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# A Hospital-Based Observational Study on Nutritional Status, Functional Impairment, and Etiological Correlates in Children with Cerebral Palsy at a Tertiary Care Center

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ABSTRACT

**Introduction:** Cerebral palsy (CP) is a non-progressive neurodevelopmental disorder manifesting in early childhood with variable motor and functional impairments. Nutritional deficiencies frequently coexist due to feeding difficulties, oral-motor incoordination, and comorbid conditions, exacerbating disability and compromising quality of life. **Aim and Objective:** This study aimed to assess the nutritional status, functional impairment, and etiological correlations in children with cerebral palsy. The objectives were to: 1) evaluate the prevalence of undernutrition, stunting, and wasting across age and gender; and 2) examine associations between nutritional status, GMFCS grading, and etiological factors. **Materials & Methods:** A hospital-based observational study was conducted from May 2020 to April 2021 at Gauhati Medical College and Hospital. Children aged ≤10 years with clinically diagnosed CP attending pediatric OPD/IPD were included. Exclusion criteria involved motor deficits due to non-central causes or progressive/chronic illnesses. Ethical clearance and informed consent were obtained. Data on nutritional status, functional grading (GMFCS), and etiological factors were collected and analyzed using descriptive statistics and chi-square tests. **Results:** Among 100 children, 59% were male and 49% were aged 0-4 years. Birth asphyxia (59%) was the leading etiology, followed by neonatal hyperbilirubinemia (26%). Undernutrition was observed in 56%, stunting in 43%, and wasting in 45%. Higher GMFCS grades (IV–V) were significantly associated with worse nutritional indices ($p<0.001$). Birth asphyxia correlated with severe motor impairment ($p=0.017$), while milder etiologies were linked to better functional grades. **Conclusion:** Birth asphyxia, neonatal jaundice, and prematurity are major contributors to CP. Nutritional deficits worsen with increasing motor disability. Early perinatal care and comprehensive nutritional and rehabilitative support are essential for improving health outcomes in children with CP.

## INTRODUCTION

Cerebral palsy is a neurological condition marked by a group of permanent movement and posture disorders that appear in early childhood. These impairments are the result of non-progressive disturbances that occur in the developing brain, either during pregnancy, birth, or the early years of life [1]. Although the brain injury does not worsen over time, the symptoms and physical limitations often evolve as the child grows. The word "cerebral" refers to the brain, and "palsy" denotes issues with muscle control or weakness in movement. Cerebral palsy represents the most prevalent motor disability seen in pediatric populations across the world [2].

The global prevalence of cerebral palsy has been estimated to be between 2 and 2.5 cases per 1,000 live births, according to recent international data. The Centers for Disease Control and Prevention (CDC) reports that in developed nations, the prevalence of cerebral palsy ranges between 1 to 4 cases per 1,000 children. In India, the incidence is approximately 3 per 1,000 live births. However, these statistics are likely to be underreported due to limited surveillance, lack of standardized diagnostic facilities in rural areas, and disparities in access to maternal and child healthcare. It is estimated that around 2.5 million children in India are currently living with this condition. The

economic burden associated with the care of these children is considerable, with studies indicating that medical expenses for children with cerebral palsy are roughly ten times higher than those without neurological or intellectual disabilities [3-5].

Children affected by cerebral palsy may experience a range of physical and cognitive challenges depending on the extent and location of the brain injury. Common manifestations include delayed developmental milestones, particularly in gross and fine motor functions, difficulty in walking, and increased muscle tone or spasticity [6]. Additional complications may include intellectual disabilities, speech and language delays, vision and hearing impairment, seizures, autism spectrum features, as well as orthopedic abnormalities such as scoliosis and hip dislocation. Some children may also face bowel and bladder control issues, which further adds to the complexity of their condition [7].

Among the many complications that affect children with cerebral palsy, nutritional deficits represent a major concern that significantly influences their overall health and developmental outcomes. These children often have difficulty with oral motor function, chewing, swallowing, and coordinating their feeding reflexes, which leads to inadequate caloric intake(8). Furthermore, conditions like gastroesophageal reflux disease (GERD), prolonged feeding times, and poor caregiver understanding can contribute to chronic undernutrition and failure to thrive. Communication barriers also play a role, as children may not be able to express hunger or discomfort effectively. Consequently, malnutrition becomes both a cause and a result of deteriorating physical function, making it a cyclical problem that demands urgent attention [9].

Adequate nutritional support can bring about remarkable improvements in children with cerebral palsy. Proper dietary management can result in increased linear growth and weight gain, better neuromuscular coordination, and a reduction in irritability and spasticity. Improved nutritional status enhances the body's immune response, speeds up wound healing, and reduces the frequency of aspiration pneumonia and reflux symptoms. In addition, it boosts alertness and promotes cognitive development, thereby improving participation in rehabilitation and educational programs. Nutrition also plays a vital role in enhancing the overall quality of life for both the child and their caregivers [8].

Assessing the nutritional condition of a child with cerebral palsy requires a multidimensional approach, as no single measure can provide a complete picture. Traditional anthropometric measurements like weight and height may not always be reliable due to postural deformities and joint contractures. Therefore, specialized growth charts tailored for children with cerebral palsy are often used in clinical practice. In addition to anthropometry, assessments of dietary intake, feeding difficulties, body composition, and energy expenditure are also necessary. Feeding time per meal, choking episodes, food textures tolerated, and caregiver assistance are all relevant parameters that help determine nutritional risk [10].

To better understand the impact of motor impairments on functional capacity, the Gross Motor Function Classification System (GMFCS) is widely used. This tool classifies children into five levels based on their ability to perform movements such as sitting and walking. Children classified at higher levels of severity often face increased challenges in feeding and require more intensive nutritional and rehabilitative interventions. GMFCS scores are helpful in predicting long-term outcomes, planning individualized care strategies, and identifying those at greatest risk of malnutrition and associated complications [11].

Managing cerebral palsy necessitates an integrated, multidisciplinary strategy that addresses the wide array of medical, nutritional, developmental, and social challenges faced by these children. A multidisciplinary team including pediatric neurologists, orthopedicians, physiotherapists, speech-language pathologists, psychologists, dietitians, occupational therapists, and special educators is essential for managing cerebral palsy [12]. Treatments may involve medications, surgeries, therapy for mobility and speech, and nutritional support such as enteral feeding. Early diagnosis and sustained intervention help reduce complications and improve outcomes. Technological advancements, early rehabilitation, and individualized nutrition plans enhance care. Ongoing research into causes and preventive strategies is vital. Public health efforts, particularly in developing countries like India, must prioritize early detection, inclusive education, and accessible community-based services to improve the long-term well-being of affected individuals [13].

This study aims to assess the nutritional challenges, functional impairments, and the role of multidisciplinary management in children with cerebral palsy to enhance their overall health and quality of life. It focuses on evaluating nutritional status and feeding difficulties using comprehensive assessment tools, and examines the impact of interventions such as physiotherapy, speech therapy, dietary support, and medical treatments on growth parameters, motor abilities, and developmental progress in affected children.

## MATERIALS AND METHODS

This hospital-based observational study was conducted in the Department of Paediatrics at Gauhati Medical College and Hospital from 1st May 2020 to 30th April 2021. It included children up to 10 years of age with clinical features suggestive of cerebral palsy or previously diagnosed cases attending inpatient or outpatient services.

Inclusion criteria included all such children within the specified age. Children with motor deficits from non-central causes, progressive neurological diseases, or chronic illnesses affecting growth other than cerebral palsy were excluded. Ethical approval was obtained from the Institutional Ethics Committee, and informed consent was taken from parents or guardians.

## RESULTS

The age-wise distribution shows that nearly half (49%) of the cases are in the 0-4 years group, highlighting early onset of the condition. Gender-wise, males constitute a larger proportion (59%) compared to females (41%), indicating a male preponderance. These findings may suggest a higher vulnerability or earlier diagnosis in younger children, particularly males. Such patterns are important for early screening and targeted interventions.

**Table 1: Etiology of Cerebral Palsy**

| | Frequency | Percentage |
|---|---|---|
| **BA** | 59 | 59 |
| **INF** | 1 | 1 |
| **NHB** | 26 | 26 |
| **Unknown** | 1 | 1 |
| **PT** | 13 | 13 |
| **Total** | 100 | 100 |

Birth asphyxia (BA) emerged as the most common cause of cerebral palsy, accounting for 59% of cases, followed by neonatal hyperbilirubinemia (NHB) at 26%. Preterm birth (PT) contributed to 13% of cases, while infections (INF) and unknown causes were minimal. This highlights the need for improved perinatal care to reduce preventable causes.

**Table 2: Distribution of Underweight in Cases**

| Underweight | Frequency | Percentage |
|---|---|---|
| Yes | 56 | 56 |
| No | 44 | 44 |
| Total | 100 | 100 |

More than half of the children with cerebral palsy (56%) were found to be underweight, indicating a high prevalence of nutritional deficiency in this population. This suggests a strong association between cerebral palsy and compromised growth or feeding difficulties. Nutritional intervention should be prioritized in the management of these patients.

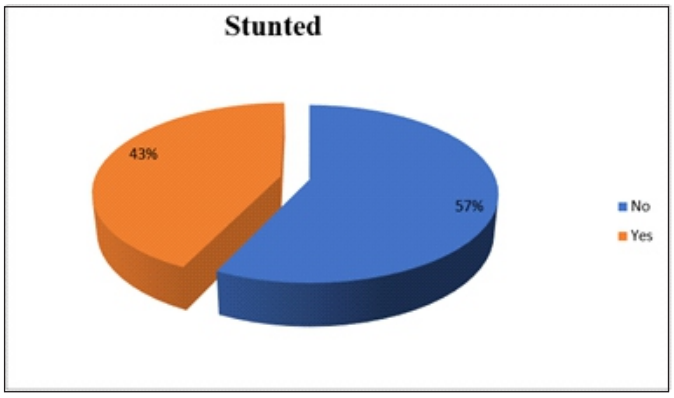


**Figure :1 Distribution of Stunted in Cases**

The pie chart indicates that 43% of children with cerebral palsy are stunted, reflecting chronic undernutrition and growth impairment. A larger proportion (57%) were not stunted, suggesting variability in nutritional status. These findings underscore the importance of regular growth monitoring and tailored nutritional support in managing cerebral palsy.

**Table 3: Distribution of Nutritional Status in Cases**

| | 0-4 Years | 4-8 Years | >8 Years | Total | Chi | p-value |
|---|---|---|---|---|---|---|
| **Underweight** | 27 | 20 | 9 | 56 | | |
| **Stunted** | 14 | 19 | 10 | 43 | 9.061 | 0.0596 |
| **Wasted** | 29 | 11 | 5 | 45 | | |

Among the children with cerebral palsy, underweight and wasting were more prevalent in the 0-4 years group, while stunting was relatively higher in the 4-8 years group. The chi-square value for stunting across age groups was 9.061 with a p-value of 0.0596, indicating a borderline statistical association. This suggests that age may influence specific nutritional deficits, warranting age-targeted nutritional interventions.

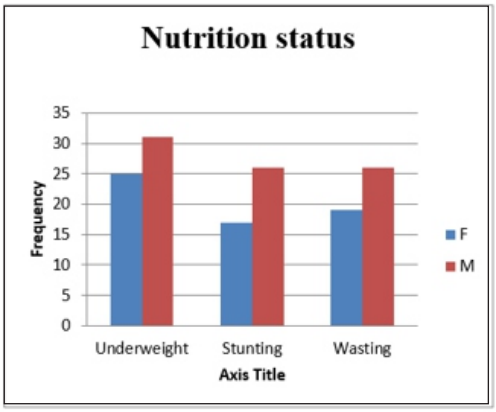


**Figure 2: Correlation of Nutritional Status with Gender**

The bar chart shows that underweight, stunting, and wasting were more frequent in male children compared to females. This indicates a higher burden of malnutrition among males with cerebral palsy in the study population. The gender disparity may reflect differences in care, feeding practices, or biological vulnerability.

**Table 4: Distribution of Cases According to GMFCS Grading**

| GMFCS GRADE | Frequency | Percentage |
|---|---|---|
| Grade I | 5 | 5.2% |
| Grade II | 20 | 20.8% |
| Grade III | 16 | 16.7% |
| Grade IV | 35 | 36.5% |
| Grade V | 20 | 20.8% |
| Total | 96 | 100.0% |

The distribution shows that the majority of children (36.5%) were classified as GMFCS Grade IV, indicating severe motor impairment. Grades II and V each accounted for 20.8%, while Grade I (mildest form) was the least common at 5.2%. This suggests a higher burden of moderate to severe functional disability among the study population.

**Table 5: Relation of Age Group with GMFCS Grade**

| | | AGE_GROUP | | | | |
|---|---|---|---|---|---|---|
| GMFCS GRADE | 0-4 Year | 4-8 Years | >8 Year | Total | Chi | p value |
| Grade 1 - 3 | 23(48.9) | 8(25.8) | 10(55.6) | 41(42.7) | 5.579 | 0.061 |
| Grade 4-5 | 24(51.1) | 23(74.2) | 8(44.4) | 55(57.3) | | |
| Total | 47(100) | 31(100) | 18(100) | 96(100) | | |

The data shows that higher GMFCS grades (IV-V) were more common in the 4-8 years group (74.2%), suggesting increased severity of motor impairment with age. Lower grades (I-III) were more frequent in the >8 years group (55.6%), possibly reflecting milder cases surviving longer or improved function over time. The p-value of 0.061 indicates a borderline statistically significant association between age and GMFCS grade.

**Table 6: Relation of Undernutrition with GMFCS Grade**

| GMFCS | Grade I | Grade II | Grade III | Grade IV | Grade V | Total | Chi | p-value |
|---|---|---|---|---|---|---|---|---|
| Underweight | 3(100%) | 1(5%) | 13(81.3%) | 22(62.9%) | 15(75%) | 54(57.4%) | 31.375 | <0.001 |
| Stunted | 0(0%) | 0(0%) | 6(37.5%) | 19(54.3%) | 16(80%) | 41(42.7%) | 24.533 | <0.001 |
| Wasted | 5(100) | 1(5) | 9(56.25) | 19(54.29) | 11(55) | 45(46.88) | 21.62 | <0.001 |

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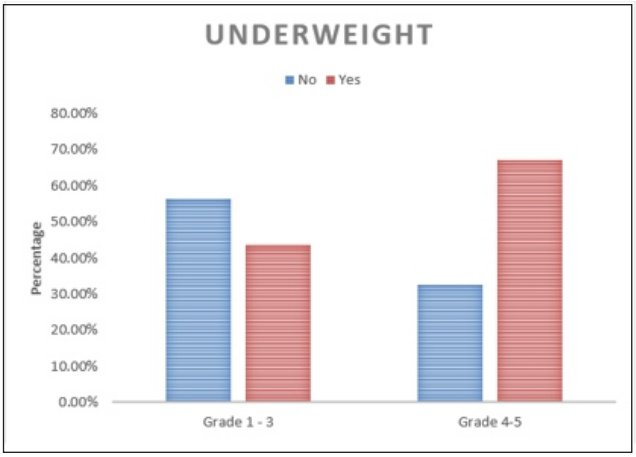


**Figure 3: Relation of Underweight with GMFCS Grading**

The bar chart illustrates that underweight prevalence increases significantly with higher GMFCS grades. In Grades 4-5, the majority of children are underweight, whereas Grades 1-3 show a higher proportion of children with normal weight. This indicates a clear correlation between greater motor impairment and poor nutritional status

**Table 7: Relation Between Etiology and GMFCS Grading**

| | GMFCS GRADE | | | | |
|---|---|---|---|---|---|
| | Grade 1 - 3 | Grade 4-5 | Total | Chi | p value |
| BA | 17(41.5%) | 40(72.7%) | 57(59.4%) | 12.806 | 0.017 |
| INF | 1(2.4%) | 0(0%) | 1(1%) | | |
| NHB | 14(34.1%) | 10(18.2%) | 24(25%) | | |
| Other | 0(0%) | 1(1.8%) | 1(1%) | | |
| PT | 9(22%) | 4(7.3%) | 13(13.5%) | | |
| Total | 41(100%) | 55(100%) | 96(100%) | | |

The table shows a statistically significant association (p = 0.017) between etiology and GMFCS grade. Birth asphyxia (BA) is the leading cause and is more commonly associated with severe motor impairment (Grade 4-5),seen in 72.7% of such cases. In contrast, neonatal hyperbilirubinemia (NHB) and prematurity (PT) are more frequent in milder grades, indicating differing impacts on motor outcomes based on etiology.

## DISCUSSION

Our study found that 49% of cases were in the 0-4 years age group, indicating early onset, and 59% were males, suggesting male preponderance. These findings are supported by Chagas PS et al. (2024), who reported that 54.7% of children with cerebral palsy were male, and 90.4% were under 12 years, with 49% in GMFCS levels IV-V, indicating higher severity in early childhood. Similarly, Fafolahan AO et al. (2024) observed a significant male preponderance, with 62.3% males affected, and a higher prevalence of CP among males (33.6%) compared to females (16.4%), reinforcing our findings of early and gender-skewed presentation [14, 15].

Our study identified birth asphyxia as the most common cause of cerebral palsy (59%), followed by neonatal hyperbilirubinemia (26%) and preterm birth (13%). Notably, 56% of children were underweight, reflecting nutritional compromise. These findings are supported by Zhang S et al. (2020), who reported a 20-22% incidence of CP among term infants with perinatal asphyxia, reinforcing it as a major preventable cause. Saini AG et al. (2021) found identifiable risk factors in 89% of CP cases, with birth asphyxia and neonatal hyperbilirubinemia frequently co-occurring and associated with severe motor and cognitive impairments, consistent with our observed clinical patterns [16, 17].

Our study found that 43% of children with cerebral palsy were stunted, with stunting more common in the 4-8 years group, while underweight and wasting were more prevalent in the 0-4 years group. Male children exhibited higher rates of malnutrition across all indicators. These findings correlate well with Chanie ES et al. (2024), who reported a pooled malnutrition prevalence of 59.7%, with rising stunting rates from 54% to 62% post-2017, indicating persistent chronic undernutrition. Similarly, Jahan I et al. (2023) found that in children under five, 46% were underweight, 42.5% stunted, and 31% wasted, while children aged five and above showed even more severe malnutrition. Both studies also observed gender-based disparities and feeding-related issues, supporting our observations [18, 19].

Our study found that 36.5% of children were classified as GMFCS Grade IV, with a higher prevalence of Grades IV-V in the 4-8 years group, indicating severe motor impairment associated with increased age and undernutrition. This closely matches findings by García-Romero R et al. (2025), who reported that ~70% of children were in GMFCS IV-V, with significantly lower anthropometric z-scores and high rates of dysphagia (62%) in these grades ($p < 0.0001$). Similarly, Bharti N et al. (2024) observed comparable GMFCS distribution-35.4% Grade IV and 28.1% Grade V-and found severe wasting in 54.5% and underweight status in 50% of children, strongly associated with higher GMFCS levels ($p < 0.05$), supporting our findings [20, 21].

Our study found a clear correlation between higher with most children in Grades IV-V being undernourished, while those in Grades I–III were more often of normal weight. We also observed a statistically significant association ($p = 0.017$) between etiology and GMFCS grade; birth asphyxia was the leading cause and more frequently associated with severe motor impairment (72.7% in Grades IV-V), while neonatal hyperbilirubinemia and prematurity were linked to milder forms. These findings align with Jahan I et al. (2019), who reported significantly higher odds of undernutrition in GMFCS IV-V (underweight OR = 2.8 and 4.0, stunting OR = 5.1 and 7.0, respectively), and a strong link between birth asphyxia and severe impairment. Viswanath M et al. (2023) also confirmed this etiology-severity pattern [22, 23].

## CONCLUSION

This study highlights birth asphyxia, neonatal jaundice, and prematurity as key causes of cerebral palsy. Preventive strategies such as early detection of fetal distress, timely cesarean delivery, phototherapy, and exchange transfusion for neonatal jaundice, along with maternal education, proper nutrition, appropriate marriage age, and family planning can reduce these risks. Malnutrition is common in children with CP, affecting immunity and recovery. Nutritional rehabilitation improves micro- and macronutrient intake, enhancing quality of life. These findings are vital for policymakers and disability program planners. Establishing nutritional rehabilitation centers and composite regional centers for physiotherapy is essential for comprehensive cerebral palsy care.

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