

A Review of Dietary Intake and Nutritional Status of Children with Cerebral Palsy

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Abstract

Cerebral palsy (CP) is a group of neurologic disorders typically caused by a non-progressive lesion or abnormality of the developing brain that appears in infancy or early childhood and permanently affects body movement, muscle coordination, and balance. It is the most common cause of physical disability in childhood and is a significant health problem with major effects over the lifespan. The global prevalence of CP ranges between 2-10 per 1000 children in community-based samples with prevalence varying widely from country to country. Children are vulnerable to protein energy malnutrition (PEM) as well as micronutrient deficiencies because of their continuing growth that hikes their bodies' demand for nutrients. This risk of malnutrition is increased in neurologically impaired (NI) children due to a number of nutritional and non-nutritional factors. Among the nutritional factors is insufficient dietary intake due to feeding difficulties resulting from impaired chewing and swallowing. Cerebral palsy may be associated with a host of comorbidities such as undernutrition (46% to 90% of the patients), Studies have reported increased prevalence of morbidity and mortality secondary to compromised nutritional status among children with CP compared to their normal counterparts in the same age group. This review is aimed at assessing the effect of dietary intake on nutrition status of children with cerebral palsy. A review of various publications was conducted using the key words, Cerebral Palsy, disability, and feeding difficulties. This review shows that feeding difficulties due to motor dysfunction is common in children with CP and may reduce their dietary intake resulting to poor health and nutritional status. There is need to develop effective interventions aimed at improving the dietary intake of children with CP. Such interventions could help mitigate poor nutritional status as well as improve their quality of life.

Key Words: *Cerebral Palsy, Dietary intake, Nutrition status, feeding difficulties*

INTRODUCTION

Background to the study

Cerebral palsy is a common childhood disability that affects sensory motor functions and leads to impaired motor behaviour and oral motor dysfunction. It is a physical disability that affects 0.4% of children globally (Pulgar et al., 2019). According to the World Disability Report (2011), 15% of the global population constitutes persons with disability. In Kenya, the overall disability rate is 4.6% translating to 1.7 million Persons with disabilities. Of this, the largest proportion is physical impairment, amounting to 24% (413,698), of which CP is inclusive (KNBS; NCAPD, 2008). CP is thought to be even more common and severe in low-income countries due to lack of access to early intervention and obstetric, neonatal, and rehabilitation services (Claudia et al., 2018). Studies conducted in Kenya by Auka and Afedo in 1986 and Kennedy in 1990, showed

that CP affected about 0.25% of children. In the same study, CP was noted to be the second most common neurological condition causing physical impairments after poliomyelitis in Kenya (Auka and Afedo, 1985; Kennedy, 2001). Current data on prevalence of CP in Kenya is lacking.

Malnutrition, either under or over-nutrition, is a common condition among neurologically impaired children. Energy needs are difficult to define in this heterogeneous population, and there is a lack of information on what normal growth should be in these children. Non-nutritional factors may influence growth, but nutritional factors such as insufficient caloric intake, excessive nutrient losses and abnormal energy metabolism also contribute to growth failure. (Aggarwal et al., 2015; Penagini et al., 2015).

Depending on the severity of the impairments, children with cerebral palsy have feeding difficulties due to their inability to put food into their mouth and due to chewing and, or, swallowing problems. This situation makes them dependent on others, risking malnutrition, which negatively impacts on the quality of their life(Kakooza-Mwesige,2015). Various studies have reported high prevalence of malnutrition among CP children in different settings (Almuneef et al., 2019; Penagini et al., 2015b; Rajikan et al., 2017). A study conducted by Koriata (2012), in Kenya among children with CP attending Kenyatta National Hospital outpatient clinic, showed that 70.3% were malnourished.

Food intake is one of the factors that determine malnutrition. Feeding dysfunction such as Oropharyngeal dysphagia due to motor dysfunction is common in children with CP and may reduce their food intake, resulting to poor health and nutritional status (Rempel, 2015) 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 (Power et.al.,2018).

Nutritional requirements of children with CP

Studies reviewed indicate that many children with CP have decreased energy requirements in comparison with typically developing groups and that these differences increase with increasing severity of gross motor impairment. Differences are partly because of decreased basal metabolic rate and largely because of reductions in physical activity levels. (Bell and Samson, 2013). It is reported that the energy requirements of CP children who are able to walk and have athetosis are higher than those unable to walk (kakooza-mwesige et.al., 2015). A healthy child requires 2000 kcal/day. However, energy requirements of children with severe CP who utilize a wheelchair for mobility have been reported to be between 60 and 70% lower than healthy typically developing children (Walker et al., 2012), so their energy requirements are between 1200-1400 kcal/day. Children with mild to moderate CP, who can ambulate often require more calories to perform daily activities than their normal counterparts (kakooza-mwesige et.al., 2015).

Adequate protein intake is required to build and repair tissue, for adequate growth and development in childhood. There is currently no data available for protein requirements of children with CP therefore their requirements do not differ from the typically normal developing children and recommendations can be applied (1.0 g/kg of bwt/day) Severely malnourished children with CP, require additional protein for 'catch up' growth. Overall, an intake of 2.0 g/ kg of bwt/day of protein intake is considered to be sufficient in these instances (Pencharz, 2010).

Many studies have found that children with cerebral palsy have poor bone density. Factors leading to this are both nutritional and non-nutritional. Non-nutritional factors are lack of weight bearing activity due to long periods of immobilization; anticonvulsant medication interfering with vitamin D metabolism (sodium valproate); lack of exposure to sunlight; and metabolic bone disease associated with prematurity. Nutritional factors include oral motor dysfunction resulting in poor nutrition and low calcium intake. The development of healthy bones is dependent on adequate Vitamin D, Calcium intake and Weight bearing or resistance physical activity. Vitamin D deficiency can lead to osteopenia, which in turn can lead to chronic bone pain and fractures. The most common site of fracture in children with immobility is the distal femur (Herderson et.al., 2002).

Children with cerebral palsy that are high risk for vitamin D deficiency include those, with low exposure to sunlight living in residential care, with dark skin those taking anticonvulsant medications as they can cause increased degradation of hydroxy vitamin D in the liver

A study by Henderson et al., (2002) found that bone mineral density (BMD) in the femur of children with spastic cerebral palsy was lower than recommended calcium intakes. Regarding fluid intake, studies reviewed show that some children with cerebral palsy experience fluid losses through excess salivation or sweating and unable to consume adequate quantities of fluid and/or to communicate thirst (Bell and Samson, 2013).

Children with cerebral palsy are at risk of inadequate micronutrient intakes because of their reduced energy requirements and subsequent intake. (Bell and Samson, 2013) Micronutrient deficiency can impair immune function, lower cognitive function, reduce bone density, and stunt growth. There has been little research on micronutrient adequacy in children with cerebral palsy. Estimated Average Requirement (EAR) or approximately 70% of the Recommended Dietary Intake (RDI) or Adequate Intake (AI), with specific note to: Iron, Zinc and vitamin C for pressure ulcers, Calcium (Schoendorfer et.al.,2010).

Causes of Malnutrition in CP

According to Claudia et al., (2018), a large number of children with special needs are malnourished. Malnourishment in children can lead to serious problems and they may constantly feel cold and loose muscle mass and body tissue. Over time, their skin may become dry and pale. Malnourished children also tend to get sick at higher rates. They also take longer to heal from wounds and illnesses, and they may experience respiratory failure. These health complications are serious, and severe cases of malnourishment can lead to death. It is important therefore to ensure that children with cerebral palsy receive the necessary nutrition to remain healthy.

Some of the factors that lead to malnutrition in children with CP are;

- 1) **Inadequate nutrient intake** due to feeding dysfunction. Feeding difficulties(FD) interferes with the child's ability to adequately consume essential nutrients required for growth (Bell and Samson, 2013), impaired chewing and swallowing Coughing/choking during feeding, inability to take solid foods, inability to self- feed, vomiting/regurgitation and drooling.
- 2) There is also **increased nutrient losses** due to frequent regurgitation. Reflux esophagitis may cause discomfort leading to food refusal and further decreasing food intake.

3) **Altered metabolism** is another factor. The resting energy expenditure is lower in children with CP than in controls matched for age and weight. Hypotonic CP Children require few calories above the resting energy expenditure to thrive. Children with increased muscle tone (athetoid) forms of CP may require an increased amount of calories.

4) **Longer Duration of feeding;** Children with CP often take longer duration to eat as compared to normal children. Parents have reported mealtimes to be stressful and time consuming. It can take up to 7 hours a day to feed these children. Mealtimes are often interrupted with repeated spillage of food, coughing, choking and regurgitation. Several studies have reported the mean duration of feeding session among these children to be 30 minutes (range 10-60 minutes). Children with more number of feeding problems took longer to eat.

5) **Chewing problem;** Chewing food with solid textures is difficult for children having eating impairments. They often have difficulty in transitioning to solid food and can better withstand liquid and/or semi-solid diets (Aggarwall, 2015). Children with CP can develop atypical and compensatory movements during oral functioning, evidenced by the difficulty in coordinating swallowing and breathing, as well as in dissociated oral movements, determining eating disorders, which affect different aspects of the child's life.

MATERIALS AND METHODS

From the studies reviewed, all caretakers were interviewed and informed consents were obtained. Information on demographic characteristics and feeding disorders were gathered by using a questionnaire. For feeding problems, the Parent Nutrition Screening Checklist questionnaire was used. The questionnaire comprised of questions which included subject's general health, feeding problems, behavior problems and dietary habits based on the parent's perception. Information on nutrient intakes was collected from parents/caregivers by recording their child's food intake for three consecutive days (two weekdays and one weekend) in the food diary that was provided. Their mean daily energy and macronutrient intakes were calculated. Energy intakes of subjects were compared to their energy needs based recommendation which were adjusted for their age, gender and level of physical activity. The macronutrient and micronutrient intakes were compared to the Recommended Nutrient Intake (RNI) distribution values based on sex and age (walker et.al.,2013)

In other studies, a 24-hr dietary recall questionnaire and a feeding observation schedule were also used. The 24-hr dietary recall recorded feeding frequency, types of food, and food modification methods. The feeding observation used a structured observation checklist during observation of one meal. (Claudia et.al,2018) The interview guide, food recall questionnaire, and observation checklist were all based on tools developed for a study by Adams et al. in Bangladesh (Adams, 2009). A recent study on children with cerebral palsy in Uganda confirmed that use of the WHO standard deviation scores (Z-scores) provides accurate parameters for assessing malnutrition in patients with cerebral palsy (Kakooza-mwesige ,2015).

RESULTS AND DISCUSSION

In many studies, it was observed that children with CP had significantly lower caloric intake in comparison to controls (CG). The ratio of daily nutrient intake of being under 80% of RDA, were lower in the children with CP than the CG, although the differences were not significant. The mean daily calorie intake of the children with CP was lower than the CG ($p < 0.05$). In a study carried out in Kenya by Koriata (2012), it indicated that Overall, 70.3 % of children with CP were malnourished, 35.0 % were severely wasted and 10.7% were severely stunted. Some of the factors that were significantly associated with moderate to severe wasting were; vomiting/regurgitation after feeding ($p = 0.031$). A Study carried out in Uganda reveal that more than half (52%) of the children with cerebral palsy were malnourished, as they had a Z-score of below 2.0 in at least one of the indicators. Underweight was the most common form of malnutrition, recorded in 53 of 127 children (42%), followed by stunting in 48 of 128 (38%). Notably, 4% of the children were overweight (Kakooza-Mwesige et.al,2015). A study in Ghana, which assessed feeding difficulties and nutritional status among 76 children with CP and explored the impact of a 12-month, community-based, parent training program revealed that caregivers found mealtimes stressful due to time demands, messiness, and the pressure of providing enough quality food. They felt that the training program had helped reduced this stress and dietary recall data suggested some improved dietary quality. However, there was neither improvement nor deterioration in anthropometric status of the children (Claudia et.al.,2018).

In a study by Rajan and Zakaria (2017), it shows that fiber intakes amongst subjects were very poor (24%), lower than the recommended levels with significantly lower intakes amongst the severe subjects (20%) compared to subjects with mild severity ($z = -2.361$, $p < 0.05$). This happens due to subjects' poor ability to chew vegetables and fruits, causing parents to feed these children with smaller vegetables and fruit portions.

Quality of life (QoL) scores were significantly lower among caregivers whose children had the greatest difficulties with feeding (median score 9.0) compared to those with least difficulties (24.6, $p = 0.004$) even with adjustment for potential confounders (caregiver and child age, SES, north/south and cerebral palsy severity). QoL was similar for caregivers with a child with cerebral palsy who was underweight (10.8) compared to caregivers whose child was not underweight (11.8, $p = 0.12$).

CONCLUSION AND RECOMMENDATION

Conclusion

Children with CP experience difficulties during eating and drinking, which if not managed properly may result in stressful mealtimes, chronic malnutrition, respiratory disease, reduced quality of life of child and caregiver and reduced life expectancy. Further, lack of medical care facilities, cultural barriers, minimal formal education and extreme poverty, worsen the condition of disabled children in developing countries (Aggarwal et.al,2015).

The findings of this review points out mealtime challenges encountered by children with CP and their caregivers which are largely reported in studies from many countries. The results suggest that caregiver training can alleviate some of the difficulties faced in relation to feeding their child

with CP, and some of the stress associated with these. However, in some studies which the intervention involved caregiver training alone, there was no significant improvement in the children's anthropometric nutritional status (Claudia et.al.2013).

Researches have shown that an improvement in nutritional status results in improvements in general health. This review shows that feeding difficulties due to motor dysfunction is common in children with CP and may reduce their dietary intake resulting to poor health and nutritional status. Caregiver burden is also a significant concern, the feeding process may require considerable time and may be associated with stress and caregiver fatigue, therefore impacting on their quality of life (Sullivan,2005).

Emphasis should be therefore placed on an early identification, treatment and correction of FD. Management of feeding problems should co-exist with timely assessment of growth among these children. Increasing awareness among caregivers/ parents, government and health care providers, regarding the needs of children with disabilities and their feeding difficulties is urgently warranted (Aggarwal et.al, 2015).

Recommendations:

Based on the study results, there is need to develop effective interventions aimed at improving the dietary intake of children with CP. Such interventions could help mitigate poor nutritional status as well as improve quality of life of children with CP and secondly parents' should be taught on ways to incorporate higher portions of vegetables and fruits in their children's diet in order to increase their fiber intakes.

REFERENCES

- Adams, M., Khan, N., Begum, S., Wirz, S., Hesketh, T., & Pring, T. (2011). *Feeding difficulties in children with cerebral palsy: low cost caregiver training in Dhaka, Bangladesh*. *Child: Care, Health and Development*, 38(6), 878–888. <https://doi.org/10.1111/j.1365-2214.2011.01327>
- Aggarwal S, Chadha R, Pathak R. Nutritional status and growth in children with cerebral palsy: a review. *International Journal of Medical Science and Public Health*. 2015;4(6):737-44
- Almuneef, A. R., Almajwal, A., Alam, I., Abulmeaty, M., Bader, B. A., Badr, M. F., Almuammar, M., & Razak, S. (2019). Malnutrition is common in children with cerebral palsy in Saudi Arabia – a cross-sectional clinical observational study. *BMC Neurology*, 19(1), 317. <https://doi.org/10.1186/s12883-019-1553-6>
- Auka, M.N., & Afedo, N.E (1985). On the job in servicing and seminar programme for the teachers of physically handicapped. Nairobi: Ministry of Education, Science & Technology

Arrowsmith F, Allen J, Gaskin K, Somerville H, Clarke S, O'Loughlin E(2010). *The effect of palsy*. Dev Med Child Neurol.;52(11):1043-7.

Bell KL, Samson-Fang L (2013). *Nutritional Management of Children With Cerebral Palsy*. Eur J Clin Nutr.; 67 Suppl 2: S13-6. 112.

[Claudia Mary Donkor](#), [Jackie Lee](#), [Natasha Lelijveld](#), [Melanie Adams](#), [Marjolein Meande Baltussen](#), [Gifty Gyamah Nyante](#), [Marko Kerac](#), [Sarah Polack](#), [MariaZuurmond](#)(2018). *Improving Nutritional Status of Children With Cerebral Palsy: A Qualitative Study of Caregiver Experiences and Community-Based Training in Ghana*

Donald KA, Kakooza AM, Wammanda RD, Mallewa M, Samia P, Babakir H, et al. Pediatric Cerebral Palsy in Africa Where Are We? Journal of Child Neurology. 2014;30(8):963-71

Fung E. B, Samson-Fang L, Stallings V. A, (2002). Feeding Dysfunction Is Associated With Poor Growth and Health Status in Children with CP. J Am Diet Assoc.; 102:361-373.

Henderson RC, Lark RK, Gurka MJ, Worley G, Fung EB, Conaway M, et al. (2002) *Bone Density and Metabolism in Children and Adolescents With Moderate to Severe Cerebral Palsy*. Pediatrics. ;110(1 Pt 1): e5.

Jahan, I.; Karim, T.; Das, M.C.; Muhit, M.; McIntyre, S.; Smithers-Sheedy, H.; Badawi, N.; Khandaker, G (2019). *Mortality in Children With Cerebral Palsy in Rural Bangladesh: a Population-Based Surveillance Study*. Dev. Med. Child Neurol. [[Google Scholar](#)] [[CrossRef](#)]

Kennedy W.M (1990). An Investigation of Current Practices in Education of the Physically Handicapped In Kenya And Their Effects On Curriculum Development, Examinations And Methods Of Teaching. Unpublished manuscript: Kenya Institute of Education at Nairobi.

Kenya National Survey for Persons with Disabilities (2008). Preliminary Report; Published by: National Coordinating Agency for Population and Development PO Box 48994 - GPO, Nairobi 00100, Kenya

Koriata N.S. (2012). Nutritional status of children with cerebral palsy attending Kenyatta National Hospital. Unpublished master's thesis.

Kuperminc MN, Gurka MJ, Bennis JA, Busby MG, Grossberg RI, Henderson RC, et al. (2010) *Anthropometric Measures: Poor Predictors of Body Fat in Children With Moderate to Severe Cerebral Palsy*. Dev Med Child Neurol.;52(9):824-30.

Pencharz P.B. (2010). Protein and energy requirements for 'optimal' catch-up growth. Eur J Clin Nutr; 6S5-S7.

Penagini, F., Mameli, C., Fabiano, V., Brunetti, D., Dilillo, D., & Zuccotti, G. V. (2015b).

Dietary Intakes and Nutritional Issues in Neurologically Impaired Children. 16.

Power, R.; King, C.; Muhit, M.; Heanoy, E.; Galea, C.; Jones, C.; Badawi, N.; Khandaker, G.

Health-related quality of life of children and adolescents with cerebral palsy in low-and middle-income countries: A systematic review. Dev. Med. Child Neurol. **2018**, *60*, 469–479. [[Google Scholar](#)] [[CrossRef](#)]

Pulgar, S., Bains, S., Gooch, J., Chambers, H., Noritz, G. H., Wright, E., Sawhney, T. G., Pyenson,

B., & Ferro, C. (2019). Prevalence, Patterns, and Cost of Care for Children with Cerebral Palsy Enrolled in Medicaid Managed Care. *Journal of Managed Care & Specialty Pharmacy*, *25*(7), 817–822. <https://doi.org/10.18553/jmcp.2019.25.7.817>

Rajikan. R, N. M. Zakaria (2017). *The Effect of Feeding Problems on The Growth of Children And Adolescents With Cerebral palsy.* Journal of Fundamental and Applied Sciences ISSN 1112-9867 Available online at <http://www.jfas.info>

Rempel, G. (2015). *The Importance of Good Nutrition in Children with Cerebral Palsy.*

Phys Med Rehabil Clin N Am, *26*, 39–56.

Schoendorfer N, Boyd R, Davies PS (2010). *Micronutrient Adequacy And Morbidity: Paucity of Information in Children With Cerebral Palsy.* *Nutr Rev.*;68(12):739-48.

Sullivan PB, Juszczac E, Bachlet A, Lambert B, Vernon-Roberts A, Grant H *et al.* (2005)

Gastrostomy tube feeding in cerebral palsy: a prospective, longitudinal study. Dev Med Child Neurol; **47**: 77–85.

NSW Ministry of Health (2017) *Management of Cerebral Palsy in Children: A Guide for Allied Health Professionals.* 73 Miller Street NORTH SYDNEY NSW 2060

Walker, J., Bell, K., Davies, P., & Boyd, R. (2012). Energy Requirements in Preschool-Age Children With Cerebral palsy. *American Journal Clinical Nutrition*, *96*, 1309–1315.

Walker JL, Bell KL, Boyd RN, Davies PS (2013). *Validation of a Modified Three-Day Weighed Food Record for Measuring Energy Intake in Preschool-Aged Children With Cerebral palsy.* *Clin Nutr.*;32(3):426-31.

WHO (2011). World Report on Disability, Geneva: World Health Organisation

Angelina Kakooza-Mwesige , James K Tumwine Ann-Christin Eliasson , Hanifa K

Namusoke , Hans Forssberg (2015). *Malnutrition is Common In Ugandan Children With Cerebral Palsy, Particularly Those Over the Age of Five and Those Who Had Neonatal Complications.* *Acta Paediatr*;104(12): 1259-68.doi: 10.1111/apa.13089.