Malnutrition and Disability: Evaluating Factors Influencing Severe Malnutrition in Children with Cerebral Palsy in Lusaka, Zambia

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Abstract The aim of this study was to identify the main risk factors associated with severe malnutrition in children with CP. An unmatched case control study was used to compare 33 children with CP presenting with severe malnutrition (WAZ ≤ -3 SD) against 66 non-malnourished CP children (WAZ ≥ -2SD) at the University Teaching Hospital in Lusaka. Risk factors for severe malnutrition in children with CP were determined with bivariate and multiple logistic regression. A p-value of < 0.05 was considered significant at 95% confidence interval. After adjusting for other variables, factors that remained statistically significant (p-value < 0.05) included the following: use of unflushed pit latrine toilet (p=0.0119); bilateral CP (p=0.0054); GMFCS level 4 or 5 (p=0.0001); history of illness in the past six months (p=0.0241); swallowing difficulties (p=0.0006); tonic bite (p=0.0011); no weight gain in the past 2 to 3 months (p=0.0001); dependent on feeding Irish potatoes (p=0.0008) and Fish (p=0.0001). The risk factors identified in the current study are related to the child’s severity and feeding difficulties including caregiver caring practices.

Keywords: Malnutrition, Disability, Cerebral palsy; Feeding Difficulties; Low- and middle-income countries

1. Research Background

Cerebral palsy (CP) is one of the most common causes of childhood disability globally with an estimated prevalence of approximately 2 per 1000 live births globally and between 2 to10 per 1000 live births in Southern Africa (Donald et al, 2014). This prevalence could be higher in Africa due to high levels of perinatal complications such as birth asphyxia and neonatal infections as well as the late presentation of symptoms and lack of early intervention services (Donald et al, 2014). Children with CP are faced with many associated disorders including oral motor dysfunctions which result in feeding difficulties (FD), speech delay, drooling, risk of aspiration, prolonged feeding times, gastroesophageal reflux and vomiting after feeds (FDs) (Aggarwal et al, 2015; Santoso et al, 2012). Feeding difficulties have been identified as one of the main factors contributing to under nutrition in children with CP (Dahlseng et al, 2012). Malnutrition in children with disabilities have many consequences which include growth failure and reduced cerebral function leading to reduced potential for growth, inactivity and irritability (Sullivan, 2013).

Assessment of nutritional status for children who have disability such as those with CP is an important aspect of management because it can provide the basis for individual treatment as well as planning of public health interventions (Lopes et al, 2013). The proposed areas for assessment of growth and nutritional status in children with neurological impairments include taking the nutrition and
feeding history, medical history, anthropometric measurements and laboratory tests (Samson & Bell, 2013). The World Health Organization (2006) has developed growth standards using anthropometric indicators namely weight-for-age, length-for-age, height-for-age, weight-for-height and Body Mass Index (BMI)-for-age. However, using anthropometric measurements in children with physical disabilities such as CP is challenging because of factors such as scoliosis, spasticity, contractures or limb length differences (Gladstone, 2010).

Risk factors for malnutrition in children with disabilities can be identified using the UNICEF conceptual framework for malnutrition, which recognizes causes of malnutrition as being at three levels namely the immediate, underlying and basic (Bellamy, 1998). Inadequate dietary intake at the individual level are mainly due to feeding difficulties resulting from poor oral motor dysfunction (Santoso et al, 2012). Underlying causes of malnutrition are dependent on the family’s socioeconomic status, feeding practices and inadequate access to health care services (Minja et al, 2015; Groce et al, 2014). These underlying causes may be due to basic causes such as political, legal and cultural factors including lack of policies for children with disabilities (Bellamy, 1998). In Low- and middle-income countries (LMIC), children below the age of five years are more susceptible to socioeconomic inequities because they depend on others for their health (Blas, 2010). However, children with disabilities in these countries are more likely to be exposed to underlying and basic causes of malnutrition than those in the general population. In a systematic review by Agarwal and colleagues (2015), it was reported that children with CP in LMIC were undernourished while the majority in High income countries were obese.

Identifying malnutrition in children with disabilities using the UNICEF conceptual framework can be used to plan for intervention and preventive measures. This may be difficult in LMIC like Zambia because there is limited or no information on children with disabilities which makes it difficult to plan for interventions (Gladstone, 2010). The aim of this study was to identify risk factors associated with severe malnutrition in children with CP. This would highlight the magnitude of malnutrition in this population so that country planning for children in the general population can also consider children with disabilities.

2. Research Methodology

2.1. Design and setting

A prospective case control design was used by comparing a group of children with CP (n = 33) who had severe malnutrition with another group of children with CP (n = 66) who did not have severe malnutrition. The purpose was to determine if certain variables or characteristics are more prevalent among those with severe malnutrition compared to those without malnutrition. This study was conducted in Lusaka, the capital city of Zambia, at the University Teaching Hospital (UTH). University Teaching Hospital is a tertiary level hospital which serves as the national referral center as well as the principal training institution for health disciplines. Children with CP and other disabilities come to UTH for a variety of services which include Physiotherapy, medical care, fitting of orthotics, multidisciplinary assessment for school enrolment and special equipment.

2.2. Population and recruitment procedures

All children with CP aged between 2-10 years, who accessed health care services (both in-patients and out-patients) at UTH during the study period which ranged from May 2017 to August 2017. Recruitment for both cases and controls were dependent on the number of children who were admitted in UTH or those who accessed out-patient services according to the days on which that particular service is offered or assigned date of follow up visit. Identification of cases and controls was done by taking anthropometric measurements using WHO guidelines for anthropometry (WHO, 2006). The procedure for collecting age, weight and length measurements were based on the WHO recommended measurement protocols (WHO, 2006). Weight-for-age indices were converted into z scores using EPI-info version 7.2.
Severe malnutrition was defined as weight-for-age z-score (WAZ) of ≤ -3 according to the WHO criteria. In order to take account of the fact that children with CP have growth patterns below those of the normal population, the controls for this study were those children with CP presenting with WAZ z-score of ≥ -2 SD of the WHO growth standards. Weight-for-age indices were used because they do not differentiate between acute or chronic malnutrition, and since children with CP have malnutrition of chronic duration, the best indices to use for anthropometric measurements are the weight-for-age indices (Gladstone et al, 2014; Karagiozoglou-Lanpoudi et al, 2014). Classification of CP was done according to the criteria of Surveillance of CP in Europe (SCPE) while severity of CP was ascertained using the Gross Motor Functional Classification System (GMFCS) (Rosenbaum et al, 2008; Cans et al, 2007).

Sample size was calculated using Epi Info version 7.2. The assumptions for sample size calculation were as follows: Odds ratio to be detected was 4; ratio of cases to controls 1:2; Confidence interval 95%; Statistical power 80%; Expected frequency of oral motor dysfunction to be at 50% for cases and 20% for controls. Using Epi Info statCalc tool, the expected sample size was 33 for cases and 66 for controls.

Included in this study were all children with CP aged between 2-10 years, who accessed health care services at UTH and presenting with WHO WAZ z-scores of ≥ -2SD for controls and z-scores of ≤ -3SD for cases. Children with CP who accessed services at UTH but not residents of Lusaka, or those presenting with other chronic illnesses such as TB, sickle cell disease or other chromosomal abnormalities were excluded. Further exclusion for controls were those with a history of severe malnutrition or being admitted to hospital in the past three (3) months.

2.3. Data collection

Data collection was carried out by the researcher using two structured data capturing tools namely a Child data collection tool and Caregiver data collection tool. The Child data collection tool was used to collect data on the child through physical examination, anthropometric measurements, child’s medical record and interviews with caregivers. Child data obtained included demographic data, obstetric history, child’s clinical profile (including type of CP and severity), anthropometric measurements and feeding patterns/problems. The Caregiver data collection tool was used to record information on caregiver and family socioeconomic characteristics through structured interviews with the caregiver.

Independent variables included various child, caregiver and family characteristics while the dependent or outcome variable was severe malnutrition (WAZ ≤ -3 SD). The data collection tools were piloted at a level one health facility within Lusaka.

2.4. Statistical analysis

Data was analysed using epi Info version 7.2. Descriptive summaries of individual variables are displayed in frequency tables. Chi-square tests were used to compare associations between categorical variables while Mann-Whitney U test was used to test for associations between the dependent variable and various continuous independent variables. The significance of the associations was determined by simple and multiple logistic regression. A p-value of < 0.05 was considered significant at 95% confidence interval.

2.5. Validity and reliability

Validity and reliability measures taken included clearly defining variables using standard measures, excluding or stratifying confounding variables as well as taking the average of two measurements. Data collection on variables such as classification and severity of CP was done using standardised measures by the principle researcher who is a Bobath NDT trained Physiotherapist.

3. Ethical consideration

Ethical approval was obtained from the Senate Research Committee of the University of the Western Cape and Excellence in Research Ethics Science (ERES) Converge in Zambia. Written permission to conduct the study at UTH was obtained from the UTH.

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management. Informed consent was obtained from mothers and caregivers of children.

4. Results and Discussion

4.1. Child and family characteristics

This study enrolled 33 cases and 66 controls at a ratio of 1 case to 2 controls. Table 1 shows the characteristics for cases and controls while Table 2 shows caregiver and family characteristics. Chi-square tests showed that most of the child characteristics and caregiver characteristics were not associated with severe malnutrition. Income earners for controls were more likely to be in formal employment than those for cases (p = 0.0252). No variables under obstetric and birth history were statistically significant as shown in table 1. Family socioeconomic characteristics were also similar except for type of toilet which had a p-value of 0.0365.

Spastic CP was the most common type for both cases and controls although more cases had spastic CP compared to controls. Cases were also more likely to be classified as having bilateral CP (quadriplegia) compared to controls and chi-square tests showed a significant association between severe malnutrition and type of CP (Chi-square= 23.5712; df= 4; p= 0.0001). Majority of cases had severe forms of CP with most of them being classified as level IV and V GMFCS compared to controls who had majority in level III GMFCS (p = 0.0001). More cases were reported to be ill in the past six months and were taking medication compared to controls as shown in table 3. Associated impairments that were statistically significant during bivariate analysis were vision (p = 0.0235) and epilepsy (p = 0.0061), but not significant in multiple logistic regression.

4.2. Feeding difficulties

Descriptive analysis for the feeding difficulties resulting from oral motor dysfunction showed that most of the cases experienced feeding difficulties compared to controls. In simple logistic regression, all feeding difficulties were statistically significant (Table 3). However, when these variables were placed in a multiple logistic regression model as shown in Table 4, only swallowing difficulties (OR = 7.9747; CI= p = 0.0006) and tonic bite (OR= 11.0462; p= 0.0011) remained statistically significant.

Complications associated with feeding difficulties such as child not gained weight in the past 2 to 3 months, breathing difficulties, totally dependent on feeding, food consistency and constipation were all statistically significant during bivariate analysis. However, in multiple logistic regression, Variables that remained statistically significant were child not gained weight in the past 2 to 3 months (p= 0.0001), totally dependent on feeding (p= 00061), taking only semi-solids or liquids (0.0231) and opening bowels after 3 or more days (0.0057) (Table 4).

Table 1. Child characteristics

| Characteristic                          | Cases N (% | Controls N (%) | p-value |
|----------------------------------------|------------|----------------|---------|
| Gender                                 |            |                |         |
| Male                                   | 19 (58.59) | 26             | 0.0868  |
| Female                                 | 14 (42.42) | (39.39)        |         |
|                                         |            | (60.61)        |         |
| Mean age                               | 60.5152    | 59.9697        |         |
| Mean WAZ                               | -4.7170    | -1.3280        | 0.0001  |
| Birth order (1st born)                 |            |                |         |
| Yes                                    | 23 (69.70) | 33             | 0.0654  |
| No                                     |            | (50.00)        |         |
| Has younger siblings                   |            |                | 0.9502  |
| Yes                                    | 11 (33.33) | 23             |         |
| No                                     | 22 (66.67) | (34.85)        |         |
|                                          |            | (65.15)        |         |
| Mother had prolonged labour            | 18 (54.55) | 23             | 0.4232  |
| Child did not cry at birth             | 21 (65.63) | 31             | 0.1719  |
|                                          |            | (50.82)        |         |
| Child currently taking medication       | 23 (69.70) | 23             | 0.0079  |
|                                          |            | (50.00)        |         |
| HIV status                             |            |                | 0.8528  |
| Positive                               | 2 (6.06)   | 6              |         |
| Negative                               | 28 (84.85) | 55             |         |
| Unknown                                | 3 (9.09)   | (83.33)        |         |
|                                          |            | (15.15)        |         |
| Associated impairments                 |            |                |         |
| Epilepsy                               | 20 (60.60) | 21             | 0.0061  |
| Speech                                 | 32 (96.97) | (31.82)        | 0.0500  |
| Vision                                 | 7 (21.21)  | 55             | 0.0237  |
| Hearing                                | 1 (3.03)   | (83.33)        | 1.0000  |
| Cognitive                              | 5 (15.15)  | 4 (6.06)       | 0.3761  |

Table 1: Child characteristics

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Table 2. Caregiver and family characteristics

| Characteristic                        | Cases n (%) | Controls n (%) | P-value |
|---------------------------------------|-------------|----------------|---------|
| Both biological parents alive         | 28 (84.85)  | 60 (90.91)     | 0.6011  |
| Child lives with biological parents   | 16 (48.48)  | 44 (66.67)     |         |
| Primary caregiver                     |             |                | 0.1425  |
| Biological mother                     | 27 (81.82)  | 47 (71.21)     |         |
| Grandmother                           | 3 (9.09)    | 6 (9.09)       |         |
| Aunt                                  | 2 (6.06)    | (9.09)         |         |
| Other                                 | 1 (3.03)    | 3 (4.55)       |         |
|                                       |             | 10 (15.15)     |         |
| Caregiver age range                   |             |                | 0.6608  |
| 15-24                                 | 9 (27.27)   | 13 (19.70)     |         |
| 25-34                                 | (27.27)     | (19.70)        |         |
| 35-44                                 | 15 (45.45)  | 27 (40.91)     |         |
| 45 years and above                    | 6 (18.18)   | 17 (25.76)     |         |
|                                       | (18.18)     | (25.76)        |         |
|                                       | 3 (9.09)    | 9 (13.64)      |         |

4.3. Caregiver feeding practices

Caregiver feeding practices that were significantly associated with severe malnutrition at bivariate analysis were child being fed by mother on a regular basis (p=0.0024), child being fed for 3 times or less per day (p=0.0013) and caregiver being concerned with the child’s feeding difficulties (p=0.0005) (Table 3). Having stressful meals was not statistically significant under this category (p= 0.5817). In multiple logistic regression, child fed ≤ 3 times/day and caregiver concerned about child’s feeding remained significant with p-values of 0.0025 and 0.0076 respectively.

4.4. Types of food given to child

Foods that were given to the children were categorised into groups such as cereals, vegetables, meat/poultry/fish, fruits and dairy products. At bivariate analysis, all vegetables, bread, rice, beef, chicken, fish, mangoes and yogurt were statistically significant as foods less likely to be eaten by cases. However, cases were more likely to be fed on soups for both vegetables and meat/poultry products as shown in Table 3. When all the foods were placed in a multiple logistic regression model, the only foods that remained statistically significant were Irish potatoes (p= 0.0008) and Fish (p= 0.0001) as shown in table 4.

Table 3. Bivariate analysis of factors associated with severe malnutrition

| Characteristic                        | Cases n (%) | Controls n (%) | Crude Odds ratio (95% CI) | P-value |
|---------------------------------------|-------------|----------------|----------------------------|---------|
| **Child characteristics**             |             |                |                            |         |
| Bilateral spastic CP                  | 16 (48.49)  | 8 (12.12)      | 8.7499 (3.35-22.86)       | 0.0001  |
| GMFCS 4 or 5                          | 31 (93.94)  | 27 (40.91)     | 22.3734 (4.94-101.41)     | 0.0001  |
| History of illness in the past 6 months | 15 (53.13)  | 49 (75.38)     | 22.3734 (4.94-101.41)     | 0.0271  |
| Totally dependent on feeding          | 32 (96.97)  | 30 (45.45)     | 2.7022 (1.10-6.61)        | 0.0003  |
| Constipation                          | 20 (60.67)  | 6 (9.09)       | 38.3974 (4.95-297.80)     | 0.0001  |
|                                       |             |                | 15.3845 (5.16-45.84)      |         |

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| Characteristic                          | Cases n (%) | Controls n (%) | Crude Odds ratio (95% CI) | P-value |
|----------------------------------------|-------------|----------------|----------------------------|---------|
| Chewing                                | 27 (81.82)  | 27 (40.91)     | 6.5000 (2.36-17.86)       | 0.0003  |
| Swallowing                             | 18 (54.55)  | 6 (9.09)       | 17.86                      | 0.0001  |
| Vomiting                               | 11 (33.33)  | 5 (7.58)       | 12.0000 (4.06-36.46)      | 0.0023  |
| Chocking/coughing                      | 18 (54.55)  | 15 (22.73)     | 35.46                      | 0.0021  |
| Problems opening mouth                 | 5 (15.15)   | 2 (3.03)       | 6.1000 (1.90-19.67)       | 0.0445  |
| Tonic bite                             | 15 (45.45)  | 3 (4.55)       | 19.54                      | 0.0001  |
| Tongue thrust                          | 13 (39.39)  | 7 (10.61)      | 4.0754 (1.67-9.97)        | 0.0015  |
| Totally dependent on feeding           | 32 (96.97)  | 30 (45.45)     | 5.6997 (1.04-29.84)       | 0.0003  |
| Feeds only on semi-solids or liquids   | 22 (66.67)  | 18 (54.55)     | 31.14                      | 0.0003  |
| Feeding for more than 30 minutes       | 20 (60.67)  | 6 (9.09)       | 17.467 (4.55-67.07)       | 0.0001  |
| Constipation                           | 8 (24.24)   | 62 (93.94)     | 67.07                      | 0.0271  |
| Child has gained weight in past 2-3 months |            |                |                            |         |
| Family socioeconomic characteristics   |             |                |                            |         |
| Income earner in formal employment     | 11 (33.33)  | 32 (49.23)     | 0.5313 (0.53-0.22)        | 0.1542  |
| Family use of flush toilet             | 9 (27.27)   | 36 (54.54)     | 0.3125 (0.13-0.78)        | 0.119   |
| Feeding practices                      |             |                |                            |         |
| Child regularly fed by mother          | 25 (78.13)  | 28 (42.42)     | 4.2410 (1.67-10.79)       | 0.0024  |
| Child fed ≤ 3 times                    | 16 (48.48)  | 11 (16.67)     | 4.6986 (1.83-12.04)       | 0.0013  |
| Caregiver concerned about child’s feeding | 28 (84.85) | 29 (45.31)     | 6.7557 (2.32-19.72)       | 0.0005  |
| Type of food given to child            |             |                |                            |         |
| Bread                                  | 9 (27.27)   | 47 (71.21)     | 0.1516 (0.06-0.46)        | 0.0001  |
| Rice                                   | 12 (36.36)  | 48 (72.73)     | 0.36                        | 0.0007  |
| Beef                                   | 14 (42.42)  | 54 (81.82)     | 0.2143 (0.08-0.56)        | 0.0001  |
| Chicken                                | 15 (45.45)  | 54 (81.82)     | 0.52                        | 0.0004  |
| Soup for meat/poultry                  | 18 (54.54)  | 8 (12.12)      | 0.1637 (0.07-0.33)        | 0.0010  |
| Soup for vegetables                    | 12 (36.36)  | 3 (4.54)       | 0.42                        | 0.0001  |
| Irish potatoes                         | 17 (51.52)  | 60 (90.91)     | 0.1852 (0.07-0.47)        | 0.0001  |
| Pumpkin leaves                         | 11 (33.33)  | 51 (77.27)     | 0.47                        | 0.0001  |
| Fish                                   | 8 (24.24)   | 51 (77.27)     | 9.4117 (3.19-27.77)        | 0.0001  |
| Mangoes                                | 1 (6.06)    | 20 (30.30)     | 27.77                      | 0.0141  |
| Yogart                                 | 14 (42.42)  | 43 (65.15)     | 6.9714 (2.20-22.13)       | 0.0331  |
4. Discussion

Findings from the current study have shown that the risk factors for severe malnutrition among children with CP are similar to what has been reported in literature for both LMIC countries and High-income countries. Furthermore, the findings are consistent with the UNICEF conceptual framework for causes of malnutrition. Variables that remained significant in multivariate analysis were identified as risk factors for severe malnutrition in this study. These risk factors are discussed in the context of the UNICEF conceptual framework for malnutrition which classifies causes of malnutrition at three levels namely, the Immediate, Underlying and Basic (Bellamy, 1998).

Table 4. Variables that remained statistically significant in multivariate analysis

| Characteristic                        | Cases n (%) | Controls n (%) | Crude Odds ratio (95% CI) | P-value |
|---------------------------------------|-------------|----------------|---------------------------|---------|
| Bilateral spastic CP                  |             |                |                           |         |
| GMFCS 4 or 5                          |             |                |                           |         |
| History of illness in the past 6 months |             |                |                           |         |
| Child has gained weight in past 2 to 3 months |             |                |                           |         |
| Swallowing difficulties               |             |                |                           |         |
| Tonic bite                            |             |                |                           |         |
| Totally dependent on feeding          |             |                |                           |         |
| Feeding for more than 30 minutes      |             |                |                           |         |
| Feeds only on semi-solids or liquids  |             |                |                           |         |
| Constipation                          |             |                |                           |         |
| Child fed ≤ 3 times/day               |             |                |                           |         |
| Caregiver concerned about child’s feeding |         |                |                           |         |
| Use of flush toilet                   |             |                |                           |         |
| Irish potatoes                        |             |                |                           |         |
| Fish                                  |             |                |                           |         |

Factors that were significantly associated with severe malnutrition at the immediate level included CP spastic quadriplegia (bilateral CP), GMFCS level 4 and 5, history of illness in the past 6 months, swallowing difficulties, tonic bite, only able to feed on semi-solids or liquids, lack of weight gain in the past 2-3 months, longer feeding time (more than 30 minutes), totally dependent on feeding and Constipation (opening bowels after 3 or more days).

Bilateral spastic CP, which is associated with severe forms of CP, has been reported in other studies as a major risk factor for poor growth and malnutrition in children with CP (Karagiozoglu-Lanpoudi et al, 2012; Kamala et al, 2014). The strong association between severe malnutrition and GMFCS level 4 and 5 is consistent with findings from previous studies in both LMIC and High-income countries (Johnson et al, 2017; Herrera-Anaya et al, 2016; Diwan & Diwan, 2013; Dahlseng et al, 2012). In a study that was done in Botswana to identify risk factors for malnutrition in children with CP, Johnson and colleagues (Johnson et al, 2017) reported that children with CP with GMFCS level 4 and 5 were more likely to have malnutrition, a finding that was statistically significant at both unadjusted (OR= 13.8, 95% CI= 3.8-50.1, p= 0.001) and adjusted analysis (OR= 3.8, 95% CI= 1.5-9.6, p= 0.006). GMFCS which is a standardized system to measure severity of movement in children with CP has been reported to be a predictor of survival among these children, with those in level 5 having a significantly poorer survival at both bivariate and multiple logistic regression analysis (Touyama et al, 2013).

History of illness in the past 6 months which was significantly associated with severe malnutrition in this study could be associated with frequency of chest infections in children with severe forms of CP. Most children with CP who present with feeding and swallowing problems (dysphagia) are often at risk of aspiration with consequent pulmonary complications (Arvedson, 2013). Ill health or
infection leads to loss of appetite and increases the body’s nutrient requirements while poor or inadequate dietary intake makes the body more susceptible to infection or ill health (Pridmore, 2009), thus leading to a vicious malnutrition cycle (Katona & Katona, 2008).

Among the many feeding difficulties that were significant at bivariate analysis, only swallowing difficulties and tonic bite remained statistically significant at multivariate analysis with p-values of 0.0006 and 0.0011 respectively. Swallowing problems have been reported in other studies to be associated with severe forms of CP and lower z-scores for all anthropometric parameters (Herrera-Anaya et al, 2016). Abnormal tonic bite or bite reflex is one of the abnormal oral motor reflexes that contributes to oral motor dysfunction in most children with CP (Dadger & Lira, 2016).

With regards to consistency of food, cases were more likely to be fed on semi-solids and liquids while controls were fed on semi-solids and solid foods. Similarly, in a study that was done in Australia to examine the association between parent reported ability of CP children to manage food textures and gross motor functional abilities, it was reported that children with GMFCS level 4 or 5 were significantly less likely to be able to manage a range of food textures than those in level 1 regardless of age (Wier et al, 2013).

Another complication of feeding difficulties is lack of weight gain. Majority of cases in the current study (75.76%) had not gained weight in the last 2 to 3 months compared to 6.06% for controls. Lack of weight gain for over 2 to 3 months could be a sign of inadequate dietary intake at the individual level and is mainly due to feeding difficulties (Arvedson, 2013). Length of feeding time was also significantly associated with severe malnutrition in this study. Longer feeding times have been reported in many other studies and is said to be associated with severe types of CP (Melunovic et al, 2017; Ghayas et al, 2014; Diwan & Diwan, 2013).

Another immediate cause of severe malnutrition in the current study was constipation, which was significantly associated with severe malnutrition at both bivariate (p= 0.0001) and multivariate analysis (= 0.0057). This finding is consistent with findings from other studies which reported constipation to be associated with severe GMFCS (Usman, 2017; Herrera et al, 2016; Kamala et al, 2014). Constipation, a common characteristic in CP presenting with severe GMFCS levels is said to be due to low body mobility and difficult in fluid intake resulting from dysphagia and rigidity of abdominal muscles (Lopes et al, 2013).

Underlying factors according to the UNICEF conceptual framework for malnutrition are dependent on the family’s socioeconomic status and caring practice. In the current study, underlying factors that were significantly associated with severe malnutrition at multivariate analysis included caregiver feeding the child for only 3 times or less per day, child not likely to be fed Irish potatoes and Fish, caregiver concerned about the child’s feeding problems and use of unflushed pit latrine. Feeding practices such as low frequency of feeding and type of food given to the child were strongly associated with severe malnutrition in this study. Feeding for less or equal to 3 times per day was significantly associated with severe malnutrition at both unadjusted (p=0.0013) and adjusted analysis (p=0.0025). Contrary to findings from this study, Low frequency of meals per day was not associated with undernutrition in a study that was done in Saudi Arabia despite the majority of them having three main meals/day (Al Hammad, 2015). This was attributed to dietary practices that included well balanced diets for main meals as well as in-between meals consisting of assorted snacks. The low frequency of feeding times among cases in the current study could be due to individual feeding problems experienced by the child as well as low socioeconomic status of the family which makes it difficult for the caregiver to give variety of foods to the child. Low socioeconomic status among caregivers for cases in the current study, which was indicated by use of unflushed pit latrine, is evidence of underlying determinants of malnutrition. Low family socioeconomic status has been reported by other authors to be associated with malnutrition. In a study that compared the anthropometric indices between children with CP and normal children in Nigeria, it was reported that there was a significant association between malnutrition and socioeconomic status (Okeke & Ojinnaka, 2010).
With regards to type of food that was given to the child, cases were less likely to be fed on Irish potatoes and Fish, but more likely to be given only soups of vegetables and meat/poultry instead of the actual foods. This was possibly because caregivers did not prepare special meals for the children such as blending or mashing. According to Marques and Sa (Marques JM, 2016), there is usually monotony in the way parents of children with CP cook and feed their children because they have to choose food that is easier to cook and with the same consistency which the child would be able to eat.

When caregivers were asked if they were concerned about the child’s feeding pattern, caregivers for cases were more likely to be concerned compared to those for controls. This is consistent with Marques and Sa who observed that feeding difficulties in children with CP such as chewing and swallowing can cause major anxieties among parents (Marques JM, 2016).

Basic causes of malnutrition constitute the social determinants of health which in turn are related to the way society is organised in relation to distribution of resources (WHO, 2008). Underlying causes of malnutrition are due to basic causes of malnutrition. For example, the caregivers’ lack of knowledge and poor feeding practices could be attributed to lack of access to appropriate services such as Speech and Language Pathologists who are experts in managing children with feeding difficulties. Findings from the current study are also consistent with literature which shows that caregivers of children with disabilities in developing countries take care of their children under difficult socioeconomic conditions such as poverty and lack of access to health care and assistive equipment (Geere et al, 2013).

5. Conclusion

The current study has highlighted the important aspects concerning risk factors that are associated with severe malnutrition in children with disabilities in LMIC. This study has shown that the risk factors for severe malnutrition among children with CP are more related to severity of CP and caring practices, which is consistent with what previous studies have reported. Caregiver interventions such as training them in low cost techniques of feeding and positioning the child have revealed positive results in countries where they have been implemented. Furthermore child care practices should be explored and where possible support for caregivers to relieve the burden of care could be considered including provision of High Energy Protein Supplements and gastrostomy feeding. In a country like Zambia where there are no speech and language therapists, Physical therapists who are the major rehabilitation specialists attending to children with CP should be empowered with knowledge on how to assess and manage nutrition and feeding difficulties for these children.

6. Study limitations

The most probable limitation was recall bias among caregivers as the study did not take into considerations the measurement of actual dietary intake and therefore the researcher only relied on the information given by caregivers concerning the types of food they gave to the children.

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