International Journal of Contemporary Pediatrics
Sultana MA et al. Int J Contemp Pediatr. 2023 Dec;10(12):1756-1763
http://www.ijpediatrics.com
pISSN 2349-3283 | eISSN 2349-3291

DOI: https://dx.doi.org/10.18203/2349-3291.ijcp20233595

Original Research Article

Nutritional status of children with cerebral palsy in a selected tertiary care hospital

M. Afiya Sultana[1], M. Jahangir Chowdhury[2], A. F. M. Farhad[1], Mohammad Ahad Adnan[3]*, Wahida Khanam[3], M. Asma Akter[4]

[1]250 Bedded General Hospital, Jhenaidah, Bangladesh
[2]Department of Pediatrics, Marks Medical College and Hospital, Dhaka, Bangladesh
[3]Department of Pediatrics, ICMH, Dhaka, Bangladesh
[4]250 Bedded TB Hospital, Dhaka, Bangladesh

Received: 21 September 2023
Revised: 11 October 2023
Accepted: 18 October 2023

***Correspondence:**
Dr. Mohammad Ahad Adnan,
E-mail: ahadnann@gmail.com

ABSTRACT

Background: Nutritional status in children with chronic disease like cerebral palsy is crucial in growth and development. This study was conducted with the aim of assessing nutritional status of children with CP by using anthropometric indices and few associated factors.
Methods: This cross-sectional study was conducted in ICMH, Dhaka from July 2020 to June 2021. A total of 30 children underwent proper history taking and thorough anthropometric examinations. Twenty-four hours dietary recall method was used for estimating approximate calorie intake.
Results: Out of 30 children two thirds age was under 60 months and mean±SD age was 59.2±33.1 months. 60.0% children were male and majority (86.7%) of children were found calorie intake ≤50 percent of adequate calorie intake. Most (83.3%) of studied children presented with spastic quadriplegia, in according to age, 2 group were created (<60 months & ≥60 months). In children under 5 years age, 75.0% were severely wasted, 35.0% were severely stunted, 85.0% were severely underweight and 75.0% were severely malnourished. In ≥5 years, 60.0% were severely stunted and 90.0% were underweight or thin. Wasting and\underweight had significant association with swallowing difficulty and inadequate calorie intake in under 5 years age group and stunting had significant association with those factors in ≥5 years age group.
Conclusions: This study shows that undernutrition affects a large number of children with CP in a selected tertiary care hospital. Risk of severe undernutrition increases with swallowing difficulty.

Keywords: Anthropometry, Cerebral palsy, Malnutrition, Nutritional status, Swallowing difficulty

INTRODUCTION

Cerebral palsy (CP) describes a group of permanent disorders of posture, movement due to static encephalopathy acquired during brain growth resulting from a defect or lesion in the developing fetal or infant brain & is often accompanied by disturbances of sensation, cognition, communication, perception and behavior, and also by epilepsy and secondary musculoskeletal problems.[1] It is one of the common pediatric neurologic disorders in low-economic countries.[2,3] A recent population-based study in Bangladesh reported a prevalence of 3.4 per 1000 live births.[4] Children with CP

develops oral motor dysfunction, which predispose them to undernutrition.[5] On the other hand, under-nutrition causes decrease in muscle strength which increases motor impairment in CP. There is also some evidence that children with less severe motor impairments, increased risk of being overweight.[6,7] Although nutritional status assessment is necessary to guide for appropriate diet and exercise interventions but it remains difficult to measure and interpret nutritional status in CP children. The variability in the prevalence of malnutrition may be related to different anthropometric indices which are 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. Nutritional assessment and appropriate intervention remained difficult in the care of children with CP.[5,8] For growth and nutritional assessment there is need to review the patient and family's perspective. Some factors such as severe motor impairment, which is measured using the gross motor functional classification system (GMFCS), presence of associated impairments and oropharyngeal dysphagia affect the nutritional status of children with CP.[9-11] Adverse consequences of malnutrition among children with CP are widespread. Evidence from different countries reveals that malnutrition among children with CP results in poor health-related outcomes, poor quality of life and premature mortality.[10,12] In these perspectives we aimed to assess the nutritional status of children with cerebral palsy attending a selective tertiary care hospital.

METHODS

This cross-sectional study was conducted at ICMH, Dhaka, from July 2020 to June 2021. All Children age between 2-12 years of age diagnosed clinically as cerebral palsy were included into the study. Those who were either below 2 years or above 12 years of age as well as who denied to participate were excluded. Sample size was calculated by using the following statistical formula:

$$n = z^2 p(1-p)/d^2$$

Where n=the desired sample size, Z=the standard normal deviate, usually set at 1.96 at 5 % level which corresponds to 95% confidence level, p means prevalence=(0.034%)[4], The degree of accuracy or precision level is d which is considered at 5%, Z statistic is 1.96, which corresponds to the 95% confidence level, d is the level of accuracy that is considered 0.05 (5%). The calculated sample was 50.5 but due to COVID pandemic we managed to include 30 CP children in this study.

After enrollment of diagnosed CP cases a thorough history was taken with a pre-tested questionnaire and physical examination (including types of CP, GMFCS grading, associated co-morbidities) was done. For nutritional assessment, anthropometry was measured in accordance with the standard procedure. All measurements were carried out by the same person (the principal investigator). Weight was obtained on a digital scale with taring capability (Seca UNICEF). Height was measured using a stadiometer (UNICEF) in those over 2 years who are able to stand. Recumbent length was obtained in those over 2 years who are unable to stand independently. A recumbent measuring board was used instead of a tape measure laid on examining table. Height/length measurements were recorded to nearest 0.1 cm. Using calipers, knee length was measured for those children, who had contracture. Height was calculated by using a formula;

$$Height = (2.69 \times knee\ height) + 24.2\ cm$$

The formula is mentioned by Stevenson.[13] Mid upper arm circumference (MUAC) was measured in children between 6 months to 5 years of age by Shakir's tape. MUAC was recorded on left side while the arm hanging normally. Three indices were used to describe the nutritional status of children with CP-weight for age (WAZ), height for age (HAZ) and weight for height (WHZ).[14] Anthropometric measurements were converted into indices using the WHO Growth Standard Chart for Z-scores based on subjects age and sex by using world health organization Anthro & Anthroplus software.[15] Nutritional status was determined using Z-scores for weight-for-age weight-for-height, height-for-age and body mass index (BMI) for age (BAZ). Z-scores of ≥-1 was considered normal <-1 to -2 was considered mildly malnourished, <-2 to -3 Z score was considered moderately malnourished, while scores <-3 severely malnourished & presence of oedema was considered as severely malnourished, MUAC <115 mm was considered as severely malnourished, 115 to <125 was considered as moderately malnourished, ≥125 was considered as normal. Calorie intake was evaluated by 24 hours retrospective dietary recall method. Feeding difficulties assessment included history taking, physical examination and observation of feeding skill in the indoor and outpatient clinic.

Statistical analysis

Statistical analysis was performed with statistical package for social science (SPSS) version 24. Descriptive analytical techniques including percentage, mean, SD etc. were used. Continuous data were expressed as mean±SD. Categorical data were expressed as frequency and percentages. Association between categorical variables were done by Chi-square test, Fisher' exact test, p value <0.05 was considered as significant. Informed written consent was taken from each parent of the study subject.

RESULTS

Among 30 study subjects 20 (66.7%) children were below 60 months group and 10 (33.3%) were ≥60 months group. There were 18 boys and 12 girls. So male female ratio was 1.5:1. Majority of the participants (22) hailed from rural area and remainder 8 lived in urban area. History of caregiver; age, education level and profession of mother

were taken into account. In 28 (93.3%) cases mother was primary caregiver.

Table 1: Socio demographic and family characteristics of the studied children (n=30).

Socio demographic & family characteristics	N	%
Age group distribution (months)		
<60	20	66.7
≥60	10	33.3
Gender distribution		
Male	18	60
Female	12	40
Monthly family income		
Low income	1	3.3
Lower middle income	16	53.3
Upper middle income	11	36.7
High income	2	6.7
Mother's education status		
Below primary	6	20.0
Primary	7	23.3
Secondary and above	17	56.7
Mother's occupation status		
Housewife	29	96.7
Service	1	3.3
Age of mother (years)		
≤20	5	16.7
21-30	17	56.7
>30	8	26.6
Type of family		
Joint family	22	73.3
Nuclear family	8	26.7
Primary care giver		
Mother	28	93.3
Others	2	6.7
Secondary care giver		
Grandmother	16	53.3
Sister/Brother	5	16.7
None	9	30.0

Table 2: Types of cerebral palsy of studied children (n=30).

Types of cerebral palsy	N	%
Spastic quadriplegia	25	83.3
Spastic diplegia	3	10
Spastic hemiplegia	1	3.3
Dyskinetic	1	3.3

In 21 cases secondary care was given by grandmother (16) and sibling(s) (5) respectively. Most of the mothers (17) were between 21 to 30 years of age while 5 were at or below 20 years and 8 were above 30 years of age. More than half (56.7%) of the mother completed secondary school level at least. Almost all (96.7%) the mothers were homemaker (Table 1). Majority 25 (83.3%) of children found with spastic quadriplegia, 3 (10.0%) spastic diplegia, 1 (3.3%) spastic hemiplegia and 1 (3.3%) dyskinetic group (Table 2). According to GMFCS 18 (60.0%) children had GMFCS grading V followed by 7 (23.3%) in grade IV, 3 (10.0%) grade II, 1 (3.3%) grade I and 1 (3.3%) grade III (Figure 1). Only 2 (6.7%) of studied children had contracture.

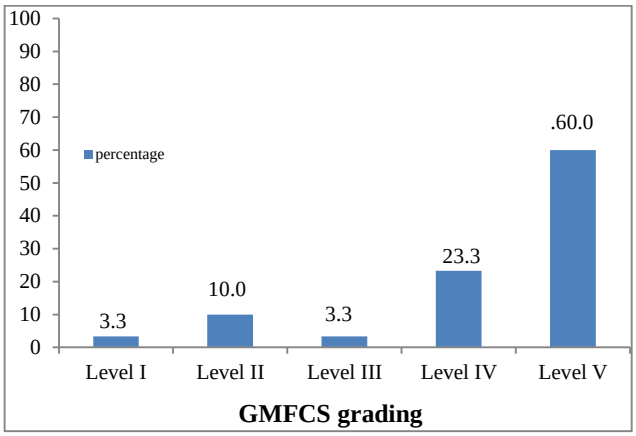

Figure 1: GMFCS grading of the studied children (n=30).

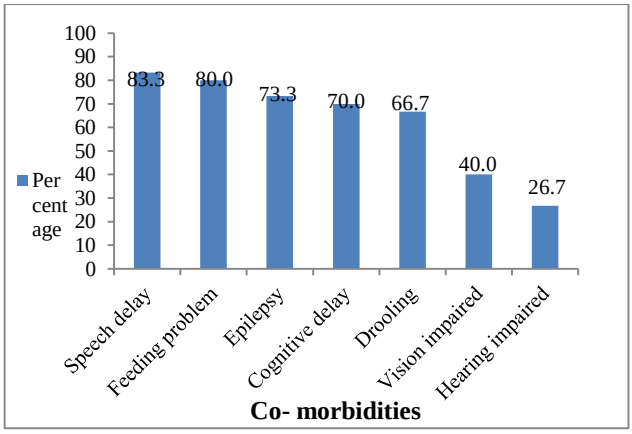

Figure 2: Associated co-morbidities of the studied children.

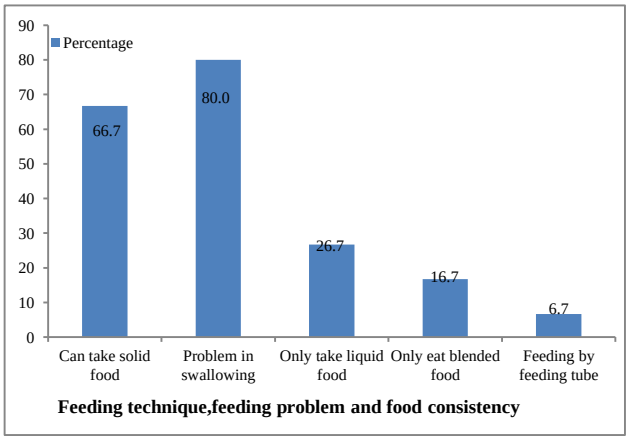

Figure 3: Distribution of studied children by feeding technique, feeding problem and consistency of food.

Table 3: Association between wasting and clinical characteristics, related history of studied children under 5 years (n=20).

Clinical characteristics and history	Wasted (N=16)		Normal (N=4)		P value
	Frequency	%	Frequency	%	
Types of CP					
Spastic diplegia	1	6.3	0	0	0.757
Spastic quadriplegia	14	87.5	4	100	
Dyskinetic	1	6.3	0	0	
Spastic hemiplegia	0	0	0	0	
GMFCS grading					
Level I-III	0	0	0	0	1.000
Level-IV	4	25.0	1	25.0	
Level-V	12	75.0	3	75.0	
Problem in swallowing					
Yes	16	100.0	1	25.0	0.001
No	0	0.0	3	75.0	
Calorie intake (%)					
≤50	16	100.0	1	25.0	0.001
>50	0	0.0	3	75.0	
Monthly family income					
Low income	1	6.3	0	0.0	0.691
Lower middle income	10	62.5	2	50.0	
Upper middle income	4	25.0	1	25.0	
High income	1	6.3	1	25.0	

Table 4: Association between stunting and clinical characteristics, related history of studied children under 5 years (n=20).

Clinical characteristics and history	Stunted (N=13)		Normal (N=7)		P value
	Frequency	%	Frequency	%	
Types of CP					
Spastic diplegia	1	7.7	0	0	0.549
Spastic quadriplegia	11	84.6	7	100	
Dyskinetic	1	7.7	0	0	
Spastic hemiplegia	0	0	0	0	
GMFCS grading					
Level I-III	0	0	0	0	0.176
Level-IV	2	15.4	3	42.9	
Level-V	11	84.6	4	57.1	
Problem in swallowing					
Yes	12	92.3	5	71.4	0.212
No	1	7.7	2	28.6	
Calorie intake (%)					
≤50	12	92.3	5	71.4	0.212
>50	1	7.7	2	28.6	
Monthly family income					
Low income	1	7.7	0	0.0	0.451
Lower middle income	9	69.2	3	42.9	
Upper middle income	2	15.4	3	42.9	
High income	1	7.7	1	14.3	

Among all associated co-morbidities, speech delay was on top which was 83.3%. Followed in decreasing order feeding problem 80.0%, epilepsy 73.3%, cognitive delay 70.0%, drooling 66.7%, impaired vision 40.0%, and hearing 26.7%.

Most of the children had multiple co-morbidities (Figure 2). In only 26.7% children exclusive breastfeeding for 6 months was maintained. Caregiver assisted feeding was offered in 28 (93.3%) children. Most (56.7%) of the children took less than five times of meal per day. More than three fourth (80%) children had problem in swallowing.

Table 5: Association between underweight and clinical characteristics, related history of studied children under 5 years (n=20).

Clinical characteristics and history	Underweight (N=17)		Normal (N=3)		P value
	Frequency	%	Frequency	%	
Types of CP					
Spastic diplegia	1	5.9	0	0	0.821
Spastic quadriplegia	15	88.2	3	100	
Dyskinetic	1	5.9	0	0	
Spastic hemiplegia	0	0	0	0	
GMFCS grading					
Level I-III	0	0	0	0	0.717
Level-IV	4	23.5	1	33.3	
Level-V	13	76.5	2	66.7	
Problem in swallowing					
Yes	17	100	0	0	0.001
No	0	0	3	100	
Calorie intake (%)					
≤50	17	100	0	0	0.001
>50	0	0	3	100	
Monthly family income					
Low income	1	5.9	0	0.0	0.455
Lower middle income	11	64.7	1	33.3	
Upper middle income	4	23.5	1	33.3	
High income	1	5.9	1	33.3	

Table 6: Association between stunting and clinical characteristics, related history of studied children ≥5 years (n=10).

Clinical characteristics and history	Stunted (N=8)		Normal (N=2)		P value
	Frequency	%	Frequency	%	
Types of CP					
Spastic diplegia	2	25.0	0	0	0.585
Spastic quadriplegia	1	12.5	0	0	
Dyskinetic	5	62.5	2	100	
Spastic hemiplegia	0	0	0	0	
GMFCS grading					
Level-I	1	12.5	0	0	0.211
Level-II	3	37.5	0	0	
Level-III	1	12.5	0	0	
Level-IV	2	25.0	0	0	
Level-V	1	12.5	2	100	
Problem in swallowing					
Yes	7	87.5	0	0	0.015
No	1	12.5	2	100	
Calorie intake (%)					
≤50	8	100	1	50	0.035
>50	0	0	1	50	
Monthly family income					
Low income	2	25.0	1	50	0.731
Lower middle income	5	62.5	1	50	
Upper middle income	1	12.5	0	0	
High income	0	0	0	0	

Though 66.7% children could take solid food, 26.7% swallowed liquid food only, 16.7% took blended food only and feeding tube was inserted in 6.7% children (Figure 3). Majority of children had history of taking CHO (rice, bread, noodles, suji, semai, burly, sugu, biscuit, mixture of corn and rice powder, sugar) in breakfast, morning snacks, lunch, evening snacks and dinner, lack of overall fat intake, fruit intake.

Table 7: Association between BMI and clinical characteristics, related history of studied children ≥5 years (n=10).

Clinical characteristics and history	BMI (kg/m^2)				P value
	Underweight/thin (N=9)		Normal (N=1)		
	Frequency	%	Frequency	%	
Types of CP					
Spastic diplegia	1	11.1	1	100	0.053
Spastic quadriplegia	1	11.1	0	0	
Dyskinetic	7	77.8	0	0	
Spastic hemiplegia	0	0	0	0	
GMFCS grading					
Level-I	1	11.1	0	0	0.349
Level-II	3	33.3	0	0	
Level-III	1	11.1	0	0	
Level-IV	1	11.1	1	100	
Level-V	3	33.3	0	0	
Problem in swallowing					
Yes	7	77.8	0	0	0.300
No	2	22.2	1	100	
Calorie intake (%)					
≤50	8	88.9	1	100	0.900
>50	1	11.1	0	0	
Monthly family income					
Low income	3	33.3	0	0	0.690
Lower middle income	5	55.6	1	100	
Upper middle income	1	11.1	0	0	
High income	0	0	0	0	

Fat intake only in the form of cooking oil used in preparation of curry, vegetables. Almost 86.7% children had calorie intake ≤50%. Anthropometrically about three fourth (75%) of the children were severely wasted, 35.0% were severely stunted, majority (85%) of studied children were severely underweight and 75.0% were severe malnourished, who were in below 5 years group. While in children above 5 years group, more than half (60.0%) were severely stunted and most (90%) of the studied children were underweight or thin. Two children had bipedal edema. All (100.0%) wasted children had swallowing problem, all (100.0%) wasted children's calorie intake ≤50 percent of adequate calorie and only 25% of normal children had both. P value was significant in between two groups. There was no significant relation among CP types, GMFCS grading and monthly family income and wasting group (Table 3). In children under 5 years, 92.3% had swallowing problem in stunted group and 71.4% in normal height. Most (92.3%) of children's calorie intake ≤50% in stunted group and 71.4% in normal group. P value was not significant in between two groups. Also, there was no significant relation among CP types, GMFCS grading and monthly family income and stunting (Table 4).

In children under 5 years, all (100.0%) children had swallowing problem in underweight group and not found in normal group respectively. All (100.0%) children's calorie intake ≤50 percent in underweight and not found in normal weight respectively. P value was significant in between two groups (Table 5). In ≥5 years, all children of stunted group and half of normal calorie intake was ≤50 percent. Majority (87.5%) had swallowing problem in stunted group, no in normal height, p value was significant in between two groups (Table 6). In ≥5 years, 77.8% of children with spastic quadriplegia is underweight or thin and no in normal BMI. About three fourth (77.8%) children had swallowing problem in underweight group and not found in normal BMI. One thirds (33.3%) children's GMFCS grading V in underweight and not found in normal BMI most (88.9%) children's of underweight calorie intake ≤50 percent. About 55.6% children belonged to lower middle-income category in underweight group, p value was not significant in between two groups (Table 7).

DISCUSSION

The demographic characteristics of this study show male preponderance and male: female is 1.5:1, which is similar

to another study in Kano, Nigeria.[16] The reason for this male dominancy is not clearly known. Some of the reasons includes, there may be more vulnerability of male preterm to white matter injury and intraventricular hemorrhage & the neuroprotective action of female sex hormone estrogen. Majority of our studied children belonged to younger age group or under five age categories. These characteristics had similarities with several other studies in low- and middle-income countries.[10,16,17] This may be as a result of loss to follow-up and increased mortality with increasing age. Several socio-demographic factors may be responsible for malnutrition such as caregiver educational status, occupation and caregiver quality of life.[10] In others study conducted in Bangladesh and Tanzania have described the impact of low-cost caregiver training for improving feeding skills and the nutritional status of the children.[18]

Poor feeding practices such as incorrect positioning and nutritional insufficiency of the diet are closely related with the poor socio-economic status of family. In our study majority of children belonged in lower-middle class family. Which is similar to another study carried out in Uganda.[19] Most of the studied children had history of taken carbohydrate rich food, poor intake of fat, seasonal fruits which is dissimilar to another study in Brazil, were high intake of fat and inadequate intake of carbohydrates and proteins.[20] It may be due to variation of food pattern in various countries. In our countries there is a tendency to less intake of chesse-salad, fried sausage and savory foods in dietary pattern. Majority of studied children in this study presented with spastic quadriplegia and very few percentages with other types, which is differ with other studies in where half of the children presented with hemiplegia and 44% presented with spastic diplegia.[10,20] It may be due to this is hospital-based study, not a epidemiological study or conducted in a community. It was observed that more than three-fourth of the children with cerebral palsy from a tertiary selective care hospital were in GMFCS levels IV and V, similar to previous study in Argentina.[21] These findings are different from studies in developed countries, such as the USA and Australia, where the prevalence of GMFCS level IV and V is close to 20% in children with CP.[22] However the high prevalence of GMFCS level IV and V cases found in this study might not be representative of the whole CP population in Bangladesh. A local CP register would be helpful in case of here.

Among the associated co-morbidites speech delay was on top then feeding problem. Which is similar to another study, where speech impairment present about 77.5%.[10] Aggarwal et al observed CP children frequently associated with feeding difficulties.[23] The current study found that undernutrition in the forms of wasting, stunting, underweight affects a large number of children in both age groups. These findings had similarities with result of other studies in Uganda and in Bangladesh.[10,19] This finding is different from those reported in developed countries, where there is a greater proportion of studied children's nutritional status was normal or being overweight.[22] In our study, we identified a subgroup of children who had severe acute malnutrition which was diagnosed by presence of oedema and this group needed emergency management. We also found a significant role of swallowing problem and inadequate calorie intake with undernutrition in both age groups. Swallowing problem acts a barrier to adequate feeding. We know that CP children are vulnerable to malnutrition due to the functional motor limitations, oropharyngeal and gastro-intestinal difficulties.[10,24] Aggarwal et al observed severeity of feeding problem also has a negative impact on the nutritional status of children.[23] Those with severe feeding problems tend to have lower weight which is similar with this study.[25]

Studies from other countries also reported the relationship between malnutrition and types of CP, GMFCS grading. Neurological type of CP affects the nutritional status of children both directly and indirectly. Children with quadriplegia are solely dependent on other for dietary intake leading to poor nutritional status.[19] Being unable to eat without help from caregiver usually significantly associated with thinness in studied children. It has been reported that feeding regulated by the caregiver overestimating both the feeding time and child's caloric intake.[26] GMFCS levels III-V often fail to meet their nutritional requirement observed by Jahan et al.[10] In our study we found no significant relation between types of CP, GMFCS grading and undernutrition which differs from above study.

Limitations

The sample size of the study was relatively smaller as well as single centric. It may not indicate true scenario. The segmental length measurements in the children with contractures may have yielded imprecise results. Nutritional status of children with CP was measured by comparing anthropometric measurements to conventional standards, e.g., WHO growth chart developed for typically developing children.

CONCLUSION

In children under-5 years age group with CP, about three fourth (75%) were severely wasted and malnourished, 85% were severely underweight, 35% were severely stunted. In ≥5 years age group almost all (90%) of the children were underweight or thin, 60% were severely stunted. Wasting and underweight had significant association with swallowing difficulty and inadequate calorie intake in children under 5 years age and stunting had significant association with those in ≥5 years age group. There was no significant association among undernutrition and types of CP, GMFCS grading, monthly family income status.

Funding: No funding sources
Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Sultana MA, Chowdhury MJ, Farhad AFM, Adnan MA, Khanam W, Akter MA. Nutritional status of children with cerebral palsy in a selected tertiary care hospital. Int J Contemp Pediatr 2023;10:1756-63.