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Original Article

Association of Nutritional Status with Gross Motor Function in Cerebral Palsy

Maryam Shams[1], Danish Hassan[2], Mehwish Boota[3]*, Ali Asad Naeem[4], Osama Khalil[4]

[1]Student in physical therapy department, Riphah International Institute Lahore, Pakistan.

[2]Assistant Professor, physical therapy department, Riphah International Institute Lahore, Pakistan.

[3]Student at University Institute of Physical Therapy, The University of Lahore-Lahore Pakistan.

[4]Student in University Institute of Physical Therapy department, The University of Lahore-Lahore Pakistan.

Corresponding Author: Mehwish Boota; Email: mehwish.b974@gmail.com

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ABSTRACT

Background: Cerebral palsy is a prevalent disorder characterized by severe disability in body structures, impacting physical activities and daily living. This condition is often accompanied by poor nutritional status due to its complex interaction with movement and posture disorders.

Objective: The study aimed to determine the association between nutritional status and gross motor function in children with cerebral palsy.

Methods: A cross-sectional analytical study was conducted at Khawaja Arshad Hospital, Sargodha from July to December 2020. Children aged 4-12 years diagnosed with cerebral palsy were included, excluding those with genetic, metabolic, or neurodegenerative diseases affecting growth. Nutritional status was assessed using the WHO ANTHRO PLUS calculator, and children were categorized into five levels of gross motor function based on the Gross Motor Function Classification System.

Results: The study consisted of 55% males and 45% females. Gross motor function assessments revealed that 25% of participants were in level I, 60% in levels II and III, and 15% in levels IV and V. Nutritional assessments indicated that 17% of the children were malnourished, 70% had normal nutrition, and 12% were overweight. Height for age percentile showed 30% malnutrition and 70% normal nutritional status.

Conclusion: There was a significant correlation between the severity of gross motor dysfunction and nutritional status in children with cerebral palsy, with higher levels of motor impairment associated with greater nutritional deficits.

Keywords: Cerebral Palsy, Gross Motor Function Scale, Nutritional Status, WHO ANTHRO PLUS, Malnutrition.

INTRODUCTION

Cerebral palsy (CP) is a prevalent disorder that significantly impairs physical activity due to a non-progressive disturbance in the developing fetus (1). This condition, characterized by severe disabilities of body structures, is frequently accompanied by poor nutritional status. Historically, children with CP have been observed to be malnourished and exhibit stunted growth compared to their peers without the disorder. The incidence of CP is estimated at 2.5 per 1,000 live births, a rate that has increased in recent years, partly due to a rise in low birth weight incidents (1).

Children with CP often face numerous feeding challenges due to oral motor dysfunctions, contributing to undernutrition (1). Over 90% of children with CP experience gastrointestinal symptoms, which exacerbate these nutritional challenges (2). Consequently, approximately one-third of children with CP are malnourished, and recent studies suggest this proportion is rising (3). Compounding the problem, mental retardation in these children often impedes their ability to express hunger or communicate their needs effectively, which further complicates caregivers' efforts to provide optimal nutrition (4).

Despite these challenges, the direct link between malnutrition and its impact on the gross motor function in CP children remains under-researched. Previous investigations have noted the adverse effects of malnutrition, such as compromised brain development, weakened immune systems, and cognitive impairments, which can be mitigated by early and accurate assessment and management of nutritional deficits (6,7,8).

Nutritional assessments in CP children typically encompass both subjective and objective methods. The Subjective Global Nutritional Assessment (SGNA) is a widely recognized subjective tool that evaluates fat composition and muscle wasting through physical examinations and patient history (9). Objectively, anthropometric measurements and body composition analyses offer critical data that help in monitoring the nutritional status of these children, although contractures and altered body postures can pose significant challenges in obtaining accurate measurements (12).

Despite the availability of methods like SGNA, literature confirming its efficacy in identifying and managing nutritional complications in CP is limited (10). This lack of robust evidence underscores the need for further research to explore the nuances of nutritional assessment in CP and its implications for treatment outcomes.

The objective of our study is to elucidate the association between nutritional status and gross motor function in children with cerebral palsy. By understanding and documenting the impact of dietary and nutritional rehabilitation on motor skills, this research aims to contribute to the body of knowledge necessary for improving the quality of life for children affected by CP.

METHODS

The study was conducted using a cross-sectional correlational design at Khawaja Arshad Hospital, Sargodha, and spanned a duration of ten months following the approval of the synopsis. The selection of participants was based on non-probability convenience sampling. Eligible participants included cerebral palsy children aged 4 to 12 years, irrespective of gender. Individuals with a history of genetic, metabolic, or neurodegenerative diseases, or other medical conditions affecting growth, were excluded from the study.

The minimum required sample size was calculated to be 45 subjects, determined using the formula N=(z2×p(1−p))/d2N = (z^2 \times p(1-p))/d^2N=(z2×p(1−p))/d2, where NNN is the minimum sample size, zzz is the confidence interval at 95% (standard value of 1.96), ppp is the estimated prevalence of CP in Pakistan from a previous study (3%), and ddd is the margin of error (0.05).

The Gross Motor Function Scale, a 66-item scale, was employed to assess the motor function in CP children. Participants were categorized into five levels based on their motor function, with Level 1 indicating the least and Level 5 the most severe dysfunction (33). The age of each child was determined from their date of birth recorded on the history-taking form. Height measurements were taken using a standiometer to the nearest 0.1 meter if the child could stand erect; otherwise, a lying position was used. Weight was estimated to the nearest 0.1 kg using a portable weighing scale, with any extra clothing, shoes, or braces removed prior to measurement.

Body Mass Index (BMI) was calculated based on the Center for Disease Control Standards for children aged 2 to 17 years, involving a two-step process where weight (in pounds) was multiplied by 703, and the resulting value was divided by the squared height in inches (34). The Weight for Age, Length/Height for Age, and BMI for Age percentiles were measured using the WHO ANTHRO PLUS calculator, an online downloadable software where the weight in kg, height in cm, and exact date of birth were entered to obtain the percentile and Z-score (35).

Data collection adhered to the ethical guidelines outlined in the Declaration of Helsinki, with approval granted by the Ethical Review Committee of the Riphah College of Rehabilitation & Allied Health Sciences, Riphah International University Lahore. Guardians of the children provided informed consent before data collection. Demographic information such as socioeconomic status and gestational period was obtained from the guardians. Basic anthropometric measurements were recorded for each child.

Data were analyzed using SPSS version 25. Continuous variables like age were presented as mean and standard deviation, while categorical variables were shown as frequency and percentage. The association between nutritional status and GMFC level in CP children was determined using Spearman correlation.

RESULTS

The analysis of the study population revealed a gender distribution where over 50% were males and approximately 45% were females. In terms of the severity of cerebral palsy as categorized by the Gross Motor Function Classification System, 25% of participants were classified in level I, demonstrating the least severe motor dysfunction, whereas more than 60% were grouped into levels II and III, indicating moderate severity. Levels IV and V, representing the most severe motor dysfunction, comprised less than 15% of the population.

Regarding nutritional status, the results indicated varying degrees of nutrition across different severity levels of cerebral palsy. The weight for age percentile showed that about 12% of the children were malnourished, over 70% had normal nutritional status, and around 10% were classified as overweight. The BMI for age percentile data similarly showed that approximately 17% of the children were malnourished, while over 70% maintained normal nutrition, and 12% were found to be overweight. Notably, stunting, which includes mild to severe conditions, was less prevalent, affecting less than 5% of participants in level I and only a slight increase in higher levels, peaking at 4% in level IV.

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Stature discrepancies were evident, with nearly 30% of the children showing signs of malnutrition when assessed by height for age percentiles, yet more than 70% were within the normal range for their age and gender. The gestational history of the participants indicated that less than 40% were born preterm, while the majority, exceeding 60%, experienced a normal birth.

These findings illustrate a complex interplay between the severity of motor dysfunction in cerebral palsy and various aspects of nutritional status, highlighting the critical need for tailored nutritional management in this population.

Table 1: Distribution of Demographic Variable (N=90)

Gender	Frequency (age%)	Number (n)
Male	55.00	50
Females	45.00	40
Total	100	90

Results showed that more than 50% of the population was males while almost 45% of the population was females.

Table 2: Distribution Of Gross Motor Functional Level (GMFC)

Gross Motor Functional Level (GMFC)	Frequency (age%)	Number (n)
Level 1	25.50	23
Level II	31.11	28
Level III	30.00	27
Level IV	8.88	8
Level V	4.44	4
Total	100	90

Results showed that 25% of the population with levels I, more than 60% of the population with level II and level III. However level IV and level V include less than 15% of the population.

Table 3: Manual ability classification system (MACAS)

Manual Ability Classification System (MACS)	Frequency (age%)	Number (n)
Level 1	32.22	29
Level II	28.88	26
Level III	30.00	27
Level IV	6.66	6
Level V	2.22	2
Total	100	90

Results showed that 32% of the population with levels I, more than 50% of the population with level II and level III. However level IV and level V include less than 10% of the population.

Table 4: Socioeconomic Status

Socioeconomic Status	Frequency (age%)	Number (n)
Level 1	6.66	6
Level 2	16.66	15
Level 3	44.44	40
Level 4	32.22	29
Total	100	90

Results showed that less than 10% of the population falls in level I, 16% of the population falls in level II, almost 50% of the population showed level III. Level IV was found in 32% of the population.

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Table 5: Birth Type

Birth Type	Frequency (age%)	Number (n)
Pre Term	35.55	32
Normal Term	64.44	58
Total	100	90

Less than 40% of the children were pre term in their birth type while more than 60% of the children have normal birth.

Table 6: Weight for Age percentile

Weight for Age Percentile	Frequency (age%)	Number (n)
Mild & Moderate / Severe Malnutrition	12.22	11
Normal	77.77	70
Overweight	10.00	9
Total	100	90

Results showed that according to weight for age percentile almost 12% of children were malnutrished, more than 70% of the children were with normal nutrition, whereas 10% were overweight.

Table 7: Anthropometric index- weight for age percentile

	Anthropometric Index - Weight for Age Percentile		
GMFC Level	Mild & Moderate / Severe Stunting %age (n)	Normal %age (n)	Overweight /Obesity %age (n)
Level 1 (29)	4 (13.80)	25 (86.26)	-
Level II (26)	1 (3.84)	20 (77.00)	5 (19.23)
Level III (27)	2 (7.40)	25 (92.60)	-
Level IV (6)	4 (66.66)	-	2 (33.33)
Level V (2)	-	-	2 (100)
P value	0.043		

Results showed that less than 5% of the population with mild moderate/severe stunting falls in level I, 1% of the population with mild moderate/severe stunting falls in level II, almost 2% of the population with mild moderate/severe stunting showed level III. Level IV was found in 4 of the population with mild moderate/severe stunting. Results showed that less than 30% of the population with normal range falls in level I, 20% of the population with normal range falls in level II, almost 25% of the population with normal range showed level III.

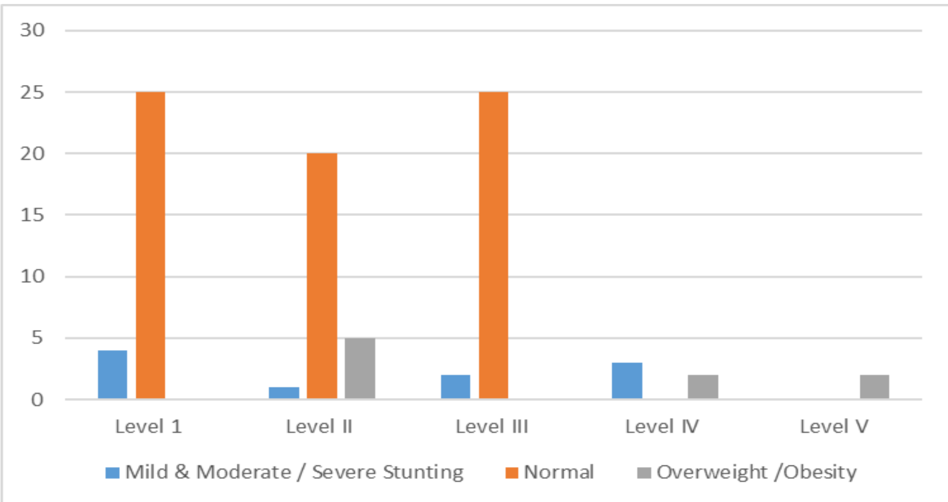

Figure 1 Multiple Bar Chart of GFMS Level and BMI for age percentile

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Table 8: BMI for age percentile

BMI for Age Percentile	Frequency (age%)	Number (n)
Mild & Moderate / Severe Malnutrition	17.77	16
Normal	70.00	63
Overweight /obesity	12.22	11
Total	100	90

Results showed that according to BMI for age percentile almost 17% of children were malnourished, more than 70% of the children were with normal nutrition, whereas 12% were overweight.

Table 9: Anthropometric index- BMI for age percentile

	Anthropometric Index – BMI for Age Percentile		
GMFC Level	Mild & Moderate / Severe Stunting %age (n)	Normal %age (n)	Overweight /Obesity %age (n)
Level 1 (29)	5 (17.24)	22 (75.86)	2 (6.89)
Level II (26)	2 (7.69)	24 (92.30)	-
Level III (27)	7 (25.93)	13 (48.14)	7 (25.93)
Level IV (6)	1 (16.66)	4 (66.66)	1 (16.66)
Level V (2)	1 (50.00)	-	1 (50.00)
P value	0.029		

Results showed that less than 5% of the population with mild moderate/severe stunting falls in level I, 2% of the population with mild moderate/severe stunting falls in level II, almost 7% of the population with mild moderate/severe stunting showed level III. Level IV was found in 1% of the population with mild moderate/severe stunting. Results showed that less than 30% of the population with normal range falls in level I, 24% of the population with normal range falls in level II, almost 13% of the population with normal range showed level III. 4% of the population with normal range showed level IV.

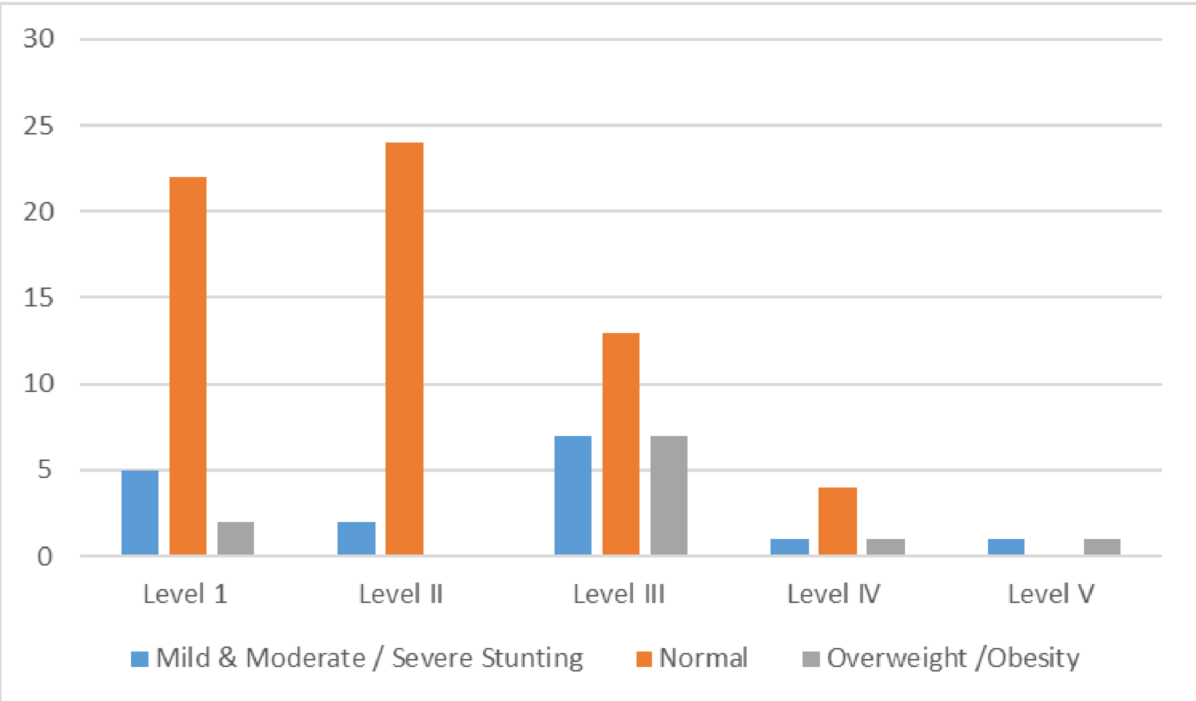

Figure 2 Multiple Bar Chart of GFMS Level and BMI for age percentile

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Table 10: Height for age percentile

Height for Age Percentile	Frequency (age%)	Number (n)
Mild & Moderate / Severe Stunting	30.00	27
Normal	70.00	63
Total	100	90

Results showed that according to height for age percentile almost 30% of children were malnourished, more than 70% of the children were with normal nutrition.

Table 11: Anthropometric index- height for age percentile

	Anthropometric Index – Height for Age Percentile	
GMFC Level	Mild & Moderate / Severe Stunting %age (n)	Normal %age (n)
Level 1 (29)	9 (31.03)	20 (68.96)
Level II (26)	5 (19.23)	19 (73.07)
Level III (27)	10 (37.03)	17 (62.96)
Level IV (6)	1 (16.6)	5 (83.33)
Level V (2)	2 (100)	-
P value	0.051	

Results showed that less than 9% of the population with mild moderate/severe stunting falls in level I, 5% of the population with mild moderate/severe stunting falls in level II, almost 10% of the population with mild moderate/severe stunting showed level III. Level IV was found in 1% of the population with mild moderate/severe stunting. Results showed that less than 30% of the population with normal range falls in level I, 19% of the population with normal range falls in level II, almost 17% of the population with normal range showed level III. 5% of the population with normal range showed level IV.

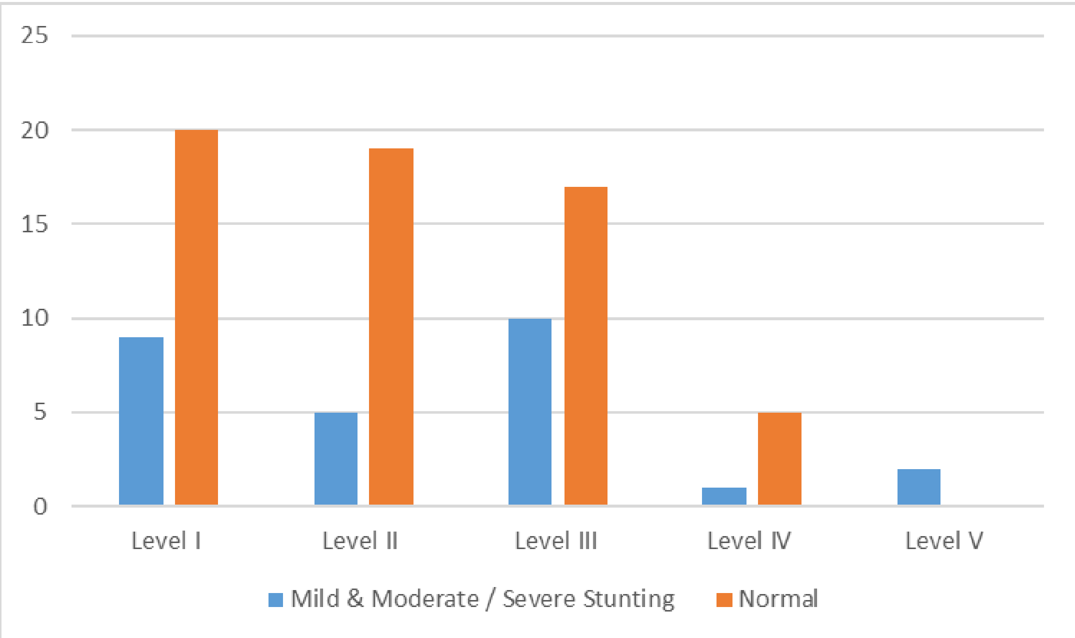

Figure 3 Multiple Bar Chart of GFMS Level and height for age percentile

DISCUSSION

In this study, a sample of children with cerebral palsy was evaluated to observe their growth and development in association with their nutritional status. The findings indicated a significant relationship between gross motor function and nutritional deficiencies. The majority of the children exhibited poor nutritional status due to a range of factors including feeding problems, limited physical activity, and challenges in communication. Despite these issues, no noticeable differences were observed in the socioeconomic statuses of the participants.

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The study utilized the Gross Motor Function Classification System (GMFCS) to categorize children based on their motor functioning. It was found that approximately half of the children were classified at functional levels II and III. This classification is crucial as it guides the physiotherapeutic interventions and is considered significant in clinical trials for its potential to influence outcomes. Notably, the distribution of children across the GMFCS levels in this study showed a lesser prevalence in the more severe levels IV and V, compared to other studies where higher severities were more common due to earlier access to advanced rehabilitation technologies in developed countries (36).

An interesting contrast emerged when comparing the results with studies from developed nations where access to advanced medical and rehabilitation resources significantly influences the gross motor function of children with cerebral palsy. In such settings, intensive technology and better management of feeding problems likely contribute to different outcomes (37). In contrast, the children in this study, predominantly from an underdeveloped country, did not have such early access to specialized care, which may explain the higher concentration of children in the moderate disability levels of II and III.

The nutritional assessment revealed that while 70% of the children were of normal weight, there were also notable percentages of malnutrition and overweight. These findings differ from other studies where higher rates of malnutrition were reported (39). The relatively high proportion of children at normal weight in this study could be attributed to dietary factors, such as the consumption of processed foods high in sugars, combined with restricted physical activities typical of urban settings (41).

The study also highlighted some strengths, such as the application of standardized growth assessments and the use of GMFCS for a robust classification of motor function. However, there were limitations including the non-probability sampling method which might not fully represent the broader population of children with cerebral palsy in urban settings. Additionally, the absence of data from non-responders could have introduced bias in the results.

Overall, this study underscores the complex interplay between nutritional status and motor function in children with cerebral palsy and points to the necessity for targeted nutritional and rehabilitation strategies that consider the unique needs of this population. The findings suggest that improving access to specialized care and nutritional management could significantly enhance the growth and development outcomes for these children.

CONCLUSION

The study confirmed a significant correlation between nutritional status and gross motor dysfunction in children with cerebral palsy, highlighting that greater motor impairment is often accompanied by more severe nutritional deficits. The research faced limitations due to the COVID-19 pandemic, which restricted participant availability, and the lack of standardized growth and development benchmarks for the Asian region, particularly Pakistan. Given the pivotal role physical therapists play in managing children with cerebral palsy, it is recommended that they also possess expertise in nutritional assessment to enhance overall care and improve outcomes for this vulnerable population.

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