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Assessment of nutritional status of children with cerebral palsy

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Abstract

Introduction: Cerebral Palsy (CP) affects muscle coordination due to abnormal brain development.
Objective and Methods: The objective was to assess nutritional status of children with CP. Anthropometric measurements and dietary recall was obtained from 75 children between age group (5-18) years.
Results: There were monoplegic (14.67%), diplegic (38.67%), triplegic (12%), hemiplegic (20%) and quadriplegic children (14.67%). Mean height and weight was 128.26±25.83cm and 27.61±13.78kg, respectively. There were severely thin (29.33%), thin (9.33%), overweight (6.67%), and obese (5.33%) children. Mean energy and protein intake was lower than the requirements.
Conclusions: Nutrient intake was poor and RDA was not met by the subjects. There were more undernourished children than overweight children.

Key words: Cerebral palsy, spastics, nutritional status, anthropometry.

Introduction

Cerebral Palsy (CP) is a neurodevelopmental condition which has many clinical spectrums. The causes of CP are many, but they may not be apparent (Sankar et al., 2005). It is the commonest physical disability among children and affects nearly 2-2.5 children per 1000 born in the United States (Kigger, 2006). The most common disorders found in CP children are the motor and nutritional disorders. Growth of CP children is affected due to malnutrition and endocrine disturbances (Kuperminc and Stevenson, 2008).

Nutrition plays an important role in the health and overall quality of life in children with neurodevelopmental disability like Cerebral Palsy. Malnutrition is found to be associated with reduced linear growth, delayed woundhealing, increased spasticity and irritability (Penagini et al., 2015). Malnutrition among CP children varies from 46-90% cases depending on the severity of the case (Dahl et al., 1996). It is common for children with moderate or severe CP to be associated with poor health status and thereby limits the social participation for the child (Samson-Fang et al., 2002).

Lack of ability to self-feed in CP children is a risk factor which contributes to the retardation of height growth and is a cause for undernourishment (Vik et al., 2001). It has been noted that prevalence of underweight is more common compared to overweight. Hence in order to take appropriate preventive measures, it is necessary to understand the nutritional status of CP child (Colver et al., 2014). It is also necessary to recognize the nutritional challenges that these children face. Improving nutritional status as early as possible would result in a positive outcome for the CP children (Dobhal et al., 2014). The objectives of the study were to assess nutritional status using anthropometric measurements (height, weight, BMI, MUAC) and to understand nutrient intake of the cerebral palsy children.

Materials and Methods

Study Design: Seventy-five spastic Cerebral Palsy children were the subjects for the study. Size of the sample was based on the number ofCP children present in the centers which permitted the study to be conducted. Purposive sampling technique was used to select children identified with CP. The study was approved by Inter System Biomedica Ethics Committee (ISBEC) letter number ISBEC/NR-29/KM-JVJ/2017 dated 13th October 2017.

Inclusion criteria: Girls and boys between the age of 5-18 years as identified with spastic cerebral palsy. Only those children with Gross Motor Function Classification System (GMFCS) grade I-IV were included in the study.

Exclusion criteria: Severe spastic CP children GMFCS level V-inability to control anti-gravity postural control), children with CP other than spastics (athetosis, rigidity, ataxia, tremor and atonia) were excluded from the study.

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Setting: Data collection was done from the period of October 2018 to December 2018. Figure 1 gives the diagrammatic representation of sample selection from various centres and institutes. There was no investigator bias regarding nutritional status of CP children.

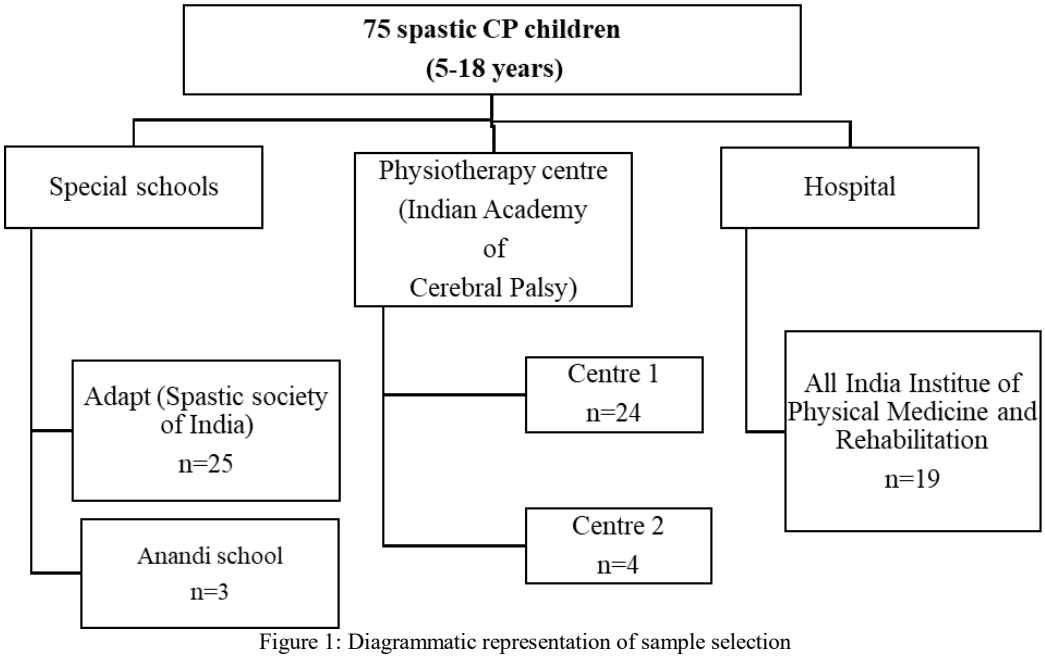

Figure 1: Diagrammatic representation of sample selection

Data Source: Groups were made based on the type of CP children and their age as children were between 5-18 years of age. Hence, they were classified into age groups 5-12 years and 12-18 years of age. Anthropometric measurements of height, weight and Mid-Upper Arm Circumference (MUAC) were taken and BMI was calculated. WHO standards (2007) of BMI for age z-score were used to assess nutritional status. Knee height and length measurements were taken for children who could not stand erect. The formulae specified by Chumlea et al., (1994) and Stevenson (1995) were used to calculate full height from the knee height and are given below.

The formula to calculate full height from knee height is as follows:

- 0-12 years
  Knee height = (2.68 × KH) + 24.2 (Stevenson, 1995)
- >12 years upto 18 years
  Knee height = (2.18 × KH) + 39.60 (Male)
  Knee height = (2.02 × KH) + 46.59 (Female)
  (Chumlea et al., 1994); KH= Knee height

Dietary information was collected from the mother/caregiver. It included data about whether child is vegetarian/non-vegetarian, number of meals taken, time taken to consume meal, texture of food served etc. A 24- hour dietary recall was also taken to understand the nutrient consumption of the children.

Statistical methods: The data was analyzed using the statistical package for the social sciences (SPSS) version 22.0. The statistical tests included mean, standard deviation, Chi square, ANOVA (Analysis of Variances), intergroup and intra group differences.

Results

The subjects in the study were between 5-18 years of age and included both girls and boys. The mean age of the children was 6.71±4.2 years. Out of 75 subjects, 27 (36%) were females and 48 (64%) of them were males. The study included spastic Cerebral Palsy children of all types, i.e. it included monoplegic, diplegic, triplegic, hemiplegic and quadriplegic.

Anthropometric measurements were done for all the children. The measurements taken included height, weight and MUAC. Knee height measurements were taken for a child who had skeletal contractures or was unable to stand erect. Knee height was converted to full height. BMI was calculated from the height and weight measurements. Using the anthropometry information HAZ, WAZ and BAZ was obtained using WHO Anthroplus software. The results of the anthropometry data are presented below in the Table 1.

Table 1: Anthropometric Measurements of Subjects

Anthropometric Parameter	Mean±SD (n=75)
Height(cm)	128.26±25.83
Knee height (cm)	13.62±19.79* (n=24)
Weight (kg)	27.61±13.78
MUAC (cm)	21.42±16.28
Weight for age (z-score)	-0.84±1.4
Height for age (z-score)	-2.3±1.76
BMI for age (z-score)	-1.61±2.50

The present study revealed that many children were at a risk for undernourishment. According to WHO classification (2007) of BMI for age z-score, children were severely thin (29.33%), thin (9.33%), normal (49.33%), overweight (6.67%) and obese (5.33%). It was seen that 38.7% children had gained weight while 10.7% had lost weight in the past 3 months. The types of spastic CP vary among themselves to a great extent in terms of nutritional status; hence their anthropometric parameters were compared within the different types of CP and is given in Table 2.

Table 2: Mean Anthropometric Measurements in Different Types of CP

Parameters	Type of CP						
	Monoplegic n=11	Diplegic n=29	Triplegic n=9	Hemiplegic n=15	Quadriplegic n=11	F	P
Height(cm)	131.25±25.13	130.72±16.40	124.4±23.55	133.09±27.07	115.3±42.66	0.972	0.428
Knee height (cm)	0.0	15.65±20.82	15.88±23.92	11.06±19.20	21.8±19.29	1.73	0.154
Weight (kg)	29.34±18.27	29.55±12.93	23.45±11.19	30.28±15.11	20.53±9.45	1.279	0.287
BMI(kg/m^2)	15.42±3.94^{ab}	16.9±4.44^{ab}	14.21±2.27^{ab}	15.85±2.46^{ab}	12.59±2.05^{ac}	3.329	0.015
MUAC(cm)	18.92±6.64	25.78±2.52	18.49±3.45	19.57±4.01	17.4±3.49	0.867	0.488
BAZ	-1.31±1.2	-1.02±2.49	-2.7±1.77	-2.0±2.74	-1.94±3.42	1.07	0.378

A significant difference was seen in BMI (F= 3.32, p=0.015) within different groups of CP. BMI was found to be the least among quadriplegic children followed by triplegic children. BMI was highest for the diplegic children. BMI of diplegic children was significantly different when compared with the quadriplegic children (p=0.010). There were no significant differencesin any of the other anthropometric measurements.

Table 3 shows anthropometric measurements in the two age groups.

Table 3: Anthropometric measurements between the Two Age Groups

Anthropometric parameters	5-12 years Mean ± SD (n=37)	12-18 years Mean ± SD (n=38)	F	p
Height(cm)	110.6± 22.51	145.4 ±15.12	61.93	0.000
Knee height (cm)	7.69±14.67	19.54 ±22.52	6.99	0.010
Weight (kg)	17.8±5.44	37.14 ±12.74	72.29	0.000
BMI(kg/m^2)	13.6 ±2.19	17.38± 4.04	24.91	0.000
MUAC(cm)	20.56± 2.89	22.27± 4.30	0.204	0.652
WAZ#	-1.69± 1.61	0.0	41.904	0.000
HAZ#	-2.13±1.68	-2.46±1.85	0.636	0.428
BAZ#	-1.01±2.34	-2.19±2.54	4.28	0.042

WAZ- Weight for age z-score, HAZ- Height for age z-score, BAZ- BMI for age z-score

Height, knee height, weight and BMI were significantly higher in the older age group. However, no difference was seen in the MUAC measurement. BAZ was also significantly different between thetwo age groups.

A 24 hour recall was taken and nutrient content of their meals was calculated. Table 4 gives the mean nutrient intake of CP children.

Table 4: Mean Daily Nutrient Intake of Subjects

Energy and Nutrients	Mean±SD(n=75)
Energy (kcal)	1150.01±343.81
CHO (g)	165.33±84.64
Protein (g)	33.6±12.61
Fats (g)	43.50±17.64

Mean energy intake of the children was found to be 1150.01±343.81 Kcal. The mean consumption of protein was 33.6±12.61g which was lower than the recommended protein intake for the respective age and sex. Thus protein requirement was not adequate for most of the children. Energy and macronutrient intake was also compared between the two age groups. Table 5 shows the energy and macronutrient intake between the two age groups.

Both energy and protein was significantly lower in younger age group compared to the older (F= 9.34, p=0.003; F=8.75, p=0.004). Carbohydrate and fat intake was also lower in the younger age group but this difference was not significant.

Table 5: Energy and Macronutrient Intake in the Two Age Groups.

Energy and Nutrients per day	Mean ± SD 5-12 years (n=37)	Mean ± SD 12-18 years (n=38)	F	P
Energy (Kcal)	1033.47± 306.6	1263.47± 343.68	9.34	0.003
CHO (g)	150.79±108.00	179.89±50.59	2.19	0.143
Protein (g)	29.44±11.92	37.65±12.07	8.75	0.004
Fat (g)	41.26±19.27	45.68±15.84	1.182	0.281

Children did not consume adequate amounts of food to meet their RDA requirements.

Energy and nutrient consumption was compared with BMI. No significant difference was seen between BMI and energy/ protein consumption. However, it was noted that children who were obese consumed lowest number of calories. Calorie consumption was highest for children who were in normal category for BMI. Protein consumption was highest for children who were overweight group while lowest amount of protein was consumed by obese children. The protein consumption was almost same for children in the severely thin, normal and overweight categories.

Further, texture of the food eaten by CP children was enquired. This study found that maximum children (96%) could eat normal table food and only 4% (n=3) of them used to take a soft diet. Also, most of them (45.3%) on an average consumed five meals in a day. There were few children who consumed three meals a day (10.7%) and four meals a day (21.3%) Frequent meal consumption (6 meals) was seen in 22.7% of CP children.

Income influences food selection and food intake. Many studies conclude,family with a lower income has lesser healthy food options, which directly impacts their dietary intake. Lower income group had reduced intake of fruits and vegetables and a reduction in the calorie intake (French et al., 2019, Hazano et al., 2016, Chen et al., 2012).Hence, comparison was done within different income groups for energy and macronutrient intake (Table 6).

A significant difference was seen in the energy, carbohydrate and protein intake within different income groups. Mean energy intake was low for the lowest income group while it was highest for the high income group. Carbohydrate intake also significantly varied among them. Lowest income group had least carbohydrate consumption while that of higher income group had highest compared to other income groups (F=3.974, p= 0.006). Significant differences were seen in the protein consumption (F= 2.959, p=0.026). Lowest protein consumption was seen among children who belonged to the income group of Rs. 10,000-15,000 while highest protein consumption was seen in the highest income group (>25000/month). No significant difference was seen in the fat consumption between the different income groups.

Table 6: Comparison of Energy and Macronutrient Intake in Different Income Groups.

	Income (Rs)					
Nutrients	**5000-10000 (n=8)**	**10000-15000 (n=23)**	**15000-20000 (n=9)**	**20000-25000 (n=1**	**>25000 (n=34)**	**F, p**
Energy (Kcal)	938.2± 264.8	1016.49± 315.15	1144.63± 340.91	1101.0	1293.04± 333.67	3.527, 0.011
Carbohydrate (g)	120.75± 36.24	125.21± 38.48	167.96± 39.28	195.5	201.39± 107.01	3.974, 0.006
Protein (g)	29.71± 14.53	27.57± 10.31	35.03± 17.54	33.6	38.22± 10.72	2.959, 0.026
Fats(g)	33.88± 14.32	40.57±17.09	44.74±23.03	27.7	47.89±16.47	1.536, 0.201

Discussion

The present study indicated that weight status of most of the children was normal, with the mean weight for age z-score being -0.84±1.4. However, the mean z-core for height was found to be -2.3 ±1.76 signifying low height for age (WHO, 2007). This is a foremost concern for CP children.

Results from a Greece study are similar to this study wherein according to WAZ, 38.1% patients were undernourished (z-score under -2 SD), while 7.1% were overnourished (z-score over +2 SD). Undernourished children were mainly quadriplegic (p = 0.008) Help is required for feeding the child which is also an indicator of nutritional status. Children with severe impairment were dependent on the caregiver and were found to be malnourished (Karagiozoglou-Lampoudi, et al., 2012).

Nutritional status of CP children has been reported to be poor by other studies. An Indian study done by Bansal et al., (2014) reported 40% CP children to be underweight, 45% normal weight, 7.5% overweight and 7.5% obese. Nutritional status of the CP children between the ages of 2-12 years in Uganda revealed malnourishment to be quite prevalent among them (52% were found to be malnourished as the z-scores were below -2). Out of 52% malnourished children, 42% were underweight, 38% were stunted, 21% were thin, and 18% were wasted (Kakooza-Mwesige et al., 1992). The reasons for weight loss the same could be frequent illness of the child and/or inability of the child to feed properly. Melunovic et al.,(2017) found more malnourished CP children compared to this study. Their results concluded 47.5% as malnourished and 11.3% as obese children. Oromotor dysfunction was the main reason for the poor nutritional status of these children. In Norway, 7% CP children were thin and 16 % overweight and obese. In all, 20% of the children had mean z-scores for weight and ⁄ or height below – 2 SD (Dahlseng et al., 2011).

In the present study many children in the age group of 12-18-year-old were thin compared to the younger group. A study in China reported similar results wherein thinness of 12-18-year-old children and overweight and obesity in 2-12-year-old CP children was a concern (Wang et al., 2016). Obesity has increased in the last decade amongst CP children from 7.7% to 16.5% which has an effect on their general health and functional abilities of these children (Rogozinski, et al., 2007).

Texture of food does matter for CP children as many of these children are unable to chew and swallow foods properly. Frequent meal consumption suggests that parents do ensure that the child is well fed. Also, these children who had six meals were fed by parents irrespective whether the child demanded food. Al-Hammad (2015), reported dietary pattern of CP children in Saudi Arabia where most of the children (71%) consumed 3 meals (71.3%,) while the rest (24.8%) consumed only 2 meals daily.

According to the Indian recommended dietary allowances RDA (2010), the requirement for a 5 year old child is 1350 kcal/day while for the 16- 17 year old age group it is 3020 kcal for boys and 2440 kcal for girls. In this study, mean energy intake was lower than the RDA (2010) for both the age groups. Low calorie intake could be related to the feeding issues that these children suffer from. As observed in the study, a high fat intake but low protein consumption could be attributed to the consumption of processed foods which may be high in fat. Processed foods were consumed by 53.3% children. Results suggest that protein consumption needs to be improved while fat consumption should be reduced (ICMR, 2010).

Variations were seen in the macronutrient intake amongst younger age group. Macronutrient intakes were different in this study. Calorie and protein intake was low while fat intake was high. Study conducted by Lopes et al (2013) reported that dietary intake of energy for 2-3 year old children were as per the recommendations. However, it was below the recommended limit for 4-6 year old age group and in children with hemiplegia and tetraplegia, energy intake was below the recommended limits. All children presented low intake of carbohydrates, adequate intake of proteins and high intake of lipids. It was observed that CP children face nutritional issues and other allied problems which are related to spasticity of the muscles. As food consumption is affected nutrient intake differs. Nutritional status of CP children is affected by feeding problems. Inadequate dietary intake and disability are the main cause of malnourishment with 40% of children malnourished and 24% wasted (Bertoliet al., 2006).

Other factors like health care and education might be compromised for children who are of lower socioeconomic group. Income also influences food selection. Assis-Madeira et al., (2013) have concluded in their study that development of the child is influenced by socioeconomic status. Norwegian children had higher prevalence of obesity (13.8%) and it was highest in the younger age group (6-11 years) (Júlíusson et al., 2010). It was noted in this study that nutritional status of CP children varies with the type of CP and also the income status of the family. Nutritional status of quadriplegic children was poor followed by the triplegic children. These children were not meeting the RDA for energy and protein.

Conclusion

The results of the study can be generalized for CP children from other parts of world as the condition of Cerebral Palsy has similar features. Maintaining good nutritional status may be a challenge for parents and caregiver of CP children. An effort must be made to ensure adequate nutritious food intake of the CP children to maintain good nutritional status.

Limitations:

1. A wide age group of children was taken due to difficulty in finding more number of subjects in specific ages.

2. Study included spastic CP of all types, and it did not was not focus on one type of CP children.
3. Gender distribution was not equal for the current study.
4. Only 24 hour dietary recall was taken for dietary assessment.
5. Taking knee height was difficult as it caused pain to the child when leg was positioned for measuring knee height.

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