ORIGINAL ARTICLE

The Correlation Between Eating Patterns and Nutritional Adequacy of Children with Cerebral Palsy

Marina Indriasari[1]

[1] Department of Nutrition, Faculty of Health Science and Technology, Binawan University, Jakarta, Indonesia

ABSTRACT

Due to sensory and motor dysfunction, some children with cerebral palsy (CP), have trouble chewing and ingesting, which may result in inadequate feeding. The goal of this study is to look into the correlation between eating patterns and nutritional adequacy of children with cerebral palsy. This research was carried out in 11 Special Schools Depok, Bogor and Jakarta. Taking into the topic inclusion requirements of the subjects (i.e. aged 5-18 years, had hemiplegic and diplegic types of cerebral palsy, had no infection, and good communication), 45 subjects were interviewed for data collection. A pre-test structured questionnaire which uncovered the identity and dietary intake (1x24-hour food record by caregiver) was used to guide the interviewer and also interview about the type of food of meal and snack and the frequency of eating in children. The results showed that the children with cerebral palsy liked to consume soft and liquid foods. Protein, fat, energy, and carbohydrate showed mean sufficiency levels of 80,9%, 53,5%, respectively. 62.0%, and 66.2%. Iron, calcium, zinc, Vitamins A, D, E, B9, C, calcium, iron, and zinc all exhibited mean sufficiency levels of 40.7%, 29.9%, 41.1%, 135.9%, 36.4%, 63.3%, 30.9%, and 70.8%. There was a substantial beneficial relationship between eating behaviors and protein and carbohydrate sufficiency ($p<0.05$). This implies that the children with cerebral palsy inadequately consumed both macro- and micronutrient source foods. The result showed that there's a correlation between eating patterns and nutritional adequacy in children with CP.

Keywords: cerebral palsy, eating patterns, nutritional adequacy

ABSTRAK

Sebagian anak dengan cerebral palsy (CP) mengalami kesulitan dalam mengunyah dan menelan akibat disfungsi sensorik dan motorik yang dapat menyebabkan tidak terpenuhinya pola makan yang benar. Tujuan penelitian ini adalah untuk mengetahui hubungan antara pola makan dengan kecukupan gizi pada anak dengan cerebral palsy. Penelitian ini dilakukan di 11 Sekolah Luar Biasa di Depok, Bogor, dan Jakarta. Kriteria inklusi subjek yaitu usia 5-18 tahun, jenis cerebral palsy hemiplegia dan diplegia, tidak mengalami infeksi, dan dapat berkomunikasi dengan baik. Data dikumpulkan dari 45 subjek secara wawancara. Kuesioner *pre-test structured* digunakan untuk mengidentifikasi data personal dan asupan makan (catatan makanan selama 24 jam oleh pengasuh) digunakan sebagai pedoman pewawancara untuk mengeksplorasi ragam makanan yang dikonsumsi anak, baik makanan utama maupun selingan serta frekuensi makan anak. Hasilnya menunjukkan bahwa anak dengan cerebral palsy lebih suka mengonsumsi makanan lembut dan cair. Protein, lemak, energi, dan karbohidrat menunjukkan tingkat kecukupan rata-rata sebesar 80.9%, 53.5%, 62.0%, dan 66.2%. Vitamin A, D, E, B9, C, kalsium, zat besi, dan zinc semuanya menunjukkan tingkat kecukupan rata-rata sebesar 40.7%, 29.9%, 41.1%, 135.9%, 36.4%, 63.3%, 30.9%, dan 70.8%. Terdapat hubungan yang signifikan antara pola makan dan kecukupan protein dan karbohidrat ($p<0,05$). Hal ini mengimplikasikan bahwa anak-anak dengan cerebral palsy mengonsumsi makanan sumber zat gizi makro dan mikro secara tidak mencukupi. Hasil penelitian menunjukkan adanya korelasi antara pola makan dan kecukupan gizi pada anak-anak dengan cerebral palsy.

Kata kunci: pola makan, kecukupan gizi, cerebral palsy

Correspondent Detail:

Marina Indriasari

Faculty of Health Science and Technology, Binawan University, Jakarta, Indonesia Email: marina.indriasari@binawan.ac.id

INTRODUCTION

Children with cerebral palsy (CP) experience bodily restrictions due to various signs, such as posture and movements, while their brains are still developing. The disorder is permanent but not progressive and can occur in immature brains.[1] One of the most typical classifications is spastic CP. Spastic hemiplegic CP affects one side of the limbs and the diplegic CP affects both legs.[2] Due to sensory and muscular disabilities, some children with CP experience difficulty chewing and swallowing, leading to inadequate dietary intake.[3]

Children with CP face challenges and suffer both physical and emotional problems.[4] An example of their physical difficulties includes eating and swallowing, with the severity of these issues affecting nutrient intake.[5] Inadequate dietary intake may cause malnutrition problems in children with CP. Eating pattern is one of the factors affecting food consumption. Lassi Z et. al (2017)[6] stated that good eating patterns could ensure adequate nutritional requirements,

whereas poor eating habits might inhibit the fulfillment of nutritional adequacy. Children with CP must be carefully researched and monitored over time because they deserve to be orally fed in a developmentally suitable way.[7]

In terms of an individual's dietary habits, eating patterns encompass the foods consumed over a specific course of time, comprising the type of food, the frequency of intake, and the serving size.[8] When considering eating patterns, numerous factors come into play. The frequency and quantity of meals, types of food chosen, methods of food preparation, the environment in which meals are consumed, and the influence of other factors such as physical activity and genetic makeup all play a role in shaping an individual's eating patterns. These intricate and interrelated aspects of eating patterns must be taken into account when examining one's overall relationship with food.[9]

A study by Lopes in 2013[10] on Children with CP revealed low dietary consumption of carbohydrates, high fat, and adequate protein. A study by Leal-Martinez et al. (2020)[11] stated that Children with CP had a poor intake and plasma concentration deficits of folate, iron, calcium, niacin, vitamins D and E, protein, selenium, and zinc despite receiving nutritional supplements. Therefore, it was important to identify the eating patterns and nutritional adequacy of children with CP. The null hypothesis in this study posits that there was no correlation between eating patterns and nutritional adequacy in children with CP, while the alternative hypothesis in this study suggests that there was a correlation between eating patterns and nutritional adequacy in children with CP. The goal of this research was to examine the correlation between eating patterns and nutritional adequacy of children with CP at the Institute for Physically and Mentally Handicapped Children (IPMHC) and special schools (SS) in Depok, Bogor, and Jakarta.

METHOD

Design, Place, and Time of Study

This cross-sectional study was carried out in IPMHC and 11 special schools in Depok, Jakarta, and Bogor cities. They were Public special schools 2, 4, and 5, as well as IPMHC in Jakarta; Public special school, Manunggal Bhakti, Darma Asih, and Frobel Montessori Special Schools in Depok; Al-Irsyad, Mentari Kita and Sejahtera Special Schools in Bogor. The research was conducted in three months, from November 2020 to 2021.

Sampling Procedure

The population for this study consisted of children with CP in IPMHC and special schools in Depok, Jakarta, and Bogor cities. The inclusion criteria included children aged 5-18 years with spastic diplegia and hemiplegia CP, free from infectious diseases, and able to converse effectively. A total of 45 participants were recruited. Purposive sampling technique, which involves recruiting samples based on features relevant to the purpose of the study aims, was employed. Exclusion criteria in this study were children with CP other than diplegia or hemiplegia, those with other neurological disorders besides CP, and those with serious medical conditions that could affect participation in research, especially those related to food and oral intake. Ethical clearance was obtained for this clinical trial.

Data Categories and Collection

The quantity of food or nutrients a person consumes over time is referred to as their food intake. The quantity of calories, carbs, proteins, fats, vitamins, minerals, and other nutrients a person takes each day can all be included. Characteristics of the participants and their food intake and pattern were gathered through a 24-hour food record. Data were garnered through interviews with participants' parents or caregivers based on questionnaires filled by the researchers. The questionnaire included inquiries about the frequency and type of food consumed.

Data Processing and Analysis

Data were processed and analyzed using the Microsoft Excel software and SPSS. The participants' food consumption data were then processed using the 2016 NutriSurvey. Data analysis was performed descriptively and statistically. The Spearman correlation test was used to examine the relationship between factors.

RESULT

Subjects' Characteristics

Table 1. Subject Characteristics

Subject	Quantity	Percentage
Boys	28	62.2%
Girls	17	37.8%

The incidence of CP mostly occurs at the age of 6-12 years (44.4%). The study participants were 28 males (62.2%) and 17 females (37.8%). Most participants were 11 years old (26.7%), with a mean age of 11.8±3.0 years. The incidence of CP among boys was more common than among girls. It was 1.3% more prevalent among boys in Europe.[12]

Eating Patterns

Table 2. Meal frequency in a day of the CP children

Frequency (times/day)	Main meal		Snack	
	n	%	n	%
0	0	0	9	20
1	0	0	30	66.7
2	12	26.7	6	13.3
3	29	64.4	0	0
4	4	8.9	0	0
Total	45	100	45	100

The term "snack" refers to foods that are not on a main menu (breakfast, lunch, or dinner). Most participants (66.7%) consumed snacks once a day. The snacks consumed were the ones that tasted sweet, such as sponge cake, fruits, chocolate milk and biscuits. As for carbohydrate sources, rice, bread, and biscuits were the most commonly consumed by participants, with all participants eating rice as their carbohydrate sources. Chicken, eggs, fish, and milk were the most popular forms of animal protein sources, while tofu and tempeh served as the most preferred sources of plant protein. The most popular fruits to be consumed were avocado, orange, and papaya, while the most widely consumed vegetables were vegetable soup and spinach. The foods consumed by children with CP had smooth textures to facilitate the biting and swallowing processes. Since they often have trouble digesting solid meals, *puréed form* is suggested.[14]

DISCUSSION

Adequacy of Energy and Nutrients

The subjects were determined after a sampling process of 45 children with spastic CP, diplegia, and hemiplegia from IPMHC (Institute for Physically and Mentally Handicapped Children) and SS (Special Schools) in Depok, Bogor, and Jakarta. There were 28 male and 17 female participants. Most participants were 11 years old (26.7%), with a mean age of 11.8±3.0 years. Survey results show that the incidence of CP mostly occurs at the age of 6-12 years (44.4%). According to Mardiani (2006), the incidence of CP in boys is more common than in girls. Research conducted by Oskuoui et al. (2013) reported that in Europe, the incidence of CP was 1.3 times more common in men. Following research subject determination, the adequacy of energy and nutrients (both macro and micro nutrients) was calculated, as shown in Table 3.

Based on the findings in Table 3, the subjects' energy and nutritional requirements were still less than 100% of the RDA (Recommended Dietary Allowance). According to the Ministry of Health (1996)[15], the average adequacy of fat, calories, and carbohydrates was categorized as severe (<70% RDA), while protein adequacy was categorized as moderate (80-89% RDA).

These findings were consistent with the findings of Madrigal et al. (2020)[16], who investigated the calorie consumption and nutrient profile of 1448 toddlers in Spain. Their study noted that energy deficiency was a prominent issue, while the protein intake was normal. The assessment of energy adequacy in the participants was compared to RDA values, and energy intake was linked to mobility and exercise level. As a result, it is possible that the energy requirements of children with disorders, particularly neurological diseases, were fewer than typically developing children.

Table 4 shows that only vitamin A reached the adequate category (≥77%), while the rest were classified as inadequate.[17] This prevalence of micronutrient deficits was consistent with the findings of the previous studies[18,19] reporting deficiencies in vitamins A and C, iron, zinc, calcium, thiamine, and riboflavin in children with cognitive impairments. Food selection may have contributed to the subjects' low mean adequacy of micronutrients. Red meat, a source of iron and

zinc crucial for addressing deficiency in these micronutrients, was not the primary source of animal protein for participants in this research. Due to its solid texture, red meat tends to be avoided by children with CP, who often have difficulties chewing, biting, and swallowing.[20] A study by Indriasari & Hardinsyah (2019)[21] suggests that solid-but-not-pureed textures like mashed or non-mashed potato can be suitable for children with CP. Sensorimotor therapies like oral stimulation exercises or intra-oral appliances can be used to improve the effectiveness..

Table 3. Mean Adequacy of Macronutrient in Children with Cerebral Palsy

Mean Adequacy of Macronutrient in Children with Cerebral Palsy (%)	
Energy	62.0
Protein	80.9
Carbohydrate	66.2
Fat	53.4

Table 4. Mean Adequacy of Micronutrient in Children with Cerebral Palsy

Mean Adequacy of Micronutrient in Children with Cerebral Palsy(%)	
Vit. A	135.9
Vit. D	36.4
Vit. E	63.3
Vit B9	30.9
Calcium	70.8
Iron	29.9
Zinc	41.1

Correlation between Eating Patterns and the Adequacy of Energy and Nutrients

The Spearman correlation test indicates a significant positive correlation between eating patterns and the adequacy of protein and carbohydrates ($p<0.05$). It implies that better eating patterns are associated with better protein and carbohydrate sufficiency. This finding aligns with the study by Al-Jawaldeh (2020)[22], which emphasized that eating patterns and food consumption patterns were significantly related to adequacy levels and density of nutrient intakes in individuals.

Reddivari & Mehta (2022)[13] stated that to prevent gastric emptying, a regular meal frequency of three times per day is advised to satisfy their nutritional needs. In addition to adequate quantity, it is also important to pay attention to regular eating times to ensure that the nutrients in the food are correctly absorbed. The frequency of participants' major meals in this study varied from two to four times per day, with the majority (64.4%) consuming meals three times a day.

The result of this research is in line with research carried out by Jafari et al. (2019)[23] in Iran, which

analyzed the nutritional intake of 120 children with CP. The study highlighted an alarming number of children with suboptimal nutrition, implying that most of these children fall short of the required nutritional requirement for optimal development. An intriguing correlation between eating patterns and nutrition was also uncovered, suggesting that a child's eating pattern plays a vital role in their nutritional well-being. The study observed that an adequate nutritional diet not only bolsters a child's overall physical and cognitive health but also contributes to healthy growth and development, leading to better life outcomes.

In children with cerebral palsy (CP), the effects of eating patterns and nutritional sufficiency might be particularly significant. Children with CP frequently need more energy, and difficulties in eating and digesting may affect their nutritional health. Malnutrition, slow growth, and delayed development in children with CP can all be caused by poor eating practices and insufficient nutritional intake, which can further worsen these problems. On the other hand, a balanced diet and a sufficient intake of nutrients may support development and growth while enhancing general health and wellness.[24]

CONCLUSION AND RECOMMENDATION

Conclusion

Eating patterns and nutritional adequacy of Children with CP are very important to observe. In this study, although they already eat three times a day, the adequacy of macro- and micronutrients is still below the RDA. The results of the correlation test showed a positive, significant correlation between eating patterns and the adequacy of carbohydrates and protein as energy sources.

Recommendation

The participants' good meal frequency (i.e. three times a day) should also be balanced with the consumption of more diverse foods and foods containing enough nutrients to ensure better fulfillment of nutritional adequacy, both in terms of quality and quantity. This study did not explain the ability to eat further in children with CP. Therefore, future studies need to explore the eating ability of children with CP and food consistency.

Acknowledgement

The authors would like to thank to the participating schools (State SS 3, State SS 4, State SS 5 and IPMHC in Jakarta; State SS, Manunggal Bhakti SS, Darma Asih SS and Frobel Montessori SS in Depok; Al-Irsyad SS, Mentari Kita SS, and Sejahtera SS in Bogor) for facilitating research on Eating Patterns and Nutritional Adequacy of Children with CP. We would also like to thank the parties involved for their support during this research and the writing process of this paper.

REFERENCE

1. Patel D, Neelakantan M, Pandher K, Merrick J. Cerebral palsy in children: a clinical overview. Transl Pediatr. 2020;1(1):125–35.
2. Kenny T. Cerebral Palsy. 2015.
3. Ahmed K, Kim H, Han K, Yim J. Nutritional status of children with cerebral

palsy according to their body mass index percentile classification. J Nutr Heal. 2021;54(5):474– 88.

4. Kim H, Choi H, Yim J. Food Habits, Dietary Intake, and Body Composition in Children with Cerebral Palsy. Clin Nutr Res. 2018;7(4):266–75.
5. Costa A, Martin A, Arreola V, Pizzaro A, Carol C, Serras L, et al. Assessment of Swallowing Disorders, Nutritional and Hydration Status, and Oral Hygiene in Students with Severe Neurological Disabilities Including Cerebral Palsy. Nutrients. 2021;13(7):2413.
6. Lassi Z, Moin A, Bhutta Z. Nutrition in Middle Childhood and Adolescence. 2017;11.
7. Aryedson J. Feeding children with cerebral palsy and swallowing difficulties. Eur J Clin Nutr 67 (Suppl 2). 2013;9–12.
8. World Health Organization. Healthy diet [Internet]. 2018. Available from: https://www.who.int/news-room/fact-sheets/detail/healthy-diet
9. Satija A, Hu FB. Cardiovascular benefits and dietary challenges during extended working years. Annu Rev Nutr.
10. Lopes P, Amancio O, Arajo R, Vitalle M, Braga J. Food pattern and nutritional status of children with cerebral palsy. Pediatr. 2013;31:344–9.
11. Leal-Martínez F, Franco D, Peña-Ruiz A, Castro-Silva F, Escudero-Espinosa A, Rolón- Lacarrier O, et al. Effect of a Nutritional Support System (Diet and Supplements) for Improving Gross Motor Function in Cerebral Palsy: An Exploratory Randomized Controlled Clinical Trial. Foods. 2020;9(10):1449.
12. Oskoui M, Countinho F, Dykeman J. An update on the prevalence of cerebral palsy: a systematic review and meta-analysis. Dev Med Child Neurol. 2013;55(6):509–19.
13. Reddivari A, Mehta P. Gastroparesis [Internet]. StatPearls Publishing; 2022. Available from: https://www.ncbi.nlm.nih.gov/books/NBK551528/
14. Kamal S, Kamaralzaman S, Sharma S, Jaafar N., Chern P., Hassan N., et al. A Review of Food Texture Modification among Individuals with Cerebral Palsy: The Challenges among Cerebral Palsy Families. Nutrients. 2022;14:5241.
15. Kesehatan D. Pedoman Praktis Pemantauan Gizi Orang Dewasa (Practical Guidelines for Adult Nutrition Monitoring). Jakarta: Depkes (MoH); 1996.
16. Madrigal C, Soto-Méndez M, Hernández-Ruiz Á, Valero T, Ávila J, Ruiz E, et al. Energy Intake, Macronutrient Profile and Food Sources of Spanish Children Aged One to <10 Years—Results from the EsNuPI Study. Nutrients. 2020;12(4):893.
17. Aserese A, Atenafu A, Sisay M, Sorrie M, Yirdaw B, Zegeye M. Adequate vitamin A rich food consumption and associated factors among lactating mothers visiting child immunization and post-natal clinic at health institutions in Gondar Town, Northwest Ethiopia. PLoS One. 2020;15(9).
18. Skrzypek M, Koch W, Goral K, Soczyńska K, Poźniak O, Cichoń K, et al. Analysis of the Diet Quality and Nutritional State of Children, Youth and Young Adults with an Intellectual Disability: A Multiple

Case Study. Preliminary Polish Results. Nutrients. 2021;13(9):3058.

19. Berger M, Pantet O, Schneider A, Ben-Hamouda N. Micronutrient Deficiencies in Medical and Surgical Inpatients. J Clin Med. 2019;8(7):931.
20. Benfer K., Weir K., Bell K., Ware RS, Davies PSW, Boyd R. Oropharyngeal dysphagia in preschool children with cerebral palsy: Oral phase impairments. Res Dev Disabil. 2014;35:3469–81.
21. Indriasari M, Hardiansyah. Abstracts of the Asian Congress of Nutrition. Ann Nutr Metab. 2019;75((suppl 3)):1–424.
22. Al-Jawaldeh A, Taktouk M, Nasreddine L. Food Consumption Patterns and Nutrient Intakes of Children and Adolescents in the Eastern Mediterranean Region: A Call for Policy Action. Nutrients. 2020;12(11):3345.
23. Jafari P, Taghizadeh M, Farhadi M, Mirzaei M, Mottaghi A. The relationship between nutritional status and gross motor function in children with spastic cerebral palsy. J Pediatr Rehabil Med. 2019;12(1):23–30.
24. Shimmura T, Shimizu T, Hagiwara K, Abe T, Nakamura T. Nutritional status of children with cerebral palsy: a cross-sectional multicenter study. J Child Neurol. 2013;28(1):77–82.
25. Mardiani, E. 2006. Faktor-faktor risiko prenatal dan perinatal kejadian cerebral palsy [tesis]. Semarang (ID) : Universitas Diponegoro.
26. Oskoui M, Coutinho F, Dykeman J, Jette N, Pringsheim T. 2013. An update on the prevalence of cerenral palsy : a systematic review and meta analysis. *J Dev Medicine & Child Neurology.* 55 (6) : 509 -519