Asian Journal of Medicine and Biomedicine
eISNN: 2600-8173
https://journal.unisza.edu.my/ajmb

PENERBIT Universiti Sultan Zainal Abidin

Asian Journal of Medicine and Biomedicine, Vol 4:SI 1.

Original Article

Open Access

Association Between Body Weight Status and Nutritional Problems Among Cerebral Palsy Children in Community-Based Rehabilitation Centres, Terengganu

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Abstract

Cerebral Palsy (CP) is a disorder that cause persisting and non-progressive conditions in the motor control development as a result of an injury in parts of the brain. It occurs in 1 – 2 of every 2000 babies born in Malaysia and 2.11 per 1000 live births worldwide. Poor oral-motor will impair the child's ability to safely consume calories and nutrients daily. Besides, low resting energy expenditure due to hypertonia or movement disorder will consequently lead to feeding issues such as dysphagia, constipation, gastroesophageal reflux disease and malnutrition. This study was conducted to determine the association between body weight status and feeding issues among CP children in Community-Based Rehabilitation (CBR) in Kuala Nerus and Kuala Terengganu. A total of 26 primary caregivers were involved in this cross-sectional study. Body mass index was used as an indicator for body weight status and feeding issues were reported through questionnaire via face-to-face interview with the primary caregivers. This study reported 57.7% CP children were underweight and 42.3% were having normal body weight status. The common feeding issues reported obtained through the questionnaire and the result found 11 types of problems related to oral, digestive and other issues such as allergy, less appetite and strict food choices. No significant association between the presence of feeding problems and nutritional status was found by using Chi-Square test. The results of this study can be used as reference for the new and recent information regarding nutritional information related to CP children.

Keywords: cerebral palsy, disability, community-based rehabilitation centres, feeding issues, body weight status

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Received (10th Oct 2020), Accepted (10th Nov 2020) & Published (30th Nov 2020)

Cite as: Nurhazrina, Z., Karimah Fakhriah, I., Aryati, A., Sakinah, H., Wan Rohani, W. T., Pei Lin, L. & Wan Pauzi, W. I. (2020). Association Between Body Weight Status and Nutritional Problems Among Cerebral Palsy Children in Community-Based Rehabilitation Centres, Terengganu, *Asian Journal of Medicine and Biomedicine*, *4* (SI 1), 104–113.

DOI: https://doi.org/10.37231/ajmb.2020.4.SI 1.408

Introduction

Generally, obesity is referring to the excessive adipose tissue relative to lean mass and it has projected to become a public health concern worldwide [1]. Obesityhas reached epidemic levels in developed as well as in developing countries among children and adolescent population. The last three decades have witnessed an increase in health care costs due to obesity and related issues among children and adolescents. Childhood obesity is a global phenomenon affecting all socio-economic groups, irrespective of age, sex or ethnicity. Aetiopathogenesis of childhood obesity is multifactorial and includes genetic, neuroendocrine, metabolic, psychological, environmental and socio-cultural factors [2].

Overweight and obesity in childhood are known to have a significant impact on both physical and psychological health. A report by WHO related toDiet,Nutrition, and the Prevention of Chronic Diseasesmentioned that obesity is the main risk factor forall non-communicable diseases [3]. Overweight and obese children are likely to stay obese into adulthood and more likely to develop non-communicable diseases like diabetes and cardiovascular diseases at a younger age.In Indonesia, the prevalence of childhood stunting remainshigh, whereas the prevalence of overweight/obesity in all agegroups is rising indicating a double burden of malnutrition [4].

However, as per literature review searching there is limited published data on the prevalence of obesity adolescent on each district of Indonesia. Therefore, this study aims to investigate the prevalence of obesity among adolescent at Kecamatan Johan PahlawanKabupaten Aceh Barat which is one of the districts in Indonesia.

MATERIALS AND METHODS

Subject recruitment

This present study applied a cross-sectional design. This study was conducted from 1 January 2020 until 15 March 2020 at eight rehabilitation centres in Kuala Terengganu and Kuala Nerus, both districts in the state of Terengganu, Malaysia. The respondents included were either father, mother or primary caretakers such as aunty, grandmother for the CP who were registered with the rehabilitation centre. Sample size was calculated by using G-power software Inclusion criteria included caregivers of children aged between 3 to 15 years old, CP children with Gross Motor Function Classification System (GMFCS) level I and II, able to communicate in Malay language, literate and provided consent to participate. Caregivers of children with other types of disability were excluded in this study. This study received a formal permission from Jabatan Kebajikan Masyarakat, Malaysia (Ref. no: JKMM 100/12/5/2: 2017/459) and was ethically approved by UniSZA Human Ethics Research Committee (Ref. no: UniSZA.C/2/UHREC/628-2 Jld 2 (31) and

Sample size calculation

Sample size was calculated using a comparing mean formula by Musa [8]. The standard deviation used for sample size calculation is according to child's body mass index between gender (Zaragoza, 2019) [9] by considering 20% drop out data.

Measures

Face to face interview was conducted to gather the data by using a set of questionnaires which comprised of socio-demographic items, including parent's name, monthly income, marital status, ethnicity, and education level. Besides, children's information such as gender, age, ambulatory status, co-morbidities and medication intake were also obtained. The caregivers were well informed on the content of the questionnaire instruments and were reassured of their anonymity regarding their identity and confidentiality with regards to the data collected.

Feeding issues of the children were gathered using a nutrition screening checklist documents that contained questions on child's eating ability, accepted food texture, specific feeding and nutrition problems identification such as difficulty in chewing, sucking or swallowing, swallowing without appropriate chewing, frequent vomiting or coughing during eating, choking, drooling, dental problems, food allergies, constipation and picky eating. These checklists were selected on the basis of its common occurrence among CP children from the literature and were used by previous study[10]. Parents indicated yes if their children experiencing it or no when the problem in the checklist is not applicable.

Anthropometric measurements of the children were also obtained. The parameters included the measurement of standing height or recumbent length and weight for the calculation of body mass index (BMI). The anthropometric data obtained such as body weight, height and BMI were compared to the growth reference standard for CP children [6]. The value below than 10th percentile indicates underweight while the value between 10th until 50th percentile indicate normal weight status. All equipment was calibrated before use and all measurements were conducted by the researcher based on the standard techniques.

Statistical Analysis

All data were stored and analyzed using the IBM SPSS software (SPSS v25.0). The frequencies were described as percentage. The anthropometric data between the genders were compared using both parametric (t-test) and non-parametric (Mann-Whitney U test). A Chi-Square Test was used to show the association between the variables. All tests of significance were two-tailed with a p-value <0.05 indicating a statistically significant difference.

RESULTS AND DISCUSSION

Sociodemographic characteristics

Overall, majority of the CP children attending CBR in Kuala Terengganu and Kuala Nerus are boys (57.7%) and aged between 7-10 years old (46.2%) with mean age of 8.58±3.3 years old. Most of the participants were from rural area (61.5%), obtained education level up to primary/secondary school (76.9%) and came from low socioeconomic background (57.7%) which they had monthly household income less than RM1500. The sociodemographic data are summarized in Table 1.

Anthropometric profile

The anthropometric data of participants are presented and compared between genders in Table 2. Mean weight for girls in this study was significantly higher compared to boys ($p < 0.046$). However, there were no significance group differences for mean height and mean BMI ($p > 0.05$) between groups. The result indicate majority (57.7%) of the CP children were underweight while the remaining of 42.3% had normal BMI status. None of the participants were classified as overweight.

Feeding issues

Majority of the participants (84.6%) needed assistance or unable to eat by themselves during meal time. Even so, majority (76.9%) of the children able to tolerate solid food or family food such as rice and noodles instead of taking porridge as thinner liquids may travel into the throat quickly and can cause choking.

For the identification of the specific feeding issues, Table 3 shows 11.5% had sucking problem, 15.4% had choking/spluttering problem, 23.1% had chewing problem, 7.7% had swallowing problem and 19.2% with teeth decay. Participants that had puking problem when eating were only 3.8% and also strict food selection. The most common feeding problem was constipation with 23.1% out of participants. Drooling, allergy and less appetite were also contributed to the feeding problems by 11.5% for these problems. These 11 types of feeding issues were further being divided into three main categories namely oral health issues (sucking, teeth decay, chewing, drooling); digestive health issues (swallowing, choking, puke, constipation); and others (allergy, less appetite, strict food choices). A total of 16 participants (62.5%) had feeding problems but were not significant with nutritional status, $\chi^2(4, n=26) = 0.99$, $p = 0.42$ as shown in Table 4.

Overall, this study recruited nearly same proportion of participant for both genders. The incidence of CP is 20% higher in boys reported by Himmelmann et.al (2014) in a cohort study in Sweden. The higher incidence in boys is explained by biological vulnerability in terms of cerebral structure, hormone protective role and genetics polymorphism [11] and were reported in several previous studies [12,13]. CP also have trouble balancing and coordinating movements or struggle to move their muscles and joints correctly. Due to this, CP children were usually unable to walk or need assistance to move as it will cause pain to them.

Besides, CP children need assistance during eating due to poor oral motor function. In this current study approximately 80% children need help during eating. According to a cross sectional study conducted in Brazil, the oral motor evaluation was performed by using the Oral Motor Assessment Scale (OMAS) instrument and revealed that patients with CP had greater prevalence of lower score (less ability) when compared to healthy patients. If using Nordic Orofacial Test Screening (NOT-S) instrument, higher scores revealed greater impairment or poorer oral motor function [14]. Another research conducted by Reilly and colleagues reported that 60% of children were totally dependent on their mother for all aspects of food selection and intake [15].

With regards to food texture as their meal, children's ability to consume food textures with advancing complexity like ground/lumpy and cut-up/chunky foods is higher in those with GMFCS I and progressively decreased as GMFCS level increased or gross motor functional ability decreased [16]. Therefore, most of the participants (76.9%) in this study can tolerate solid food as the inclusion criteria for this study was only included CP children of GMFCS with level I and II.

Mean weight for both genders in this study were found to be lower than the finding by Whitney et al. [17]. Both boys and girls were reported to have lower mean BMI as compared to children aged 2 to 15 years old from community rehabilitation centres and spastic centres around Kuala Lumpur, Muar and Penang that had feeding problems [18]. Approximately 40% (11 participants) were categorized as normal/healthy category according to their BMI status from the specific growth chart [6]. Previous study found higher prevalence of children who were underweight and healthy in CP population and lower incidence of children who were overweight due to association between gross motor function and weight. Children with a higher level of gross motor function (GMFCS level I) were more likely to have a healthy weight whereas children with a lower level of gross motor function (GMFCS level III) were more likely to be obese. This is due to greater neuromuscular involvement with greater difficulties of doing physical activity, which may contribute to a higher level of obesity [19].

The prevalence of underweight in this study was in line with a previous study in which it found 52% of children with CP were malnourished, with underweight being the most common category at 42%. Greater feeding difficulties were strongly associated with the child being underweight [20]. Thus it shows that the CP children with feeding difficulties have increased the risk of being underweight. Malnutrition has become a major worldwide challenge and based on a study conducted by Dahlseng et al (2010) only 63% of cerebral palsy children have normal Body Mass Index (BMI), with 21% of them were categorized as thinness/underweight or severe thinness and 16% with overweight or obese.
Nearly 63% of participants had feeding problems and the high prevalence is similar (61% to 100%) as compared to previous studies [18,21]. Constipation and allergy to food (egg and seafood) were the highest incidence within boys (20%) while chewing issue is the highest prevalent problem within girl (36.4%). Constipation is also the common problem in girl with 27.3%. Constipation is more prevalent among children with motor problem but it is not

solely the result of motor response and immobilization [22]. Children with CP and constipation often have resulting co-morbidities such as increased frequency of seizures, abdominal pain, decreased appetite, increased gastro-esophageal reflux and hospitalization [23].

Gastroesophageal reflux disease (GERD) specifically refers to symptoms of complications that are result of GER such as dysphagia, poor weight gain and vomiting and has annual prevalence of 10% to 15% [24]. According to the result obtained, puke is recorded the lowest prevalent among the participants. This might be due to reflux is common in infants, ranging from 50% in 3 months old infants to 5% in those 10 to 12 months old [25.26]. Reflux generally resolves as children stay upright more often, eat more solid food and have improved lower esophageal sphincter (LES) muscle tone [26]. These characteristics are met by majority of this study participants which may indicate lower GERD or resolved GERD as the children growing.

In this study, which was conducted in CBR in Kuala Terengganu and Kuala Nerus, it was to observed an association between different types of feeding issues with body weight status of the participants. The 11 types of feeding problems are being categorized into three main domains; oral health issue, digestive health issues and others issues related to feeding. However, this study has not found any statistically significant association between the presence of feeding issues and the participant's body weight status. The finding is in contrast with previous study which concluded that CP with feeding disorder were common and were associated with the impaired nutritional status [27].

No significant association between oral health issues and nutritional status of participants in this study. However, previous study found that the neuromuscular problems inherent in CP can affect oral health significantly in different ways [28]. These can include changes in structures of the oro-facial region, feeding problems, difficulties with maintaining oral hygiene; additionally, people with CP can encounter barriers in accessing oral health care. There is a high prevalence of orofacial motor dysfunction among people with CP, which can hinder oral hygiene and hence increase dental biofilm formation and retention [29]. Motor deficiencies associated with CP contribute to gross limitations in a child's ability to perform activities of daily living which is self-care functions such as maintaining adequate oral hygiene. In a research involving 130 children with CP, 98.8% presented deficiency in the oral phase while eating drinking, or when controlling the saliva [30].

Digestive health issues including swallowing, choking, puke and constipation problems as well as other issues including allergy, less appetite, strict food choices also showed non-significant associations with nutritional status of the participants. However, a study in Brazil involving 114 children with CP, assessing their weight, height and BMI, arm muscle area and arm fat area found frequent malnutrition. The tetraplegic CP presented the most impaired anthropometric indicators: weight and BMI, with 72.4% and 73.1% with Z-score $\leq$ -2 respectively. The authors concluded that one of the factors that significantly influenced the nutritional status of the sample was the difficulty to swallow [31].

Meanwhile, there is a study which emphasized that, even when properly nourished, children with CP are smaller than children from the general population, possibly due to physical inactivity, mechanical forces exerted on the bones, articulation and muscles, endocrinal factors, high prevalence or prematurity and low birth weight [28]. Such that, specific growth chart for CP is customary practice to prevent under-estimation of growth for CP children thus can explore possible clinical explanation for the subpar growth. These factors seem to act synergistically to affect growth in each of its dimensions, including diminished linear growth, weight gain and alterations in body composition such as reduced muscle mass, fat mass and bone density. Achieving anthropometric indexes of weight and height established for the general population must not be the goal when dealing with people with CP and their health and growth [32]. This finding from previous studies can support this study in which regardless of the absence or presence of various type of feeding problems, the participants can still develop malnutrition or shown low nutritional status.

CONCLUSIONS

The prevalence of underweight in children with CP is high in CBR Kuala Terengganu and Kuala Nerus. Common feeding issues are chewing and constipation in CP children in which reduce the energy intake and lead to underweight. The malnutrition occurs among CP children may not be due to their feeding problems but may be due to the other factor associated with the various impairment factors such as muscle and motor difficulties may lead to physical inactivity and make eating more tiring and long when having difficulty in holding utensil. There is a need for proactive routine nutritional assessment, management and regular follow-up of children with CP in order to prevent any complication due to extension of malnutrition.

LIMITATION AND RECOMMENDATION

One of the limitations of this study is the sample size too small thus make this study difficult to find significant relationship between the data and unable to generalize or represent the study to the CP children population. Increasing the sample size by expanding the rehabilitation centres to other districts can help to overcome the limitation. Time constraints which caused the care givers were not able to return the questionnaires due to the sudden pandemic. Furthermore, other study can implement the method of submission questionnaire through online such as by using Google Form. The study design (cross-sectional) only allows the prevalence to be measured at a particular point in time. Dietary data such as 24-hour diet recall is recommended in order to obtain more information that can relate with nutritional status thus can help in early identification and intervention of poor oral motor as it is needed to improve overall oral motor function in mild CP children before progress to severe level.

ACKNOWLEDGMENTS

We would like to express appreciation to the Jabatan Kebajikan Masyarakat, Terengganu for granting permission to conduct this research, and most importantly to children and their caregivers who made this study successful. This study is funded by Dana Penyelidikan Universiti, Universiti Sultan Zainal Abidin, Kuala Terengganu.

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Table 1 Sociodemographic characteristics of cerebral palsy children

Characteristics	Frequency n (%)
Gender	
Boy	15 (57.7)
Girl	11 (42.3)
Age (years)	Mean age: 8.58±3.3
3-6	8 (30.8)
7-10	12 (46.2)
11-15	6 (23.0)
Number of siblings	
<5	23 (88.4)
≥5	3 (11.5)
Ambulatory status	
Ambulatory	7 (26.9)
Ambulatory with assistance (helper or apparatus)	19 (73.1)
Area of living	
Rural	16 (61.5)
Urban	10 (38.5)
Parent's education level	
Primary /Secondary school	20 (76.9)
Diploma/Degree	6 (23.1)
Monthly household income	
≤RM 1500	15 (57.7)
RM 1501 – RM 4000	8 (31.0)
≥RM 4001	3 (11.5)

Table 2 Anthropometric characteristics of cerebral palsy children

Variables	Gender				*p*-value
	Boys (n=15)		Girls (n=11)		
	Mean (SD)	Frequency	Mean (SD)	Frequency	
Body weight, kg	17.8 (7.31)		23.3 (8.34)		0.046[a]
Height, cm	115.3(18.48)		120.5 (14.44)		0.324[b]
BMI, kg/m^2	13.0(1.84)		15.8(4.38)		0.07[b]
Body weight status		n (%)		n (%)	
Underweight		11 (73.3)		4 (36.4)	
Normal		4 (26.7)		7 (63.6)	

SD= standard deviation
The proportions were compared using [a]independent *t*-test [b]Mann-Whitney U Test
p-value<0.05 indicating a statistically significant difference

Table 3 Prevalence for each type of feeding problems of by cerebral palsy children

Characteristics	Frequency n (%)
Eating ability	
Self-fed	4 (15.4)
With assistance	22 (84.6)
Child's food texture acceptance	
Solid	20 (76.9)
Puree/Liquid	6 (23.1)
Feeding issues (overall)	
No	10 (37.5)
Yes	16 (62.5)
Oral health issues	
1) Sucking	
No	23 (88.5)
Yes	3 (11.5)
2) Teeth decay	
No	21 (80.8)
Yes	5 (19.2)
3) Chewing	
No	20 (76.9)
Yes	6 (23.1)
4) Drooling	
No	23 (88.5)
Yes	3 (11.5)
Digestive health issues	
1) Choking	
No	22 (84.6)
Yes	4 (15.4)
2) Swallowing	
No	24 (92.3)
Yes	2 (7.7)
3) Puke	
No	25 (96.2)
Yes	1 (3.8)
4) Constipation	
No	20 (76.9)
Yes	6 (23.1)
Appetite and allergy	
1) Strict food selection	
No	25 (96.2)
Yes	1 (3.8)
2) Allergy	
No	23 (88.5)
Yes	3 (11.5)
3) Less appetite	
No	23 (88.5)
Yes	3 (11.5)

Table 4 Body weight status among cerebral palsy children presence with feeding problems

Variables	n(%)	Normal	Underweight	χ^2 -statistics (*df*)	*p*-value
Presence of feeding issues					
Yes	16(62.5)	6	10	0.99(4)	0.42[a]
No	10(37.5)	5	5		

[a]Chi-Square assumption was applied
n: Number of participants