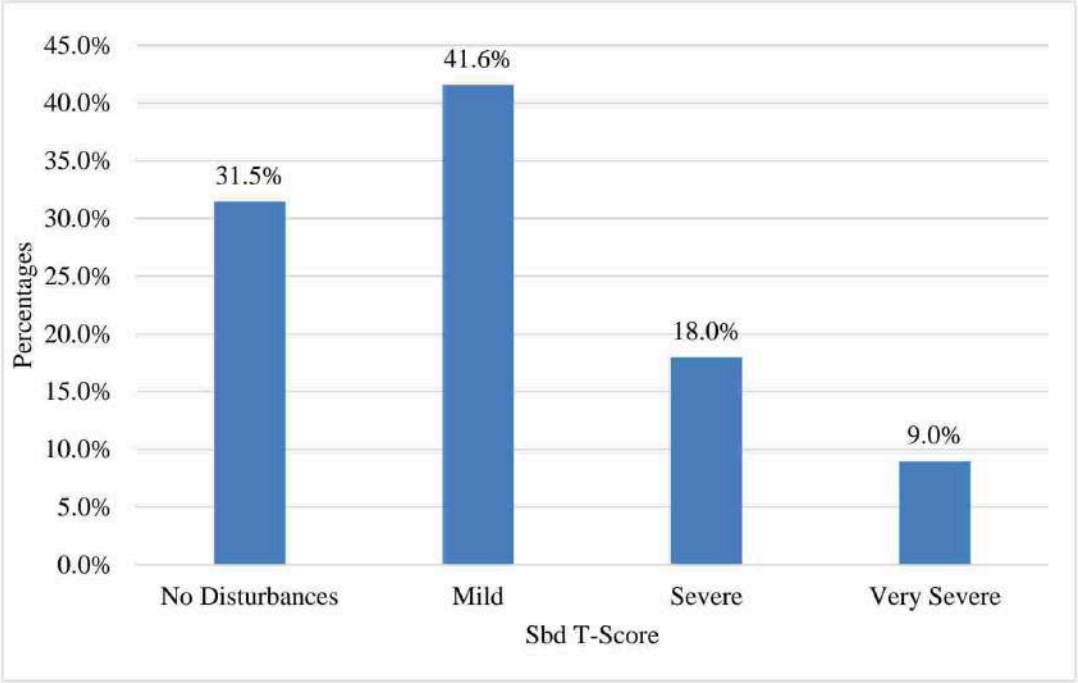

Figure 16: Bar chart of DA T-score in the study population (N=89)

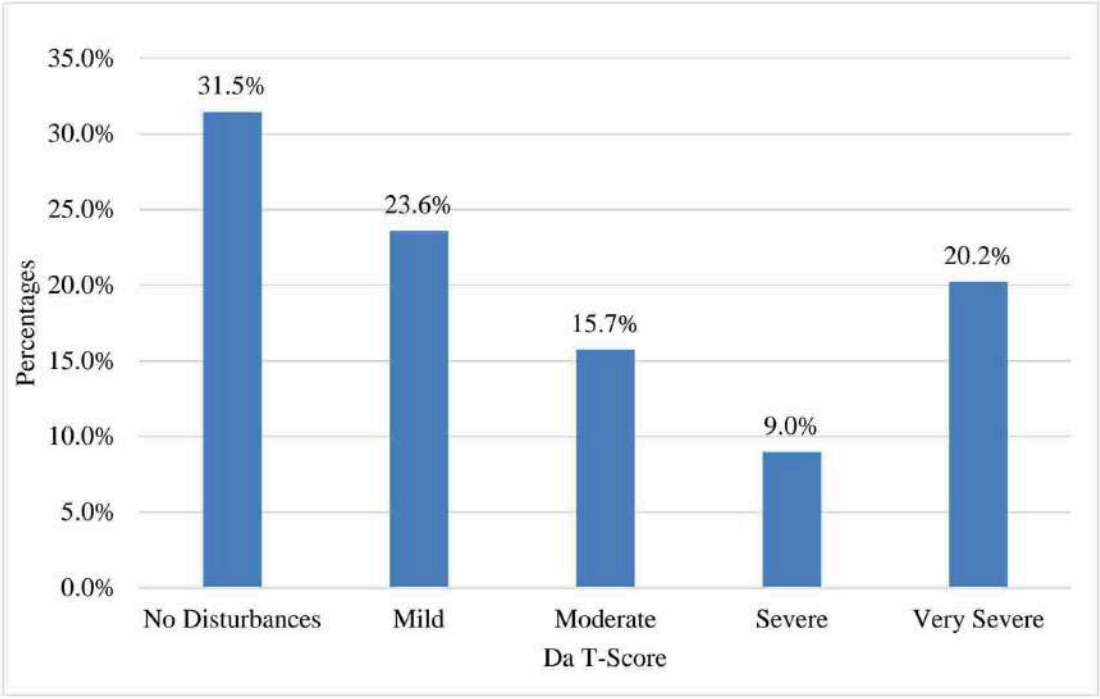

Figure 17: Bar chart of SWTD T-Score in the study population (N=89)

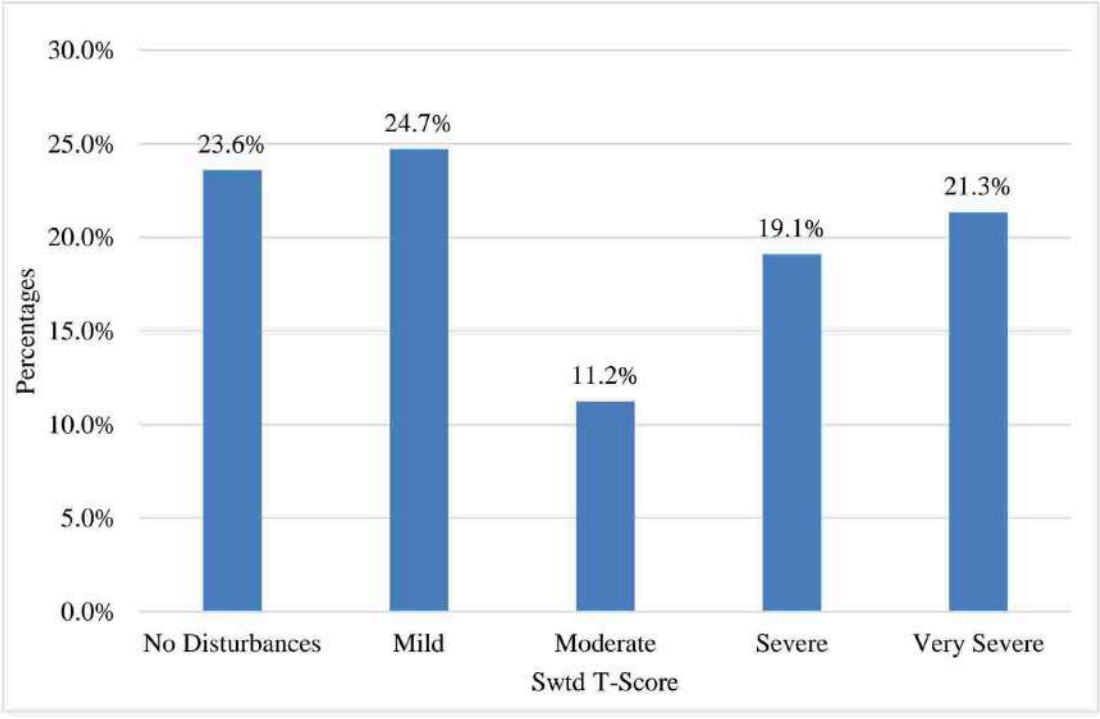

Figure 18: Bar chart of DES T-Score in the study population (N=89)

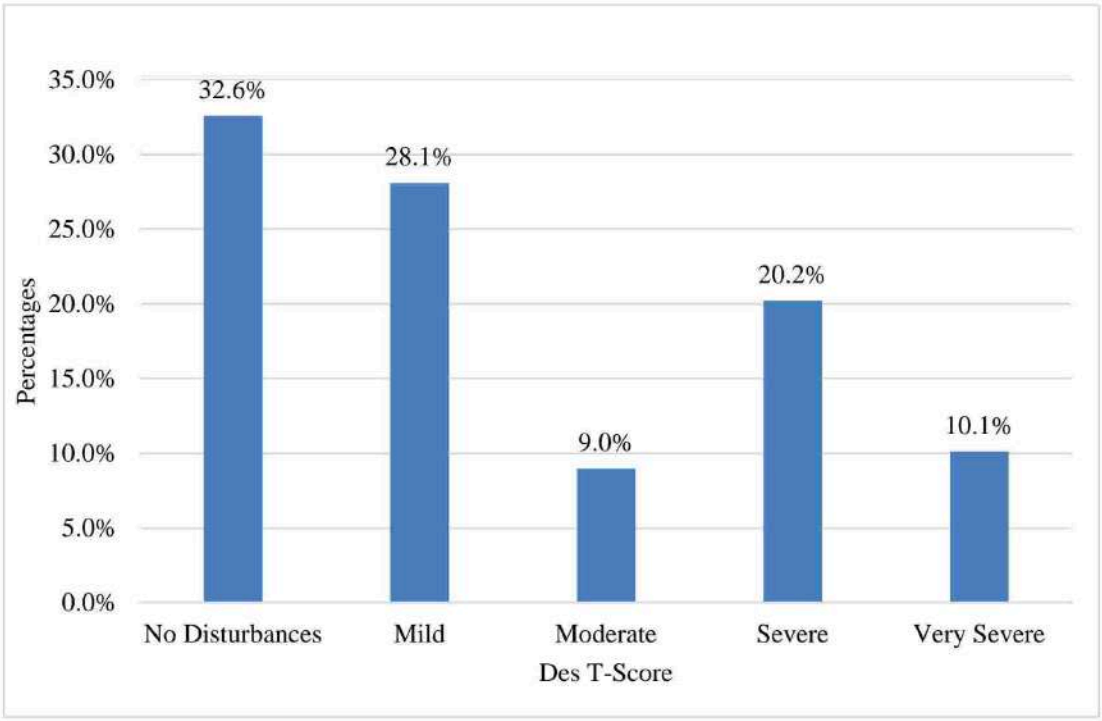

Figure 19: Bar chart of SHY T-Score in the study population (N=89)

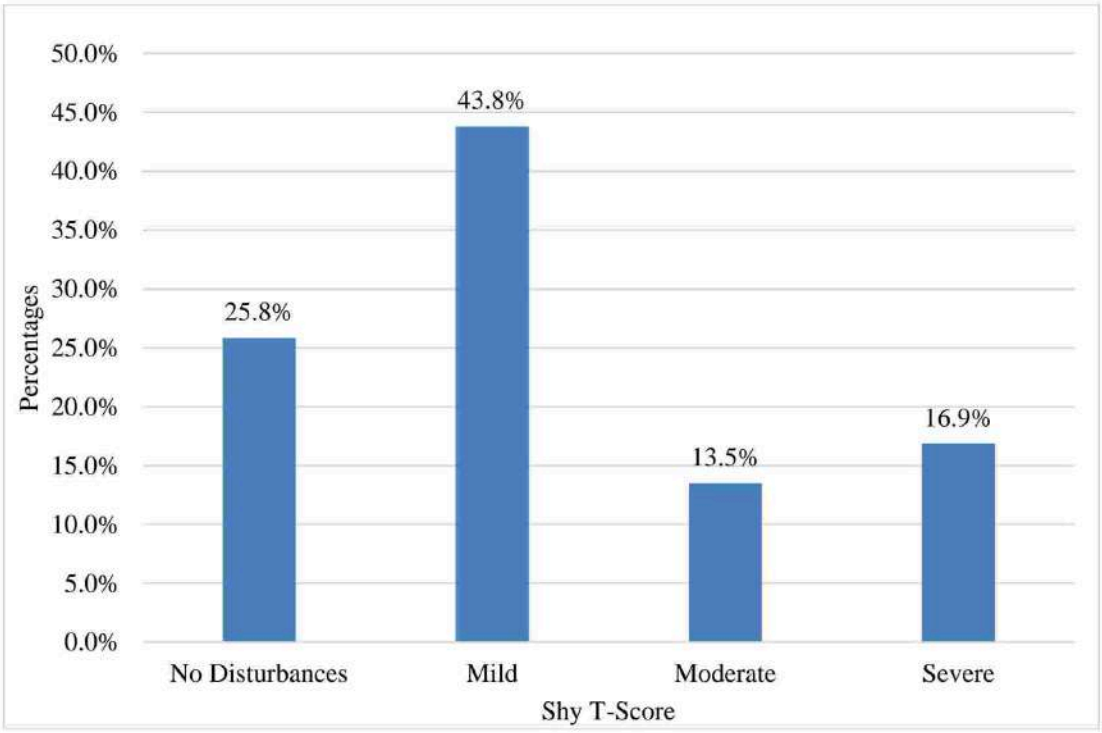

Table 14: Comparison of mean T scores of sleep disturbance scale with physiological classification of CP(N=89)

Mean T score	Physiological classification of CP			ANOVA (P Value)
	Spastic (N=22)	Dyskinetic (N=37)	Mixed (N=30)	
DIMS score	68 ± 17.55	65.03 ± 18.71	79.7 ± 17.87	0.005
SBD score	59.82 ± 17.89	63.32 ± 17.87	58.73 ± 16.07	0.529
DA score	61.14 ± 17.68	68.65 ± 19.98	68.47 ± 19.89	0.302
SWTD score	67.82 ± 18.79	67.14 ± 20.63	72.83 ± 18.25	0.457
DES score	61.64 ± 17	62.27 ± 14.81	68.13 ± 16.79	0.241
SHY score	56.09 ± 12.42	60.27 ± 12.1	60 ± 12.66	0.412
TOTAL	69.91 ± 20.72	71.92 ± 20.3	78.63 ± 18.74	0.236

The table compares the mean T scores of the sleep disturbance scale between physiological classifications of CP. The mean DIMS T score was significantly higher in the mixed CP group (79.7 ± 17.87) compared to spastic CP (68 ± 17.55) and dyskinetic CP (65.03 ± 18.71) with the difference being statistically significant ($p = 0.005$). However, there was no significant difference in other sleep disturbance scores or total sleep disturbance scores across the different CP types.

Table 15: Comparison of individual type of sleep disturbance T scores across physiological classification of CP (N=89)

Type of Sleep Disturbance	Physiological Classification of CP			Chi square	P value
	Spastic (N=22)	Dyskinetic (N=37)	Mixed (N=30)		
DIMS					
No Disturbances (38-50)	4 (18.18%)	13 (35.14%)	3 (10%)	15.779	0.046
Mild (51-65)	7 (31.82%)	10 (27.03%)	4 (13.33%)		
Moderate (66-71)	1 (4.55%)	2 (5.41%)	2 (6.67%)		
Severe (72-92)	8 (36.36%)	8 (21.62%)	10 (33.33%)		
Very Severe (92-100+)	2 (9.09%)	4 (10.81%)	11 (36.67%)		
SBD					
No Disturbances (38-50)	7 (31.82%)	10 (27.03%)	11 (36.67%)	2.453	0.874
Mild (51-65)	10 (45.45%)	14 (37.84%)	13 (43.33%)		
Severe (72-92)	3 (13.64%)	9 (24.32%)	4 (13.33%)		
Very Severe (92-100+)	2 (9.09%)	4 (10.81%)	2 (6.67%)		
DA					
No Disturbances (38-50)	9 (40.91%)	10 (27.03%)	9 (30%)	7.931	0.440
Mild (51-65)	7 (31.82%)	10 (27.03%)	4 (13.33%)		
Moderate (66-71)	2 (9.09%)	4 (10.81%)	8 (26.67%)		
Severe (72-92)	1 (4.55%)	4 (10.81%)	3 (10%)		
Very Severe (92-100+)	3 (13.64%)	9 (24.32%)	6 (20%)		
SWTD					
No Disturbances (38-50)	5 (22.73%)	12 (32.43%)	4 (13.33%)	8.298	0.405
Mild (51-65)	7 (31.82%)	7 (18.92%)	8 (26.67%)		

Moderate (66-71)	1 (4.55%)	4 (10.81%)	5 (16.67%)		
Severe (72-92)	6 (27.27%)	7 (18.92%)	4 (13.33%)		
Very Severe (92-100+)	3 (13.64%)	7 (18.92%)	9 (30%)		
DES					
No Disturbances (38-50	9 (40.91%)	12 (32.43%)	8 (26.67%)		
Mild (51-65)	8 (36.36%)	12 (32.43%)	5 (16.67%)		
Moderate (66-71)	0 (0%)	3 (8.11%)	5 (16.67%)	9.705	0.286
Severe (72-92)	3 (13.64%)	8 (21.62%)	7 (23.33%)		
Very Severe (92-100+)	2 (9.09%)	2 (5.41%)	5 (16.67%)		
SHY					
No Disturbances (38-50) (38-50)	9 (40.91%)	7 (18.92%)	7 (23.33%)		
Mild (51-65)	9 (40.91%)	17 (45.95%)	13 (43.33%)		
Moderate (66-71)	2 (9.09%)	6 (16.22%)	4 (13.33%)	4.351	0.629
Severe (72-92)	2 (9.09%)	7 (18.92%)	6 (20%)		
Total					
No Disturbances (38-50)	3 (13.64%)	8 (21.62%)	1 (3.33%)		
Mild (51-65)	8 (36.36%)	10 (27.03%)	9 (30%)		
Moderate (66-71)	1 (4.55%)	0 (0%)	2 (6.67%)	8.173	0.417
Severe (72-92)	4 (18.18%)	10 (27.03%)	7 (23.33%)		
Very Severe (92-100+)	6 (27.27%)	9 (24.32%)	11 (36.67%)		

Above table compares the individual type of sleep disturbance across physiological classification of CP.

Severity of DIMS Across Physiological Classification of CP:

Among children with spastic CP (N=22), 8 cases (36.36%) experienced severe T Scores in DIMS, while 2 cases (9.09%) fell into the very severe category. Among children with dyskinetic CP (N=37), 8 cases (21.62%) had severe T Scores, and 4 cases (10.81%) were in the very severe category. In the mixed CP (N=30) group, 10 cases (33.33%) experienced severe T Scores, while 11 cases (36.67%) fell into the very severe category.

Severity of SBD Across Physiological Classification of CP:

Among children with spastic CP (N=22), 3 cases (13.64%) experienced severe T Scores in SBD, while 2 cases (9.09%) fell into the very severe category. Among children with dyskinetic CP (N=37), 9 cases (24.32%) had severe T Scores, and 4 cases (10.81%) were in the very severe category. In the mixed CP (N=30) group, 4 cases (13.33%) experienced severe T Scores, while 2 cases (6.67%) fell into the very severe category.

Severity of DA Across Physiological Classification of CP:

Among children with spastic CP (N=22), 1 case (4.55%) experienced severe T Scores in DA, while 3 cases (13.64%) fell into the very severe category. Among children with dyskinetic CP (N=37), 4 cases (10.81%) had severe T Scores, and 9 cases (24.32%) were in the very severe category. In the mixed CP (N=30) group, 3 cases (10%) experienced severe T Scores, while 6 cases (20%) fell into the very severe category.

Severity of SWTD Across Physiological Classification of CP:

Among children with spastic CP (N=22), 6 cases (27.27%) experienced severe T Scores in SWTD, while 3 cases (13.64%) fell into the very severe category. Among children with dyskinetic CP (N=37), 7 cases (18.92%) had severe T Scores, and 7

cases (18.92%) were in the very severe category. In the mixed CP (N=30) group, 4 cases (13.33%) experienced severe T Scores, while 9 cases (30%) fell into the very severe category.

Severity of DES Across Physiological Classification of CP:

Among children with spastic CP (N=22), 3 cases (13.64%) experienced severe T Scores in DES, while 2 cases (9.09%) fell into the very severe category. Among children with dyskinetic CP (N=37), 8 cases (21.62%) had severe T Scores, and 2 cases (5.41%) were in the very severe category. In the mixed CP (N=30) group, 7 cases (23.33%) experienced severe T Scores, while 5 cases (16.67%) fell into the very severe category.

Severity of SHY Across Physiological Classification of CP:

Among children with spastic CP (N=22), 2 cases (9.09%) experienced severe T Scores in SHY. Among children with dyskinetic CP (N=37), 7 cases (18.92%) had severe T Scores. In the mixed CP (N=30) group, 6 cases (20%) experienced severe T Scores.

Severity of Total Sleep Disturbance Across Physiological Classification of CP:

Among children with spastic CP (N=22), 4 cases (18.18%) experienced severe T Scores in total sleep disturbance, while 6 cases (27.27%) fell into the very severe category. Among children with dyskinetic CP (N=37), 10 cases (27.03%) had severe T Scores, and 9 cases (24.32%) were in the very severe category. In the mixed CP (N=30) group, 7 cases (23.33%) experienced severe T Scores, while 11 cases (36.67%) fell into the very severe category.

The analysis revealed a statistical significance in DIMS T scores across the various physiological classification of CP, the mixed group having the most severe and very severe scores (Chi-square = 15.779, P = 0.046).

Figure 20: Cluster bar chart of comparison of DIMS T-score across physiological classification of CP (N=89)

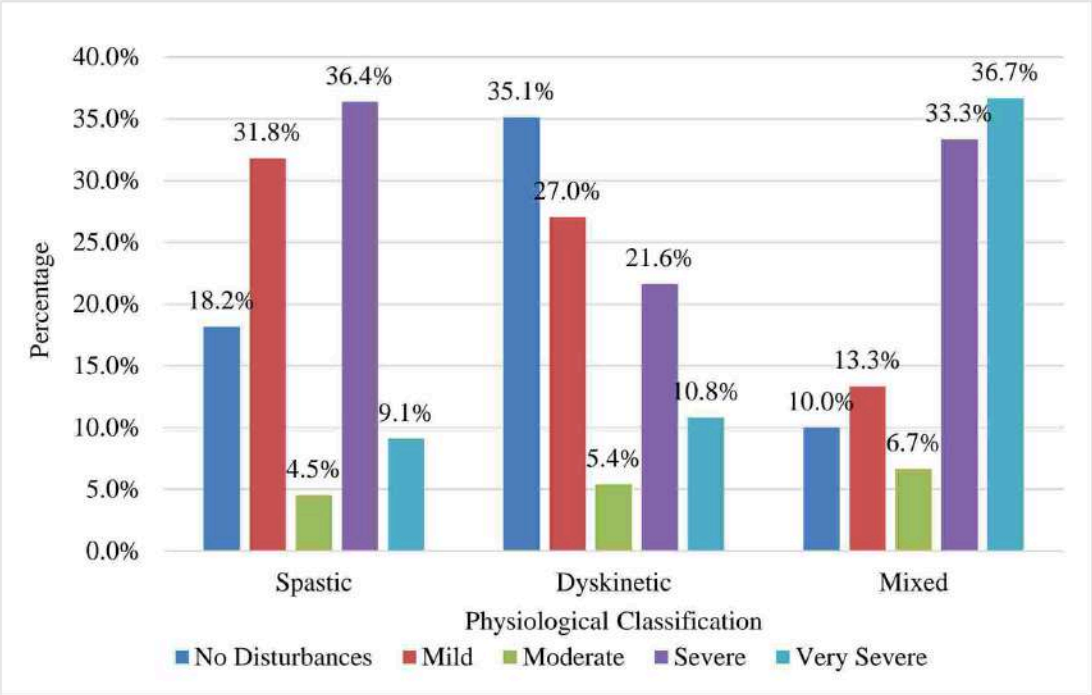

Figure 21: Cluster bar chart of comparison of SBD T-score across physiological classification of CP (N=89)

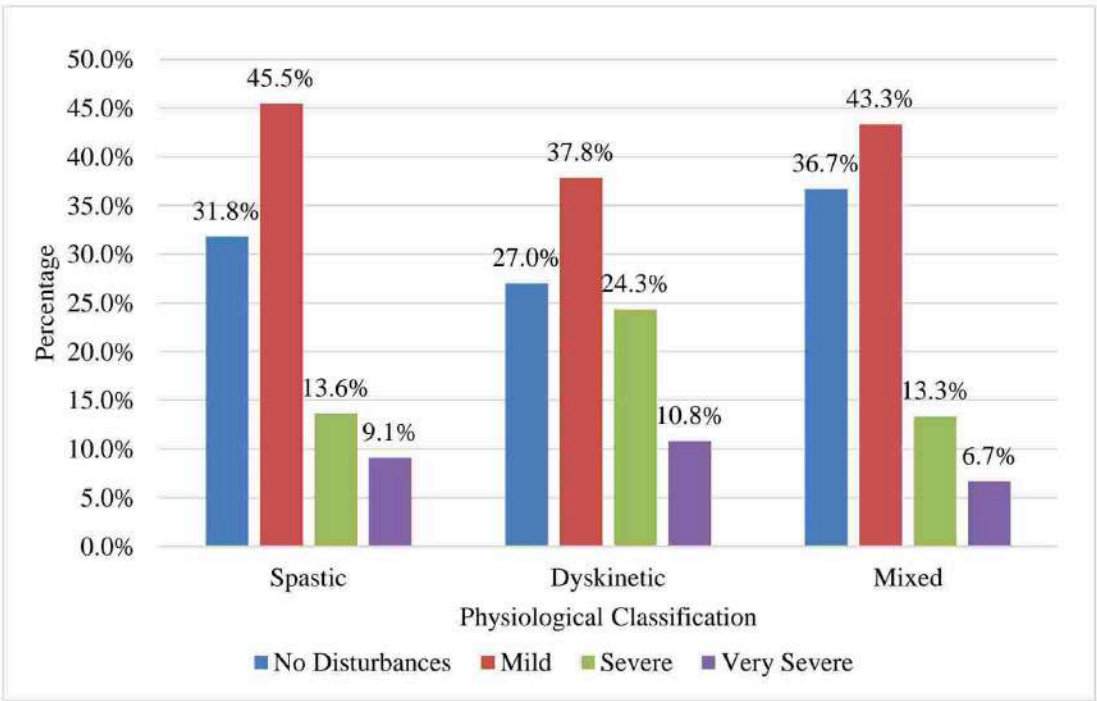

Figure 22: Cluster bar chart of comparison of DA T-score across physiological classification of CP (N=89)

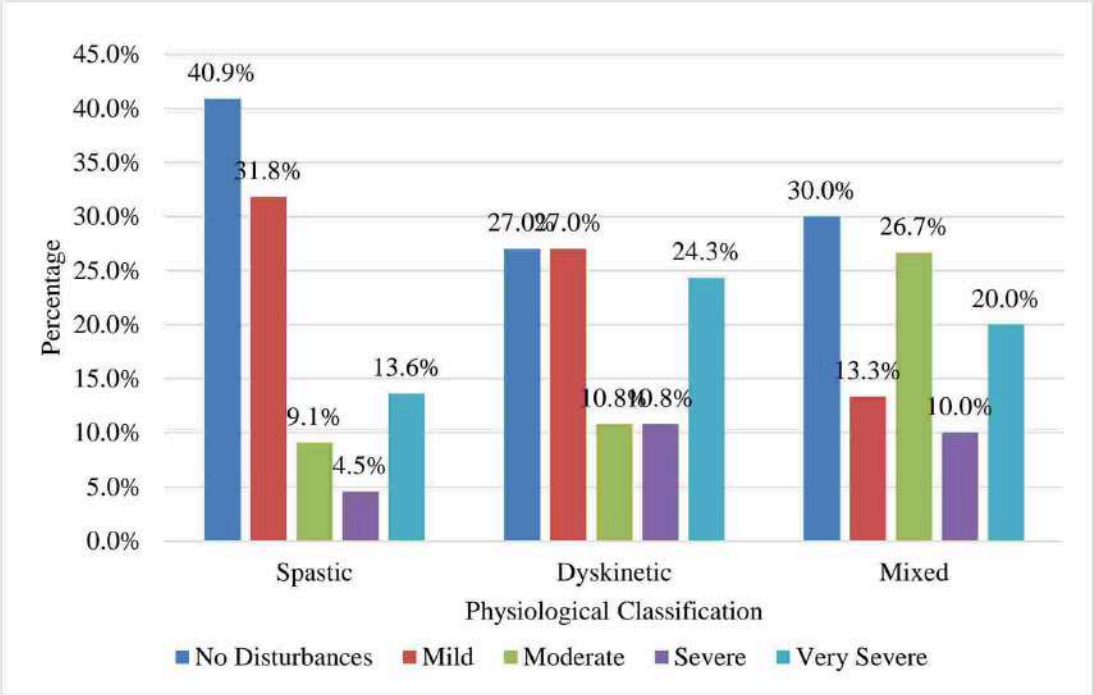

Figure 23: Cluster bar chart of comparison of SWTD T-score across physiological classification of CP (N=89)

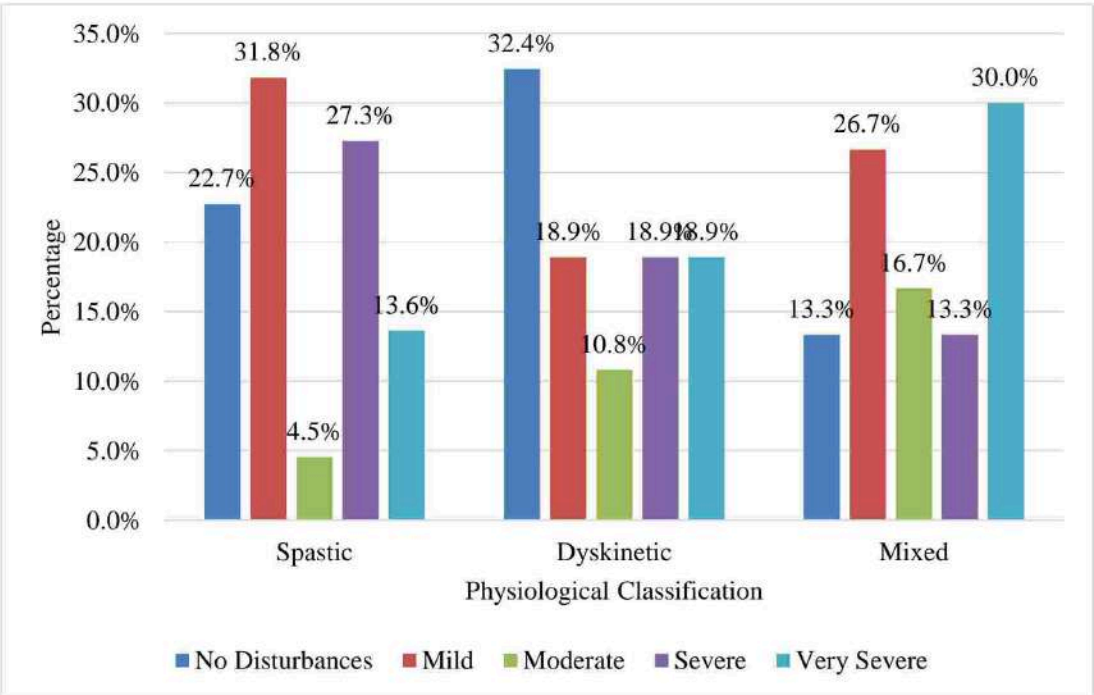

Figure 24: Cluster bar chart of comparison of DES T-score across physiological classification of CP(N=89)

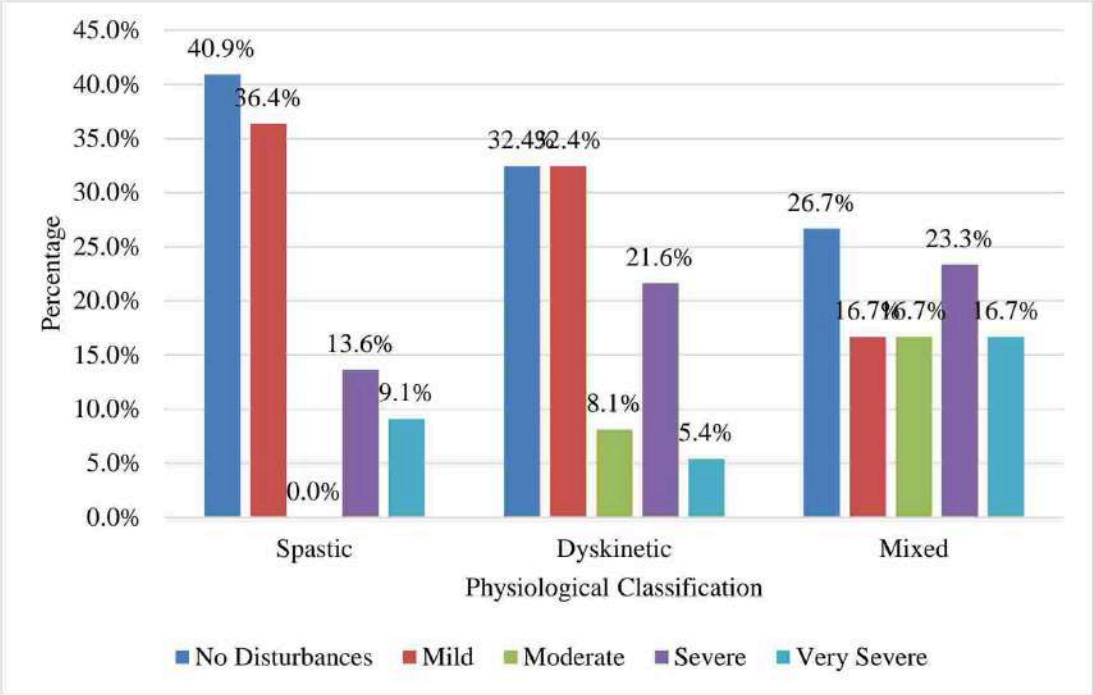

Figure 25: Cluster bar chart of comparison of SHY T-score across physiological classification of CP (N=89)

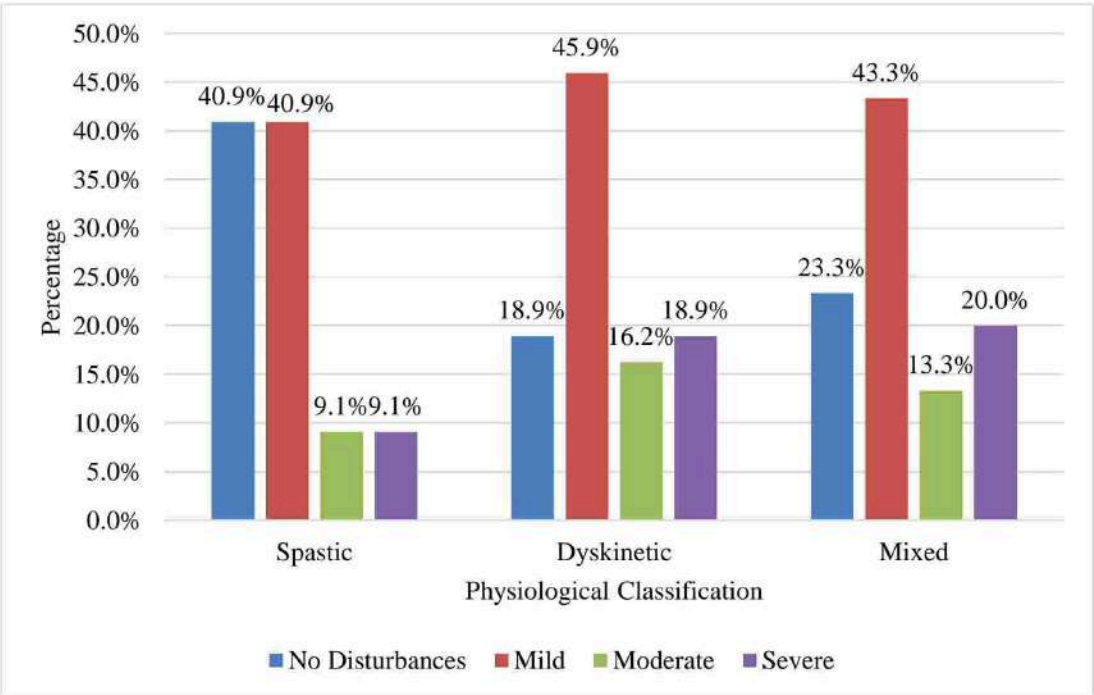

Figure 26: Cluster bar chart of comparison of Total T-score across physiological classification of CP (N=89)

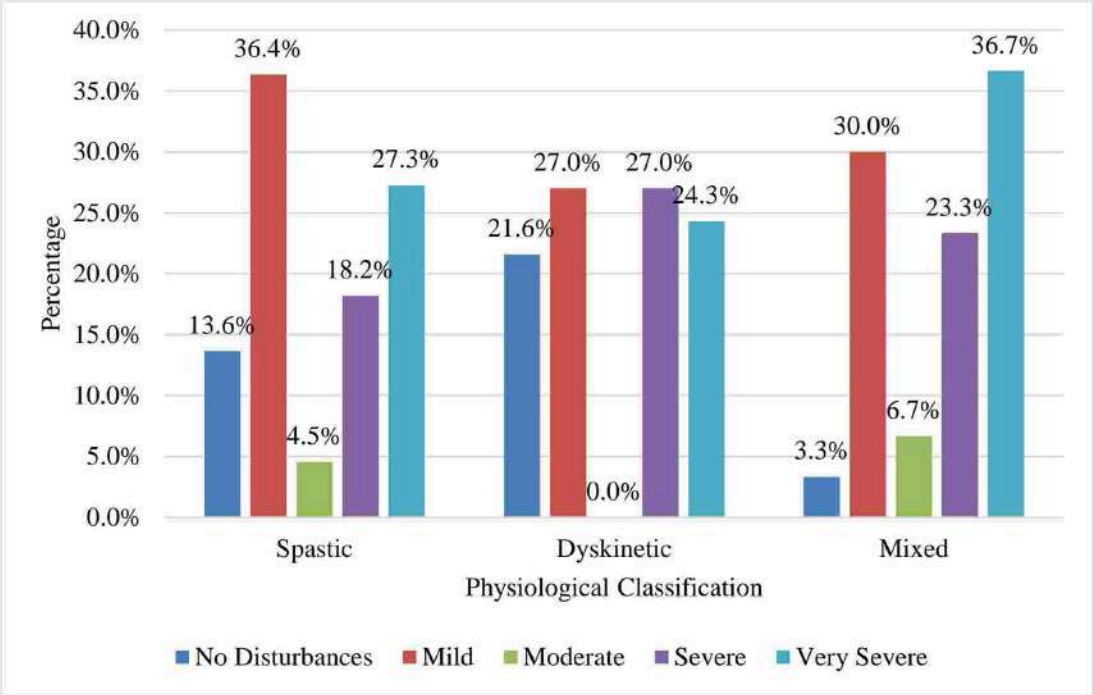

Table 16: Comparison of mean T scores of sleep disturbance scale with topographical classification of CP(n=89)

Mean T Score	Topographical Classification of CP (Mean ± SD)			ANOVA (P Value)
	Hemiparetic (N=7)	Diplegic (N=11)	Quadriparetic (N=71)	
DIMS score	58.86 ± 15.72	59.91 ± 14.72	73.55 ± 19.13	0.019
SBD score	51.43 ± 8.26	56.55 ± 14.31	62.52 ± 17.97	0.179
DA score	50.14 ± 5.37	59 ± 17.13	69.56 ± 19.66	0.014
SWTD score	61.14 ± 13.04	53.82 ± 10.64	72.41 ± 19.66	0.005
DES score	48.29 ± 5.09	55.55 ± 6.95	66.97 ± 16.52	0.002
SHY score	54.43 ± 15.58	54 ± 10.04	60.41 ± 12.19	0.160
TOTAL score	57.29 ± 14.07	59.82 ± 11.93	77.45 ± 19.85	0.001

The table compares the mean T scores of the sleep disturbance scale between topographical classifications of CP. The mean DIMS T score was significantly higher in the quadriparetic CP group (73.55 ± 19.13) compared to hemiparetic CP (58.86 ± 15.72) and diplegic CP (59.91 ± 14.72), with a statistically significant difference ($p = 0.019$).The mean DA (69.56 ± 19.66 vs. 50.14 ± 5.37 vs. 59 ± 17.13, $p = 0.014$), SWTD (72.41 ± 19.66 vs. 61.14 ± 13.04 vs. 53.82 ± 10.64, $p = 0.005$), and DES (66.97 ± 16.52 vs. 48.29 ± 5.09 vs. 55.55 ± 6.95, $p = 0.002$) scores were statistically significantly and higher in the quadriparetic group when compared to Diplegic and Hemiparetic groups. The mean total sleep disturbance T score was also significantly higher in the quadriparetic CP group (77.45 ± 19.85) compared to hemiparetic (57.29 ± 14.07) and diplegic CP (59.82 ± 11.93) ($p = 0.001$), with a statistically significant difference. However, the differences in SBD and SHY scores were not statistically significant.

Table 17: Comparison of individual type of sleep disturbance T score across topographical classification of CP (N=89)

Type of Sleep Disturbance	Topographical Classification of CP			Chi square	P value
	Hemiparetic (N=7)	Diplegic (N=11)	Quadriparetic (N=71)		
DIMS					
No Disturbances (38-50)	3 (42.86%)	3 (27.27%)	14 (19.72%)	11.366	0.182
Mild (51-65)	2 (28.57%)	5 (45.45%)	14 (19.72%)		
Moderate (66-71)	1 (14.29%)	1 (9.09%)	3 (4.23%)		
Severe (72-92)	1 (14.29%)	2 (18.18%)	23 (32.39%)		
Very Severe (92-100+)	0 (0%)	0 (0%)	17 (23.94%)		
SBD					
No Disturbances (38-50)	4 (57.14%)	5 (45.45%)	19 (26.76%)	7.089	0.313
Mild (51-65)	3 (42.86%)	3 (27.27%)	31 (43.66%)		
Severe (72-92)	0 (0%)	3 (27.27%)	13 (18.31%)		
Very Severe (92-100+)	0 (0%)	0 (0%)	8 (11.27%)		
DA					
No Disturbances (38-50)	5 (71.43%)	5 (45.45%)	18 (25.35%)	12.912	0.115
Mild (51-65)	2 (28.57%)	4 (36.36%)	15 (21.13%)		
Moderate (66-71)	0 (0%)	0 (0%)	14 (19.72%)		
Severe (72-92)	0 (0%)	1 (9.09%)	7 (9.86%)		
Very Severe (92-100+)	0 (0%)	1 (9.09%)	17 (23.94%)		
SWTD					
No Disturbances (38-50)	3 (42.86%)	6 (54.55%)	12 (16.9%)	13.702	0.090
Mild (51-65)	2 (28.57%)	3 (27.27%)	17 (23.94%)		

Moderate (66-71)	0 (0%)	1 (9.09%)	9 (12.68%)		
Severe (72-92)	2 (28.57%)	1 (9.09%)	14 (19.72%)		
Very Severe (92-100+)	0 (0%)	0 (0%)	19 (26.76%)		
DES					
No Disturbances (38-50)	6 (85.71%)	4 (36.36%)	19 (26.76%)		
Mild (51-65)	1 (14.29%)	7 (63.64%)	17 (23.94%)		
Moderate (66-71)	0 (0%)	0 (0%)	8 (11.27%)	21.582	0.006
Severe (72-92)	0 (0%)	0 (0%)	18 (25.35%)		
Very Severe (92-100+)	0 (0%)	0 (0%)	9 (12.68%)		
SHY					
No Disturbances (38-50)	4 (57.14%)	4 (36.36%)	15 (21.13%)		
Mild (51-65)	2 (28.57%)	6 (54.55%)	31 (43.66%)		
Moderate (66-71)	0 (0%)	0 (0%)	12 (16.9%)	7.949	0.242
Severe (72-92)	1 (14.29%)	1 (9.09%)	13 (18.31%)		
Total					
No Disturbances (38-50)	3 (42.86%)	2 (18.18%)	7 (9.86%)		
Mild (51-65)	2 (28.57%)	5 (45.45%)	20 (28.17%)		
Moderate (66-71)	0 (0%)	1 (9.09%)	2 (2.82%)	14.427	0.071
Severe (72-92)	2 (28.57%)	3 (27.27%)	16 (22.54%)		
Very Severe (92-100+)	0 (0%)	0 (0%)	26 (36.62%)		

Above table compares the individual type of sleep disturbance across topographical classification of CP.

Severity of DIMS Across Topographical Classification of CP:

Among children with hemiparetic CP (N=7), 1 case (14.29%) experienced severe T Scores in DIMS, while no cases (0%) fell into the very severe category. Similarly, among children with diplegic CP (N=11), 2 cases (18.18%) had severe T Scores, and no cases (0%) were in the very severe category. In the quadriparetic CP (N=71) group, 23 cases (32.39%) experienced severe T Scores, while 17 cases (23.94%) fell into the very severe category.

Severity of SBD Across Topographical Classification of CP:

Among children with hemiparetic CP (N=7), no cases (0%) experienced severe or very severe T-scores in SBD. Among children with diplegic CP (N=11), 3 cases (27.27%) had severe T Scores, and no cases (0%) were in the very severe category. In the quadriparetic CP (N=71) group, 13 cases (18.31%) experienced severe T Scores, while 8 cases (11.27%) fell into the very severe category.

Severity of DA Across Topographical Classification of CP:

Among children with hemiparetic CP (N=7), no cases (0%) experienced severe or very severe T-scores in DA. Among children with diplegic CP (N=11), 1 case (9.09%) had severe T Scores, and 1 case (9.09%) was in the very severe category. In the quadriparetic CP (N=71) group, 7 cases (9.86%) experienced severe T Scores, while 17 cases (23.94%) fell into the very severe category.

Severity of SWTD Across Topographical Classification of CP:

Among children with hemiparetic CP (N=7), 2 cases (28.57%) experienced severe T Scores in SWTD, while no cases (0%) fell into the very severe category. Among children with diplegic CP (N=11), 1 case (9.09%) had severe T Scores, and no cases (0%) were in the very severe category. In the quadriparetic CP (N=71) group, 14 cases (19.72%) experienced severe T Scores, while 19 cases (26.76%) fell into the very severe category.

Severity of DES Across Topographical Classification of CP:

Among children with hemiparetic CP (N=7), No cases (0%) experienced severe or very severe T-scores in DES. Among children with diplegic CP (N=11), no cases (0%) had severe T Scores, and no cases (0%) were in the very severe category. In the quadriparetic CP (N=71) group, 18 cases (25.35%) experienced severe T Scores, while 9 cases (12.68%) fell into the very severe category. The analysis revealed a statistical significance in DES T scores across the topographical classification of CP (Chi-square = 21.582, P = 0.006).

Severity of SHY Across Topographical Classification of CP:

Among children with hemiparetic CP (N=7), 1 case (14.29%) experienced severe T Scores in SHY. Among children with diplegic CP (N=11), 1 case (9.09%) had severe T Scores. In the quadriparetic CP (N=71) group, 13 cases (18.31%) experienced severe T Scores.

Severity of Total Sleep Disturbance Across Topographical Classification of CP:

Among children with hemiparetic CP (N=7), 2 cases (28.57%) experienced severe T Scores in total sleep disturbance, while no cases (0%) fell into the very severe category. Among children with diplegic CP (N=11), 3 cases (27.27%) had severe T Scores, and no cases (0%) were in the very severe category. In the quadriparetic CP (N=71) group, 16 cases (22.54%) experienced severe T Scores, while 26 cases (36.62%) fell into the very severe category.

The analysis revealed a statistical significance in DES T scores across the various topographical classification of CP, the quadriparetic group having most cases with severe and very severe score. (Chi-square = 21.582, P = 0.06)

Figure 27: Cluster bar chart of comparison of DIMS T-score across topographical classification of CP (N=89)

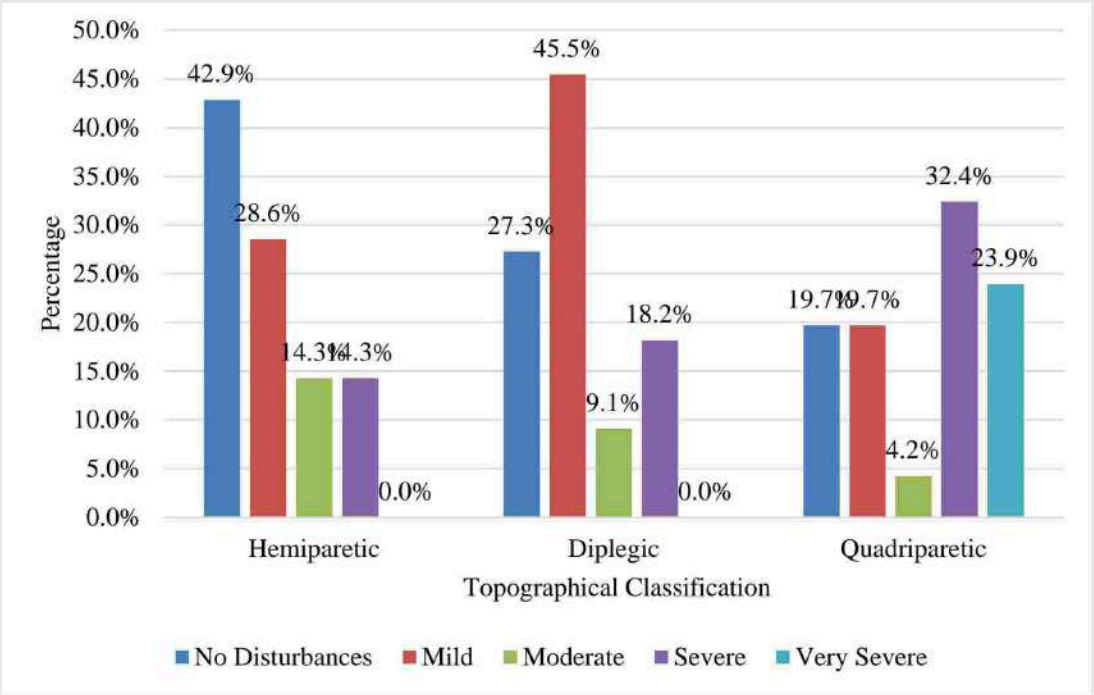

Figure 28: Cluster bar chart of comparison of SBD T-score across topographical classification of CP (N=89)

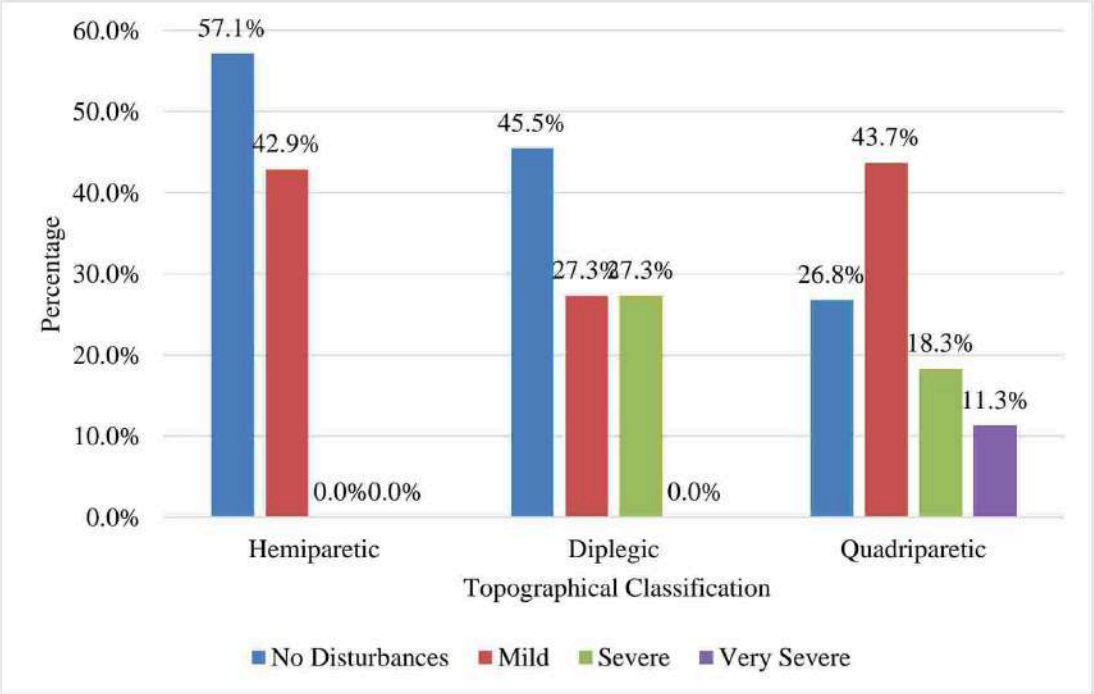

Figure 29: Cluster bar chart of comparison of DA T-score across topographical classification of CP (N=89)

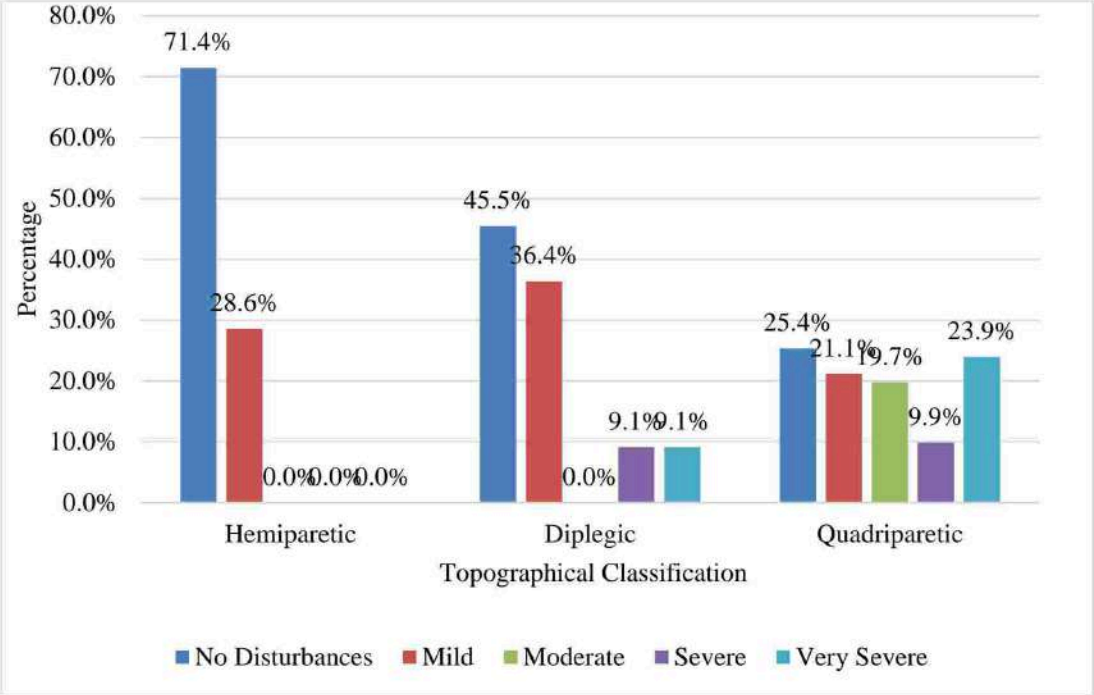

Figure 30: Cluster bar chart of comparison of SWTD T-score across topographical classification of CP (N=89)

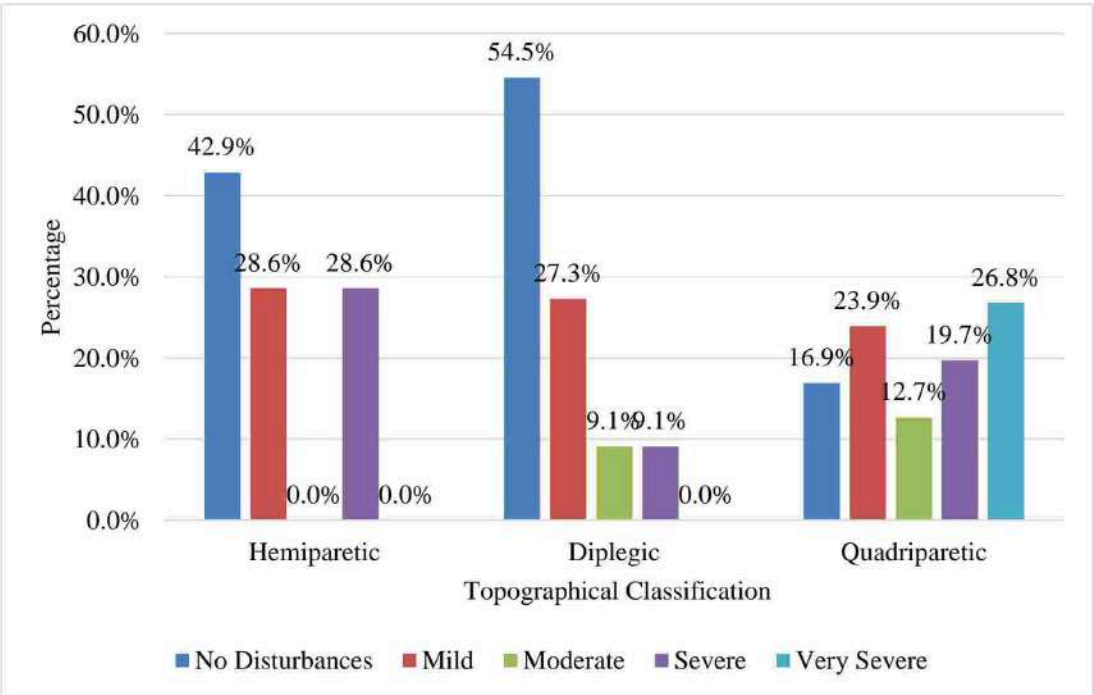

Figure 31: Cluster bar chart of comparison of DES T-score across topographical classification of CP (N=89)

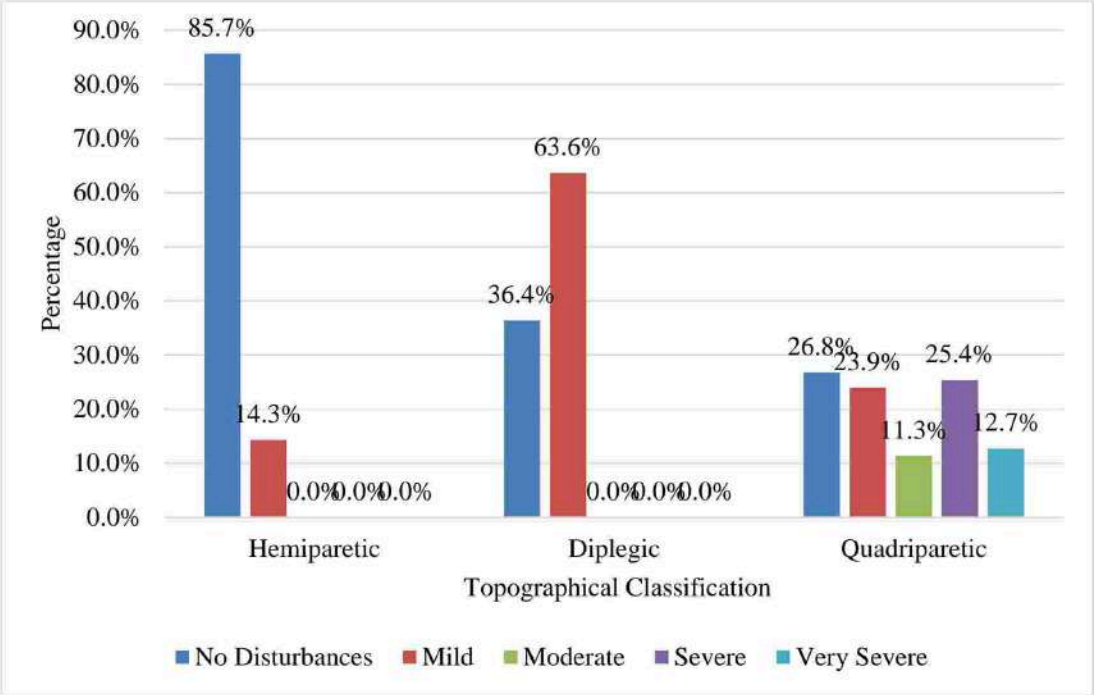

Figure 32: Cluster bar chart of comparison of SHY T-score across topographical classification of CP (N=89)

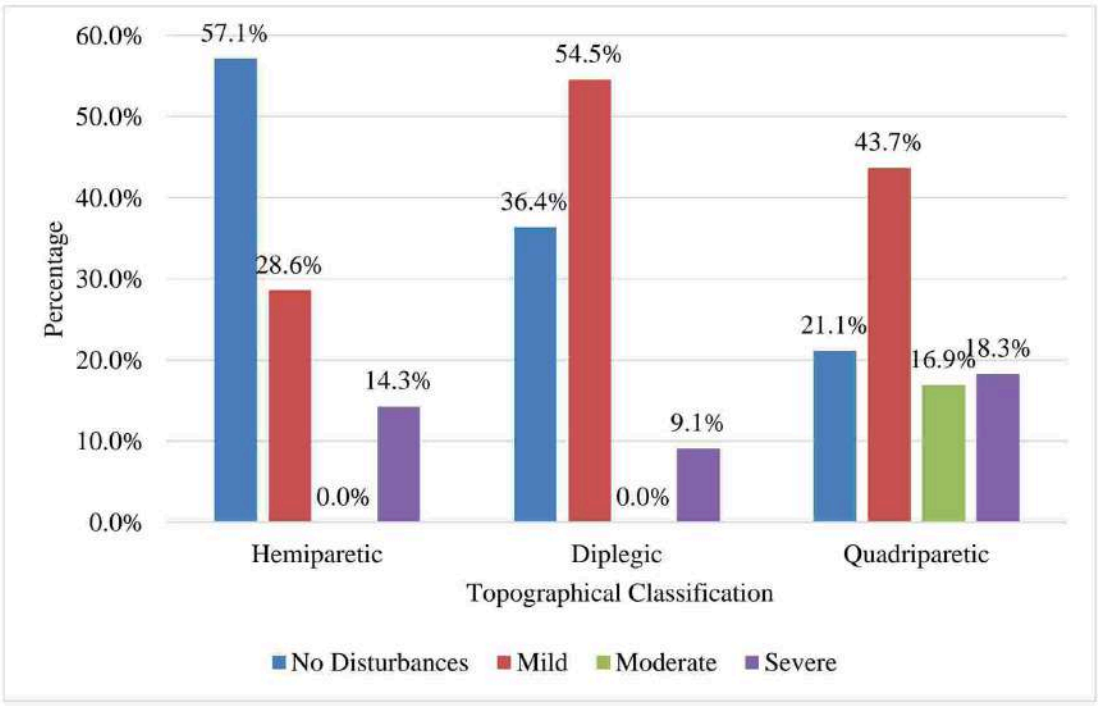

Figure 33: Cluster bar chart of comparison of Total T-score across topographical classification of CP (N=89)

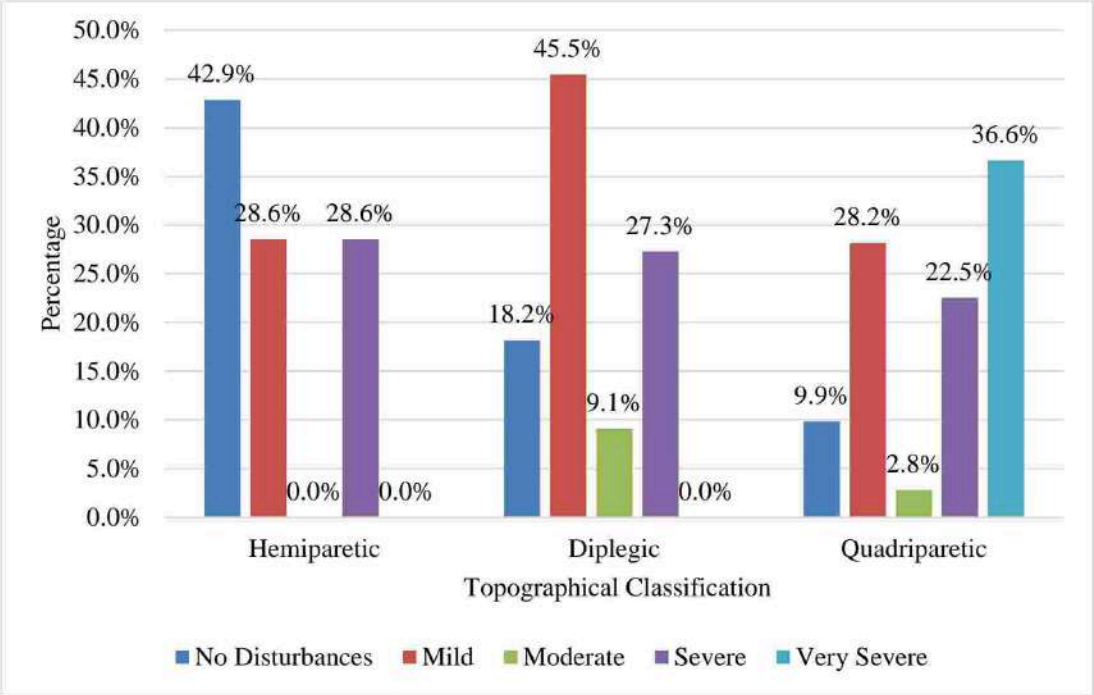

Table 18: Comparison of mean T scores of sleep disturbance scale with GMFCS of CP (N=89)

Mean T Score	GMFCS of CP (Mean ± SD)					ANOVA (P Value)
	I (N=7)	II (N=23)	III (N=14)	IV (N=14)	V (N=31)	
DIMS score	51.14 ± 7.6	58.87 ± 13.64	63.43 ± 17.86	70.21 ± 14.93	87.42 ± 13.32	<0.001
SBD score	50.71 ± 12.67	54.17 ± 12.56	58.71 ± 15.33	55.21 ± 14.59	71.77 ± 18.15	<0.001
DA score	53.43 ± 8.96	60.13 ± 13.15	64.43 ± 20.92	69 ± 19.07	74.65 ± 21.82	0.019
SWTD score	53.29 ± 12.49	58.48 ± 12.93	59.21 ± 17.16	67.79 ± 15.05	85.97 ± 15.33	<0.001
DES score	54.14 ± 13.68	52.87 ± 8.67	58.79 ± 10.69	64.36 ± 14.04	76.94 ± 15.23	<0.001
SHY score	60 ± 13.94	55.13 ± 11.27	54.57 ± 12.4	56.21 ± 10.41	65.32 ± 11.68	0.009
TOTAL score	55.43 ± 11.56	59.87 ± 12.7	67.29 ± 19.03	72.43 ± 15.23	91.52 ± 14.1	<0.001

The table compares the mean T scores of the sleep disturbance scale between GMFCS classifications of CP. The mean DIMS T score was significantly higher in the GMFCS V group (87.42 ± 13.32) compared to other groups and the difference was statistically significant ($p < 0.001$). The mean SBD ($p < 0.001$), mean DA ($p = 0.019$),mean SWTD ($p < 0.001$),mean DES ($p < 0.001$), and mean SHY ($p = 0.009$) scores were also statistically significant . The mean total sleep disturbance T score was significantly higher in GMFCS V (91.52 ± 14.1) and the difference being statistically significant ($p < 0.001$).

Table 19: Comparison of individual type of sleep disturbance across GMFCS of CP(N=89)

Type of Sleep Disturbance	GMFCS of CP					Chi square	P value
	I (N=7)	II (N=23)	III (N=14)	IV (N=14)	V (N=31)		
DIMS							
No Disturbances (38-50)	4 (57.14%)	8 (34.78%)	5 (35.71%)	2 (14.29%)	1 (3.23%)	48.86	<0.001
Mild (51-65)	2 (28.57%)	10 (43.48%)	3 (21.43%)	4 (28.57%)	2 (6.45%)		
Moderate (66-71)	1 (14.29%)	1 (4.35%)	2 (14.29%)	1 (7.14%)	0 (0%)		
Severe (72-92)	0 (0%)	4 (17.39%)	3 (21.43%)	5 (35.71%)	14 (45.16%)		
Very Severe (92-100+)	0 (0%)	0 (0%)	1 (7.14%)	2 (14.29%)	14 (45.16%)		
SBD							
No Disturbances (38-50)	5 (71.43%)	11 (47.83%)	4 (28.57%)	5 (35.71%)	3 (9.68%)	25.72	0.012
Mild (51-65)	1 (14.29%)	9 (39.13%)	7 (50%)	8 (57.14%)	12 (38.71%)		
Severe (72-92)	1 (14.29%)	3 (13.04%)	2 (14.29%)	0 (0%)	10 (32.26%)		
Very Severe (92-100+)	0 (0%)	0 (0%)	1 (7.14%)	1 (7.14%)	6 (19.35%)		
DA							
No Disturbances (38-50)	4 (57.14%)	7 (30.43%)	6 (42.86%)	4 (28.57%)	7 (22.58%)	18.28	0.308
Mild (51-65)	2 (28.57%)	9 (39.13%)	3 (21.43%)	2 (14.29%)	5 (16.13%)		
Moderate (66-71)	1 (14.29%)	5 (21.74%)	1 (7.14%)	3 (21.43%)	4 (12.9%)		
Severe (72-92)	0 (0%)	1 (4.35%)	1 (7.14%)	2 (14.29%)	4 (12.9%)		
Very Severe (92-100+)	0 (0%)	1 (4.35%)	3 (21.43%)	3 (21.43%)	11 (35.48%)		
SWTD							
No Disturbances (38-50)	5 (71.43%)	8 (34.78%)	5 (35.71%)	2 (14.29%)	1 (3.23%)	49.04	<0.001

Mild (51-65)	1 (14.29%)	9 (39.13%)	5 (35.71%)	5 (35.71%)	2 (6.45%)		
Moderate (66-71)	0 (0%)	3 (13.04%)	2 (14.29%)	2 (14.29%)	3 (9.68%)		
Severe (72-92)	1 (14.29%)	2 (8.7%)	1 (7.14%)	4 (28.57%)	9 (29.03%)		
Very Severe (92-100+)	0 (0%)	1 (4.35%)	1 (7.14%)	1 (7.14%)	16 (51.61%)		
DES							
No Disturbances (38-50)	4 (57.14%)	15 (65.22%)	6 (42.86%)	2 (14.29%)	2 (6.45%)	41.57	<0.001
Mild (51-65)	1 (14.29%)	6 (26.09%)	5 (35.71%)	7 (50%)	6 (19.35%)		
Moderate (66-71)	1 (14.29%)	1 (4.35%)	1 (7.14%)	1 (7.14%)	4 (12.9%)		
Severe (72-92)	1 (14.29%)	1 (4.35%)	2 (14.29%)	3 (21.43%)	11 (35.48%)		
Very Severe (92-100+)	0 (0%)	0 (0%)	0 (0%)	1 (7.14%)	8 (25.81%)		
SHY							
No Disturbances (38-50)	2 (28.57%)	8 (34.78%)	6 (42.86%)	3 (21.43%)	4 (12.9%)	21.25	0.047
Mild (51-65)	4 (57.14%)	12 (52.17%)	5 (35.71%)	7 (50%)	11 (35.48%)		
Moderate (66-71)	0 (0%)	1 (4.35%)	2 (14.29%)	4 (28.57%)	5 (16.13%)		
Severe (72-92)	1 (14.29%)	2 (8.7%)	1 (7.14%)	0 (0%)	11 (35.48%)		
Total							
No Disturbances (38-50)	3 (42.86%)	7 (30.43%)	1 (7.14%)	0 (0%)	1 (3.23%)	58.41	<0.001
Mild (51-65)	2 (28.57%)	10 (43.48%)	7 (50%)	7 (50%)	1 (3.23%)		
Moderate (66-71)	1 (14.29%)	0 (0%)	1 (7.14%)	0 (0%)	1 (3.23%)		
Severe (72-92)	1 (14.29%)	6 (26.09%)	2 (14.29%)	5 (35.71%)	7 (22.58%)		
Very Severe (92-100+)	0 (0%)	0 (0%)	3 (21.43%)	2 (14.29%)	21 (67.74%)		

Above table compares the individual type of sleep disturbance across Gross Motor Function Classification System of CP

Severity of DIMS Across GMFCS of CP:

Among children with GMFCS I (N=7), no cases had severe or very severe T Scores. In GMFCS II (N=23), 4 cases (17.39%) had severe T Scores, with none in the very severe category. GMFCS III (N=14) had 3 cases (21.43%) with severe scores and 1 case (7.14%) with very severe score. GMFCS IV (N=14) had 5 cases (35.71%) with severe and 2 cases (14.29%) with very severe scores. GMFCS V (N=31) had the highest occurrence, with 14 cases (45.16%) each in both severe and very severe categories. The analysis revealed statistical significance (Chi-square = 48.86, P <0.001).

Severity of SBD Across GMFCS of CP:

GMFCS I (N=7) had 1 case (14.29%) with severe T Scores, with none in the very severe category. GMFCS II (N=23) had 3 cases (13.04%) with severe scores and none in the very severe category. GMFCS III (N=14) had 2 cases (14.29%) with severe scores and 1 case (7.14%) with very severe scores. GMFCS IV (N=14) had no severe cases and 1 case (7.14%) with very severe scores. GMFCS V (N=31) had 10 cases (32.26%) with severe and 6 cases (19.35%) with very severe scores. Statistical significance was observed (Chi-square = 25.72, P = 0.012).

Severity of DA Across GMFCS of CP:

GMFCS I (N=7) had no cases of severe or very severe scores. GMFCS II (N=23) had 1 case (4.35%) in both severe and very severe categories. GMFCS III (N=14) had 1 case (7.14%) with severe and 3 cases (21.43%) with very severe scores. GMFCS IV (N=14) had 2 cases (14.29%) with severe and 3 cases (21.43%) with very severe scores. GMFCS V (N=31) had 4 cases (12.9%) with severe and 11 cases

(35.48%) with very severe scores. No statistical significance was observed (Chi-square = 18.28, P = 0.308).

Severity of SWTD Across GMFCS of CP:

GMFCS I (N=7) had 1 case (14.29%) with severe scores and none in the very severe category. GMFCS II (N=23) had 2 cases (8.7%) with severe and 1 case (4.35%) with very severe scores. GMFCS III (N=14) had 1 case (7.14%) with severe and 1 case (7.14%) with very severe scores. GMFCS IV (N=14) had 4 cases (28.57%) with severe and 1 case (7.14%) with very severe scores. GMFCS V (N=31) had 9 cases (29.03%) with severe and 16 cases (51.61%) with very severe scores. Statistical significance was observed (Chi-square = 49.04, P <0.001).

Severity of DES Across GMFCS of CP:

GMFCS I (N=7) had 1 case (14.29%) with severe scores, with none in the very severe category. GMFCS II (N=23) had 1 case (4.35%) with severe scores, with none in the very severe category. GMFCS III (N=14) had 2 cases (14.29%) with severe scores and none in the very severe category. GMFCS IV (N=14) had 3 cases (21.43%) with severe and 1 case (7.14%) with very severe scores. GMFCS V (N=31) had 11 cases (35.48%) with severe and 8 cases (25.81%) with very severe scores. Statistical significance was observed (Chi-square = 41.57, P <0.001).

Severity of SHY Across GMFCS of CP:

GMFCS I (N=7) had 1 case (14.29%) with severe scores. GMFCS II (N=23) had 2 cases (8.7%) with severe scores. GMFCS III (N=14) had 1 case (7.14%) with severe scores. GMFCS IV (N=14) had no cases in the severe category. GMFCS V

(N=31) had 11 cases (35.48%) with severe scores. Statistical significance was observed (Chi-square = 21.25, P = 0.047).

Severity of Total Sleep Disturbance Across GMFCS of CP:

GMFCS I (N=7) had 1 case (14.29%) with severe scores and none in the very severe category. GMFCS II (N=23) had 6 cases (26.09%) with severe scores and none in the very severe category. GMFCS III (N=14) had 2 cases (14.29%) with severe and 3 cases (21.43%) with very severe scores. GMFCS IV (N=14) had 5 cases (35.71%) with severe and 2 cases (14.29%) with very severe scores. GMFCS V (N=31) had 7 cases (22.58%) with severe and 21 cases (67.74%) with very severe scores. Statistical significance was observed (Chi-square = 58.41, P <0.001).

The analysis revealed a statistical significance in Total Sleep Disturbance T scores across the various GMFCS classification of CP (Chi-square = 58.41, P < 0.001) with GMFCS having the highest T scores. Significant differences were observed in the severity of DIMS (P < 0.001), SBD (P = 0.012), SWTD (P < 0.001), DES (P < 0.001), and SHY (P = 0.047) across GMFCS levels having a greater number of severe and very severe scores in GMFCS V.

Figure 34: Cluster bar chart of comparison of DIMS T-score across GMFCS classification of CP (N=89)

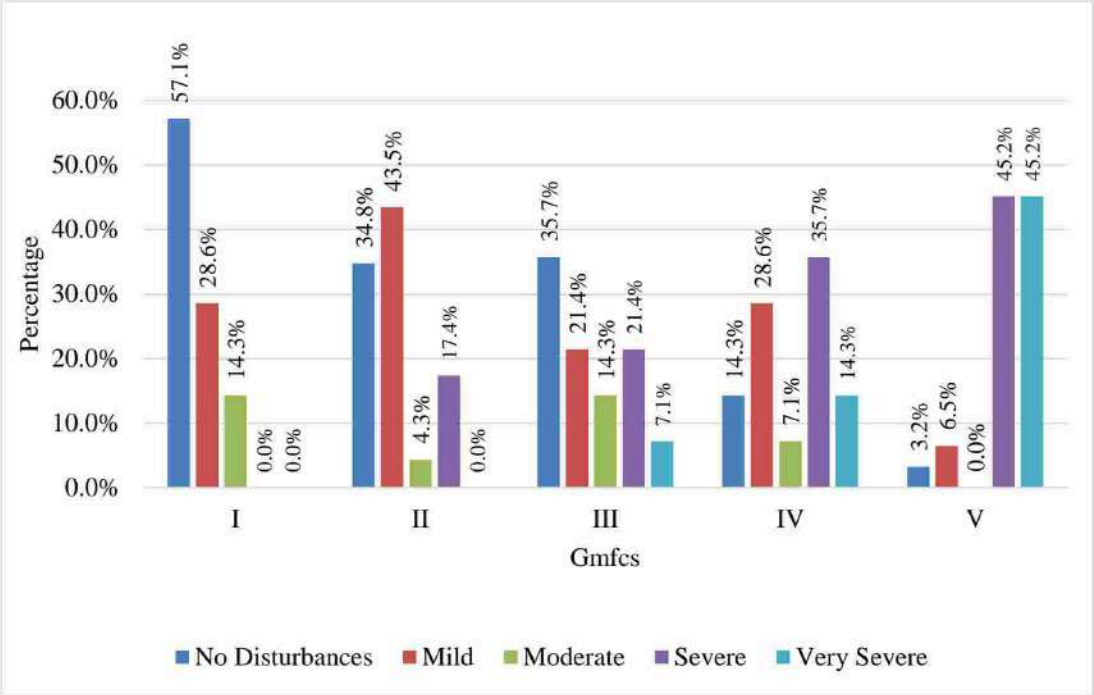

Figure 35: Cluster bar chart of comparison of SBD T-score across GMFCS classification of CP (N=89)

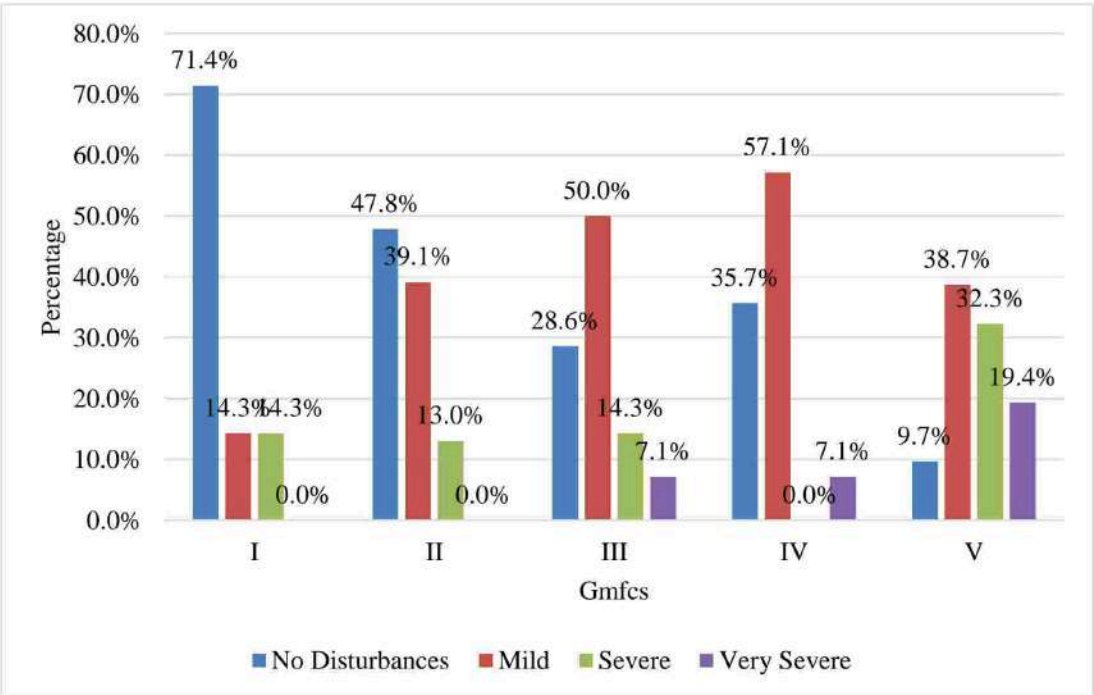

Figure 36: Cluster bar chart of comparison of DA T-score across GMFCS classification of CP (N=89)

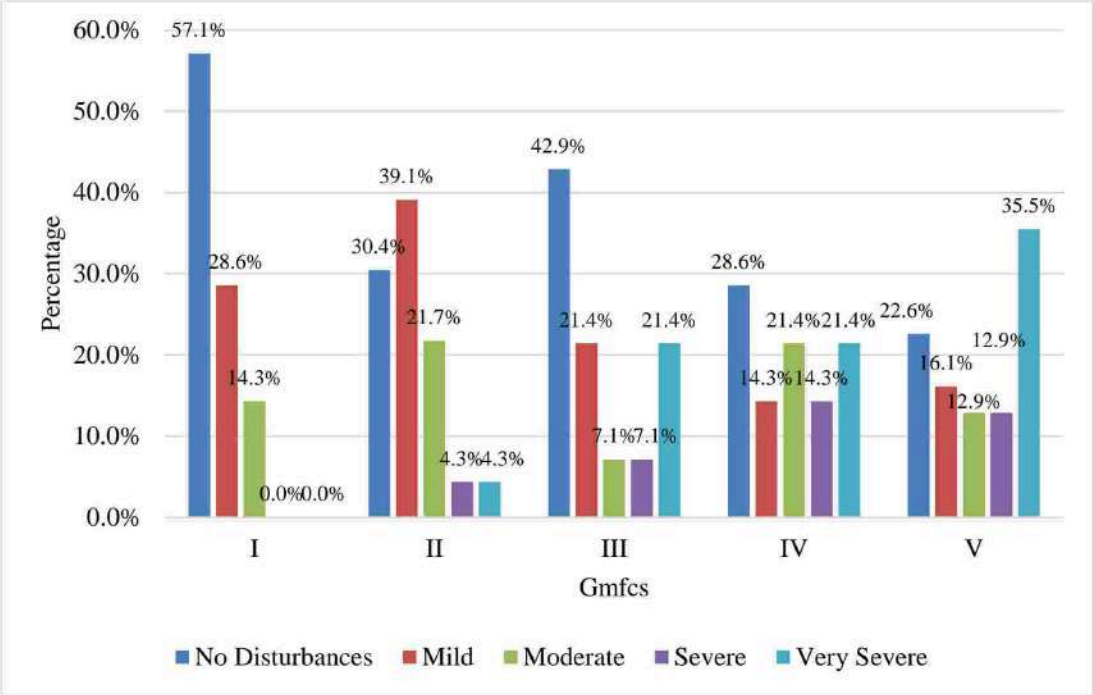

Figure 37: Cluster bar chart of comparison of SWTD T-score across GMFCS classification of CP (N=89)

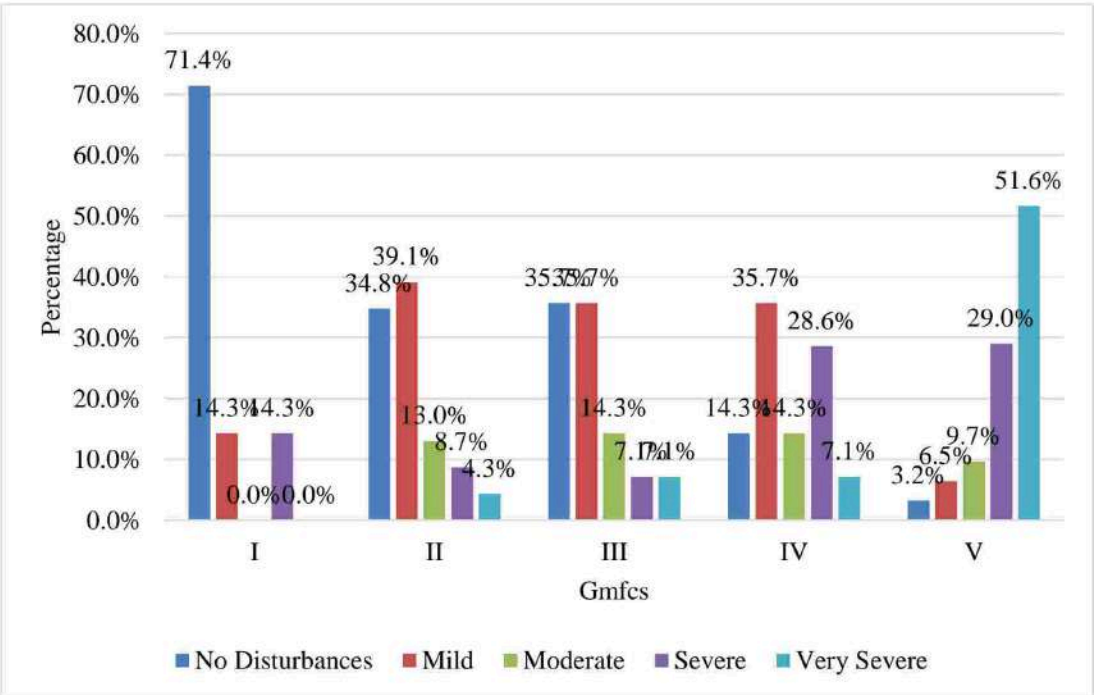

Figure 38: Cluster bar chart of comparison of DES T-score across GMFCS classification of CP (N=89)

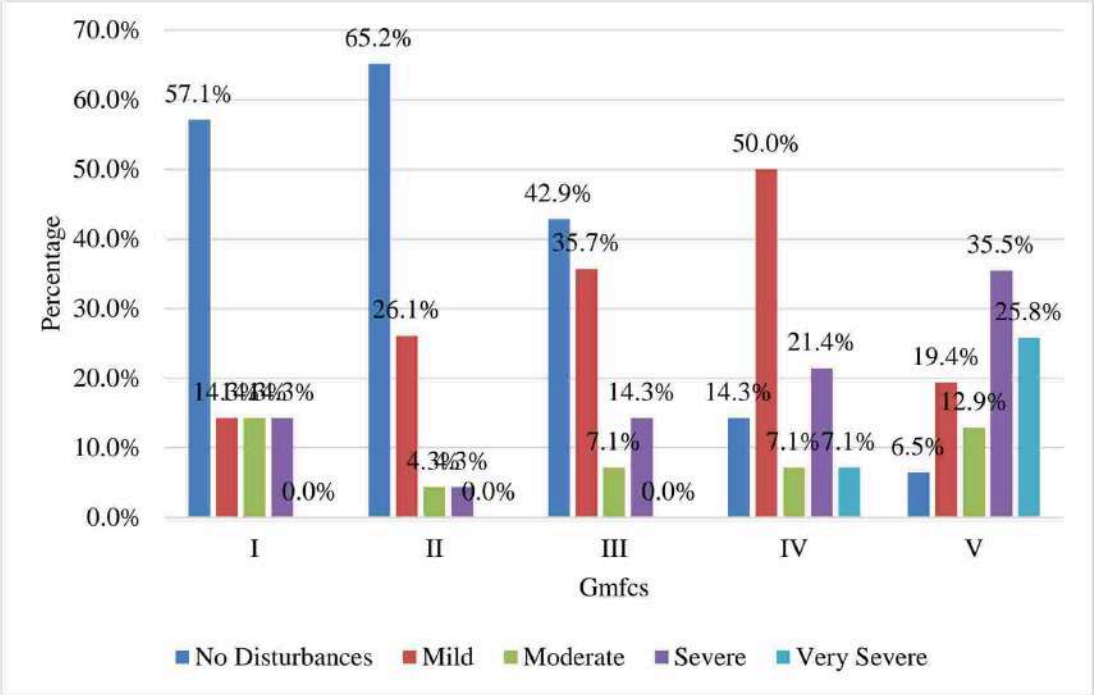

Figure 39: Cluster bar chart of comparison of SHY T-score across GMFCS classification of CP (N=89)

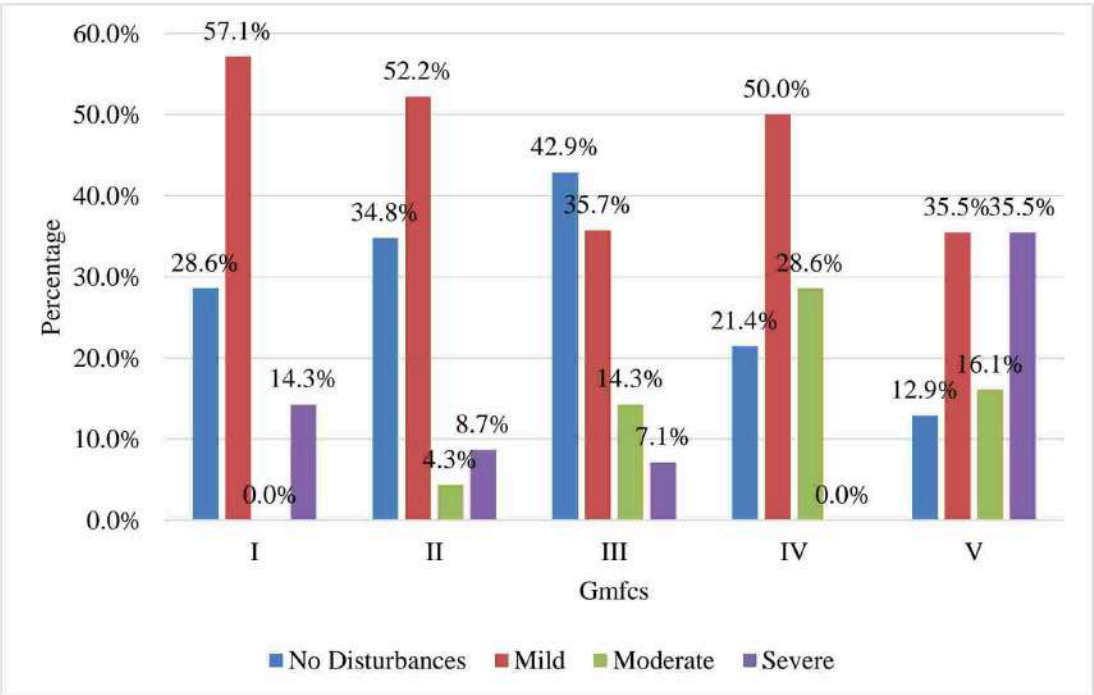

Figure 40: Cluster bar chart of comparison of Total T-score across GMFCS of CP (N=89)

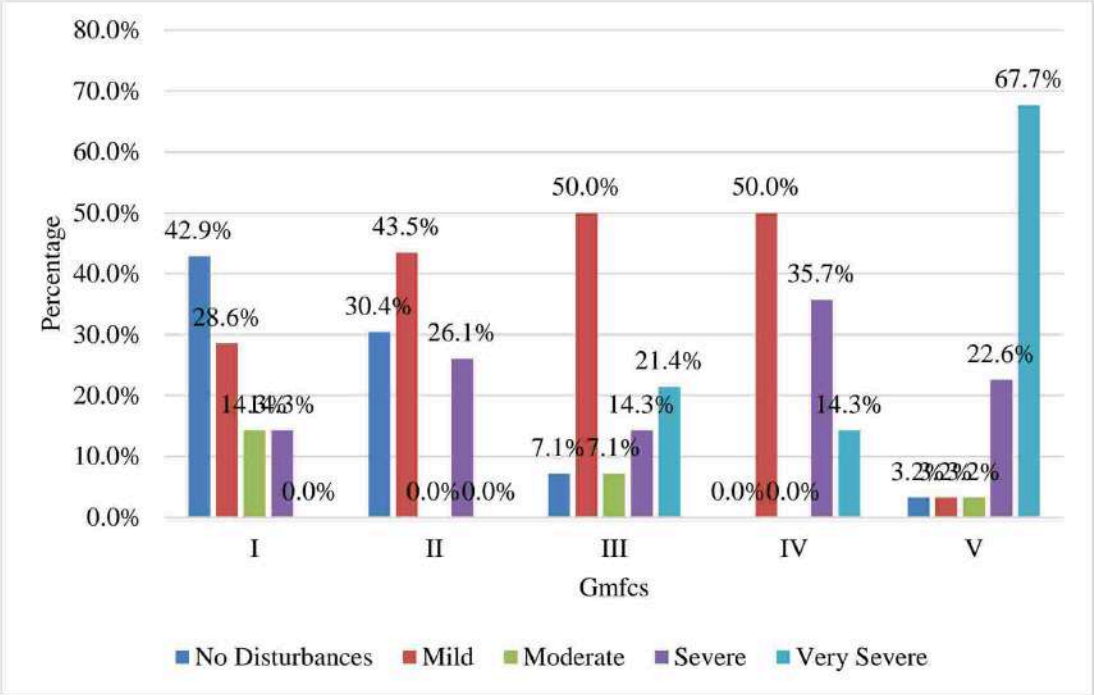

Table 20: Comparison of mean T scores of sleep disturbance scale with VFCS of CP (N=89)

Mean T Score	VFCS of CP (Mean ± SD)					ANOVA (P Value)
	I (N=14)	II (N=27)	III (N=10)	IV (N=21)	V (N=17)	
DIMS score	59.21 ± 14.06	61.89 ± 16.89	73.2 ± 19.66	80.14 ± 16.63	81.06 ± 18.4	<0.001
SBD score	52.93 ± 11.57	58.04 ± 15.35	61.1 ± 19.58	63.48 ± 17.97	68.76 ± 19.39	0.097
DA score	53.36 ± 7.28	63.7 ± 17.26	67.2 ± 18.78	75.9 ± 21.9	70.94 ± 21.34	0.010
SWTD score	55.21 ± 12.46	64.85 ± 17.33	73 ± 23.5	76.05 ± 18.92	77.06 ± 18.73	0.004
DES score	53.64 ± 9.54	56 ± 10.94	72.3 ± 19.17	72.14 ± 15.99	70.76 ± 15.96	<0.001
SHY score	54.07 ± 13.18	55.74 ± 11.21	61.6 ± 9.29	60.9 ± 12.07	65.12 ± 13.26	0.052
TOTAL score	58.21 ± 12.01	65.56 ± 18.02	76.6 ± 20.99	84.52 ± 15.87	84.24 ± 19.85	<0.001

The table compares the mean T scores of the sleep disturbance scale across different VFCS levels in CP. The mean DIMS T score was significantly higher in the VFCS V group (81.06 ± 18.4) compared to other groups, and the difference was statistically significant ($p < 0.001$). The mean DA ($p = 0.010$), mean SWTD ($p = 0.004$), and mean DES ($p < 0.001$) scores were also statistically significant. The mean total sleep disturbance T score was significantly higher in VFCS IV (84.52 ± 15.87) and VFCS V (84.24 ± 19.85), with the difference being statistically significant ($p < 0.001$).

Table 21: Comparison of mean T scores of sleep disturbance scale between CFCS of CP (N=89)

Mean T Score	CFCS of CP (Mean ± SD)					ANOVA (P Value)
	I (N=10)	II (N=23)	III (N=22)	IV (N=12)	V (N=22)	
DIMS	61.8 ± 16.29	54.04 ± 9.25	72.86 ± 19.2	82.25 ± 11.57	83.73 ± 16.93	<0.001
SBD	58.3 ± 16.08	52.7 ± 10.09	61.68 ± 18.01	58.25 ± 14.73	71.36 ± 19.76	0.006
DA	52.6 ± 8.02	60.7 ± 13.73	70.73 ± 20.05	72.83 ± 22.24	72.14 ± 22.28	0.020
SWTD	63.2 ± 17.07	56.74 ± 9.96	70.14 ± 20.99	75.67 ± 18.53	80.59 ± 19.33	<0.001
DES	53.3 ± 7.78	54.09 ± 9.87	66.86 ± 17.93	74.67 ± 17.31	70.91 ± 14.05	<0.001
SHY	59.6 ± 15.95	53.35 ± 8.83	56.91 ± 10.51	63.17 ± 12.68	65.05 ± 12.9	0.014
TOTAL	63.5 ± 15.2	56.65 ± 8.92	75.73 ± 21.74	84.42 ± 14.36	88.23 ± 15.96	<0.001

The table compares the mean T scores of the sleep disturbance scale across different CFCS levels in CP. The mean DIMS T score was significantly higher in the CFCS V group (83.73 ± 16.93) compared to other groups, and the difference was statistically significant ($p < 0.001$). The mean SBD ($p = 0.006$), mean DA ($p = 0.020$), mean SWTD ($p < 0.001$), mean DES ($p < 0.001$), and mean SHY ($p = 0.014$) scores were also statistically significant. The mean total sleep disturbance T score was significantly higher in CFCS IV (84.42 ± 14.36) and CFCS V (88.23 ± 15.96), with the difference being statistically significant ($p < 0.001$).

Table 22: Comparison of mean T scores of sleep disturbance scale between MACS of CP(N=89)

Mean T Score	MACS of CP(Mean ± SD)					ANOVA (P Value)
	I (N=7)	II (N=30)	III (N=14)	IV (N=17)	V (N=21)	
DIMS	56.86 ± 15.7	60.6 ± 14.35	72.43 ± 20.76	79.06 ± 17.53	81.86 ± 17.17	<0.001
SBD	55.43 ± 12.26	52.63 ± 11.39	63.71 ± 18.54	68.82 ± 19.85	66.29 ± 18.18	0.006
DA	56.71 ± 10.32	61.77 ± 17.27	62.21 ± 16.55	78.29 ± 22.78	70.81 ± 19.77	0.018
SWTD	55.14 ± 9.94	58.4 ± 12.95	73.14 ± 19.79	79.71 ± 21.99	78.29 ± 17.33	<0.001
DES	54.29 ± 14.38	56.77 ± 12.9	64.36 ± 16.46	73.76 ± 15.4	69.81 ± 15.72	0.001
SHY	57.71 ± 7.36	54.37 ± 11.22	58.93 ± 12.93	62.94 ± 13.86	63.52 ± 11.96	0.061
TOTAL	58.57 ± 11.82	61.67 ± 14.72	74.86 ± 21.1	86.71 ± 16.68	84.57 ± 18.07	<0.001

The table compares the mean T scores of the sleep disturbance scale across different MACS levels in CP. The mean DIMS T score was significantly higher in the MACS V group (81.86 ± 17.17) compared to other groups, and the difference was statistically significant ($p < 0.001$). The mean SBD ($p = 0.006$), mean DA ($p = 0.018$), mean SWTD ($p < 0.001$), and mean DES ($p = 0.001$) scores were also statistically significant. The mean total sleep disturbance T score was significantly higher in MACS IV (86.71 ± 16.68) and MACS V (84.57 ± 18.07), with the difference being statistically significant ($p < 0.001$).

Table 23: Comparison of mean T scores of sleep disturbance scale between EDACS of CP (N=89)

Mean T Score	EDACS of CP(Mean ± SD)					ANOVA (P Value)
	I (N=12)	II (N=30)	III (N=21)	IV (N=14)	V (N=12)	
DIMS	58.33 ± 13.96	61.8 ± 17.34	76.52 ± 16.1	79.07 ± 18.24	85.42 ± 17.18	<0.001
SBD	51.33 ± 5.55	57.6 ± 14.14	62.24 ± 18.85	63.71 ± 18.34	73.17 ± 21.53	0.019
DA	51.67 ± 7.57	63.27 ± 16.02	73.38 ± 21.29	73.71 ± 22.17	70.67 ± 21.12	0.009
SWTD	54.5 ± 9.84	62.97 ± 16.29	75.67 ± 20.23	76.71 ± 22.64	79.58 ± 15.56	0.001
DES	50.5 ± 7.28	61.9 ± 15.78	66.24 ± 16.97	72.57 ± 16.85	69.5 ± 12.86	0.004
SHY	53.25 ± 10.56	56.37 ± 11.43	61.52 ± 12.15	61.5 ± 12.64	65.08 ± 13.9	0.077
TOTAL	55.67 ± 10.6	65.9 ± 17.53	80.29 ± 19.02	84.21 ± 18.58	87.33 ± 16.29	<0.001

The table compares the mean T scores of the sleep disturbance scale across different EDACS levels in CP. The mean DIMS T score was significantly higher in the EDACS V group (85.42 ± 17.18) compared to other groups, and the difference was statistically significant ($p < 0.001$). The mean SBD ($p = 0.019$), mean DA ($p = 0.009$), mean SWTD ($p = 0.001$), and mean DES ($p = 0.004$) scores were also statistically significant. The mean total sleep disturbance T score was significantly higher in EDACS IV (84.21 ± 18.58) and EDACS V (87.33 ± 16.29), with the difference being statistically significant ($p < 0.001$).

Table 24: Correlation of mean T Scores with domains of QOL for Children with CP(N=89)

Type of Sleep Disturbances vs Domains	Correlations	P-value
DIMS vs QOL		
D1 domain	-0.54	<0.001
D2 domain	-0.60	<0.001
D3 domain	-0.62	<0.001
D4 domain	-0.60	<0.001
D5 domain	-0.32	0.002
D6 domain	-0.04	0.694
D7 domain	-0.37	<0.001
SBD vs QOL		
D1 domain	-0.27	0.012
D2 domain	-0.41	<0.001
D3 domain	-0.39	<0.001
D4 domain	-0.40	<0.001
D5 domain	-0.24	0.024
D6 domain	0.06	0.570
D7 domain	-0.36	0.001
DA vs QOL		
D1 domain	-0.27	0.012
D2 domain	-0.35	0.001
D3 domain	-0.32	0.002
D4 domain	-0.33	0.001
D5 domain	-0.19	0.072
D6 domain	-0.18	0.087
D7 domain	-0.24	0.022
SWTD vs QOL		
D1 domain	-0.38	<0.001
D2 domain	-0.55	<0.001
D3 domain	-0.58	<0.001
D4 domain	-0.52	<0.001

D5 domain	-0.31	0.003
D6 domain	-0.03	0.785
D7 domain	-0.33	0.001
DES vs QOL		
D1 domain	-0.44	<0.001
D2 domain	-0.59	<0.001
D3 domain	-0.55	<0.001
D4 domain	-0.57	<0.001
D5 domain	-0.24	0.026
D6 domain	-0.02	0.867
D7 domain	-0.46	<0.001
SHY vs QOL		
D1 domain	-0.34	0.001
D2 domain	-0.38	<0.001
D3 domain	-0.37	<0.001
D4 domain	-0.51	<0.001
D5 domain	-0.11	0.313
D6 domain	0.01	0.901
D7 domain	-0.31	0.004
Total Score vs QOL		
D1 domain	-0.51	<0.001
D2 domain	-0.64	<0.001
D3 domain	-0.63	<0.001
D4 domain	-0.65	<0.001
D5 domain	-0.34	0.001
D6 domain	-0.07	0.507
D7 domain	-0.46	<0.001

The above table shows the correlation of mean T Scores with domains of QOL for children with CP.

DIMS vs QOL:

Mean DIMS (Disorders of Initiating and Maintaining Sleep) T Score shows a strong negative correlation with D2 domain (Feelings About Functioning) (-0.60, $p<0.001$), D3 domain (Participation and Physical Health) (-0.62, $p<0.001$), and D4 domain (Emotional Well-being and Self-esteem) (-0.60, $p<0.001$). Other domains also display significant moderate correlations, including D1 domain (-0.54, $p<0.001$) and D7 domain (-0.37, $p<0.001$). The correlation with D5 domain (Access to Services) is weaker (-0.32, $p=0.002$), and D6 domain (Pain and Impact of Disability) is not significant (-0.04, $p=0.694$).

SBD vs QOL:

Sleep-Disordered Breathing (SBD) demonstrates moderate negative correlations with most QOL domains, notably Feelings About Functioning (D2 domain) (-0.41, $p<0.001$), Participation and Physical Health (D3 domain) (-0.39, $p<0.001$), and Emotional Well-being and Self-esteem (D4 domain) (-0.40, $p<0.001$). A weaker negative correlation is seen with Social Well-being and Acceptance (D1 domain) (-0.27, $p=0.012$), Access to Services (D5 domain) (-0.24, $p=0.024$), and Family Health (D7 domain) (-0.36, $p=0.001$), while Pain and Impact of Disability (D6 domain) (0.06, $p=0.570$) does not show statistical significance.

DA vs QOL:

Disorders of Arousal (DA) presents moderate negative correlations with D2 domain (-0.35, $p=0.001$), D3 domain (-0.32, $p=0.002$), and D4 domain (-0.33, $p=0.001$). The correlations with D1 domain (-0.27, $p=0.012$) and D7 domain (-0.24,

p=0.022) are weaker and negative, and D5 domain (-0.19, p=0.072) and D6 domain (-0.18, p=0.087) do not give statistical significance.

SWTD vs QOL:

Sleep-Wake Transition Disorder (SWTD) exhibits strong negative correlations with D2 domain (-0.55, p<0.001), D3 domain (-0.58, p<0.001), and D4 domain (-0.52, p<0.001). Moderate correlations exist with D1 domain (-0.38, p<0.001), D5 domain (-0.31, p=0.003), and D7 domain (-0.33, p=0.001). However, D6 domain is not significantly correlated (-0.03, p=0.785).

DES vs QOL:

Disorders of Excessive Somnolence (DES) shows strong negative correlations with D2 domain (-0.59, p<0.001), D3 domain (-0.55, p<0.001), and D4 domain (-0.57, p<0.001). Moderate correlations are found with D1 domain (-0.44, p<0.001), D5 domain (-0.24, p=0.026), and D7 domain (-0.46, p<0.001). D6 domain does not show a significant correlation (-0.02, p=0.867).

SHY vs QOL:

Sleep Hyperhidrosis (SHY) demonstrates moderate negative correlations with D1 domain (-0.34, p=0.001), D2 domain (-0.38, p<0.001), D3 domain (-0.37, p<0.001), and D4 domain (-0.51, p<0.001). A weaker correlation is seen with D7 domain (-0.31, p=0.004), while D5 domain (-0.11, p=0.313) and D6 domain (0.01, p=0.901) are not significant.

Total Sleep Disturbance vs QOL:

The total sleep disturbance score exhibits strong negative correlations with D2 domain (-0.64, $p<0.001$), D3 domain (-0.63, $p<0.001$), and D4 domain (-0.65, $p<0.001$). Moderate correlations are found with D1 domain (-0.51, $p<0.001$), D5 domain (-0.34, $p=0.001$), and D7 domain (-0.46, $p<0.001$). The correlation with D6 domain (-0.07, $p=0.507$) is weak and not statistically significant.

The analysis indicates a predominantly moderate to strong negative correlation between various sleep disturbances and Quality of Life (QOL) domains. Higher sleep disturbance scores are associated with lower QOL scores.

The most affected QOL domains across sleep disturbances are Feelings About Functioning (D2 domain), Participation and Physical Health (D3 domain), and Emotional Well-being and Self-esteem (D4 domain), consistently showing moderate to strong negative correlations (-0.51 to -0.65, $p<0.001$). In contrast, Pain and Impact of Disability (D6 domain) is the least affected, showing no significant correlations. Total sleep disturbance has the highest negative impact, particularly on D2 domain (-0.64), D3 domain (-0.63), and D4 domain (-0.65), all $p<0.001$.

Table 25: Comparison of mean of QOL of children between physiological classification of CP (N=89)

Domains of QOL	Physiological classification of CP			ANOVA (P Value)
	Spastic (N=22)	Dyskinetic (N=37)	Mixed (N=30)	
D1 domain	51.43 ± 14.48	48.16 ± 17.42	39.22 ± 15.95	0.019
D2 domain	45.11 ± 19.94	42.08 ± 19.04	35.29 ± 16.93	0.143
D3 domain	37.89 ± 18.17	37.1 ± 17.79	29.68 ± 16.31	0.146
D4 domain	51.41 ± 16.89	46.6 ± 14.95	41.86 ± 16.01	0.103
D5 domain	67.34 ± 12.1	68.48 ± 14.11	66.4 ± 14.14	0.823
D6 domain	52.14 ± 16.79	52.62 ± 14.82	49.58 ± 15.68	0.712
D7 domain	50.96 ± 19.4	52.18 ± 21.6	48.04 ± 23.48	0.736

The above table compares the mean quality of life (QOL) domain scores between the physiological classifications of CP. For D1 (Social Well-being and Acceptance) domain, QoL scores were higher in Spastic (51.43 ± 14.48) compared to Mixed (39.22 ± 15.95) and Dyskinetic (48.16 ± 17.42), and the difference was statistically significant (p = 0.019). For D2 (Feelings about Functioning) domain, QoL scores were higher in Spastic (45.11 ± 19.94) compared to Dyskinetic (42.08 ± 19.04) and Mixed (35.29 ± 16.93), but the difference was not statistically significant (p = 0.143). For D3 (Participation and Physical Health) domain, QoL scores were higher in Spastic (37.89 ± 18.17) compared to Dyskinetic (37.1 ± 17.79) and Mixed (29.68 ± 16.31), but the difference was not statistically significant (p = 0.146).For D4

(Emotional Well-being and Self-esteem) domain, QoL scores were higher in Spastic (51.41 ± 16.89) compared to Dyskinetic (46.6 ± 14.95) and Mixed (41.86 ± 16.01), but the difference was not statistically significant (p = 0.103). For D5 (Access to Services) domain, QoL scores were similar across all groups, with Dyskinetic (68.48 ± 14.11), Spastic (67.34 ± 12.1), and Mixed (66.4 ± 14.14), and the difference was not statistically significant (p = 0.823).For D6 (Pain and Impact of Disability) domain, QoL scores were slightly higher in Dyskinetic (52.62 ± 14.82) compared to Spastic (52.14 ± 16.79) and Mixed (49.58 ± 15.68), but the difference was not statistically significant (p = 0.712). For D7 (Family Health) domain, QoL scores were similar in Dyskinetic (52.18 ± 21.6) and Spastic CP (50.96 ± 19.4) slightly higher than Mixed CP (48.04 ± 23.48), the difference was not statistically significant (p = 0.736).

Table 26: Comparison of mean of QOL of children between topographical classification of CP (n=89)

Domains of QOL	Topographical Classification of CP (Mean ± SD)			ANOVA (P Value)
	Hemiparetic (N=7)	Diplegic (N=11)	Quadriparetic (N=71)	
D1 domain	69.71 ± 6.03	53.69 ± 8.86	42.42 ± 16.22	<0.001
D2 domain	59.07 ± 7.84	56.08 ± 7.86	36.22 ± 18.4	<0.001
D3 domain	53.89 ± 12.23	43.52 ± 7.67	31.56 ± 17.57	<0.001
D4 domain	63.37 ± 8.25	57.36 ± 6.06	42.77 ± 15.85	<0.001
D5 domain	78.57 ± 10.18	69.69 ± 12.14	66.07 ± 13.6	0.054
D6 domain	48.86 ± 18.16	60.84 ± 9.74	50.28 ± 15.62	0.098
D7 domain	70.93 ± 18.59	58.8 ± 8.49	47.18 ± 21.95	0.007

The above table compares the mean quality of life (QOL) domain scores between the topographical classifications of CP.

For the D1 (Social Well-being and Acceptance) domain, QoL scores were highest in Hemiparetic (69.71 ± 6.03) compared to Diplegic (53.69 ± 8.86) and Quadriparetic (42.42 ± 16.22), and the difference was statistically significant ($p < 0.001$). For the D2 (Feelings about Functioning) domain, QoL scores were highest in Hemiparetic (59.07 ± 7.84) compared to Diplegic (56.08 ± 7.86) and Quadriparetic (36.22 ± 18.4), and the difference was statistically significant ($p < 0.001$). For D3 (Participation and Physical Health) domain, QoL scores were highest in Hemiparetic (53.89 ± 12.23) compared to Diplegic (43.52 ± 7.67) and Quadriparetic (31.56 ±

17.57), and the difference was statistically significant ($p < 0.001$). For D4 (Emotional Well-being and Self-esteem) domain, QoL scores were highest in Hemiparetic (63.37 ± 8.25) compared to Diplegic (57.36 ± 6.06) and Quadriparetic (42.77 ± 15.85), and the difference was statistically significant ($p < 0.001$). For D5 (Access to Services) domain, QoL scores were highest in Hemiparetic (78.57 ± 10.18) compared to Diplegic (69.69 ± 12.14) and Quadriparetic (66.07 ± 13.6), but the difference was not statistically significant ($p = 0.054$). For D6 (Pain and Impact of Disability) domain, QoL scores were highest in Diplegic (60.84 ± 9.74) compared to Quadriparetic (50.28 ± 15.62) and Hemiparetic (48.86 ± 18.16), but the difference was not statistically significant ($p = 0.098$). For D7 (Family Health) domain, QoL scores were highest in Hemiparetic (70.93 ± 18.59) compared to Diplegic (58.8 ± 8.49) and Quadriparetic (47.18 ± 21.95), and the difference was statistically significant ($p = 0.007$).

Table 27: Comparison of mean of QOL of children between GMFCS of CP (N=89)

Domains of QOL	GMFCS of CP (Mean ± SD)					ANOVA (P Value)
	I (N=7)	II (N=23)	III (N=14)	IV (N=14)	V (N=31)	
D1 domain	67.09 ± 10.17	58.21 ± 13.28	49.62 ± 12.13	35 ± 7.93	35.39 ± 13.88	<0.001
D2 domain	58.47 ± 6	58.91 ± 9.38	47.98 ± 12.73	29.9 ± 11.1	23.7 ± 11.7	<0.001
D3 domain	59.24 ± 14.02	49.64 ± 10.77	39.69 ± 7.28	28.52 ± 13.73	18.88 ± 8.89	<0.001
D4 domain	62.19 ± 6.08	58.32 ± 10.86	53.54 ± 14	40.75 ± 12.83	32.72 ± 10.27	<0.001
D5 domain	74.39 ± 12.77	75.27 ± 11.02	66.43 ± 6.81	63.31 ± 14.56	62.54 ± 14.56	0.003
D6 domain	51.54 ± 21.25	54.33 ± 14.83	49.66 ± 15.84	50.66 ± 10.83	50.53 ± 16.85	0.895
D7 domain	66.89 ± 18.25	61.68 ± 16.34	52.23 ± 18.11	50.67 ± 20.91	37.61 ± 21	<0.001

The above table compares the mean quality of life (QOL) domain scores between the GMFCS classifications of CP. For D1 (Social Well-being and Acceptance) domain, QoL scores were highest in GMFCS I (67.09 ± 10.17) compared to GMFCS II (58.21 ± 13.28), GMFCS III (49.62 ± 12.13), GMFCS IV (35 ± 7.93), and GMFCS V (35.39 ± 13.88), with the difference being statistically significant ($p < 0.001$). For D2 (Feelings about Functioning) domain, QoL scores were highest in GMFCS I (58.47 ± 6) and GMFCS II (58.91 ± 9.38), with lower scores in GMFCS III

(47.98 ± 12.73), GMFCS IV (29.9 ± 11.1), and GMFCS V (23.7 ± 11.7), and the difference was statistically significant ($p < 0.001$). For D3 (Participation and Physical Health) domain, QoL scores were highest in GMFCS I (59.24 ± 14.02), followed by GMFCS II (49.64 ± 10.77), GMFCS III (39.69 ± 7.28), GMFCS IV (28.52 ± 13.73), and GMFCS V (18.88 ± 8.89), with a statistically significant difference ($p < 0.001$). For D4 (Emotional Well-being and Self-esteem) domain, QoL scores were highest in GMFCS I (62.19 ± 6.08), followed by GMFCS II (58.32 ± 10.86), GMFCS III (53.54 ± 14), GMFCS IV (40.75 ± 12.83), and GMFCS V (32.72 ± 10.27), with a statistically significant difference ($p < 0.001$). For D5 (Access to Services) domain, QoL scores were highest in GMFCS I (74.39 ± 12.77) and GMFCS II (75.27 ± 11.02), followed by GMFCS III (66.43 ± 6.81), GMFCS IV (63.31 ± 14.56), and GMFCS V (62.54 ± 14.56), and the difference was statistically significant ($p = 0.003$). For D6 (Pain and Impact of Disability) domain, QoL scores were similar across groups, GMFCS I (51.54 ± 21.25) and GMFCS II (54.33 ± 14.83) having the highest scores followed by GMFCS III (49.66 ± 15.84), GMFCS IV (50.66 ± 10.83), and GMFCS V (50.53 ± 16.85), though the difference was not statistically significant ($p = 0.895$). For D7 (Family Health) domain, QoL scores were highest in GMFCS I (66.89 ± 18.25), followed by GMFCS II (61.68 ± 16.34), GMFCS III (52.23 ± 18.11), GMFCS IV (50.67 ± 20.91), and GMFCS V (37.61 ± 21), with a statistically significant difference ($p < 0.001$).

DISCUSSION

This prospective study was conducted at KLE'S Prabhakar Kore Hospital and Research Centre from June 2023 to May 2024. Over one year, 89 children with cerebral palsy (CP) aged 2-18 who attended the Paediatric Neurology OPD or were admitted to the hospital were enrolled.

A detailed history, including demographic details, birth history, and comorbidities, was obtained, followed by a clinical examination. The Sleep Disturbance Scale for Children (SDSC) was administered when the children were not ill, and T-scores were calculated to assess sleep disturbances. The Quality of Life (QoL) Questionnaire was administered to parents to evaluate the impact of sleep disturbances on daily functioning. The collected data was analyzed.

In our study, the mean age of presentation was 7.82 ± 4.05 years, with a median of 7 years. Similar findings were observed in studies by Hulst et al. (8.1 ± 3.5 years) [14] and Sandella et al. (7.5 ± 4.2 years) [15]. However, our mean age was higher than Nejabat et al. (4.02 ± 3.30 years, range: 6 months to 18 years) [94] but lower than Chopra et al. (10.1 ± 8.1 years) [95] and Rosello et al. (8.6 ± 3.9 years) [96]. This could be because we excluded children below one year to ensure the non-progressive nature of the disease.

Among the participants, 51 (57.3%) were male, and 38 (42.7%) were female, with a slight male predominance. This aligns with a study by Newman et al., where boys constituted 60.2% of CP cases[89]. A meta-analysis by Kulkarni et al. also reported a slight male preponderance (52% vs. 48%)[89]. Rosello et al. found a similar male prevalence (55.8%) [96]. Regional healthcare-seeking behavior and referral patterns may contribute to this trend.

Acquired causes accounted for 91.01% of CP cases in our cohort, while genetic factors accounted for 8.99%. Among the acquired etiologies, perinatal asphyxia was the most common (50.62%), followed by NHBI (20.99%), prematurity (9.88%), and postnatal sepsis/meningitis (9.88%). BIND contributed to 7.41%, while PROM and MAS accounted for 6.17% each. This was similar to a study by Kamate and Detroja that reported perinatal asphyxia as the leading cause of dyskinetic CP (61%) [22]. These findings highlight perinatal asphyxia as the predominant acquired cause, emphasizing the need for better perinatal care.

Dyskinetic CP (41.57%) was the most prevalent physiological type of CP, followed by mixed CP (33.71%) and spastic CP (24.72%). Kamate and Detroja also reported dyskinetic CP as the most common (52.4%), followed by spastic CP (29.1%) and mixed CP (18.4%) [22]. Löwing et al. observed a higher prevalence of dyskinetic CP (47.3%) [1]. However, our results contrast with Chopra et al., where spastic CP was most common (74%), followed by dyskinetic CP (10%) and hypotonic-ataxic CP (16%)[95]. Similarly, Li N et al. found spastic CP in 66.3%, dyskinetic CP in 18.9%, and ataxic/other types in 14.8%[97]. While spastic CP is predominant in Western countries, dyskinetic CP is more frequent in developing regions due to variations in perinatal care and health care accessibility.

Quadriparetic CP (79.78%) was the most prevalent topographical classification in our study, followed by diplegic CP (12.36%) and hemiparetic CP (7.87%). This distribution is similar to that reported by Rosello et al., where tetraparetic cases accounted for 50%, and diplegic cases comprised 40% of the total 20 patients[96]. However, different trends have been observed in the study by Himmelmann et al., who found that hemiplegia accounted for 38%, diplegia for 36%, and quadriplegia for 26% of CP cases in a large European cohort[24]. The discrepancies

in topographical distribution across studies may be due to regional differences, variations in perinatal risk factors, and differences in diagnostic criteria.

GMFCS Level V (34.83%) was the most prevalent gross motor classification in our study, followed by Level II (25.84%), while Levels III and IV had equal representation (15.73% each). Level I accounted for 7.87% of cases. This distribution aligns with findings from Reid et al., who reported a predominance of GMFCS V (33%), followed by GMFCS II (26%), with GMFCS III and IV having lower representation (17% and 15%, respectively) [34]. Similarly, Benfer et al. observed GMFCS V in 32% of cases, followed by GMFCS II (27%), with Levels III and IV at 18% and 16%, respectively[40]. The predominance of GMFCS V in our study underscores the high burden of severe motor impairments in CP.

MACS Level II (33.71%) was the most prevalent manual ability classification in our study, followed by Level V (23.60%), Level IV (19.10%), Levels III (15.73%) and I (7.87%). This distribution aligns with findings from Eliasson et al., who reported MACS II in 35% of cases, followed by MACS V (22%) and MACS IV (18%)[36]. Similarly, Öhrvall et al. observed MACS II in 32%, followed by MACS V (24%) and MACS IV (20%)[37]. The predominance of MACS II in our study highlights the functional variability in manual abilities among children with CP.

EDACS Level II (33.71%) was the most prevalent eating and drinking ability classification in our study, followed by Level V (13.48%), Level IV (15.73%), and Level III (19.10%). This distribution aligns with findings from Sellers et al., who reported EDACS II in 34% of cases, followed by EDACS V (14%) and EDACS IV (16%)[40]. Similarly, Chiu et al. observed EDACS II in 32%, followed by EDACS V

(15%) and EDACS IV (18%)[38]. The high prevalence of EDACS II highlights the spectrum of eating and drinking difficulties in children with CP.

CFCS Level II (33.71%) was the most prevalent communication function classification in our study, followed by Level V (24.72%), Level IV (19.10%), and Levels III (15.73%) and I (7.87%) with lower representation. This distribution aligns with findings from Hidecker et al., who reported CFCS II in 34% of cases, followed by CFCS V (25%) and CFCS IV (18%)[41]. Similarly, Baranello et al. observed CFCS II in 32%, followed by CFCS V (23%) and CFCS IV (20%)[42]. The predominance of CFCS II reflects varying communication abilities in children with CP, emphasizing the need for tailored interventions.

VFCS Level II (30.34%) was the most prevalent visual function classification in our study, followed by Level V (23.60%), Level IV (19.10%), Level III (15.73%), and I (10.11%). This distribution aligns with findings from Baranello et al., who reported VFCS II in 31% of cases, followed by VFCS V (22%) and VFCS IV (20%)[42]. Similarly, Rosenbaum et al. observed VFCS II in 29%, followed by VFCS V (24%) and VFCS IV (18%)[43]. The predominance of VFCS II highlights the varied visual impairments in CP, reinforcing the need for individualized visual support strategies.

Coming to the co-morbidities, hyperactivity (74.2%) was the most common noted in our study, followed by epilepsy (60.7%) and drooling (55.1%). This is comparable to Hollung et al., who reported hyperactivity in 72% and epilepsy in 58% of CP cases[44]. Similarly, Gong et al. observed epilepsy in 62% of cases, emphasizing its strong association with CP[45]. Drooling was present in over half of our study population (55.1%), aligning with Erasmus et al., who found a prevalence of 52%[63].

CVI (40.5%) was also common, with comparable findings from Jasper et al., who reported 42%[48]. Dental caries was seen in 40.4% of our children, comparable to Akhter et al., who reported a prevalence of 41% in a low-resource setting, where poor socioeconomic status and overcrowding could have contributed to poor dental hygiene[66]. Gastrointestinal issues such as GERD and constipation (34.8% each) were also noted, aligning with Fernando et al. (GERD: 33%) and Veugelers et al. (constipation: 36%)[65],[62]. Malnutrition (25.8%) was comparable to da Silva et al., who reported a prevalence of 27%[71]. Hearing defects were the least common (6.7%), closely matching with Weir et al., who reported 7% in CP populations[52]. The high prevalence of hyperactivity, epilepsy, and drooling in CP highlights the need for comprehensive multidisciplinary management. Early identification and targeted interventions for these comorbidities can significantly enhance functional outcomes, quality of life, and overall well-being in children with CP.

Eighty-six percent (86.52%) of children with CP exhibited sleep disturbances, with 52.81% experiencing severe (23.6%) to very severe (29.21%) disturbances. Mild disturbances were observed in 30.34%, while 3.37% had moderate disturbances. Only 13.48% of the population showed no sleep disturbances. Kulkarni et al. reported sleep disturbances in 62% of cases[88], Newman et al. in 38.2%[89], Zuculo et al. in 37.2%[90], Sandella et al. in 7.3%[15], and Hulst et al. in 46.7%[14] of children with CP. The higher prevalence in our study could be due to the inclusion of both urban and rural populations, with the rural population usually having poor medical care-seeking behaviors or poor access to healthcare facilities.

The most prevalent sleep disturbance observed in our study was Disorders of Initiation and Maintenance of Sleep (DIMS), with the highest mean DIMS T-score (70.71 ± 19.1), followed by Sleep-Wake Transition Disorder (SWTD) with a mean T-

score of 69.22 ± 19.36, followed by Disorders of Arousal (DA) with a mean T-score of 66.73 ± 19.46 and Disorders of Excessive Somnolence (DES) with a mean T-score of 64.09 ± 16.13. Sleep Breathing Disorders (SBD) had a mean T-score of 60.91 ± 17.22, followed by Sleep Hyperhidrosis (SHY) with a mean T-score of 59.15 ± 12.36. The mean total sleep disturbance score was 73.69 ± 20.00. These results align with studies such as Benfer et al., where sleep initiation and maintenance issues were among the most prevalent disturbances in children with CP[40]. The most common sleep disturbances reported in studies are as follows: Kulkarni et al. found DIMS at 78.2%[88], Newman et al. reported DIMS at 24.3%[89], Zuculo et al. observed SBD at 25.6%[90], Sandella et al. recorded SBD at 7.3%[15], and Hulst et al. identified DES at 33.3%[14]. Our study's Sleep Disturbance Scale T-Score analysis highlights a significant sleep disturbance burden in children with cerebral palsy, particularly in sleep initiation and maintenance, reinforcing the need for targeted interventions to enhance sleep quality and overall well-being.

In our study, the comparison of mean T scores of the sleep disturbance scale across physiological classifications of CP showed that the Mixed CP group had the highest mean DIMS T score (79.7 ± 17.87), followed by Dyskinetic (71.92 ± 20.3) and Spastic CP (69.91 ± 20.72), with the difference being statistically significant ($p = 0.005$). The mean SBD T score was highest in the Dyskinetic CP group (63.32 ± 17.87), followed by Spastic (59.82 ± 17.89) and Mixed CP (58.73 ± 16.07), with the difference not being statistically significant ($p = 0.529$). The mean DA T score was highest in the Dyskinetic CP group (68.65 ± 19.98), followed by Mixed (68.47 ± 19.89) and Spastic CP (61.14 ± 17.68), with the difference not being statistically significant ($p = 0.302$). The mean SWTD T score was highest in the Mixed CP group (72.83 ± 18.25), followed by Spastic (67.82 ± 18.79) and Dyskinetic CP (67.14 ±

20.63), with the difference not being statistically significant (p = 0.457). The mean DES T score was highest in the Mixed CP group (68.13 ± 16.79), followed by Dyskinetic (62.27 ± 14.81) and Spastic CP (61.64 ± 17), with the difference not being statistically significant (p = 0.241). The mean SHY T score was highest in the Dyskinetic CP group (60.27 ± 12.1), followed by Mixed (60 ± 12.66) and Spastic CP (56.09 ± 12.42), with the difference not being statistically significant (p = 0.412). The mean total sleep disturbance T score was highest in the Mixed CP group (78.63 ± 18.74), followed by Dyskinetic (76.91 ± 18.52) and Spastic CP (74.37 ± 19.02), with the difference not being statistically significant (p = 0.236). Similarly, a study by Gong et al. found that mixed CP cases had higher sleep impairment rates (40–45%) than spastic (30–35%) and dyskinetic types (25–30%), consistent with our results[45]. This could be due to the fact that mixed CP cases experience greater sleep fragmentation due to the combination of spasticity and involuntary movements. Severity analysis across the most commonly affected physiological type of CP that is Mixed CP, revealed it had the highest burden of severe sleep disturbances (T scores: 72–92). Severe DIMS (T score: 72–79), was observed in 33.33% of Mixed CP cases and very severe DIMS (T score: 80–92) was observed in 36.67% of Mixed CP cases, making it the most affected domain, with statistical significance when compared across mild to very severe mean scores (p = 0.046). Severe SWTD (T score: 72–79), was observed in 13.33% of Mixed CP cases and very severe SWTD (T score: 80–92) was observed in 30% of Mixed CP cases, with the difference being statistically significant when compared across mild to very severe mean scores (p = 0.039). Severe DA (T score: 72–79), was observed in 10% of Mixed CP cases and very severe DA (T score: 80–92), was observed in 20% of Mixed CP cases with statistical significance when compared across mild to very severe mean scores (p = 0.048). Severe DES (T score: 72–79), was observed in 23.33% of Mixed CP cases and very

severe DES (T score: 80–92), was observed in 16.67% of Mixed CP cases with statistical significance when compared across mild to very severe mean scores (p = 0.042). Severe SBD (T score: 72–92), was observed in 13.33% of Mixed CP cases and very severe SBD (T score: 92–100+), was observed in 6.67% of Mixed CP cases with the difference not being statistically significant when compared across mild to very severe mean scores (p = 0.134). Severe SHY (T score: 72–92), was observed in 20% of Mixed CP cases and very severe SHY (T score: 92–100+), was observed in 13.33% of Mixed CP cases with the difference not being statistically significant when compared across mild to very severe mean scores (p = 0.162). Very severe sleep disturbances (T score: 80–92), were observed in 36.67% of Mixed CP cases, the highest proportion among the physiological classifications, but when compared across mild to very severe mean scores, the difference was statistically not significant (p = 0.031). These findings suggest that Mixed CP is associated with an increased risk of severe sleep disturbances across multiple domains of sleep, particularly in DIMS, SWTD and DES. This could be probably due to a combination of spasticity, abnormal movements, poorer mobility, medications, and recurrent hospitalizations due to a high burden of comorbidities like GERD, epilepsy, etc, leading to disordered sleep initiation and transition, finally causing excessive daytime somnolence.

In our study, the comparison of mean T scores on the sleep disturbance scale across topographical classifications showed that the quadriparetic CP group had the highest mean T scores. The mean DIMS T score was highest in Quadriparetic CP (73.55 ± 19.13), followed by diplegic (59.91 ± 14.72) and hemiparetic CP (58.86 ± 15.72), with the difference being statistically significant (p = 0.019). The mean SBD T score was highest in the quadriparetic CP group (62.52 ± 17.97), followed by diplegic (56.55 ± 14.31) and hemiparetic CP (51.43 ± 8.26), but the difference was

not statistically significant (p = 0.179). The mean DA T score was highest in the quadriparetic CP group (69.56 ± 19.66), followed by diplegic (59 ± 17.13) and hemiparetic CP (50.14 ± 5.37), with the difference being statistically significant (p = 0.014). The mean SWTD T score was highest in the quadriparetic CP group (72.41 ± 19.66), followed by hemiparetic (61.14 ± 13.04) and diplegic CP (53.82 ± 10.64), with the difference being statistically significant (p = 0.005). The mean DES T score was highest in the quadriparetic CP group (66.97 ± 16.52), followed by diplegic (55.55 ± 6.95) and hemiparetic CP (48.29 ± 5.09), with the difference being statistically significant (p = 0.002). The mean SHY T score was highest in the quadriparetic CP group (60.41 ± 12.19), followed by hemiparetic (54.43 ± 15.58) and diplegic CP (54 ± 10.04), with the difference not being statistically significant (p = 0.160). The total mean sleep disturbance T score was highest in quadriparetic CP (77.45 ± 19.85) compared to diplegic (59.82 ± 11.93) and hemiparetic CP (57.29 ± 14.07), with the difference being statistically significant (p = 0.001). Galli et al. also reported that quadriplegic CP cases had the highest sleep disturbances, with 40–50% of children experiencing significant sleep fragmentation, supporting our findings[49]. Severity analysis conducted across the most commonly affected topographical type i.e Quadriparetic CP revealed that it had the highest burden of severe sleep disturbances (T scores: 72–92). Severe DIMS (T score: 72–79), was observed in 32.39% of Quadriparetic CP cases, and very severe DIMS (T score: 80–92) was observed in 23.94% of Quadriparetic CP cases, though the difference was not statistically significant when compared across mild to very severe mean scores (p = 0.182). Severe SWTD (T score: 72–79) was observed in 19.72% of Quadriparetic CP cases and very severe SWTD (T score: 80–92) was observed in 26.76% of Quadriparetic CP cases with the difference being statistically significant when compared across mild to very severe mean scores (p = 0.090). Severe DA (T score: 72–79), was observed in

9.86% of Quadriparetic CP cases and very severe DA(T score: 80–92), was observed in 23.94% of Quadriparetic CP cases with the difference not being statistically significant when compared across mild to very severe mean scores (p = 0.115). Severe DES (T score: 72–79), was observed in 25.35% of Quadriparetic CP cases and very severe DES (T score: 80–92), was observed in 12.68% of Quadriparetic CP cases with the difference being statistically significant when compared across mild to very severe mean scores (p = 0.006). Severe SBD (T score: 72–92), was observed in 18.31% of Quadriparetic CP cases and very severe SBD (T score: 92–100+), was observed in 11.27% of Quadriparetic CP cases ,with the difference not being statistically significant when compared across mild to very severe mean scores (p = 0.313). Severe SHY (T score: 72–92), was observed in 18.31% of Quadriparetic CP cases and very severe SHY was not observed, with the difference not being statistically significant when compared across mild to very severe mean scores (p = 0.242). Very severe sleep disturbances (T score: 80–92) were observed in 36.62% of Quadriparetic CP cases, with the highest proportion among all topographical classifications, but when compared across mild to very severe mean scores, the difference was not statistically significant (p = 0.071).

Our findings align with Hollung et al [44], who reported that children with quadriparetic CP had 50–60% higher sleep disturbances than those with milder CP forms. These findings suggest that Quadriparetic CP is associated with an increased risk of severe sleep disturbances across multiple domains, particularly in SWTD and DES. This could be due to the more widespread and severe motor impairments in Quadriparetic CP, which may contribute to greater sleep fragmentation, emotional distress, and difficulty with sleep initiation and maintenance. The higher burden of sleep disturbances in this group might also be linked to the greater dependency on

care, poorer mobility, and potential comorbidities, including epilepsy, leading to significant sleep disruption and excessive somnolence.

In our study, the comparison of mean T scores on the sleep disturbance scale across GMFCS levels showed that children with GMFCS level V had the highest mean T scores. The mean DIMS T score was highest in GMFCS V (87.42 ± 13.32), followed by GMFCS IV (70.21 ± 14.93), GMFCS III (63.43 ± 17.86), GMFCS II (58.87 ± 13.64), and GMFCS I (51.14 ± 7.6), with the difference being statistically significant ($p < 0.001$). The mean SBD T score was highest in the GMFCS V group (71.77 ± 18.15), followed by GMFCS III (58.71 ± 15.33), GMFCS IV (55.21 ± 14.59), GMFCS II (54.17 ± 12.56), and GMFCS I (50.71 ± 12.67), with the difference being statistically significant ($p < 0.001$). The mean DA T score was highest in the GMFCS V group (74.65 ± 21.82), followed by GMFCS IV (69 ± 19.07), GMFCS III (64.43 ± 20.92), GMFCS II (60.13 ± 13.15), and GMFCS I (53.43 ± 8.96), with the difference being statistically significant ($p = 0.019$). The mean SWTD T score was highest in the GMFCS V group (85.97 ± 15.33), followed by GMFCS IV (67.79 ± 15.05), GMFCS III (59.21 ± 17.16), GMFCS II (58.48 ± 12.93), and GMFCS I (53.29 ± 12.49), with the difference being statistically significant ($p < 0.001$). The mean DES T score was highest in the GMFCS V group (76.94 ± 15.23), followed by GMFCS IV (64.36 ± 14.04), GMFCS III (58.79 ± 10.69), GMFCS I (54.14 ± 13.68), and GMFCS II (52.87 ± 8.67), with the difference being statistically significant ($p < 0.001$). The mean SHY T score was highest in the GMFCS V group (65.32 ± 11.68), followed by GMFCS I (60 ± 13.94), GMFCS IV (56.21 ± 10.41), GMFCS II (55.13 ± 11.27), and GMFCS III (54.57 ± 12.4), with the difference being statistically significant ($p = 0.009$). The total mean sleep disturbance T score was highest in the GMFCS V group (91.52 ± 14.1), followed by GMFCS IV (72.43 ± 15.23), GMFCS III (67.29 ± 19.03),

GMFCS II (59.87 ± 12.7), and GMFCS I (55.43 ± 11.56), with the difference being statistically significant ($p < 0.001$). Reid et al. also found that higher GMFCS levels were associated with worsening sleep difficulties, with 60–70% of children in GMFCS IV and V experiencing sleep disturbances, which were similar to our findings[34]. Gray et al. reported that children with GMFCS IV and V experience significant voluntary movement limitations, leading to increased sleep fragmentation, with up to 65% of children at these levels facing disrupted sleep[32]. Löwing et al. highlighted that severe motor impairments in GMFCS IV and V are associated with higher comorbidity rates, including sleep disturbances, affecting nearly 70% of children at these levels, supporting our results[33].

Severity analysis was conducted across most commonly affected GMFCS classifications of CP revealed that GMFCS IV and GMFCS V had the highest burden of severe sleep disturbances. Severe DIMS (T score: 72–92) was observed in 45.16% of GMFCS V cases and 35.71% of GMFCS IV cases, while very severe DIMS (T score: 92–100+) was noted in 45.16% of GMFCS V cases and 14.29% of GMFCS IV cases), with statistical significance across mild to very severe disturbances ($p < 0.001$). Severe SWTD (T score: 72–92) was present in 29.03% of GMFCS V cases and 28.57% of GMFCS IV. very severe SWTD (T score: 92–100+) was recorded in 51.61% of GMFCS V cases and 7.14% of GMFCS IV cases with a significant difference when compared across mild to very severe mean scores ($p < 0.001$). Severe DES (T score: 72–92) was observed in 35.48% of GMFCS V cases and 21.43% of GMFCS IV cases, with very severe DES (T score: 92–100+) in 25.81% of GMFCS V cases and 7.14% of GMFCS IV cases showing statistical significance when compared across mild to very severe mean scores ($p < 0.001$). Severe SBD (T score: 72–92) was found in 32.26% of GMFCS V cases , while very severe SBD (T score: 92–100+) was

present in 19.35% of GMFCS V cases and 7.14% of GMFCS IV cases with a significant difference when compared across mild to very severe mean scores ($p = 0.012$). Severe SHY (T score: 72–92), was seen in 35.48% of GMFCS V cases, with statistical significance when compared across mild to very severe mean scores ($p = 0.047$). Severe DA (T score: 72–92), affected 14.29% of GMFCS IV cases and 12.9% of GMFCS V cases ,while very severe DA(T score: 92–100+), was seen in 35.48% of GMFCS V cases and 21.43% of GMFCS IV cases though not statistically significant when compared across mild to very severe mean scores ($p = 0.308$). Overall, very severe sleep disturbances (T score: 92–100+), were recorded in 67.74% of GMFCS V cases and 14.29% of GMFCS IV cases the highest proportion among GMFCS classifications, with a significant difference when compared across mild to very severe mean scores ($p < 0.001$). Higher GMFCS levels are associated with greater motor impairments, which contribute to disrupted sleep due to increased spasticity, limited mobility, pain, and dependency on caregivers for repositioning. These factors lead to difficulties in sleep initiation, maintenance, and frequent awakenings, resulting in a higher prevalence of severe sleep disturbances in GMFCS IV and V.

In our study, the comparison of mean T scores on the sleep disturbance scale across VFCS levels showed that children with VFCS levels IV and V had the highest mean T scores. The mean DIMS T score was highest for VFCS V (81.06 ± 18.4), followed by VFCS IV (80.14 ± 16.63), VFCS III (73.2 ± 19.66), VFCS II (61.89 ± 16.89), and VFCS I (59.21 ± 14.06), with the difference being statistically significant ($p < 0.001$). The mean SBD T score was highest in the VFCS V group (68.76 ± 19.39), followed by VFCS IV (63.48 ± 17.97), VFCS III (61.1 ± 19.58), VFCS II (58.04 ± 15.35), and VFCS I (52.93 ± 11.57), though the difference was not

statistically significant (p = 0.097). The mean DA T score was highest in the VFCS IV group (75.9 ± 21.9), followed by VFCS V (70.94 ± 21.34), VFCS III (67.2 ± 18.78), VFCS II (63.7 ± 17.26), and VFCS I (53.36 ± 7.28), with the difference being statistically significant (p = 0.010). The mean SWTD T score was highest in the VFCS V group (77.06 ± 18.73), followed by VFCS IV (76.05 ± 18.92), VFCS III (73 ± 23.5), VFCS II (64.85 ± 17.33), and VFCS I (55.21 ± 12.46), with the difference being statistically significant (p = 0.004). The mean DES T score was highest in the VFCS III group (72.3 ± 19.17), followed by VFCS IV (72.14 ± 15.99), VFCS V (70.76 ± 15.96), VFCS II (56 ± 10.94), and VFCS I (53.64 ± 9.54), with the difference being statistically significant (p < 0.001). The mean SHY T score was highest in the VFCS V group (65.12 ± 13.26), followed by VFCS IV (60.9 ± 12.07), VFCS III (61.6 ± 9.29), VFCS II (55.74 ± 11.21), and VFCS I (54.07 ± 13.18), though the difference was not statistically significant (p = 0.052). The total mean sleep disturbance T score was highest in the VFCS IV group (84.52 ± 15.87) and VFCS V (84.24 ± 19.85), VFCS III (76.6 ± 20.99), VFCS II (65.56 ± 18.02), and VFCS I (58.21 ± 12.01), with the difference being statistically significant (p < 0.001). Comparatively, Rosenbaum et al. reported that children classified as VFCS IV and V had a higher prevalence of nocturnal awakenings and fragmented sleep than those in VFCS I and II[43], supporting our findings. Baranello et al. found that children with higher VFCS levels had more severe sleep disturbances, with over half experiencing challenges in sleep-wake transitions and arousals, aligning with our findings[42]. Higher VFCS classifications are associated with a greater risk of severe sleep disturbances due to their impact on circadian rhythm.

In our study, the comparison of mean T scores on the sleep disturbance scale across CFCS levels showed that children with CFCS levels IV and V had the highest mean T scores. The mean DIMS T score was highest for CFCS V (83.73 ± 16.93), followed by CFCS IV (82.25 ± 11.57), CFCS III (72.86 ± 19.2), CFCS I (61.8 ± 16.29), and CFCS II (54.04 ± 9.25), with the difference being statistically significant ($p < 0.001$). The mean SBD T score was highest in the CFCS V group (71.36 ± 19.76), followed by CFCS III (61.68 ± 18.01), CFCS IV (58.25 ± 14.73), CFCS I (58.3 ± 16.08), and CFCS II (52.7 ± 10.09), with the difference being statistically significant ($p = 0.006$). The mean DA T score was highest in the CFCS IV group (72.83 ± 22.24), followed by CFCS III (70.73 ± 20.05), CFCS V (72.14 ± 22.28), CFCS II (60.7 ± 13.73), and CFCS I (52.6 ± 8.02), with the difference being statistically significant ($p = 0.020$).The mean SWTD T score was highest in the CFCS V group (80.59 ± 19.33), followed by CFCS IV (75.67 ± 18.53), CFCS III (70.14 ± 20.99), CFCS I (63.2 ± 17.07), and CFCS II (56.74 ± 9.96), with the difference being statistically significant ($p < 0.001$).The mean DES T score was highest in the CFCS IV group (74.67 ± 17.31), followed by CFCS V (70.91 ± 14.05), CFCS III (66.86 ± 17.93), CFCS II (54.09 ± 9.87), and CFCS I (53.3 ± 7.78), with the difference being statistically significant ($p < 0.001$).The mean SHY T score was highest in the CFCS V group (65.05 ± 12.9), followed by CFCS IV (63.17 ± 12.68), CFCS III (56.91 ± 10.51), CFCS I (59.6 ± 15.95), and CFCS II (53.35 ± 8.83), with the difference being statistically significant ($p = 0.014$).The total mean sleep disturbance T score was highest in the CFCS V group (88.23 ± 15.96), followed by CFCS IV (84.42 ± 14.36), CFCS III (75.73 ± 21.74), CFCS I (63.5 ± 15.2), and CFCS II (56.65 ± 8.92), with the difference being statistically significant ($p < 0.001$). Comparatively, Hidecker et al. reported that children with severe communication impairments (CFCS IV and V) had higher rates of sleep disturbances, particularly difficulties in initiating and

maintaining sleep, consistent with our findings[41]. Baranello et al. found that children with CFCS IV and V had significantly greater rates of fragmented sleep and nocturnal awakenings, with over half experiencing severe sleep disturbances[42], aligning to our results.

In our study, the comparison of mean T scores on the sleep disturbance scale across MACS levels showed that children with MACS levels IV and V had the highest mean T scores. The mean DIMS T score was highest for MACS V(81.86 ± 17.17), followed by MACS IV (79.06 ± 17.53), MACS III (72.43 ± 20.76), MACS II (60.6 ± 14.35), and MACS I (56.86 ± 15.7), with the difference being statistically significant ($p < 0.001$). The mean SBD T score was highest in the MACS IV group (68.82 ± 19.85), followed by MACS III (63.71 ± 18.54), MACS V (66.29 ± 18.18), MACS I (55.43 ± 12.26), and MACS II (52.63 ± 11.39), with the difference being statistically significant ($p = 0.006$). The mean DA T score was highest in the MACS IV group (78.29 ± 22.78), followed by MACS V (70.81 ± 19.77), MACS III (62.21 ± 16.55), MACS II (61.77 ± 17.27), and MACS I (56.71 ± 10.32), with the difference being statistically significant ($p = 0.018$). The mean SWTD T score was highest in the MACS IV group (79.71 ± 21.99), followed by MACS V (78.29 ± 17.33), MACS III (73.14 ± 19.79), MACS II (58.4 ± 12.95), and MACS I (55.14 ± 9.94), with the difference being statistically significant ($p < 0.001$). The mean DES T score was highest in the MACS IV group (73.76 ± 15.4), followed by MACS V (69.81 ± 15.72), MACS III (64.36 ± 16.46), MACS II (56.77 ± 12.9), and MACS I (54.29 ± 14.38), with the difference being statistically significant ($p = 0.001$). The mean SHY T score was highest in the MACS IV group (62.94 ± 13.86), followed by MACS V (63.52 ± 11.96), MACS III (58.93 ± 12.93), MACS I (57.71 ± 7.36), and MACS II (54.37 ± 11.22), with the difference not being statistically significant ($p = 0.061$). The total

mean sleep disturbance T score was highest in the MACS IV group (86.71 ± 16.68), followed by MACS V (84.57 ± 18.07), MACS III (74.86 ± 21.1), MACS II (61.67 ± 14.72), and MACS I (58.57 ± 11.82), with the difference being statistically significant ($p < 0.001$). Eliasson et al. found that children with MACS IV and V had significantly higher rates of disrupted sleep patterns. This aligns with our results showing more significant sleep disturbances in children with severe manual impairments[36]. Öhrvall et al. reported that children with severe manual impairments frequently struggled with adjusting sleep posture, leading to increased nighttime awakenings, which is in line with our findings that MACS IV and V had significantly elevated SWTD and DES scores[37]. These findings highlight that children with severe manual impairments experience greater sleep disturbances, emphasizing the need for targeted interventions to improve their sleep quality.

In our study, the comparison of mean T scores on the sleep disturbance scale across EDACS levels showed that children with EDACS levels IV and V had the highest mean T scores. The mean DIMS T score was highest for EDACS V (85.42 ± 17.18), followed by EDACS IV (79.07 ± 18.24), EDACS III (76.52 ± 16.1), EDACS II (61.8 ± 17.34), and EDACS I (58.33 ± 13.96), with the difference being statistically significant ($p < 0.001$). The mean SBD T score was highest in the EDACS V group (73.17 ± 21.53), followed by EDACS IV (63.71 ± 18.34), EDACS III (62.24 ± 18.85), EDACS II (57.6 ± 14.14), and EDACS I (51.33 ± 5.55), with the difference being statistically significant ($p = 0.019$). The mean DA T score was highest in the EDACS III group (73.38 ± 21.29), followed by EDACS IV (73.71 ± 22.17), EDACS V (70.67 ± 21.12), EDACS II (63.27 ± 16.02), and EDACS I (51.67 ± 7.57), with the difference being statistically significant ($p = 0.009$). The mean SWTD T score was highest in the EDACS V group (79.58 ± 15.56), followed by EDACS IV (76.71 ±

22.64), EDACS III (75.67 ± 20.23), EDACS II (62.97 ± 16.29), and EDACS I (54.5 ± 9.84), with the difference being statistically significant (p = 0.001). The mean DES T score was highest in the EDACS IV group (72.57 ± 16.85), followed by EDACS V (69.5 ± 12.86), EDACS III (66.24 ± 16.97), EDACS II (61.9 ± 15.78), and EDACS I (50.5 ± 7.28), with the difference being statistically significant (p = 0.004). The mean SHY T score was highest in the EDACS V group (65.08 ± 13.9), followed by EDACS III (61.52 ± 12.15), EDACS IV (61.5 ± 12.64), EDACS II (56.37 ± 11.43), and EDACS I (53.25 ± 10.56), with the difference not being statistically significant (p = 0.077). The total mean sleep disturbance T score was highest in the EDACS V group (87.33 ± 16.29), followed by EDACS IV (84.21 ± 18.58), EDACS III (80.29 ± 19.02), EDACS II (65.9 ± 17.53), and EDACS I (55.67 ± 10.6), with the difference being statistically significant (p < 0.001). Chiu et al. found that children with severe feeding impairments had higher rates of night awakenings, consistent with our findings that EDACS IV and V had the most severe sleep disturbances[38].Bykova et al. reported that children with severe feeding impairments had a higher prevalence of sleep disturbances due to gastroesophageal reflux and aspiration risk[39]. SWTD was also more frequent in EDACS V, with 50% experiencing severe disturbances and 25% in the very severe category[39]. These findings highlight that children with severe eating and drinking difficulties experience higher rates of sleep disturbances, emphasizing the need for comprehensive care strategies.

The study reveals a predominantly moderate negative correlation between various sleep disturbances and Quality of Life (QoL) domains, indicating that higher sleep disturbance scores lower the QoL scores and, thus, poorer the quality of life .

The Mean DIMS T Score demonstrates a moderate negative correlation with the following domains: D1 (Social Well-being and Acceptance) (-0.54), D2 (Feelings

About Functioning) (-0.60), D3 (Participation and Physical Health) (-0.62), D4 (Emotional Well-being and Self-esteem) (-0.60), D5 (Access to Services) (-0.32), and D7 (Family Health) (-0.37). These correlations are statistically significant, with p-values of <0.001 for D1, D2, D3, D4, and D7, and p = 0.002 for D5. D6 (Pain and Impact of Disability) shows no correlation (-0.04) and is not statistically significant (p = 0.694). These findings indicate that the greater the DIMS T score, the poorer the quality of life, particularly in D1(social well-being), D2 functional ability, D3 physical health, D4 emotional well-being, and D7 family health. Those with higher DIMS had poorer D5 scores due to less access to special equipment at home, poor community services and respite care. These can be due to poor societal awareness, low socioeconomic constraints, and limited access to specialized services.

The Mean SBD T Score demonstrates a moderate negative correlation with D2 (Feelings About Functioning) (-0.41), D3 (Participation and Physical Health) (-0.39), D4 (Emotional Well-being and Self-esteem) (-0.40), and D7 (Family Health) (-0.36), all of which are statistically significant (p-value < 0.001 for D2, D3, and D4; p = 0.001 for D7). D1 (Social Well-being and Acceptance) (-0.27) and D5 (Access to Services) (-0.24) show weak negative correlations, with statistical significance (p = 0.012 for D1, p = 0.024 for D5). D6 (Pain and Impact of Disability) (0.06) shows no correlation and is not statistically significant (p = 0.570). These findings indicate that the greater the SBD T score, the poorer the quality of life in D2 functional, D3 physical, D4 emotional, and D7 family health.

The Mean DA T Score demonstrates a moderate negative correlation with D2 (Feelings About Functioning) (-0.35), D3 (Participation and Physical Health) (-0.32), and D4 (Emotional Well-being and Self-esteem) (-0.33), all of which are statistically significant (p = 0.001 for D2 and D4, p = 0.002 for D3). D1 (Social Well-being and

Acceptance) (-0.27), D5 (Access to Services) (-0.19), D6 (Pain and Impact of Disability) (-0.18), and D7 (Family Health) (-0.24) show weak negative correlations, with statistical significance for D1 ($p = 0.012$) and D7 ($p = 0.022$), while D5 ($p = 0.072$) and D6 ($p = 0.087$) are not statistically significant. These findings indicate that a greater DA T score is associated with poorer quality of life in the following domains, i.e., in D2 functional, D3 physical, and D4 emotional well-being.

The Mean SWTD T Score demonstrates a moderate negative correlation with D1 (Social Well-being and Acceptance) (-0.38), D2 (Feelings About Functioning) (-0.55), D3 (Participation and Physical Health) (-0.58), D4 (Emotional Well-being and Self-esteem) (-0.52), D5 (Access to Services) (-0.31), and D7 (Family Health) (-0.33), all of which are statistically significant ($p < 0.001$ for D1, D2, D3, D4, and D7; $p = 0.003$ for D5). D6 (Pain and Impact of Disability) (-0.03) shows no correlation and is not statistically significant ($p = 0.785$). These findings indicate that a higher SWTD T score is associated with poorer quality of life, particularly in D1 social, D2 functional, D3 physical, D4 emotional and D7 family health aspects.

The Mean DES T Score demonstrates a moderate negative correlation with D1 (Social Well-being and Acceptance) (-0.44), D2 (Feelings About Functioning) (-0.59), D3 (Participation and Physical Health) (-0.55), D4 (Emotional Well-being and Self-esteem) (-0.57), and D7 (Family Health) (-0.46), all of which are statistically significant ($p < 0.001$). D5 (Access to Services) (-0.24) exhibits a weak negative correlation, with statistical significance ($p = 0.026$). D6 (Pain and Impact of Disability) (-0.02) shows no correlation and is not statistically significant ($p = 0.867$). These findings indicate that a higher DES T score is linked to poorer quality of life, particularly in D1 social, D2 functional, D3 physical, D4emotional, and D7 family health aspects.

The Mean SHY (Sleep Hyperhidrosis) T Score demonstrates a moderate negative correlation with D1 (Social Well-being and Acceptance) (-0.34), D2 (Feelings About Functioning) (-0.38), D3 (Participation and Physical Health) (-0.37), D4 (Emotional Well-being and Self-esteem) (-0.51), and D7 (Family Health) (-0.31), all of which are statistically significant ($p < 0.001$ for D2, D3, and D4; $p = 0.001$ for D1; $p = 0.004$ for D7). D5 (Access to Services) (-0.11) exhibits a weak negative correlation, which is not statistically significant ($p = 0.313$). D6 (Pain and Impact of Disability) (0.01) shows no significant correlation and is not statistically significant ($p = 0.901$). These findings indicate that a higher SHY T score is associated with poorer quality of life, particularly in D1social, D2 functional, D3 physical, D4 emotional, and D7 family health aspects.

The Mean Total Sleep Disturbance T Score demonstrates a moderate negative correlation with D1 (Social Well-being and Acceptance) (-0.51), D2 (Feelings About Functioning) (-0.64), D3 (Participation and Physical Health) (-0.63), D4 (Emotional Well-being and Self-esteem) (-0.65), D5 (Access to Services) (-0.34), and D7 (Family Health) (-0.46), all of which are statistically significant ($p < 0.001$ for D1, D2, D3, D4, and D7; $p = 0.001$ for D5). D6 (Pain and Impact of Disability) (-0.07) shows no significant correlation and is not statistically significant ($p = 0.507$). These findings indicate that a higher Total Sleep Disturbance T score is associated with poorer quality of life, particularly in D1 social, D2 functional, D3 physical, D4 emotional, D5 access to services, and D7 family health. In contrast, for QoL in the D6 Pain and Impact of Disability, no statistical significance was found. This may be because the scale is parent-reported, and caregivers might not always be able to accurately assess the child's pain or the full impact of their disability.

The above analysis shows that QoL in the D1 Domain (Social Well-being) was lower in children with higher mean T scores in DIMS, SWTD, DES, SHY, and total sleep disturbance scores, likely due to the cognitive impairment, behavioral issues, and irritability caused by these sleep disturbances, affecting their ability to engage in social activities and relationships. QoL in the D2 Domain (Feeling about Functioning) was lower in children with higher mean T scores across all the sleep disturbances, likely due to impaired physical functioning and reduced ability to perform daily activities effectively due to sleep disruption. QoL in the D3 Domain (Physical well-being) was lower in children with CP and higher mean T scores in DIMS, SBD, SWTD, DES, DA, SHY, and Total sleep disturbance scores, likely due to the physical impact of sleep disturbances on energy levels, mobility, and overall health. QoL in the D4 Domain (Emotional well-being) was lower in children with higher mean T scores in DIMS, SBD, DA, SWTD, DES, SHY, and Total sleep disturbance scores, likely due to the emotional strain and distress caused by disrupted sleep patterns and associated daytime sleepiness in children and their caregivers. QoL in the D5 Domain (Access to Services) was lower in children with higher mean T scores across all the sleep disturbances due to limited access to community resources, poorer usage of special equipment, respite care, and community services, compounded by low socioeconomic status and poor awareness. QoL in the D7 Domain (Family Health) was lower in children with higher mean T scores across all the sleep disturbances due to the increased caregiving burden and financial, physical, and emotional stress on family members. Sleep disturbances in children with higher T scores often lead to disrupted family routines, poorer family cohesion, and higher levels of emotional distress for caregivers.

Scores for quality of life (QoL) were consistently better in children with spastic CP compared to mixed and dyskinetic CP.

For D1 (Social Well-being and Acceptance) domain, QoL scores were higher in Spastic (51.43 ± 14.48) compared to Mixed (39.22 ± 15.95) and Dyskinetic (48.16 ± 17.42), and the difference was statistically significant ($p = 0.019$) indicating that children with spastic CP have better QoL probably due to better mobility and absence of abnormal movements

For D2 (Feelings about Functioning) domain, QoL scores were higher in Spastic (45.11 ± 19.94) compared to Dyskinetic (42.08 ± 19.04) and Mixed (35.29 ± 16.93), but the difference was not statistically significant ($p = 0.143$) indicating functional abilities like communication with others, usage of arms and hands, ability to participate in activities of daily living were slightly better in spastic CP but no statistical difference between the groups could be established.

For D3 (Participation and Physical Health) domain, QoL scores were higher in Spastic (37.89 ± 18.17) compared to Dyskinetic (37.1 ± 17.79) and Mixed (29.68 ± 16.31), but the difference was not statistically significant ($p = 0.146$) indicating that participation and physical health like ability to play with peers, community participation, usage of legs and physical ability with their peers were slightly better in spastic CP but no statistical difference between the groups could be established.

For D4 (Emotional Well-being and Self-esteem) domain, QoL scores were higher in Spastic (51.41 ± 16.89) compared to Dyskinetic (46.6 ± 14.95) and Mixed (41.86 ± 16.01), but the difference was not statistically significant ($p = 0.103$) indicating that emotional well-being and self-esteem like the ability to get along, the

way they look and their life in general were slightly better in spastic CP but no statistical difference between the groups could be established.

For D5 (Access to Services) domain, QoL scores were similar across all groups, with Dyskinetic (68.48 ± 14.11), Spastic (67.34 ± 12.1), and Mixed (66.4 ± 14.14), and the difference was not statistically significant (p = 0.823). indicating that access to medical care-seeking behavior is the same among all the three physiological classifications due to awareness and follow-up services, though access to respite care and home availability of special equipment was limited.

For D6 (Pain and Impact of Disability) domain, QoL scores were slightly higher in Dyskinetic (52.62 ± 14.82) compared to Spastic (52.14 ± 16.79) and Mixed (49.58 ± 15.68), but the difference was not statistically significant (p = 0.712) indicating that children with both dyskinetic and spastic CP had pain scores probably due to the fact that scale is parent reported and with bias due to inability to assess the exact pain amount of pain experienced by the children with CP.

For D7 (Family Health) domain, QoL scores were similar in Dyskinetic (52.18 ± 21.6) and Spastic CP (50.96 ± 19.4), slightly higher than Mixed CP (48.04 ± 23.48), the difference was not statistically significant (p = 0.736) indicating that children with all the three physiological classifications had affected family health probably due to the disease nature, socio-economic constraints and increased dependency on caregivers.

These findings align with Newman et al., who reported higher QoL scores in children with spastic CP than in those with mixed CP, particularly in physical well-being domains[89]. While our study demonstrated an overall trend of higher QoL in the spastic group, but statistical significance was observed only in the D1 domain (Social

Well-being and Acceptance). Children with spastic CP had better quality of life scores, particularly in social well-being.

Quality of life (QoL) scores were consistently better in children with hemiparetic CP than in those with diplegic and quadriparetic CP across all domains.

For the D1 (Social Well-being and Acceptance) domain, QoL scores were highest in Hemiparetic (69.71 ± 6.03) compared to Diplegic (53.69 ± 8.86) and Quadriparetic (42.42 ± 16.22), and the difference was statistically significant ($p < 0.001$), indicating that children with Hemiparetic CP experienced better social interactions and acceptance both at school and in the community. This could be due to relatively fewer physical limitations, leading to better integration and acceptance by peers, adults, and family members.

For the D2 (Feelings about Functioning) domain, QoL scores were highest in Hemiparetic (59.07 ± 7.84) compared to Diplegic (56.08 ± 7.86) and Quadriparetic (36.22 ± 18.4), and the difference was statistically significant ($p < 0.001$). This indicates that children with Hemiparetic CP generally reported better feelings about their ability to perform daily activities, such as using their arms and hands, dressing themselves, eating, and communicating, likely due to fewer and less severe functional impairments compared to those with Diplegic and Quadriparetic CP.

For D3 (Participation and Physical Health) domain, QoL scores were highest in Hemiparetic (53.89 ± 12.23) compared to Diplegic (43.52 ± 7.67) and Quadriparetic (31.56 ± 17.57), and the difference was statistically significant ($p < 0.001$). This indicates that children with Hemiparetic CP reported better participation in physical activities, likely due to fewer motor impairments and greater mobility.

For D4 (Emotional Well-being and Self-esteem) domain, QoL scores were highest in Hemiparetic (63.37 ± 8.25) compared to Diplegic (57.36 ± 6.06) and Quadriparetic (42.77 ± 15.85), and the difference was statistically significant ($p < 0.001$) indicating that children with hemiparetic CP experience better emotional well-being and self-esteem.

For D5 (Access to Services) domain, QoL scores were highest in Hemiparetic (78.57 ± 10.18) compared to Diplegic (69.69 ± 12.14) and Quadriparetic (66.07 ± 13.6), but the difference was not statistically significant ($p = 0.054$), indicating that access to hospital service is the same among all the three topographical classifications due to awareness and follow-up services, though access to respite care and home availability of special equipment was limited.

For D6 (Pain and Impact of Disability) domain, QoL scores were highest in Diplegic (60.84 ± 9.74) compared to Quadriparetic (50.28 ± 15.62) and Hemiparetic (48.86 ± 18.16), but the difference was not statistically significant ($p = 0.098$) This is probably due to the fact that scale is parent reported and with bias due to inability to assess the exact pain amount of pain experienced by the children with CP.

For D7 (Family Health) domain, QoL scores were highest in Hemiparetic (70.93 ± 18.59) compared to Diplegic (58.8 ± 8.49) and Quadriparetic (47.18 ± 21.95), and the difference was statistically significant ($p = 0.007$) indicating that family health was better in children with hemiparetic CP due to less burden on caregivers both mentally and physically because mobility and ability to carry out their routine activities was better in these children.

These findings align with Bjornson et al., who reported that children with hemiparetic CP exhibit better QoL due to greater mobility and independence[44]. While

our study demonstrated an overall trend of higher QoL in the hemiparetic group, the most significant difference was observed in the D1 domain (Social Well-being and Acceptance), highlighting greater challenges faced by children with quadriparetic CP.

Scores for quality of life (QoL) varied significantly across GMFCS levels, with children in GMFCS I demonstrating the highest QoL scores across most domains.

For D1 (Social Well-being and Acceptance) domain, QoL scores were highest in GMFCS I (67.09 ± 10.17) compared to GMFCS II (58.21 ± 13.28), GMFCS III (49.62 ± 12.13), GMFCS IV (35 ± 7.93), and GMFCS V (35.39 ± 13.88), with the difference being statistically significant ($p < 0.001$) indicating that children with GMFCS I have better social well-being and acceptance due to less severe mobility impairment.

For D2 (Feelings about Functioning) domain, QoL scores were highest in GMFCS I (58.47 ± 6) and GMFCS II (58.91 ± 9.38), with lower scores in GMFCS III (47.98 ± 12.73), GMFCS IV (29.9 ± 11.1), and GMFCS V (23.7 ± 11.7), and the difference was statistically significant ($p < 0.001$) indicating that functional abilities like communication and participation in daily activities are better in GMFCS I and II, with significant decline in higher GMFCS levels.

For D3 (Participation and Physical Health) domain, QoL scores were highest in GMFCS I (59.24 ± 14.02), followed by GMFCS II (49.64 ± 10.77), GMFCS III (39.69 ± 7.28), GMFCS IV (28.52 ± 13.73), and GMFCS V (18.88 ± 8.89), with a statistically significant difference ($p < 0.001$) indicating that children with GMFCS I have better participation in physical activities and overall physical health compared to those with more severe motor impairments.

For D4 (Emotional Well-being and Self-esteem) domain, QoL scores were highest in GMFCS I (62.19 ± 6.08), followed by GMFCS II (58.32 ± 10.86), GMFCS III (53.54 ± 14), GMFCS IV (40.75 ± 12.83), and GMFCS V (32.72 ± 10.27), with a statistically significant difference ($p < 0.001$) indicating that children with GMFCS I experience better emotional well-being and self-esteem.

For D5 (Access to Services) domain, QoL scores were highest in GMFCS I (74.39 ± 12.77) and GMFCS II (75.27 ± 11.02), followed by GMFCS III (66.43 ± 6.81), GMFCS IV (63.31 ± 14.56), and GMFCS V (62.54 ± 14.56), and the difference was statistically significant ($p = 0.003$) indicating that access to services was better in children with GMFCS I and II compared to those with more severe impairments because of better physical activity and easier commutation.

For D6 (Pain and Impact of Disability) domain, QoL scores were similar across groups, GMFCS I (51.54 ± 21.25) and GMFCS II (54.33 ± 14.83) having the highest scores followed by GMFCS III (49.66 ± 15.84), GMFCS IV (50.66 ± 10.83), and GMFCS V (50.53 ± 16.85), though the difference was not statistically significant ($p = 0.895$) indicating no significant difference in pain and the impact of disability across the GMFCS levels because the nature of scoring system being parent reported and with bias due to inability to assess the exact pain amount of pain experienced by the children with CP.

For D7 (Family Health) domain, QoL scores were highest in GMFCS I (66.89 ± 18.25), followed by GMFCS II (61.68 ± 16.34), GMFCS III (52.23 ± 18.11), GMFCS IV (50.67 ± 20.91), and GMFCS V (37.61 ± 21), with a statistically significant difference ($p < 0.001$) indicating that family health is better in children with GMFCS I due to less burden on care givers as child is able to perform activities of daily living.

These findings align with Sandella et al., Bjornson et al., and Davis et al., who reported a progressive decline in QoL scores with increasing GMFCS levels[15,98,72]. Bjornson et al. found that mobility restrictions contributed to lower QoL, particularly in physical well-being[98]. Davis et al. noted that social (D1) and emotional well-being (D4) remained stable, maybe because it couldn't be assessed accurately[72]. However, our findings suggest that as motor impairment severity increases, overall QoL declines, particularly in physical function (D3), social participation (D2), and emotional well-being (D4), with reduced mobility impacting independence and interaction.

STRENGTHS OF OUR STUDY

1. A validated sleep disturbance scale was utilized, enhancing the reliability of the results and minimizing inconsistencies in data collection.
2. The study was conducted with an adequate sample size, encompassing urban and rural populations.
3. A comprehensive approach was taken by incorporating all major functional classification systems, including GMFCS, VFCS, CFCS, MACS, and EDACS. This multidimensional evaluation provided a more in-depth understanding of sleep disturbances in children with CP rather than using only one classification.
4. The application of advanced statistical methods, such as ANOVA and Chi-square tests, ensured that the findings were robust and statistically reliable in assessing the association between sleep disturbances and functional classifications.

LIMITATIONS OF THIS STUDY:

1. The study did not include Objective sleep assessments, such as polysomnography, due to financial constraints.
2. A direct clinical correlation with factors such as medication use, pain severity, and spasticity levels was not established. Additionally, external influences like environmental factors, sleep hygiene, and parental stress were not examined, despite their potential impact on sleep quality and the underlying causes of sleep disturbance.
3. The study primarily relied on caregiver-reported questionnaires. While these reports provide valuable insights, they may introduce recall bias and subjective variability, potentially affecting the accuracy of the reported sleep disturbance.

FUTURE IMPLICATIONS

1. Conducting longitudinal studies to evaluate how sleep disturbances progress over time and their impact on cognitive, motor, and behavioral development in children with CP.
2. Incorporating objective sleep assessment tools, such as polysomnography, actigraphy, and wearable sleep monitors, to enhance the accuracy of data collection and identify specific sleep pathologies.
3. Developing targeted sleep management strategies based on functional classifications to optimize clinical interventions, including behavioral modifications, pharmacological treatments, and assistive technologies.

4. Adopting a multidisciplinary approach that involves pediatricians, neurologists, sleep specialists, and therapists for comprehensive sleep management in children with CP.
5. Investigating the role of comorbid conditions such as epilepsy, GERD, and hyperactivity in sleep disturbances, as addressing these factors may lead to improved sleep quality.
6. Exploring environmental and psychological factors, such as parental stress, sleep hygiene practices, and home settings, to assess their influence on sleep disturbances in children with CP.

CONCLUSION

1. The overall prevalence of sleep disturbances in children with cerebral palsy (CP) in our cohort was 86.52%, with 52.81% experiencing severe to very severe impairment. This highlights the widespread nature of sleep-related challenges in this population.
2. The most prevalent sleep disturbance observed in our study was Disorders of Initiation and Maintenance of Sleep (DIMS), with the highest mean DIMS T-score (70.71 ± 19.1), followed by Sleep-Wake Transition Disorder (SWTD) (69.22 ± 19.36), followed by Disorders of Arousal (DA) (66.73 ± 19.46) and Disorders of Excessive Somnolence (DES) (64.09 ± 16.13). Sleep Breathing Disorders (SBD) (60.91 ± 17.22), followed by Sleep Hyperhidrosis (SHY) (59.15 ± 12.36).
3. Higher the Gross Motor Function Classification System (GMFCS) levels, the greater is the frequency and magnitude of sleep disturbances notably having severe DIMS and SWTD (high T scores), reinforcing the impact of worsening motor dysfunction on sleep quality.
4. The study reveals a predominantly moderate negative correlation between total sleep disturbances and Quality of Life (QoL) domains, indicating that higher the sleep disturbance scores, lower are the QoL scores and thus, poorer the quality of life .
5. Sleep disturbances in children with CP, including DIMS, SBD, SWTD, and DES, negatively impacted their quality of life across domains D1(social well-being), D2 (feelings about functioning), D3 (physical well-being), D4 (emotional well-being) due to cognitive and behavioral decline. For D5 (Access to Services) , QoL scores were lower in children with higher mean T scores

across all the sleep disturbances due to limited access to community resources, poorer usage of special equipment, respite care, and community services, compounded by low socioeconomic constraints and poor awareness. D7 (Family Health) was lower in children with higher mean T scores across all the sleep disturbances due to the increased caregiving burden and financial, physical, and emotional stress on family members.

6. Among physiological classifications, Dyskinetic CP was the most common type (41.57%). Quadriparetic CP was the most prevalent topographical type (79.78%). GMFCS Level V (34.83%) was the most prevalent gross motor classification in our study, followed by Level II (25.84%), while Levels III and IV had equal representation (15.73% each). Hyperactivity (74.2%) was the most common comorbidity, possibly worsening sleep, followed by epilepsy (60.7%) with frequent awakenings and disrupted sleep, drooling (55.1%) causing discomfort, CVI (40.5%) and dental caries (40.4%) affecting overall well-being, GERD (34.8%) and constipation (34.8%) leading to nighttime discomfort, malnutrition (25.8%) impacting growth, and hearing defects (6.7%) potentially affecting sensory processing.
7. Children with Mixed CP exhibited higher total sleep disturbance mean T scores ((78.63 ± 18.74) compared to Spastic and Dyskinetic CP and have more severe (23.3%) and very severe (36.7%) cases of CP. These findings suggest that mixed CP is associated with an increased risk of severe sleep disturbances, particularly in sleep initiation, maintenance, and transition, indicating the need for early diagnosis and effective interventions. Children with quadriparetic CP had the highest rates of severe sleep disturbances, with 32.39% experiencing severe DIMS and 26.76% severe Sleep–Wake Transition Disorders (SWTD) compared to diplegic and hemiparetic CP. These findings suggest that factors

such as postural instability, spasticity, and pain contribute significantly to sleep fragmentation.

8. Children with greater Gross motor functional limitations (GMFCS levels IV & V) had notably lower quality of life (QoL) scores, particularly in psychosocial, emotional, communication, and social interaction domains. This reinforces the detrimental effect of poor sleep on overall daily functioning.
9. This study found strong associations between the higher levels of Visual functional classification system (VFCS), Eating and Drinking Ability Classification System (EDACS), and Manual ability classification systems associated with more significant sleep disturbances, an area less explored in research.
10. The significant correlation between functional severity, sleep disturbances, and reduced QoL highlights the need for targeted sleep interventions and parental education to enhance well-being in children with CP.

SUMMARY

Among the 89 children with cerebral palsy (CP) included in this study, sleep disturbances were observed in 86.52% of cases, with 52.81% experiencing severe to very severe impairment. The mean age of the participants was 7.82 ± 4.05 years, with a slight male predominance (57.3%).

Disorders of Initiation and Maintenance of Sleep (DIMS) was the most prevalent sleep disturbance, with the highest mean T-score (70.71 ± 19.1), followed by Sleep-Wake Transition Disorder (SWTD) (69.22 ± 19.36), Disorders of Arousal (66.73 ± 19.46), and Disorders of Excessive Somnolence (64.09 ± 16.13). Sleep Breathing Disorders (60.91 ± 17.22) and Sleep Hyperhidrosis (59.15 ± 12.36) had comparatively lower scores. Higher Gross Motor Function Classification System (GMFCS) levels were associated with increased frequency and severity of sleep disturbances, particularly severe DIMS and SWTD, emphasizing the impact of worsening motor dysfunction on sleep quality.

Regarding the etiology of CP, acquired factors were responsible for 91.01% of cases, followed by genetic causes, which accounted for (8.9%). Perinatal asphyxia was the most common cause (50.62%), followed by neonatal hypoglycemic brain injury (NHBI) at 20.99%. Prematurity and postnatal sepsis/meningitis accounted for 9.88% each, while bilirubin-induced neurological dysfunction (BIND) was noted in 7.41% of cases. Additionally, prolonged rupture of membranes (PROM) and meconium aspiration syndrome (MAS) were each seen in 6.17% of cases.

Coming to physiological classification, dyskinetic CP was the most common type (41.57%), followed by mixed CP (33.71%) and spastic CP (24.72%). Quadriparetic CP was the predominant topographical type, occurring in 79.78% of

cases, followed by Diplegic (12.36%) and Hemiparetic (7.87%). Hyperactivity (74.2%), epilepsy (60.7%), GERD (34.8%), vision and hearing impairments, and intellectual disabilities were the most commonly associated comorbidities. This reinforces the need for comprehensive multidisciplinary management. Early identification and targeted interventions for these comorbidities can significantly enhance better outcomes and improve overall well-being in children with CP.

Children with mixed CP exhibited the highest mean DIMS T score (79.7 ± 17.87) and total sleep disturbance T score (78.63 ± 18.74), with 36.67% experiencing very severe disturbances, highlighting a greater burden of sleep issues in this group. Quadriparetic CP (topographical classification) had the highest total sleep disturbance T score (77.45 ± 19.85), with 67.74% showing severe to very severe disturbances, emphasizing its strong association with severe sleep impairments.

A predominantly moderate negative correlation between sleep disturbances and Quality of Life (QoL) domains highlights that higher sleep disturbance scores are associated with poorer QoL. In children with CP, disturbances such as DIMS, SBD, SWTD, and DES adversely impacted social well-being (D1), functional abilities (D2), physical health (D3), and emotional well-being (D4) due to cognitive and behavioural decline. Limited access to services (D5) in those with higher mean T-scores was attributed to socioeconomic constraints, reduced utilization of specialized resources, and inadequate community support. Higher mean T-scores across all sleep disturbances were associated with lower family health (D7), due to increased caregiving burden, financial strain, and heightened physical and emotional stress on family members.

Sleep disturbances were significantly linked to higher levels of GMFCS, VFCS, CFCS, MACS, and EDACS. DIMS and SWTD were more frequent in children with severe motor impairments.

Children classified under GMFCS IV-V, VFCS IV-V, and CFCS IV-V had the lowest QoL scores, particularly in communication and social interactions. QoL scores in MACS V and EDACS V also correlated with poorer sleep outcomes. These findings stress the need for physiotherapy, sleep hygiene education, assistive communication, and multidisciplinary management to improve sleep quality and overall well-being in children with CP.

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ANNEXURES

ANNEXURE – I - INFORMED CONSENT FORM

" A STUDY ON THE PREVELANCE OF SLEEP DISTURBANCES IN CHILDREN WITH CEREBRAL PALSY – A CROSS-SECTIONAL STUDY"

Name of Student/Principal Investigator: _____

Name of Guide: _____

Name of Co Guide: _____

Introduction:

You are being invited to participate in this study to find out the prevalence of sleep disorders in children with cerebral palsy using the sleep disturbance scale for children and the effects of lifestyle changes impacting the quality of life. Your kind consent and cooperation is required for participating in this study.

Explanation of procedure:

The procedure is very simple the parent/guardian will have to just answer the basic questionnaire.On a scale of 1 (Never)-5 (Always) child's activities have to be marked.Children with a score of >39 on Sleep Disturbance Scale in Children will be considered.The sleep scale and quality of life scale will be administered by the investigator.

Withdrawal from participation in the study: Please spare some time and answer the basic questionnaire which will be very helpful for my study and also the patient's well-being. Participation in this study is voluntary. You will be free to decide whether to participate in this study or continue participation once enrolled. In case you decide

to withdraw your participation, you are free to do so. However, please convey the decision to the principal investigator.

Possible benefits from participating in the study: By participating in this study, probable sleep disorders can be identified and addressed. The child with CP and parent/guardian will be counseled on sleep hygiene techniques for better sleep habits thereby improving the quality of life and health of the child. There won't be any monetary benefit from participating in this study and also there is no financial liability to you. The data gathered will help the population at large.

Possible risks from participating in the study: There are no risks involved by participating in this study.

Privacy and confidentiality: The information collected from you will be coded, to prevent any person to identify you. Your identity will never be revealed. The data collected from you will be kept confidential and only processed or aggregated data will be used for publication.

Financial incentives: You will not receive any payment for participating in this study.

Cost of investigations : It is a complete questionnaire-based study. There will be no additional cost to you for participating in this study.

Authorization for publication of aggregated data: Results obtained after processing of the aggregated data will be published for scientific purpose and or presented to scientific groups. However, your identity will never be revealed.

Questions:

If you have any question or complaints with regard to your right as study participant you may contact **DR HARSHA HEGDE**, Chairperson, Ethical committee of JNMC, 0831-2473777 Extension 4052.

Legal rights: By signing this consent form, we are not waving any of your legal rights.

ASSENT STATEMENT

I am making a voluntary decision to participate in the study "**A STUDY ON THE PREVELANCE OF SLEEP DISTURBANCES IN CHILDREN WITH CEREBRAL PALSY – A CROSS-SECTIONAL STUDY"** My signature below indicates that I have decided to participate and I have read the information provided above or the information provided above has been read to me in the language that I understand best. I was given the opportunity to ask questions and that they have been answered to my satisfaction.

Name of the participant:

Signature or left thumb impression of the participant:

Name of the witness:

Signature or left thumb impression of the witness:

Name of the investigator:

Signature of the investigator:

ANNEXURE II PROFORMA

Date: OPD No./IP NO.-

CEREBRAL PALSY PROFORMA

Name: Phone No:

Age/ Sex :

Address:

Consanguinity:

DIAGNOSIS:

Presenting Complains:

History of present illness:

Pedigree chart and family history:

Antenatal history: Maternal Systemic illness:

1st Trimester

T1a: Fever with rash ; T1b: Fever, Neck LN, Joint pain ; T1c: Drug intake/abuse; T1d: Radiation-

Other:

2nd Trimester

T2a: GDM ; T2b: PIH ; T2c: Decreased fetal movements ; T2d: Anomaly Scan abnormality ; T2e: UTI

Other:

3rd Trimester

T3a: Oligohydramnios ; T3b: PROM ;T3c: Bleeding PV

Other:

Any Antenatal USG abnormality:

Birth History:

1. Prematurity /Late preterm/Term (weeks)
2. Mode of delivery: SVD/LSCS/Assisted VD
3. Vertex/Breech
4. Birth weight
5. Perinatal asphyxia
6. RDS
7. Pathological jaundice
8. Mechanical ventilation
9. Neonatal meningitis
10. Neonatal seizures
11. Neonatal sepsis
12. Hypoglycemia
13. IVH
14. Feeding issues
15. Meconium Aspiration Syndrome

Infancy/Early Childhood(tick and describe):

Early hand preference?

Trauma/Sepsis/Meningitis/Serious infection/Encephalopathy/Mechanical Ventilation

Developmental History:

	1.Gross Motor	2.Fine Motor	3. Language	4.Social
Last achieved Milestone:				
Developmental Quotient (DQ):				

5. Vision
6. Hearing
7. Bowel
8. Bladder

Family History

- Developmental delay
- Infant or childhood deaths
- Any known inherited neurometabolic conditions

Associated complaints

Seizures

- Age of onset
- Type of seizure
- Type of Epilepsy
- Epileptic syndrome

Visual deficit: Ophthalmology evaluation:

Hearing deficit: If yes, BERA report:

Feeding difficulties:

Behavioral problems:

Intellectual Disability:

Autism:

Recurrent Respiratory tract infections:

Failure to thrive:

Constipation:

Drooling:

Examination:

Weight:

Height/Length:

Head Circumference:_____cm Microcephaly / Normal/ Macrocephaly

Weight For Length=

BMI = (weight (kg)/ height (m^2)
Underweight/Normal/Overweight/Obese

General Examination:

- Dysmorphism (Describe)
- Dental Caries

Café au lait spots/Ash leaf macule/Shagreen patch/Facial angiofibromas /Lisch nodules/Adenoma sebaceum/Hairy tuft at sacrum/Facial angioma / port wine stain/Cutaneous neurofibromatosis/Hypo/hyper pigmented macules

CNS Examination:

Mental status examination

Interaction with examiner: Good/Fair/Poor

Interest in surroundings: Good/Fair/Poor

Behaviour: Normal/Irritable/Hyperactive

Language: Receptive

Expressive

Cranial Nerves:

II	Visual acuity Fundus
III, IV, VI	Strabismus Nystagmus
VII	
VIII	
IX,X	Bulbar palsy
XII	

Motor System:

Tone

HAT (Hypertonia Assessment Tool) Hypertonia type: Spasticity/ Dystonia/Rigidity/ Mixed

HAT Item	**RIGHT** UPPER limb	**RIGHT** LOWER limb	LEFT UPPER limb	LEFT LOWER limb
1				
2				
3				
4				
5				
6				
7				
Hypertonia				

Type(s)				
Clinically:				

Power: Antigravity >3/5 or <3/5

	Right	Left
Upper limb		
Lower limb		
Specific weak joint?		

Reflexes:

	Right	**Left**
Biceps Jerk		
Triceps Jerk		
Supinator Jerk		
Knee Jerk		
Ankle Jerk		
Plantar Reflex		

Primitive Reflexes Present?

ATNR/ STNR/ Moro/Stepping/ Rooting

Postural Reflex Absent?

Parachute/ Neck Righting

Sensory system- Normal/Abnormal Comment

Signs of in-coordination-

Abnormal Movements:

Dystonia / Chorea / Athetosis / Ataxia

Contractures (describe)**:**

Classify CP

Physiological:

- Spastic
- Ataxic
- Hypotonic
- Dyskinetic – Dystonic
- Choreoathetoid
- Mixed

Topographical:

- Bilateral
- Bilateral Asymmetrical L>R or R>L
- Unilateral
- Quadriplegia
- Diplegia : LL only or LL > UL
- Hemiplegia:

Functional Classification:

GMFCS level:

MACS/Mini-MACS level:

EDACS level:

CFCS level:

VFCS level:

FINAL DIAGNOSIS-

MEDICATIONS-1.

2.

3.

4.

MRI-YES/NO

IMPRESSION-

NEUROIMAGING-YES/NO

IMPRESSION-

GENETIC EVALUATION- YES/NO

IMPRESSION-

EEG-YES/NO

IMPRESSION-

CEREBRAL VISUAL IMPAIRMENT (CVI) EVALUATION-YES/NO

IMPRESSION-

SLEEP DISTURBANCE SCALE FOR CHILDREN

Sleep disturbances in children will be categorized with help of the questionnaire into below six sleep disorders:

1. Disorders of Initiation and Maintenance of Sleep (DIMS)
2. Sleep Breathing disorders (SBD)
3. Disorders of Arousal (DA)
4. Sleep-Wake Transition Disorders (SWTD)
5. Disorders of Excessive Somnolence (DES)
6. Sleep Hyper Hydrosis (SHY)

Appendix A. SLEEP DISTURBANCES SCALE FOR CHILDREN – DECISION MAKING CODE

*Clinician: Use this reference sheet to calculate **total score** on the sleep disturbances scale for children (range: 26 to 130). **Total score** can be calculated by adding the **factor scores (DIMS, SBD, DA, SWTD, DOES, SHY)** as described at the bottom of this page.*

***Note:** record the total score in the space provided on the 'Sleep Disturbances Scale for Children' assessment form.*

1. How many hours of sleep does your child get on most nights.	1 *9-11 hours*	2 *8-9 hours*	3 *7-8 hours*	4 *5-7 hours*	5 *less than 5 hours*
2. How long after going to bed does your child usually fall asleep	1 *less than 15'*	2 *15-30'*	3 *30-45'*	4 *45-60'*	5 *more than 60'*

					5 **Always (daily)**
				4 **Often (3 or 5 times per week)**	
			3 **Sometimes (once or twice per week)**		
		2 **Occasionally (once or twice per month or less)**			
	1 **Never**				
3. The child goes to bed reluctantly	1	2	3	4	5
4. The child has difficulty getting to sleep at night	1	2	3	4	5
5. The child feels anxious or afraid when falling asleep	1	2	3	4	5
6. The child startles or jerks parts of the body while falling asleep	1	2	3	4	5
7. The child shows repetitive actions such as rocking or head banging while falling asleep	1	2	3	4	5
8. The child experiences vivid dream-like scenes while falling asleep	1	2	3	4	5
9. The child sweats excessively while falling asleep	1	2	3	4	5
10.The child wakes up more than twice per night	1	2	3	4	5
11.After waking up in the night, the child has difficulty to fall asleep again	1	2	3	4	5
12.The child has frequent twitching or jerking of legs while asleep or often changes position during the night or kicks the covers off the bed.	1	2	3	4	5
13.The child has difficulty in breathing during the night	1	2	3	4	5
14.The child gasps for breath or is unable to breathe during sleep	1	2	3	4	5
15.The child snores	1	2	3	4	5
16.The child sweats excessively during the night	1	2	3	4	5
17.You have observed the child sleepwalking	1	2	3	4	5
18.You have observed the child talking in his/her sleep	1	2	3	4	5
19.The child grinds teeth during sleep	1	2	3	4	5
20.The child wakes from sleep screaming or confused so that you cannot seem to get through to him/her, but has no memory of these events the next morning	1	2	3	4	5
21.The child has nightmares which he/she doesn't remember the next day	1	2	3	4	5
22.The child is unusually difficult to wake up in the morning	1	2	3	4	5
23.The child awakes in the morning feeling tired	1	2	3	4	5
24.The child feels unable to move when waking up in the morning	1	2	3	4	5
25.The child experiences daytime somnolence	1	2	3	4	5
26.The child falls asleep suddenly in inappropriate situations	1	2	3	4	5
DIMS: Disorders of initiating and maintaining sleep (sum the score of the items 1,2,3,4,5,10,11)					
SBD: Sleep Breathing Disorders (sum the score of the items 13,14,15)					
DA: Disorders of arousal (sum the score of the items 17,20,21)					
SWTD: Sleep-Wake Transition Disorders (sum the score of the items 6,7,8,12,18,19)					
DOES: Disorders of excessive somnolence (sum the score of the items 22,23,24,25,26)					
SHY: Sleep Hyperhydrosis (sum the score of the items 9,16)					
Total score (sum 6 factors' scores)					

Appendix B. SDSC Scoring Sheet

Clinician: use this form for reference to determine the child's sleep profile. Compare the child's T-score (see last column), total score and factor score. Higher scores indicate more disturbances, lower scores indicate less disturbances.

***Note:** Values from this scoring sheet are for your reference during the assessment/follow-up assessment and are not to be recorded on the 'Sleep Disturbances Scale for Children' assessment form*

T score	DIMS	SBD	DA	SWTD	DOES	SHY	TOTAL	T score
100+	26+	11+	8+	21+	20+		74+	100+
99	25			20			73	99
98							72	98
97							71	97
95	24			19	19		70	95
94			7				69	94
93	23	10		18	18	10	68	93
90							66	90
89	22						65	89
88					17		64	88
86	21	9		17		9	63	86
85					16		62	85
84				16			61	84
82	20		6				60	82
81					15		59	81
80						8	58	80
79	19	8		15			57	79
77					14		56	77
76	18						55	76
75				14		7	54	75
73	17				13		53	73
72		7					52	72
70	16		5	13			51	70
69					12	6	50	69
68							49	68
67							48	67
66	15			12			47	66
64	14	6			11	5	46	64
63							45	63
62				11	10		44	62
60	13						43	60
59							42	59
58	12	5	4	10	9	4	41	58
56							40	56
55							39	55
54	11			9			38	54
53					8		37	53
51		4				3	36	51
50	10			8	7		35	50
49							34	49
47	9		3				33	47
46					6		32	46
45	8	3		7		2	31	45
42					5		29	42
41	7			6			28	41
40							27	40
38		2			4	1	26	38

QUALITY OF LIFE QUESTIONNAIRE FOR CHILDREN

The CP QOL-Child measures the following seven areas of a child's life:

- Social wellbeing and acceptance
- Participation and physical health
- Feelings about functioning
- Emotional wellbeing and self-esteem
- Pain and impact of disability
- Access to services
- Family health

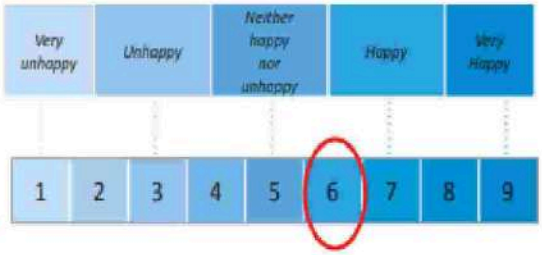
We want to ask you some questions about how you think your child FEELS about aspects of their life such as family, friends, health and school. Each question begins with "How do you think your child FEELS about.....?" It is important for you to report how you believe your child feels. Sometimes it is difficult to know how your child is feeling. Please just try and answer as best as you can.

For each question we want you to circle the best number that shows how you think your child FEELS. You can circle any number from 1 (Very unhappy) to 9 (Very happy).

This questionnaire is measuring how your child feels, not what they can do.

Here is an example:

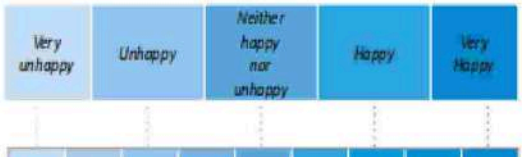
Q. How do you think your child feels about...



their ability to play games with other children

Family & Friends

Q. How do you think your child feels about...



the way they get along with people generally?	1 2 3 4 5 6 7 8 9
the way they get along with you?	1 2 3 4 5 6 7 8 9
the way they get along with their brothers & sisters?	1 2 3 4 5 6 7 8 9

OR ☐ *my child doesn't have any brothers or sisters*

the way they get along with other children at preschool or school? (If your child attends more than one school, please think about the school where your child spends the most time).	1 2 3 4 5 6 7 8 9

OR ☐ *my child does not attend preschool or school*

the way they get along with other children outside preschool or school?	1 2 3 4 5 6 7 8 9
the way they get along with adults?	1 2 3 4 5 6 7 8 9
the way they get along with their teachers and/or carers?	1 2 3 4 5 6 7 8 9

Family & Friends

Q. How do you think your child feels about...

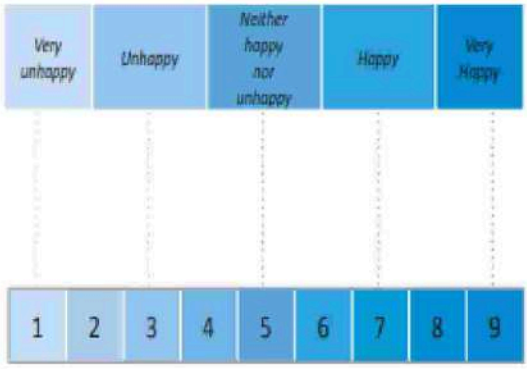
	Very unhappy	Unhappy	Neither happy nor unhappy	Happy	Very Happy
their ability to play on their own?	1	2	3	4	5	6	7	8	9
their ability to play with friends?	1	2	3	4	5	6	7	8	9
going out on trips with families?	1	2	3	4	5	6	7	8	9
how they are accepted by their family?	1	2	3	4	5	6	7	8	9
how they are accepted by other children at preschool or school? (If your child attends more than one school, please think about the school where your child spends the most time).	1	2	3	4	5	6	7	8	9

OR ☐ *my child does not attend preschool or school*

how they are accepted by other children outside of preschool or school?	1	2	3	4	5	6	7	8	9
how they are accepted by adults?	1	2	3	4	5	6	7	8	9
how they are accepted by people in general?	1	2	3	4	5	6	7	8	9
being able to do things they want to do?	1	2	3	4	5	6	7	8	9

Participation

Q. How do you think your child feels about...



their ability to participate at preschool or school? (If your child attends more than one school, please think about the school where your child spends the most time).

OR ☐ *my child does not attend preschool or school*

their ability to participate in recreational activities?

their ability to participate in sporting activities? (This question is asking how your child feels about their ability to participate in sport, not whether they can participate).

their ability to participate in social events outside of preschool or school?

their ability to participate in their community?

Communication

Q. How do you think your child feels about...

	Very unhappy		Unhappy		Neither happy nor unhappy		Happy		Very Happy
the way they communicate with people they know well (using any means of communication)?	1	2	3	4	5	6	7	8	9
they way they communicate with people they don't know well (using any means of communication)?	1	2	3	4	5	6	7	8	9
they way other people communicate with them?	1	2	3	4	5	6	7	8	9

Health

their physical health?	1	2	3	4	5	6	7	8	9
the way they get around?	1	2	3	4	5	6	7	8	9
how they sleep?	1	2	3	4	5	6	7	8	9
the way they look?	1	2	3	4	5	6	7	8	9
their ability to keep up academically with their peers?	1	2	3	4	5	6	7	8	9
their ability to keep up physically with their peers?	1	2	3	4	5	6	7	8	9

Health

Q. How do you think your child feels about...

	Very unhappy			Unhappy		Neither happy nor unhappy		Happy	Very Happy
their life in general?	1	2	3	4	5	6	7	8	9
themselves?	1	2	3	4	5	6	7	8	9
their future?	1	2	3	4	5	6	7	8	9
their opportunities in life?	1	2	3	4	5	6	7	8	9

The next 3 questions are asking how your child feels about using parts of their body, not whether your child can use part of their body.

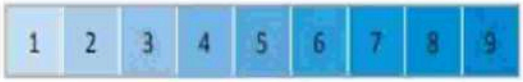
the way they use their arms?	1	2	3	4	5	6	7	8	9
the way they use their legs?	1	2	3	4	5	6	7	8	9
the way they use their hands?	1	2	3	4	5	6	7	8	9

The next 3 questions are asking how your child feels about their ability to complete daily activities, not whether your child can complete the activities.

their ability to dress themselves?	1	2	3	4	5	6	7	8	9

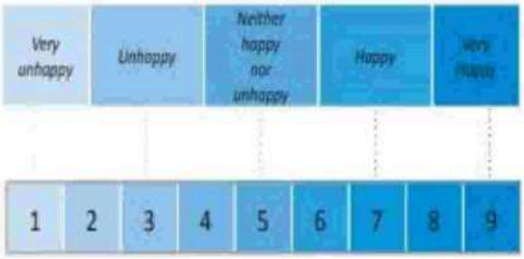
their ability to drink independently?

their ability to use the toilet by themselves?



Special Equipment

Q. How do you think your child feels about...



the special equipment they have at home (e.g. special seating, standing frames, wheelchairs, walkers)?

OR ☐ *my child does not have any special equipment at home*

the special equipment they have at their school? (e.g. special seating, standing frames, wheelchairs, walkers)?

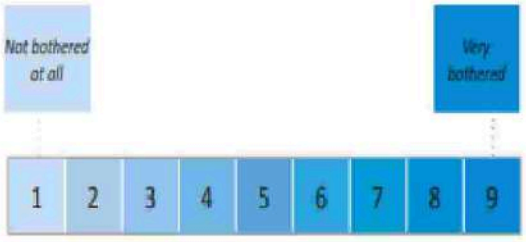
OR ☐ *my child does not have any special equipment at school*

the special equipment that is available in the community (ramps, escalators, wheelchair access)?

OR ☐ *my child does not need any special equipment in the community*

Pain and Bother

The next few questions ask about things that may bother your child.



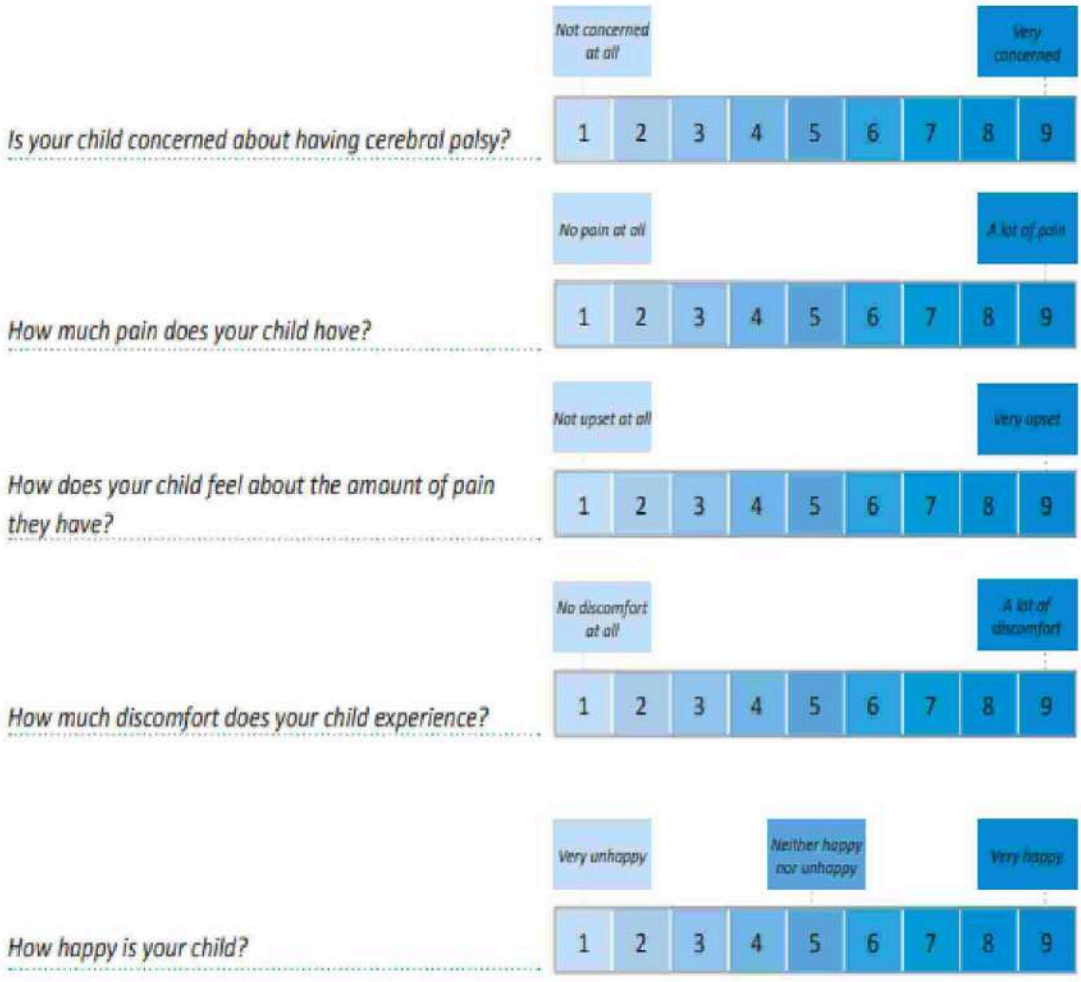
Is your child bothered by hospital visits?

Is your child bothered when they miss school for health reasons?

Is your child bothered by being handled by other people?

Does your child worry about who will take care of them in the future?

Some final questions about your child



Access to Services

The next set of questions are about YOU and how you feel about your access to services

Q. How do you feel about...

	Very unhappy	Unhappy	Neither happy nor unhappy	Happy	Very Happy
your child's access to treatment?	1 2 3 4 5 6 7 8 9				
your child's access to therapy (for example, physiotherapy, speech therapy, occupational therapy)?	1 2 3 4 5 6 7 8 9				
your child's access to specialised medical or surgical care?	1 2 3 4 5 6 7 8 9				
your ability to get advice from a paediatrician?	1 2 3 4 5 6 7 8 9				
your access to respite care?	1 2 3 4 5 6 7 8 9				

OR ☐ *I have never tried to access respite care*

(Please skip the next two questions on respite)

the amount of respite care you receive?	1 2 3 4 5 6 7 8 9
how easy it is to get respite?	1 2 3 4 5 6 7 8 9

Access to Services

Q. How do feel about...

your child's access to community services and facilities (e.g. kindergarden, childcare, after-school programs, holiday programs, community based groups such as cubs and brownies)?

your child's access to extra help with learning at preschool or school?

Your Health

your physical health?

your work situation?

your family's financial situation?

How happy are you?

How confident are you that you can report how your child feels?

ANNEXURE III

KEY TO MASTER CHART

1-Genetic

2-Acquired

3-Perinatal Asphyxia

4&6-PROM

5-NHBI

7-BIND

8-MAS

9-Prematurity

10-Post Naral Meningitis/Sepsis

ANNEXURE IV MASTER CHART

S.NO	Name	AGE	Gender	Etiology	Acquisitiveness	Epilepsy	CVI	Hearing defects	Behaviour Action	Constipation	Drooling	GERD	Dental caries	Malnutrition	Physiological classification	Topographical Classification	GMFCS	MACS	EDACS	CFCS	VFCS	SIBIM-T SCORE	SIBO-T SCORE	BA T Score	SWTD T Score	DES-T Score	SIPI-T Score	TOTAL-TScore	DIMS Disturbances	SIBO Disturbances	DA Disturbances	SWTD Disturbances	DDS Disturbances	SIPI Disturbances	Total T score	D1	D2	D3	D4	D5	D6	D7
1	Sumit Shivaraj Mirji	8.4	Male	Acquired	4	No	No	No	Yes	No	No	No	No	No	Spastic	Diplegic	III	III	II	II	II	41	72	47	54	58	45	53	No Disturbances	Severe	No Disturbances	Mild	Mild	No Disturbances	Mild	64.6	59.4	50	60.4	70.8	46.8	40.6
2	Lubaina Jamadar Ismail	7	Female	Acquired	7	No	No	No	Yes	Yes	No	No	Yes	Yes	Dyskinetic	Quadriparetic	V	V	III	V	V	79	86	58	86	88	69	98	Severe	Severe	Mild	Severe	Severe	Moderate	Very Severe	33.3	26.1	11.4	39.6	80.4	40.6	37.5
3	Manoj Monesh	7	Male	Genetic	1	Yes	No	No	No	No	Yes	Yes	Yes	Yes	Spastic	Quadriparetic	V	V	IV	V	IV	93	51	100	99	88	64	100	Very Severe	Mild	Very Severe	Very Severe	Severe	Mild	Very Severe	30.2	16.7	11.4	16.7	60.4	29.7	56.2
4	Shruti Kallappa Lohar	11	Female	Acquired	3.5	No	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Mixed	Quadriparetic	V	V	IV	V	IV	99	58	82	93	73	58	97	Very Severe	Mild	Severe	Very Severe	Severe	Mild	Very Severe	33.3	32.3	22.7	37.5	58.3	67.2	98.1
5	Akash Basaneraj Hungund	14	Male	Acquired	3.5	No	Yes	No	Yes	No	Yes	No	No	No	Dyskinetic	Quadriparetic	V	IV	III	V	III	64	93	58	100	62	45	85	Mild	Very Severe	Mild	Very Severe	Mild	No Disturbances	Severe	29.2	30.6	21.6	47.9	62.5	48.4	43.7
6	Manvitha Shivanand Tulasi	6	Female	Acquired	5	Yes	Yes	No	No	No	No	No	No	No	Dyskinetic	Quadriparetic	III	V	IV	III	V	50	45	58	50	64	51	55	No Disturbances	No Disturbances	Mild	No Disturbances	Mild	Mild	Mild	68.75	61.45	43.75	54.16	72.9	54.68	31.25
7	Shivansh Krishna Mhaloji	7	Male	Acquired	3.10	Yes	No	No	Yes	Yes	No	No	Yes	Yes	Mixed	Quadriparetic	V	V	V	V	V	73	64	100	79	62	46	80	Severe	Mild	Very Severe	Severe	Mild	No Disturbances	Severe	21.25	17.04	18.1	22.91	21.87	20.31	21.8
8	Purnima Basappa Pujar	15	Female	Acquired	3.8	No	Yes	No	Yes	No	No	No	Yes	No	Spastic	Quadriparetic	IV	III	III	III	II	73	100	82	84	73	69	97	Severe	Very Severe	Severe	Severe	Severe	Moderate	Very Severe	41.25	34.1	18.8	35.41	64.5	68.75	43.75
9	Harshita Ravindra Kelluskar	6.5	Female	Acquired	3	No	No	No	No	Yes	Yes	No	No	Yes	Mixed	Quadriparetic	V	II	II	III	II	93	86	100	95	77	64	100	Very Severe	Severe	Very Severe	Very Severe	Severe	Mild	Very Severe	45.3	16.6	22.5	25	58.9	29.7	12.5
10	Amrutha Siddaling Hadi	8	Female	Acquired	3	Yes	Yes	No	Yes	No	No	No	Yes	No	Spastic	Diplegic	II	II	I	II	II	54	45	47	41	64	45	53	Mild	No Disturbances	No Disturbances	No Disturbances	Mild	No Disturbances	Mild	62.5	67.7	53.4	66.7	77.1	70.3	68.8
11	Manvitha Santosh Patil	4.7	Female	Acquired	3.5	No	No	No	Yes	No	Yes	Yes	No	Yes	Dyskinetic	Quadriparetic	V	V	III	V	III	89	93	100	99	81	75	100	Severe	Very Severe	Very Severe	Very Severe	Severe	Severe	Very Severe	41.6	38.75	26.25	37.5	95.3	46.8	21.8
12	Muhammad Abdul Hemmlar	2.3	Male	Acquired	3	Yes	Yes	No	Yes	No	Yes	No	Yes	No	Mixed	Quadriparetic	V	IV	III	IV	IV	79	45	47	58	69	45	68	Severe	No Disturbances	No Disturbances	Mild	Moderate	No Disturbances	Moderate	38.5	43.8	42	50	60.4	32.8	15.6
13	Advit Omsrevar	2.11	Male	Acquired	3	Yes	No	No	Yes	Yes	No	No	No	No	Dyskinetic	Quadriparetic	III	IV	IV	V	IV	70	86	100	25	58	86	97	Moderate	Severe	Very Severe	No Disturbances	Mild	Severe	Very Severe	39.6	37.5	40.9	33.3	77.1	23.4	37.5
14	Mohamed Muaez Abdul Pasha	16	Male	Acquired	5.7	No	No	No	Yes	No	Yes	No	Yes	Yes	Mixed	Quadriparetic	V	V	IV	V	V	58	64	47	66	46	51	59	Mild	Mild	No Disturbances	Moderate	No Disturbances	Mild	Mild	52.5	8.3	13.6	27.1	39.6	43.75	25
15	Shivesh Ramesh Malagar	3.11	Male	Acquired	3	No	No	No	Yes	No	No	No	Yes	No	Spastic	Hemiparetic	II	III	II	I	I	89	64	58	79	58	45	80	Severe	Mild	Mild	Severe	Mild	No Disturbances	Severe	56.8	42.7	37.5	58.3	62.5	31.25	46.8
16	Nikhil Basaneraj Sanadi	4	Male	Acquired	3	Yes	No	No	No	Yes	No	No	No	No	Spastic	Hemiparetic	II	I	I	II	I	64	58	47	58	46	64	60	Mild	Mild	No Disturbances	Mild	No Disturbances	Mild	Mild	70.8	60.4	55.7	60.4	75	57.8	43.8
17	Pruthviraj Santosh Dalavi	9	Male	Acquired	8	Yes	Yes	No	No	No	Yes	No	Yes	No	Mixed	Quadriparetic	IV	II	II	IV	III	93	45	70	62	100	69	93	Very Severe	No Disturbances	Moderate	Mild	Very Severe	Moderate	Very Severe	16.7	11.5	7.9	22.9	66.7	48.4	31.3
18	Tanishka Amol Omrae	4.11	Female	Acquired	9	No	Yes	No	No	Yes	No	No	Yes	No	Mixed	Quadriparetic	IV	III	II	II	III	70	58	47	58	69	58	58	Moderate	Mild	No Disturbances	Mild	Moderate	Mild	Mild	33.3	26.1	26.1	41.7	66.7	56.3	75
19	Lakhan Laxman Kamati	11	Male	Acquired	3	No	No	No	Yes	Yes	Yes	No	No	Yes	Dyskinetic	Quadriparetic	III	IV	III	III	II	89	64	94	79	64	69	93	Severe	Mild	Very Severe	Severe	Mild	Moderate	Very Severe	47.5	13.5	26.25	33.3	64.2	64.6	32.5
20	Aziza MD Chand Khan	4	Male	Acquired	5	Yes	No	No	No	No	No	No	No	Yes	Mixed	Hemiparetic	III	II	II	II	II	47	58	47	62	46	45	53	No Disturbances	Mild	No Disturbances	Mild	No Disturbances	No Disturbances	Mild	71.9	59.4	54.5	75	68.8	56.3	75
21	Karthik Shankar Bajantri	11	Male	Acquired	9	No	No	No	Yes	No	No	No	Yes	No	Spastic	Diplegic	II	I	I	I	II	89	58	47	75	50	64	72	Severe	Mild	No Disturbances	Severe	No Disturbances	Mild	Severe	55.2	62.5	48.8	50	43.1	70.3	50
22	Amit Basavaraj Hosakatti	18	Male	Genetic	1	Yes	No	No	Yes	Yes	Yes	No	No	No	Dyskinetic	Quadriparetic	V	IV	III	III	IV	79	86	100	93	95	51	100	Severe	Severe	Very Severe	Very Severe	Very Severe	Mild	Very Severe	53.75	30.3	26.25	39.6	79.1	39.06	21.8
23	Shruti Khot	10	Female	Acquired	7	No	No	No	Yes	No	Yes	No	Yes	Yes	Dyskinetic	Quadriparetic	V	V	V	V	V	89	79	47	84	58	75	89	Severe	Severe	No Disturbances	Severe	Mild	Severe	Severe	11.25	19.31	19.4	22.91	64.58	71.42	56.25
24	Adhya Shreyanshi Patil	8	Female	Acquired	3	No	No	No	No	Yes	No	No	Yes	No	Mixed	Quadriparetic	V	V	III	IV	II	78	64	70	95	58	64	88	Severe	Mild	Moderate	Very Severe	Mild	Mild	Severe	66.67	46.87	30	47.91	58.3	39.06	46.87
25	Rachit Kiran Kallannavar	5.5	Male	Acquired	4	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	Mixed	Quadriparetic	II	V	V	V	V	86	58	58	70	69	69	84	Severe	Mild	Mild	Moderate	Moderate	Moderate	Severe	39.6	30.2	20.5	39.6	70.1	45.3	46.6
26	Aditya Channabasu Dodamani	3.3	Male	Acquired	6	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Mixed	Quadriparetic	IV	V	IV	III	II	76	51	47	58	50	58	64	Severe	Mild	No Disturbances	Mild	No Disturbances	Mild	Mild	33.3	32.3	47.7	45.8	68.8	35.9	62.5
27	Chiranjeevi Shankar Hosakoti	7	Male	Acquired	3	No	No	No	Yes	No	No	No	Yes	No	Spastic	Quadriparetic	II	III	II	II	IV	58	51	70	54	58	51	56	Mild	Mild	Moderate	Mild	No Disturbances	Mild	Mild	44.7	64.6	54.5	68.8	77.1	37.5	43.7
28	Harshitha Ladi	8.7	Female	Acquired	3.5	Yes	No	No	Yes	No	Yes	No	Yes	No	Spastic	Diplegic	I	II	I	I	II	54	45	47	45	53	58	53	Mild	No Disturbances	No Disturbances	No Disturbances	Mild	Mild	Mild	45.8	52.1	37.5	58.3	62.5	59.4	62.5
29	Praneeth Gorapati Fammar	6.5	Male	Acquired	3	Yes	No	No	Yes	No	Yes	Yes	No	Yes	Mixed	Quadriparetic	IV	V	V	V	IV	95	45	70	75	62	45	80	Very Severe	No Disturbances	Moderate	Severe	Mild	No Disturbances	Severe	33.3	26.1	47.7	33.3	47.7	53.1	37.5
30	Basaraj Mahantesh Madhal	6.9	Male	Acquired	3	Yes	Yes	No	Yes	No	Yes	No	Yes	Yes	Dyskinetic	Quadriparetic	I	II	II	III	III	47	51	58	58	69	64	62	No Disturbances	Mild	Mild	Mild	Moderate	Mild	Mild	85.6	53.1	62.5	60.4	60.4	34.4	43.7
31	Bindu Vanna Mallannavar	8	Female	Genetic	1	Yes	No	No	No	No	Yes	No	Yes	Yes	Mixed	Quadriparetic	V	V	III	IV	V	86	58	100	54	93	80	94	Severe	Mild	Very Severe	Mild	Very Severe	Severe	Very Severe	39.6	38.5	39.7	50	58.3	53.1	21.8
32	Shree Sandeep Patil	3	Male	Acquired	3	Yes	No	No	Yes	No	No	No	No	Yes	Spastic	Quadriparetic	IV	II	II	I	I	50	51	47	62	62	45	56	No Disturbances	Mild	No Disturbances	Mild	Mild	No Disturbances	Mild	33.3	41.6	29.5	54.1	54.1	40.6	43.7

33	Vihaan Anil Khanti	10.1	Male	Acquired	3	Yes	No	No	Yes	No	No	No	No	No	Spastic	Hemiparetic	I	II	I	II	II	54	45	58	50	46	45	49	Mild	No Disturbances	Mild	No Disturbances	No Disturbances	No Disturbances	No Disturbances	73.9	62.5	72.7	62.5	81.2	76.5	71.8
34	Manasi Mukund Kulkarni	10	Female	Acquired	3	Yes	No	No	No	Yes	Yes	Not	No	Yes	Spastic	Quadriparetic	V	V	IV	III	IV	95	89	70	86	100	58	100	Very Severe	Severe	Moderate	Severe	Very Severe	Mild	Very Severe	56.2	13.5	13.8	27.1	61.1	75	21.8
35	Gurukumar Shambulingai Hiramath	5	Male	Genetic	1	Yes	Yes	No	Yes	Yes	Na	No	No	Yes	Dyskinetic	Quadriparetic	II	III	II	I	II	54	86	58	93	62	86	84	Mild	Severe	Mild	Very Severe	Mild	Severe	Severe	30.2	36.5	44.3	29.1	54.2	48.4	15.6
36	Nagaveni Maddeppa Umarji	6	Female	Acquired	8	Yes	No	No	No	No	Yes	No	No	No	Spastic	Quadriparetic	V	III	II	III	III	89	51	58	100	93	69	100	Severe	Mild	Mild	Very Severe	Very Severe	Moderate	Very Severe	36.5	15.6	15.9	25	58.7	71.8	18.7
37	Praneet Vitthoba Nirsarkar	7	Male	Acquired	3	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Spastic	Quadriparetic	V	V	V	V	V	86	100	94	84	64	64	97	Severe	Very Severe	Very Severe	Severe	Mild	Mild	Very Severe	29.1	7.3	6.8	29.1	52.1	37.5	40.6
38	Sharat Prakash Patil	2.5	Male	Acquired	3	Yes	Yes	No	Yes	No	Yes	Yes	No	No	Dyskinetic	Quadriparetic	IV	IV	III	IV	IV	89	64	82	79	58	58	85	Severe	Mild	Severe	Severe	Mild	Mild	Severe	28.1	29.2	27.3	25	20.8	39.1	12.5
39	Yashas Iragppa Tirakannavar	8	Male	Acquired	7	No	Yes	No	No	No	Yes	Yes	Yes	No	Dyskinetic	Diplegic	II	II	II	II	II	60	72	100	66	58	75	77	Mild	Severe	Very Severe	Moderate	Mild	Severe	Severe	50	60.4	38.6	50	79.2	67.2	62.5
40	Ayan Yasin Mulla	2.2	Male	Acquired	5	Yes	Yes	No	Yes	No	No	No	No	Yes	Dyskinetic	Quadriparetic	IV	V	I	V	IV	50	51	47	62	53	69	59	No Disturbances	Mild	No Disturbances	Mild	Mild	Moderate	Mild	36.5	11.5	10.2	20.8	60.4	60.9	18.8
41	Ritika Patil	10	Female	Acquired	7	No	No	Yes	Yes	Yes	No	No	No	Yes	Dyskinetic	Quadriparetic	III	II	II	II	II	45	45	47	62	50	51	50	No Disturbances	No Disturbances	No Disturbances	Mild	No Disturbances	Mild	No Disturbances	34.4	50	37.5	56.2	60.4	70.3	62.5
42	Ayush Parashram Madar	3	Male	Acquired	3	No	No	No	No	Yes	No	No	Yes	No	Mixed	Quadriparetic	III	II	III	IV	II	66	45	47	52	50	58	56	Moderate	No Disturbances	No Disturbances	No Disturbances	No Disturbances	Mild	Mild	43.8	48.9	29.5	35.4	58.3	28.1	59.4
43	Kavya Shekarappa Patat	14	Female	Acquired	3	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Mixed	Quadriparetic	II	II	III	III	III	79	45	58	58	46	54	64	Severe	No Disturbances	Mild	Mild	No Disturbances	Mild	Mild	41.75	68.75	32.9	58.3	66.6	76.6	71.9
44	Sujata Shivayya Kallimath	17	Female	Acquired	5	No	No	No	No	No	No	No	No	No	Dyskinetic	Quadriparetic	II	II	II	II	I	50	45	47	45	50	45	46	No Disturbances	No Disturbances	No Disturbances	No Disturbances	No Disturbances	No Disturbances	No Disturbances	67.7	53.1	61.3	52.1	83.3	85.9	75
45	Prajwal Adiveppa Hosamani	10	Male	Acquired	8	No	No	No	No	No	No	No	Yes	No	Dyskinetic	Diplegic	II	II	II	I	I	70	86	58	50	64	64	73	Moderate	Severe	Mild	No Disturbances	Mild	Mild	Severe	46.87	55.2	37.5	54.1	58.3	73.4	65.6
46	Rakshitha Thimappa	4.6	Female	Acquired	3	No	Yes	No	Yes	Yes	No	No	No	Yes	Mixed	Quadriparetic	IV	II	II	III	I	64	45	58	45	58	36	56	Mild	No Disturbances	Mild	No Disturbances	Mild	No Disturbances	Mild	39.6	35.4	21.6	56.25	79.2	53.1	78.1
47	Adivka Darshan Gurao	4	Female	Acquired	9	No	No	No	No	No	No	No	Yes	No	Spastic	Diplegic	III	II	I	III	I	82	58	47	58	64	45	70	Severe	Mild	No Disturbances	Mild	Mild	No Disturbances	Moderate	50	53.4	40	58.3	61.1	55.3	53.1
48	Aishwarya Shankrappa Kundari	6.6	Female	Acquired	3	Yes	Yes	No	Yes	Yes	Na	No	Yes	Yes	Mixed	Quadriparetic	V	V	V	V	V	67	45	47	41	50	45	42	No Disturbances	No Disturbances	No Disturbances	No Disturbances	No Disturbances	No Disturbances	No Disturbances	14.6	17.7	7.9	29.1	72.5	78.1	18.75
49	Vamshi Narayng Mallkal	2.7	Male	Genetic	1	Yes	No	No	Yes	Yes	No	No	Yes	No	Dyskinetic	Quadriparetic	V	V	V	V	V	89	64	82	84	68	58	90	Severe	Mild	Severe	Severe	Moderate	Mild	Severe	18.7	10.8	9	31.2	75	57.8	71.8
50	Swaroop Ravi Yallur	15	Male	Acquired	5	Yes	No	No	Yes	No	Yes	No	No	No	Mixed	Quadriparetic	II	IV	IV	II	IV	54	45	70	64	50	51	56	Mild	No Disturbances	Moderate	Mild	No Disturbances	Mild	Mild	45.8	55.2	29.5	50	84.3	34.4	62.5
51	Kalesab Imamsab Kanbantanol	3.5	Male	Acquired	5,10	Yes	Yes	No	No	No	Yes	Yes	No	No	Dyskinetic	Quadriparetic	V	III	IV	V	V	99	94	47	84	77	58	94	Very Severe	Very Severe	No Disturbances	Severe	Severe	Mild	Very Severe	42.2	35.4	27.3	47.9	72.5	89	59.4
52	Ruthvika Adiveppa Kabber	3.2	Female	Acquired	5	No	Yes	No	Yes	No	Yes	Yes	No	No	Dyskinetic	Quadriparetic	V	IV	III	III	IV	100	58	100	99	81	75	100	Very Severe	Mild	Very Severe	Very Severe	Severe	Severe	Very Severe	34.4	40.6	19.3	35.4	89.5	56.25	62.5
53	Sanskriti Lakshman Panmale	12	Female	Acquired	10	Yes	No	No	Yes	No	Yes	Yes	Yes	No	Dyskinetic	Quadriparetic	II	II	II	II	II	50	58	70	70	46	45	58	No Disturbances	Mild	Moderate	Moderate	No Disturbances	No Disturbances	Mild	82.3	78.1	64.7	83.3	79.1	68.7	71.8
54	Rishikesh Narasappa Karabu	2.1	Male	Acquired	8	Yes	No	No	No	No	No	No	Yes	No	Spastic	Diplegic	II	II	I	II	I	58	51	58	62	50	45	56	Mild	Mild	Mild	Mild	No Disturbances	No Disturbances	Mild	41.7	39.6	33	66.6	72.9	53.1	62.5
55	Govindagoud Shanvappagoud Karaasudar	4.1	Male	Acquired	9	No	No	No	Yes	No	Yes	Yes	Yes	No	Mixed	Quadriparetic	IV	II	III	II	II	60	45	70	79	46	51	63	Mild	No Disturbances	Moderate	Severe	No Disturbances	Mild	Mild	52.1	51.04	44.3	60.4	83.3	66.6	65.6
56	Pratiksha Karegoudar	9.1	Female	Acquired	7	Yes	Yes	No	Yes	No	No	No	No	No	Dyskinetic	Diplegic	II	I	II	III	V	54	45	58	50	46	51	50	Mild	No Disturbances	Mild	No Disturbances	No Disturbances	Mild	No Disturbances	70.8	59.4	56.8	60.4	81.2	60.9	65.6
57	Sanvi Pradeep Karenmanavi	7	Female	Acquired	3	Yes	Yes	No	No	No	Yes	Yes	No	No	Dyskinetic	Quadriparetic	II	III	II	III	II	54	45	47	58	42	45	49	Mild	No Disturbances	No Disturbances	Mild	No Disturbances	No Disturbances	No Disturbances	56.3	63.5	50	77.1	85.4	57.8	81.3
58	Krishna Maruti Madalkar	7	Male	Acquired	3	Yes	Yes	No	Yes	Yes	Yes	Yes	No	No	Mixed	Quadriparetic	V	V	V	V	V	100	79	70	86	93	69	100	Very Severe	Severe	Moderate	Severe	Very Severe	Moderate	Very Severe	20.5	26.04	17.1	20.8	47.9	75	9.4
59	Abhishek Mallap pa Kumbhar	4	Male	Genetic	1	Yes	Yes	No	Yes	No	Yes	Yes	No	No	Mixed	Quadriparetic	V	V	V	V	V	100	51	58	93	77	80	100	Very Severe	Mild	Mild	Very Severe	Severe	Severe	Very Severe	35.4	23.9	18.2	18.7	64.6	48.4	62.53
60	Samrudhi Deepak Chougule	7	Female	Acquired	9	No	No	No	Yes	No	No	No	No	No	Dyskinetic	Diplegic	II	II	II	II	II	50	45	82	50	58	53	55	No Disturbances	No Disturbances	Severe	No Disturbances	Mild	Mild	Mild	50	60.4	38.6	50	79.2	67.2	62.5
61	Basaraj Shankarappa Hadimani	11	Male	Acquired	5	Yes	No	No	No	No	Yes	Yes	No	No	Dyskinetic	Quadriparetic	IV	IV	IV	IV	IV	60	45	84	100	73	51	84	Mild	No Disturbances	Very Severe	Very Severe	Severe	Mild	Severe	42.7	19.8	17.1	33.3	64.6	54.7	59.4
62	Rehan Majid Khan	13	Male	Acquired	3,9	Yes	No	No	Yes	Yes	Yes	Yes	Yes	No	Mixed	Quadriparetic	III	III	III	III	II	100	58	82	100	77	46	100	Very Severe	Mild	Severe	Very Severe	Severe	No Disturbances	Very Severe	57.3	48.9	39.7	66.6	58.3	37.5	68.7
63	Vinod somanna shekarannavar	14	Male	Acquired	3	Yes	No	No	Yes	Yes	Yes	No	No	No	Dyskinetic	Quadriparetic	III	IV	IV	IV	IV	76	51	47	66	77	43	73	Severe	Mild	No Disturbances	Moderate	Severe	No Disturbances	Severe	39.6	37.5	40.9	33.3	77.1	23.4	37.5
64	Shivani Mahesh Mirji	3.3	Female	Acquired	3	No	Yes	No	No	No	No	No	No	No	Dyskinetic	Quadriparetic	IV	II	III	III	III	54	51	84	45	58	58	59	Mild	Mild	Very Severe	No Disturbances	Mild	Mild	Mild	33.3	26.1	26.1	41.7	66.7	56.3	75
65	Om Mallappa Ingale	12	Male	Acquired	9	Yes	Yes	No	Yes	No	No	No	Yes	No	Mixed	Quadriparetic	V	IV	IV	V	V	100	51	100	100	88	75	100	Very Severe	Mild	Very Severe	Very Severe	Severe	Severe	Very Severe	29.2	37.5	21.6	47.9	62.5	48.4	43.7

66	Sannidhi Adappa Chalawadi	10.4	Female	Acquired	5	Yes	No	No	Yes	No	Yes	Yes	No	No	Dyskinetic	Quadriparetic	I	II	II	II	I	45	45	47	41	42	64	45	No Disturbances	No Disturbances	No Disturbances	No Disturbances	No Disturbances	Mild	No Disturbances	65.6	53.1	62.5	60.4	60.4	34.4	43.7
67	Tanushri Prabhu Vantamuri	5	Female	Acquired	10	Yes	No	No	Yes	No	No	No	Yes	No	Spastic	Quadriparetic	II	II	II	II	II	54	45	58	62	50	45	54	Mild	No Disturbances	Mild	Mild	No Disturbances	No Disturbances	Mild	62.5	67.7	53.4	66.7	77.1	70.3	68.8
68	Chinmaya Gouda Patil	5.5	Male	Acquired	4	No	No	No	Yes	No	Yes	No	No	No	Mixed	Quadriparetic	V	III	III	IV	IV	82	45	47	66	53	58	72	Severe	No Disturbances	No Disturbances	Moderate	Mild	Mild	Severe	53.8	30.2	26.1	39.6	79.1	39.1	21.8
69	Sneha Dhali	6	Female	Acquired	3	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Spastic	Quadriparetic	IV	II	II	III	IV	73	64	58	70	58	51	72	Severe	Mild	Mild	Moderate	Mild	Mild	Severe	33.3	41.6	29.5	54.1	54.1	40.6	43.7
70	Tejas Kadagouda Patil	3.3	Male	Acquired	5	Yes	Yes	No	Yes	No	Yes	Yes	No	No	Dyskinetic	Quadriparetic	III	IV	V	III	IV	60	93	100	66	69	69	86	Mild	Very Severe	Very Severe	Moderate	Moderate	Moderate	Severe	50	53.4	40	58.3	63.1	55.3	53.1
71	Aditi Kapil Melagade	10	Female	Genetic	1	No	No	No	Yes	No	No	No	No	No	Mixed	Quadriparetic	II	II	II	II	II	82	45	70	70	69	58	79	Severe	No Disturbances	Moderate	Moderate	Moderate	Mild	Severe	44.7	64.6	54.5	68.8	77.1	37.5	43.7
72	Gayatri Kapil Melagade	15	Female	Genetic	1	No	No	No	Yes	No	No	No	No	No	Mixed	Quadriparetic	I	I	II	II	II	47	79	70	50	77	58	67	No Disturbances	Severe	Moderate	No Disturbances	Severe	Mild	Moderate	73.9	62.5	72.7	62.5	81.2	76.5	71.8
73	Anagha Dattatray Apte	10	Female	Acquired	5	No	No	Yes	No	No	No	No	No	No	Mixed	Quadriparetic	IV	II	II	V	IV	76	58	100	70	81	69	90	Severe	Mild	Very Severe	Moderate	Severe	Moderate	Severe	33.3	12.3	47.7	45.8	68.8	35.9	62.5
74	Anup Nithyanand Marade	9	Male	Acquired	3	Yes	Yes	Yes	Yes	No	No	No	No	No	Dyskinetic	Quadriparetic	III	II	II	II	II	50	51	58	50	50	51	51	No Disturbances	Mild	Mild	No Disturbances	No Disturbances	Mild	Mild	34.4	50	37.5	56.2	60.4	70.3	62.5
75	Gagankumar Sharanappa Bangi	5	Male	Acquired	3	No	Yes	No	Yes	Yes	Yes	Yes	No	No	Spastic	Quadriparetic	V	IV	IV	IV	V	82	86	100	99	91	80	100	Severe	Severe	Very Severe	Very Severe	Severe	Severe	Very Severe	45.3	16.6	22.5	25	58.9	29.7	12.5
76	Om Kokasekar	8	Male	Acquired	10	Yes	Yes	No	Yes	Yes	Yes	Yes	No	No	Dyskinetic	Quadriparetic	V	IV	II	III	III	100	79	82	100	95	69	100	Very Severe	Severe	Severe	Very Severe	Very Severe	Moderate	Very Severe	52.5	8.3	13.6	27.1	39.6	43.8	25
77	Renuka Naik	4	Female	Acquired	3	Yes	Yes	No	Yes	Yes	Yes	No	Yes	No	Dyskinetic	Quadriparetic	II	II	I	III	II	45	51	58	41	42	45	42	No Disturbances	Mild	Mild	No Disturbances	No Disturbances	No Disturbances	No Disturbances	67.7	53.1	61.3	52.1	83.3	35.9	75
78	Spoorthi Patil Basanagouda	17	Female	Acquired	3	Yes	Yes	No	No	Yes	Yes	Yes	No	No	Dyskinetic	Quadriparetic	V	IV	IV	IV	IV	95	79	70	84	81	75	100	Very Severe	Severe	Moderate	Severe	Severe	Severe	Very Severe	29.1	7.3	6.8	29.1	52.1	37.5	40.6
79	Prabhu Shrikant Halamani	10	Male	Acquired	3	Yes	No	No	Yes	No	Yes	No	Yes	No	Mixed	Quadriparetic	V	V	V	V	V	100	100	82	100	69	88	100	Very Severe	Very Severe	Severe	Very Severe	Moderate	Severe	Very Severe	34.4	40.6	19.3	35.4	89.5	56.3	62.5
80	Pratham Shridhar Pattar	9	Male	Acquired	3	Yes	No	Yes	Yes	No	Yes	Yes	No	No	Mixed	Quadriparetic	V	IV	V	V	IV	100	100	40	93	93	75	100	Very Severe	Very Severe	No Disturbances	Very Severe	Very Severe	Severe	Very Severe	12.5	14.6	6.8	18.7	87.5	67.2	37.5
81	Laxmi Pattreppa Manniken	7	Female	Acquired	3	No	Yes	No	Yes	No	Yes	Yes	No	Yes	Dyskinetic	Quadriparetic	II	II	I	I	II	47	58	47	54	46	45	49	No Disturbances	Mild	No Disturbances	Mild	No Disturbances	No Disturbances	No Disturbances	83.3	65.6	72.7	56.2	77.1	56.2	87.5
82	Abujar Shabir Parit	13	Male	Acquired	3	No	Yes	No	Yes	No	Yes	No	No	No	Dyskinetic	Quadriparetic	III	I	II	I	I	54	45	70	45	46	58	51	Mild	No Disturbances	Moderate	No Disturbances	No Disturbances	Mild	Mild	51.1	58.8	42.1	62.5	66.6	56.2	75
83	Anil Suresh Gundugri	8	Male	Acquired	5	Yes	Yes	No	Yes	No	Yes	Yes	No	No	Dyskinetic	Hemiparetic	II	IV	III	III	III	47	45	47	50	50	51	47	No Disturbances	No Disturbances	No Disturbances	No Disturbances	No Disturbances	Mild	No Disturbances	69.8	62.5	50	56.2	87.5	40.6	84.4
84	Rajveer Behudeshwar Patil	6	Male	Acquired	10	Yes	No	No	No	No	Yes	Yes	No	No	Spastic	Hemiparetic	I	II	III	I	I	66	45	47	79	50	86	72	Moderate	No Disturbances	No Disturbances	Severe	No Disturbances	Severe	Severe	69.8	58.3	42.1	56.2	89.6	56.2	84.4
85	Nandish Jagadish Hanchind	11	Male	Acquired	10	Yes	No	No	Yes	No	No	No	No	No	Spastic	Hemiparetic	I	I	I	I	I	45	45	47	50	42	45	42	No Disturbances	No Disturbances	No Disturbances	No Disturbances	No Disturbances	No Disturbances	No Disturbances	75	67.7	64.7	75	85.4	23.4	90.3
86	Hanamavva Karevva Madar	16	Female	Acquired	10	Yes	No	No	Yes	No	No	No	Yes	No	Dyskinetic	Quadriparetic	II	III	I	II	II	58	51	70	58	50	69	62	Mild	Mild	Moderate	Mild	No Disturbances	Moderate	Mild	53.1	46.8	44.5	56.2	81.2	45.3	53.1
87	Gurunath Dnyanadev Gondake	5.11	Male	Acquired	4	Yes	No	No	Yes	Yes	No	No	No	No	Dyskinetic	Quadriparetic	II	I	II	II	I	45	58	58	58	73	64	63	No Disturbances	Mild	Mild	Mild	Severe	Mild	Mild	70.8	59.4	56.8	60.4	81.2	60.9	65.6
88	Suraksha Prakash Kandi	4	Female	Acquired	9	Yes	No	No	No	No	No	No	No	No	Spastic	Diplegic	II	III	III	II	I	47	45	58	41	46	51	45	No Disturbances	No Disturbances	Mild	No Disturbances	No Disturbances	Mild	No Disturbances	53.1	46.8	44.5	56.2	81.2	45.3	53.1
89	Vedika Rakesh Javel	2.2	Female	Acquired	3	Yes	Yes	No	Yes	Yes	Yes	Yes	No	No	Mixed	Quadriparetic	V	III	III	IV	IV	100	72	100	95	93	75	100	Very Severe	Severe	Very Severe	Very Severe	Very Severe	Severe	Very Severe	16.7	11.5	7.9	22.9	66.7	48.4	31.3