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Relationship Between Gross Motor Function and Nutritional Status of Children with Cerebral Palsy-A cross-sectional study in a Tertiary Care Hospital of Bangladesh

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Abstract:

Background: Cerebral Palsy (CP) is one of the most common causes of chronic disability in children. Childhood malnutrition is a major public health issue in low- and middle-income countries. The gross motor function of children with CP can easily be assessed by the tool Gross Motor Function Classification System- Expanded &Revised (GMFCS-E&R). This study aimed to determine the relationship between GMFCS and nutritional status in children with cerebral palsy.

Materials & Method: This cross-sectional observational study was conducted in the Department of Pediatric Neurology, IPNA, BSMMU from October 2019 to August 2020. All the patients aged 2-12 years were diagnosed as CP by clinical criteria and classified by GMFCS. Nutritional status (weight for age, height for age, weight for height, BMI) is assessed and classiûed according to the World Health Organization growth charts. Then linear and multinomial logistic regression methods to determine the associations between GMFCS and nutritional status. The correlation between motor function and nutritional status was assessed.

Results: Among the 50 children 68% were male and 32% were female. The mean age of the CP children was 4.90±3.05 years. Most patients (66.0%) came from poor families followed by 24% from the middle class. Functionally majority of patients were in GMFCS level IV (28.0%) and level V (20.0%). Maximum patients in spastic quadriplegia 42%, spastic hemiplegia 16%. The level of GMFCS was associated with nutritional status, as determined by anthropometry. Moderate and severe underweight significantly related with GMFC level IV and V. Moderate and severe stunted was significantly related with IV and V GMFC level. Moderate wasted was significantly related to GMFC levels III and IV. Mild malnutrition was significantly with GMFC level II and III. Severe malnutrition is significantly related to GMFC level IV and V.

Conclusion: This study showed majority of cerebral palsy cases had severe functional gross motor disability and also severe grade of malnutrition. A significant association between severe grade of malnutrition and severe grade of motor disability was found.

Key word: GMFC, Nutrition, CP

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Introduction

Cerebral palsy (CP) is the most prevalent cause of motor disorders in childhood. The incidence of CP is about 2-2.5/ 1000 live births[1]. In Bangladesh, the prevalence is about 3.4/ 1000 live births [2]. It has been estimated that globally 80% of children with disabilities live in low- and middle-income countries. Based on a recent study, it is estimated that there are over 260,000 children with CP in Bangladesh which makes CP one of the leading causes of childhood disability in the country. Children with disabilities are at high risk for nutritional deficiencies as malnutrition can act as both a "cause" and "consequence" of disability in these settings. Childhood malnutrition is a major public health issue in low- and middle-income countries. Early detection of malnutrition in children with cerebral palsy may help in better prognosis and favorable outcomes after the initiation of appropriate nutrition therapy[3].

Gross Motor Function Classification System- Expanded and Revised (GMFCS-E & R) is the most commonly used classification of gross motor function in children with CP. This system is a very simple and well-recognized classification of mobility in CP. It was introduced by Palisano and Rosenbaum in 1997. The International Classification of Functioning (ICF) shifts the health professionals' attention from focusing on primary motor impairments to functional activities and social participation which are considered the optimal outcomes of medical services for children with CP[4].

Functional classifications are useful in setting functional goals and planning services for children with CP in health care systems. According to the system, function is divided into five levels; children in Level I represent the most independent motor function and children in Level V have the least. The distinction between the levels is thought to be clinically significant and is based on functional abilities and limitations. (i.e., self-initiated movement, sitting, transfers and need for hand-held mobility devices such as walkers or wheeled mobility). This grading is reliable across observers and invariant with increasing age[5]

The variability in the prevalence may be related to different anthropometric indices used in classifying the nutritional status of children with CP. Amongst these anthropometric indices, the World Health Organization (WHO) Growth Standard Chart got universal acceptance because it took cognizance of socio-economic and environmental factors affecting anthropometry.

In Bangladesh very limited studies have been done on nutritional status in children with CP. The purpose of this study will be to observe the nutritional status and to find out the correlation of GMFCS with nutritional status in children with cerebral palsy.

Method:

This cross-sectional study was conducted in the Department of Pediatric Neurology, Institute of Paediatric Neurodisorder & Autism (IPNA) of BSMMU from October 2019 to September 2020. The objective of the study was to assess the relationship between gross motor function and nutritional status among children with cerebral palsy. Children diagnosed as CP according to the current definition aged between 2 to 12 years. The children were suspected as neurometabolic diseases, neurodegenerative diseases and syndromic children were excluded from this study. Study subjects were enrolled by consecutive sampling after informed written consent was obtained from the parents.

A total 50 diagnosed CP children were enrolled in this study. A detailed history from parents or caregivers with special emphasis on antenatal, natal, postnatal history and physical examination was done including general examination, developmental assessment, neurological examinations and other systemic examinations. The assessment protocols were followed for all subjects. Functional classification of mobility was done according to the Gross Motor Functional Classification Extended & Revised. Children at GMFCS E & R level I: walk and perform all the activities of age-matched peers, but with limitations of speed, balance, and coordination. Children at level V need to be transported, have extreme difficulties with trunk posture, and have little voluntary control of limb movements.

Anthropometry (weight, height, BMI) was measured in accordance with the standard procedure. Weight was measured using a digital weighing scale. Recumbent length was measured in children who are unable to stand using the length board. Anthropometric measurements obtained was converted into indices using the WHO Growth Standard Charts for Z-scores based on subjects' age and sex. Nutritional status was determined using Z-scores for weight-for-age (WAZ), weight-for-height (WHZ), height-for-age and body mass index (BMI)-for-

age (BAZ). Z-scores of <“2 to “3 Z-score were considered malnourished, while scores <“3 severely malnourished. BAZ of >+1–2 were classified overweight, while scores of >+2 were considered obese.

Data were compiled and was analyzed by using SPSS Windows version 23. The mean values were calculated for continuous variables. The quantitative observations were indicated by frequencies and percentages.

Results and Observations

A total of 50 children between 2 to 12 years irrespective of sex diagnosed with cerebral palsy. Mean age was 4.90±3.05yrswith male: female ratio 2.1:1

Table-I

Socio-demographic characteristics of the study patients (n= 50)

Socio-demographic characteristics)	Frequency	Percentage
Age (in years)		
2-4	30	60.0
4-6	11	22.0
6-12	9	18.0
Mean±SD (Range)	4.90±3.05 (2-12) years	
Gender		
Male	34	68.0
Female	16	32.0
Male : female ratio	2.1:1	
Mother’s education		
Illiterate	2	4.0
Primary	35	70.0
SSC and HSC	12	24.0
Graduate and above	1	2.0
Father’s education		
Illiterate	4	8.0
Primary	32	64.0
SSC and HSC	11	22.0
Graduate and above	3	6.0
Socioeconomic status		
Poor	33	66.0
Middle Class	12	24.0
Upper middle	5	10.0
High income	0	0.0

Table-II

Distribution of patients according to types of cerebral palsy (n=50)

Type of cerebral palsy	Frequency	Percentage
Spastic quadriplegia	21	42.0
Spastic hemiplegia	8	16.0
Spastic diplegia	10	20.0
Hypotonic	4	8.0
Dyskinetic	5	10.0
Mixed	2	4.0
Total	50	100.0

Table II shows different types of CP patients. Maximum patients reported in spastic quadriplegia 42.0%, spastic diplegia 20.0%, spastic hemiplegia 16.0%, dyskinetic 10.0% and mixed 4%.

Table-III

Distribution of patient according to GMFCS level (n=50)

GMFCS level	Frequency	Percentage
Level I	7	14.0
Level II	8	16.0
Level III	11	22.0
Level IV	14	28.0
Level V	10	20.0
Total	50	100.0

Table III shows the distribution of the study patients by GMFCS level. It was observed that 14.0% GMFCS level was I, 16% patients GMFCS level was II, 22.0% GMFCS level was III, 28.0% GMFCS level IV and 20.0% level V.

Regarding nutritional status, 46.0% CP children were moderate underweight and 30.0% patients severe underweight. 20.0% children were moderate stunted, 44.0% were stunted. 30.0% CP patients were moderate wasted, 24.0% patients severe wasted. 26.0% patients were mild malnutrition and 54.0% patients were severe malnutrition.

Table-IV

Distribution of cerebral palsy children by nutritional status (n=50)

Nutritional status	Frequency	Percentage
Weight for age Z-score (WAZ)		
Normal	12	24.0
Moderate Underweight (-3 to ≤2)	23	46.0
Severe underweight (< -3)	15	30.0
Total	50	100.0
Height for age Z-score (HAZ)		
Normal	18	36.0
Moderate stunted (-3 to ≤2)	10	20.0
Severe stunted (< -3)	22	44.0
Total	50	100.0
Weight for height Z-score (WHZ)		
Normal	23	46.0
Moderate wasted (-3 to ≤2)	15	30.0
Severe wasted (< -3)	12	24.0
Total	50	100.0
BMI (kg/m^2)		
Normal (>20.0)	10	20.0
Mild malnutrition (17.0-18.4)	13	26.0
Severe malnutrition (<16.0)	27	54.0
Total	50	100.0

Table-V

Relationship of nutritional status with GMFCS level (n=50)

Nutritional status	GMFCS Level					p-value
	I (n=7) No. (%)	II (n=8) No. (%)	III (n=11) No. (%)	IV (n=14) No. (%)	V (n=10) No. (%)	
Weight for age Z-score (WAZ)						
Normal	5(71.4)	5(62.5)	2(18.2)	0(0.0)	0(0.0)	<0.001*
Moderate underweight	2(28.6)	3(37.5)	7(63.6)	11(78.6)	0(0.0)	
Severe underweight	0(0.0)	0(0.0)	2(18.2)	3(21.4)	10(100.0)	
Total	7(100.0)	8(100.0)	11(100.0)	14(100.0)	10(100.0)	
Height for age Z-score (HAZ)						
Normal	6(85.7)	5(62.5)	5(45.5)	2(14.3)	0(0.0)	0.002*
Moderate stunted	1(14.3)	2(25.0)	1(9.1)	5(35.7)	1(10.0)	
Severe stunted	0(0.0)	1(12.5)	5(45.5)	7(50.0)	9(90.0)	
Total	7(100.0)	8(100.0)	11(100.0)	14(100.0)	10(100.0)	
Weight for height Z-score (WHZ)						
Normal	7(100.0)	7(87.5)	4(36.4)	5(35.7)	0(0.0)	<0.001*
Moderate wasted	0(0.0)	0(0.0)	6(54.5)	6(42.9)	3(30.0)	
Severe wasted	0(0.0)	1(12.5)	1(9.1)	3(21.4)	7(70.0)	
Total	7(100.0)	8(100.0)	11(100.0)	14(100.0)	10(100.0)	
BMI (kg/m^2)						
Normal	5(71.4)	3(37.5)	2(18.2)	0(0.0)	0(0.0)	<0.001*
Mild malnutrition	2(28.6)	4(50.0)	4(36.4)	3(21.4)	0(0.0)	
Severe malnutrition	0(0.0)	1(12.5)	5(45.5)	11(78.6)	10(100.0)	
Total	7(100.0)	8(100.0)	11(100.0)	14(100.0)	10(100.0)	

Data are presented as frequency and percentage

Chi-Square test was used to association between nutritional status with GMFC level

n=Number of study patients; *significant

Table-VI

Association of nutritional status with type of CP (n=50)

Nutritional status	Type of CP						p-value
	Spastic Hemiplegia (n=8) No. (%)	Spastic Diplegia (n=10) No. (%)	Spastic Quadriplegia (n=21) No. (%)	Hypotonic (n=4) No. (%)	Dyskinetic (n=5) No. (%)	Mixed (n=2) No. (%)	
Weight for age Z-score (WAZ)							
Normal	2(25.0)	3(30.0)	3(14.3)	1(25.0)	2(40.0)	1(50.0)	
Moderate underweight	5(62.5)	5(50.0)	9(42.9)	1(25.0)	2(40.0)	1(50.0)	0.756
Severe underweight	1(12.5)	2(20.0)	9(42.9)	2(50.0)	1(20.0)	0(0.0)	
Total	8(100.0)	10(100.0)	21(100.0)	4(100.0)	5(100.0)	2(100.0)	
Height for age Z-score (HAZ)							
Normal	3(37.5)	4(40.0)	6(28.6)	2(50.0)	3(60.0)	0(0.0)	
Moderate stunted	2(25.0)	1(10.0)	6(28.6)	0(0.0)	0(0.0)	1(50.0)	0.779
Severe stunted	3(37.5)	5(50.0)	9(42.9)	2(50.0)	2(40.0)	1(50.0)	
Total	8(100.0)	10(100.0)	21(100.0)	4(100.0)	5(100.0)	2(100.0)	
Weight for height Z-score (WHZ)							
Normal	2(25.0)	6(60.0)	7(33.3)	2(50.0)	4(80.0)	2(100.0)	
Moderate wasted	3(37.5)	3(30.0)	8(38.1)	1(25.0)	0(0.0)	0(0.0)	0.501
Severe wasted	3(37.5)	1(10.0)	6(28.6)	1(25.0)	1(20.0)	0(0.0)	
Total	8(100.0)	10(100.0)	21(100.0)	4(100.0)	5(100.0)	2(100.0)	
BMI (kg/m^2)							
Normal	1(12.5)	0(0.0)	3(14.3)	2(50.0)	2(40.0)	2(100.0)	
Mild malnutrition	4(50.0)	4(40.0)	3(14.3)	0(0.0)	2(40.0)	0(0.0)	0.020*
Severe malnutrition	3(37.5)	6(60.0)	15(71.4)	2(50.0)	1(20.0)	0(0.0)	
Total	8(100.0)	10(100.0)	21(100.0)	4(100.0)	5(100.0)	2(100.0)	

Data are presented as frequency and percentage
Chi-Square test was used to association between nutritional status with type of CP
n=Number of study patients
*significant

Table V shows relationship between GMFCS level with nutritional status. The level of GMFCS was associated with nutritional status, as determined by anthropometry. Moderate and severe underweight significantly related with GMFC level IV and V. Moderate and severe stunted was significantly related with IV and V GMFC level. Moderate wasted was significantly related with GMFC level III and IV. Severe stunted significantly associated with GMFC level V. Mild malnutrition was significantly with GMFC level II and III. Severe malnutrition significantly related with GMFC level IV and V.

Regarding relation of nutritional status with type of CP. It was observed that there was no significant relation with WAZ , HAZ and WHZ. BMI was significantly related with type of CP. Hypotonic, spastic quadriplegia and spastic diplegia was significantly related severe malnutrition.

Discussion:

In this study, the severity of the motor deficit associated with CP was classified using the GMFCS. The GMFCS grades the self-initiated movement of CP patients, with particular emphasis on their functional abilities (sitting, crawling, standing and walking), and their need for assistive devices (such as walkers, crutches canes and wheelchairs). It emphasizes the concepts inherent in World Health Organization's International Classification of Functioning, Disability and Health (ICF)[6]. The distribution of patients across different levels of GMFCS

varies among different studies depending on the place of the study and the population studied[7] . In this study it was observed that majority children were in the level of GMFCS IV(28.0%) followed by GMFCS V level(20.0%). Enkelaar et al. (2008) found similar findings.[8]

In this study children maximum (60%) were age 2-4 years and 22% were age 4-8 years and 18% patients age 8-12 years. Mean age of the CP children was 4.90±3.05 years. Jahan et al. (2019) reported mean age 7.6±4.5 years in Bangladesh Cerebral Palsy Registra.[9]

In the current study 68% were male and 32% were female. Male : Female ratio was 2.1:1. This findings were consistent with Adamu et al. (2018) where 103 (68.7%) males and 47 (31.3%) females with male to female ratio 2.2:1.[10]

Majority of the patients (66.0%) came from poor family followed by 24% from middle class and 10% from upper middle class family. Simpamba et al. (2020) reported low family socioeconomic status associated with malnutrition.[11] In a study that compared the anthropometric indices between children with CP and normal children in Nigeria, it was reported that there was a significant association between malnutrition and socioeconomic status.[12] Parkes et al. (2010) reported relationship between the nutritional status and socioeconomic status in children with CP.[13] They found that the indicators of malnutrition were common in poor class. In our study socioeconomic status found significantly associated with moderate underweight, stunting, moderate wasting and malnutrition among children with CP.

Moderate and severe underweight significantly related with GMFC level IV and V.Moderate wasted was significantly related with GMFC level III and IV. Severe stunted significantly associated with GMFCS level V. Mild malnutrition was significantly with GMFC level II and III. Severe malnutrition significantly related with GMFC level IV and V. In agreement with this study Sung et al. (2017) conducted a study to assess differences in body composition according to gross motor function in children with cerebral palsy (CP) compared to healthy controls .[14] Liptak et al. (2001) showed that decreased nutritional status in children with CP was related to decreased mobility (GMFCS).[15] Brooks et al. (2011) reported that children in GMFCS levels I and II had significantly better weight than the ones in GMFCS levels III, IV, and V.[16] There were no significant differences between normal and abnormal height percentiles, based on CP type and GMFCS level. Herrera-Anaya et al. (2016) reported 39.5%, 6.8%, 5.6%, 16.4%, and 31.6% patients classified in levels I to V respectively.[3] The mean adjusted differences for weight-for-age, height-for-age, BMI-for-age, and height-for-weight z-scores were significantly larger for children classified in levels II to V compared with those in level I. The children classified in levels IV and V were more likely to have malnutrition than those classified in GMFCS levels I to III.

In our study, approximately half of the children (48%) with CP were classified in functional levels IV and V; however, this estimate is directly comparable with the previous reports from Colombia because the study used the GMFCS to evaluate motor function. Compared with international studies, we found that the proportion of children in levels IV and V in our study was higher. [17]

This difference might be partly explained by the broader and earlier access of patients with CP to more intensive and technologically advanced rehabilitation therapies in developed countries than in developing economies.

In present study GMFCS level IV and V significantly higher in poor socioeconomic class compare to middle and upper class. Level I and II was higher in middle class. Herrera-Anaya et al. (2016) reported no differences in gross motor function across socioeconomic position or health care access/ utilization. This result is consistent with the absence of a socioeconomic gradient with gross motor functional ability among patients with CP from African-American and Hispanic ethnic groups in the USA, as reported by Wu et al. (2011) specifically among predominantly disadvantaged populations.[18] Because our patients primarily belonged to the lowest socioeconomic status spectrum (socioeconomic status I and II 90%).

In this study, it was observed that the z-scores of anthropometric parameters, such as weight-for-age, BMI-for-age, height-for-age and weight-for-height progressively decreased as the levels of GMFCS increased. Our findings are consistent with results from studies conducted in children from developed countries.[19]

A relevant finding of this study is the existence of a burden of malnutrition (80%) and underweight (76%)

in pediatric outpatients with CP. We observed high proportions of stunted (64%) and wasted (54%) in our patients; are comparable to those reported by Delalic et al.[20]

Nutritional assessment and appropriate intervention are critical in the care of children with CP. Unfortunately, routine nutritional assessment of children with CP is low, in this country where access to health-care services is limited and the prevalence of malnutrition in the general population is high.

Conclusion

This study showed that the majority of cerebral palsy cases had a severe functional gross motor disability and also a severe grade of malnutrition. A significant association between severe grade of malnutrition and severe grade of motor disability was found.

Recommendations All children with Cerebral palsy should be assessed GMFCS and nutritional status on initial evaluation because one is dependent on another especially where the advanced level of GMFCS.

Conflict of interest: We have no conflict of interest to declare.

Limitation of study

The sample size was small; the study duration was short and cases were taken from one selected hospital in Dhaka city. The study's results may not reflect the exact picture of the community.

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