Assessment of nutritional status for Sudanese children with cerebral Palsy in two rehabilitation centers in Khartoum state, Sudan

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Abstract

The prevalence of cerebral palsy (CP) among Sudanese children is increasing, and there is scarcity in studies concerning CP in Sudan. The aim of the present study was to assess the nutritional status for children with CP. About 70children (Male and Female) diagnosed with CP were selected randomly from Cheshire Home and Ousratna centers in Khartoum state. Consents were obtained from the parents of the children to participate in the study. Data were collected from the children by interviewing their parents using pre-tested questionnaire: containing demographic, socioeconomic, dietary habits, dietary intake, health data and anthropometric measurements. Data were analyzed using SPSS program and the results displayed on tables, the results show that, (47.1%) of them have Jaundice, meningitis and fever due to maternal or neonatal health problems. (37.1%) of them have CP due to lack of oxygen during birth,(15.7%)of the children have CP due to accidents. The participants divided in to two groups the age of : Group(1) ranged from 6 months to 5 years and their body mass index(BMI) can be classified as underweight (70%),normal 23.3%, underweight,(3.3%) overweight and (3.3%) were obese. The age of Group (2) ranged between 6years to 10 years and BMI can be classified as underweight 90% and normal weight(10%). As a conclusion poor nutrition status is common in children with cerebral palsy and rehabilitation and therapeutic centers are very important to analyze the risk of under nutrition Children suffering from CP have feeding difficulties, they need high energy and protein rich foods in addition to sufficient micronutrients to satisfy their nutritional needs.

Keywords: Cerebral palsy, feeding difficulties, Jaundice, meningitis, micronutrients deficiency.

1. Introduction

Disability is any impairment of the body or mind that makes it more difficult to work and the person with this condition cannot be able to do certain activities (activity limitation) and interact with the world around (participation reactions (Okoro *etal.,* 2019). About 10% of the global population has some form of disability; the disorders are associated with a number of other disorders including nutritional deficiencies and growth deviations (Almajwal and Alam, 2019).Few countries provide adequate quality services for people with disability, and very few countries collect data to enable disaggregation by disability in the health sectors this become very apparent during the covid-19 pandemic where countries failed to include disability consistently in their response to control the pandemic, these people specially children exposed to increase risks with devastating consequences because they were already had very poor health, There are many forms of disabilities, such as physical, sensory (Deafness and blindness), intellectual, mental and health impairment (Sandowska *etal.,*2020).

Cerebral palsy(CP):Is a group of disorders that affect person ability to maintain balance and posture, that result from an insult to or anomaly of the immature central nervous system. Cerebral palsy (CP) is a group of permanent disorders of the development of movement and posture, causing activity limitations that are attributed

to non-progressive disturbances that occur in the developing fetus or infant brain(Sandowska *et. al.,*2020).Cerebral palsy is one of the most common causes of disability, children with CP and their families have special requirements depending on what part of their body CP affects. Some may need assistance to move around, while others may need hearing and speaking aids. Many with more severe impairment may require an assistant to help them through the day. World Cerebral Day (2022) is an attempt to bring multi-sectoral organizations which can help to create innovative solutions for real life and daily problem faced by those with CP(Wicklund,2022). Abdullahi *et. al.,* (2013) reviewed two Sudanese studies investigated 222 Children and found that 69.4% of the children have spastic CP, whereas the other cross-sectional based study in Sudan investigated 65 children with CP who have complications e.g. feeding problems.

CP is usually classified using clinical description of the type of muscle tone, body distribution and severity of the motor impairment. In Europe, the classification which divides CP into spastic, dyskintetic or ataxic forms. The first form being the most common type, with typical signs and symptoms of CP. Children with spastic CP have low muscle tone, slow to reach, (feel floppy when picked up), difficulty with fine motor tasks such as (writing or using scissors), walking with abnormal gait with one foot or legs dragging, involuntary movements and excessive drooling (Sandowska *et. al.*, 2020)

Center for Disease Control (CDC) growth chart is an accurate measurement for the assessment of stature and weight, in addition to the Body Mass Index (BMI) which is needed to determine the appropriate weight for specific height and the ideal body weight for children. Disability specific growth charts are available to assess typical growth of various syndromes (Areum *et. al.*,2021).

There are several studies about the nutrition assessment for children with cerebral palsy (CP), but all these studies were done around the world, but not in Sudan. There is no available data from the Sudan reflecting the magnitude of CP as neurological disorders and disabilities in toddler age group. No research was carried out on the nutrition assessment for children with CP at this age (Sage, 2016). The aim of this study was to assess the nutrition status for children with CP under 10 years old, including, determining nutrients intake and anthropometric measurements.

2. Methodology

2.1. Study area, design and sample size

This study carried during the period from November 2020 to May 2021. To investigate the nutritional status of children under10 years who were diagnosed with CP. The participants were selected from two centers in Khartoum State. The Darshashar, Altaif center(Khartoum City) and Ousratna center for disability and development (Omdurman City). A cross-sectional study design based on these centers settings was used. From the total population 70 patients with CP were selected by convenient method which include only the patients diagnosed with CP.

2.2. Primary data collection

Data were collected by direct interviewing the parents of the patients via Questionnaire containing demographic data which include gender, number of household and area of residence, socioeconomic and health data that include level of income, level of education, mother age and parent's relatives and dietary habits of the patients with cerebral palsy.

2.3. Anthropometric measurements

The anthropometric data were collected by using BMI for age as a documented method to identify the nutrition status of the child. By using UNISCALE balance in kilograms which designed to allow a mother to hold the child and also to enable the child to stand alone. Measuring height by using locally constructed board calibrated in centimeters (used by federal ministry of health) with a fixed head rest and a movable foot board. Specific growth chart for children with CP was used to identify the degree of malnutrition. The classification of BMI for children with CP was recorded according to specific growth chart (Developmental Medicine and Child Neurology 2006).
As follows:
<13.5 kg/m^2 =under weight

14-15.5 kg/m^2 =normal weight
16-19.5 kg/m^2 =over weight
>20 kg/m^2=obese

2.4. Dietary intake

Food frequency questionnaire to record habitual food items consumption per week and24 hour recall used to record dietary intake in three successive days. Food processer software program (ESHA,2000) was used to determine the nutrients intake according to the data obtained every day.

2.5. Secondary data

Secondary data were collected from books, articles and documented websites.

2.6. Statistical analysis

The data were analyzed statistically using SPSS program version (2011) and the results were presented in tables and forms of frequencies and percentages for descriptive data and means and ranges for numerical data, person's correlation test was carried out to determine significant correlations between the variables of the study.

2.7. Ethical considerations

Consents from the centers were obtained after addressing them by letters from Ahfad University for Women. Written consents from the parents were obtained prior to the study. Letters of approval were obtaining for the centers as permission to carry on the research after receiving the letter from Ahfad university for women(AUW) Khartoum state.

3. Results and discussion

3.1. Demographic data of the respondents

As shown in Table(1), males were more than females (57.1 and 42.9% respectively).The majority of the respondents (67.1%) age ranged between(1-5 years), 32.9% of them aged between (6-10 years), Children under five years are the most affected because they are vulnerable, they are more susceptible to many diseases specially under nourished and there is strong relation between CP and underweight (Jose et. al.,2020).

Also in Table (1), 82.9% of the family size between (3-5) members, 12.9% of them ranged between (6-8), 4.3% of them ranged between (9-11) members, whereas the majority of the respondents (82.9%) have normal family size, the availability of food in the family is definitely affected by the family size. The highest percentage of the respondents(57.1%) were from urban areas.

People in the urban areas have good accessibility to health services, especially CP patients need specialize health care. Jayl et. al., (2012) reported that there is strong positive correlation (0.01 level) between residence of the family and parents visits (P value 0.000). The study showed that people live near the health services are able to continue and follow up for their CP children.

Socioeconomic data of the respondents

The data in Table(1) showed that, 42.9% of the respondents are from low income families. Almost half of Sudanese population live under poverty line. Studies in Taiwan showed that low family income was associated with higher risk of CP (Sung-Hui Tseng, 2017). This study showed that family income is strongly correlated with the cause of CP (0.729^{**}) (P value 0.000), Jinu(2018) reported that, poor families or families with low income are more exposed to the disease, therefore, most causes of CP are related to maternal or neonatal health problems or complications during delivery. Low income mothers were not able to make regular follow up because they cannot afford the visit to the health center.

The majority (88.6%) of the mothers in this study are literate. Literate mothers can handle their CP children more efficiently than illiterate mothers, because literacy help them respond easily with the environment within the

health facility. The majority (91.4%) of the fathers are literate, as well. In the present study 94.3% of mothers got married before 35 years old, but studies showed mother age is not an important factor of having a baby with CP because there are many other factors that increase risk of CP disease (Sara et. al., 2020).
Table (1) showed that 62.9 % of parents are genetically related, whereas 37.1% of them were not relatives. The results agree with Sara (2020)in the genetic study of cerebral palsy, where relatives are one of the most important factor of becoming CP child, also there is indication that genetic factors are associated with CP disease. (Sara et. al., 2020)

3.2. Health data

Table (2) shows that, highest percent (62.9 %) of the mothers delivered CP child at age between (26-40 years), Sudanese study shows that mother age is not important factor in delivering CP child. Literature reports showed that 87% of the mothers delivered CP child at the age between (21-36) years old (Gamar, 2013).
The results shows that, 57.1% of children where vaginally delivered, 42.9 % of them by cesarean section, because of low health services in the country. Studies shows that, lack of health services in the country may increase the risk of CP. Traditional ways of delivery may increase the risk and this is a challenge for youngsters born with CP (Solanke and Colver, 2018).

Table (2) shows that, 58.6% of children were diagnosed during the first year of life, 7.1% of were diagnosed in the second year of birth and 3% in the third year. Kristin (2021) indicated that high percentage of the children diagnosed in early stage of life, because the diagnosis of CP is generally carried out between 18 months to 5 years of age by testing motor skills and reflexes of the child. In addition to looking into the medical history and by employing a variety of specialized tests. Parents and caregivers are usually the first to notice abnormalities in the child development.

In this study, 90% of the interviewed families had only one child with CP, whereas the remaining has more than one child with CP. Indeed, caring for CP children lay a heavy burden on the family, especially when there is more than one CP child. As shown in Table (2), 85.7% of the parents were aware about their child nutritional needs, but14.3% had no such knowledge. Having such knowledge helps to manage CP symptoms and complications. Parents make monthly follow up with a CP child in the centers, 62.9% of the respondents performed follow up visits, while 37.1%did not have regular follow up, because they were living far away from centers or outside of Khartoum state. Continuing follow up is needed to avoid complications that may occur due to CP. As show in Table (2), 87.1% of CP children receive systematic parental support in their daily lives, where 12.9% did not have the required support. The parental close support is a complementary part to control the severity of the disease and its complications. Referring to Table (2),47.1% of the cases of children with CP have jaundice, seizure, meningitis as the results of the maternal or newborn health problems. In some cases, 37.1% of these symptoms are due to lack of oxygen during birth (hypoxia) and 15.7% due to accidental reasons such as drowning and burning. Accidental brain injury in the early year of life of the child could cause permanent brain injury, which lead to permanent physical and developmental disability(Kim, 2022).Maternal and newborn complications can increase the risk of CP as shown in this study. Other studies showed that severe jaundice can cause condition called kernicterus (is a type of brain damage) that can result from high level of billirubin in a baby blood and consequently can cause CP, hearing loss, vision problems and teeth problems. Early detection and management of jaundice can prevent kernicterus (Tomas et. al., 2019).

Table (1) Socioeconomic data of the respondents

Gender	Frequency	Percent
Male	40	57.1
Female	30	42.9
Total	70	100
Age/year		
< 1	4	5.7
1-2	13	18.6
3-5	30	42.9
6-10	23	32.9
Total	70	100
Number of family size		
3-5	58	82.9
6-8	9	12.9
9-11	3	4.3
Total	70	100
Area of residence		
Urban	40	57.1
Rural	30	42.9
Total	70	100
Level of income in SDG		
High (>100,000)	13	18.6
Medium (30,000-100,000)	27	38.6
Low (<30,000)	30	42.9
Total	70	100
Mothers educational level		
Illiterate	8	11.4
Primary	21	30
Secondary	16	22.9
University	22	31.4
Other	3	4.3
Total	70	100
Fathers educational level		
Illiterate	6	8.6
Primary	20	28.5
Secondary	17	24.3
University	21	30
Other	6	8.6
Total	70	100
Mothers age when got married		
Below 35	66	94.3
Above 35	4	5.7
Total	70	100
parents kinship as relatives		
Yes	44	62.9
No	26	37.1
Total	70	100

Table (2). Health data

Mother's age when gave birth to CP child	Frequency	Percent
20-25	23	32.8
26-40	44	62.9
Above 40	3	4.3
Total	70	100
Type of delivery		
Normal vaginal delivery	40	57.1
Cesarean section	30	42.9
Total	70	100
Age of diagnosing the child with CP		
At birth	41	58.6
First year	22	31.3
Second year	5	7.1
Third year	2	3
More than third year	0	0
Total	70	100
Presence of other CP children in the family		
Yes	7	10
No	63	90
Total	70	100
Consultation of physician and nutritionist regarding the dietary intake	Frequency	Percent
Yes	60	85.7
No	10	14.3
Total	70	100
Parents visits for follow up		
Yes	44	62.9
No	26	37.1
Total	70	100
Child helping by the family		
Yes	61	87.1
No	9	12.9
Total	70	100
Causes of CP		
Maternal/ neonatal health problem	33	47.1
Accident	11	15.7
Complications of delivery	26	37.1
Total	70	100

3.3. Classification of the respondents according to CP growth chart

Table(3) shows the classification of the patients according to CP growth chart: (Marc and Putterson 2006). This Table is divided into two groups according to the patient's age i.e from 6months old to 5 years and from 6 years to 10 years. The majority of the patients were 70% and 70.6% male and female, respectively, and were underweight. The other group from (6 to 10 years) were 90% male and 84.6% female were underweight. This study show that, CP patients are usually underweight because they have feeding difficulties i.e maldigestion and malabsorbtion, although low percentage of the patients, have normal or ideal body weight, but low percentage of them are overweight or obese.

Children with CP have impaired growth and nutritional standing. Study shows that more than half (56.4%) of the children with CP were undernourished as they had z-score <-2SD thinness (50%) was the most common, which is followed by underweight, stunting and wasting El (Mouzan et. al., 2010)

Table (3): Classification of children according to their body mass index:-

Group (1) Children from (6 months to 5 years):-						
Sex	Total number	Under Weight	Normal weight	Ideal body weight	Over Weight	Obese
Male	30	21	7	0	1	1
Percent%)		70	23.3	0	3.3	3.3
Female	17	12	3	1	1	0
Percent (%)		70.6	17.6	5.9	5.9	0
Group (2) Children from (6 years to 10 years):-						
Sex	Total number	Under Weight	Normal weight	Ideal body weight	Over weight	Obese
Male	10	9	1	0	0	0
Percent(%)		90	10	0	0	0
Female	13	11	2	0	0	0
Percent(%)		84.6	15.4	0	0	0

Classification according to specific growth chart for children with CP source: (Marc and Putterson -Developmental medicine and child neurology, 2006).

3.4. Nutrients intake of the respondents

As show in Table (4), children with CP age between (6 months to 5 years) have low calories intake. Gastroesphageal reflex is common in children under 5 years, they need high calorie diet even high caloric baby formula may also be needed with high nutritional value. Semisolid foods in addition to the formula should be introduced to this group because of poor appetite to provide adequate energy (Renee 2020). Children with CP have frequent feeding difficulties, therefore they need high energy diet (Douglas and Huxham, 2015).Protein requirements during rapid growth is needed in higher amounts per kilogram body weight compared with adults, so that to promote rapid growth. The correlations of this study showed that BMI of the child is medium correlated at (0.05 level) with protein intake (P value 0.031). Another study shows there is association between CP children and low BMI and the level of their protein intake, because proteins promote tissue replacement and increase weight of the child. Fat intake of this group of children should be low for the children with CP because of their low mobility due to their weak motor function. Low micronutrients serum concentration is common for children with CP and feeding support is important to assist children to correct growth impairments. Micronutrients should be prescribed to meet 100% of recommended dietary intake (RDI) of vitamins and minerals(Douglas and Huxham, 2015).

As shown in Table 4, children have low level of vitamin A, due to low muscles contraction of the eyes and this may lead to serious vision problem in the future(Rumbold et al.,2015). Vitamin D level is also low, which is important for children with CP mainly for bone development and immune function. Vitamin C level is normal among children with CP age between (6 months to 5 years)as reported by Rumbold et al.,(2015), who stated that, vitamin C supplementations may help to reduce risk of pregnancy complications such as pre-eclampsia, intrauterine growth restriction and maternal anemia. It may also help in brain development of the child.Electrolytes concentration provided for this group were high because the rate of saliva flow among children with CP is high.

Table (4): Nutrients intake of (6 month to 5 years) children

No	Nutrients	Mean	Range	RDA (mean)
	Basic components			
1	Calories	900	137-1185	1375
2	Proteins (g)	31.1	4-62	5.2
3	Carbohydrates(g)	48	5.7-162	127.5
4	Fat-total (g)	23.8	4.3- 46.8	68.5
	Vitamins			
5	Vitamin A (RE)	46.1	2.5-68.8	300-400
6	Vitamin B1(mg)	0.5	0.1-0.85	0.2-0.5
7	Vitamin B2 (mg)	1.8	0.3-55	0.3-0.6
8	Vitamin B3 (mg)	1.9	0.8-28.4	2-7
9	Vitamin B6 (mg)	0.5	0.07-1.4	0.5-0.6
10	Vitamin B9 (mcg)	128.4	6.2-216.9	65-400
11	Vitamin B12 (mcg)	1.4	0.4-2.8	0.4-1.2
12	Vitamin D (IU)	10.8	0.3-412.5	1500-3500
13	Vitamin C (mg)	22.7	1.2-195	10-22
	Minerals			
14	Calcium (mg)	410.8	33.8-735.4	8.5-10.3
15	Iron (mg)	4.6	0.06-8.8	50-120
16	Magnesium (mg)	89.6	0.9-175.7	1.4-1.7
17	Phosphorus (mg)	476.8	137-779.7	4.0-7.0
18	Potassium (mg)	951.07	234-1516	3.4-7.4
19	Selenium (mcg)	39.6	2.6-68.7	1-1.5
20	Sodium (mg)	745.8	102.9-1215.5	135-145
21	Zinc (mg)	3.7	0.5-7.1	3-5

RDA: Recommended Dietary Allowance

As show in Table (5), children from 6 to 10 years old have prolonged feeding disorders and may present inadequate growth, therefore, appropriate oral feeding is needed to achieve catch up growth. As shown in Table 5, children with CP have low intake of calories and fat because they were not consuming adequate level of nutrients and hence the risk of developing deficiencies is seeming. Severe weight loss is common problem in children with CP, so adequate calorie intake is needed in accordance with the type and severity of the disease. Protein is required according to actual body weight and height, mainly for tissue replacement. Those children always consume protein formulas due to severe weight loss. Even if they prefer to take protein rich foods such as milk and milk products. Essential vitamins and minerals deficiency is a problem for children with CP, as shown in Table 5 which is below children from 6 to 10 years old and obvious in their low intake of vitamin A. Most of these kids may have a vision problem due to poor contract muscles of the eyes. Also, the children have low intake of vitamin B6 rich foods, Abuzeinah and Desancho (2020) reported that vitamin B6 is important to deal with CP, because children with low vitamin B6 are more susceptible to sideroblastic anemia (pyridoxine responsive anemia).

As show in the Table (5) the intake of vitamin D is low, as well, normal level of vitamin D is needed to promote bone development and normal immune system. Decreased serum vitamin D level is another major deficiency noted for these children. Inadequate exposure to sunlight and unticonvulsant medications along with decreased food intake contribute to this. Kerala (2017) described the decrease in bone mineral density cause muscular weakness, development of contractures, functional impairment and physiological fractures .

Also vitamin C intake of this group is low and need vitamin C rich foods and or vitamin C supplements, since vitamin C is important for immune system because it protects against infections. These children have iron deficiency due to low intake of iron rich foods and supplements. So, they need iron supplementations to prevent iron deficiency

anemia. Attia etal., (2019)recorded that there is a relation between serum iron level and muscles strength, lower motor function which is related to iron deficiency.

The present study showed that sodium, potassium, calcium, phosphorus and magnesium concentrations were high among children with CP in both groups with different ages (Table 4 and 5),where the rate of saliva flow among CP children is high. Neonatal magnesium sulfate is prescribed currently in children with CP at < 28 weeks gestation(Aruem et al.2021).

A study showed a comparison of electrolytes concentration among saliva children with CP and found electrolytes levels were highly concentrated among them, whereas children with CP have always electrolytes imbalance (Mohammed etal.,2020).

Table(5): Nutrients intake of (6 years to 10 years) children

No	Nutrients	Mean	Range	RDA (mean)
	Basic components			
1	Calories	1030	177-2819	1700
2	Proteins (g)	75.3	6-84	6.9
3	Carbohydrates(g)	45	10.3-64	28
4	Fat-total (g)	27.2	5.3-39.1	72.1
	Vitamins			
5	Vitamin A (RE)	51	6.5-70	400-600
6	Vitamin B1(mg)	10	3-9.3	0.6-0.9
7	Vitamin B2 (mg)	1.7	02-59	0.6-0.9
8	Vitamin B3 (mg)	2.2	0.7-28.7	8-16
9	Vitamin B6 (mg)	0.7	0.07-1.2	0.7-1.0
10	Vitamin B9 (mcg)	133.3	7.6-311.2	400-600
11	Vitamin B12 (mcg)	2.1	0.6-3.8	1.2-1.8
12	Vitamin D (IU)	9.3	0.2-401.3	4000
13	Vitamin C (mg)	26.4	0.6-199	25-45
	Minerals			
14	Calcium (mg)	501.2	36.1-835.4	8.5-10.2
15	Iron (mg)	6.2	0.6-11.2	50-120
16	Magnesium (mg)	91.3	0.6-181.4	1.4-1.7
17	Phosphorus (mg)	481.5	133-801.7	4.0-7.0
18	Potassium (mg)	969.4	334-10812	3.4-7.4
19	Selenium (mcg)	41.4	5.6-72.3	1-1.5
20	Sodium (mg)	813.2	106.9-1317.6	4.2-3.2
21	Zinc (mg)	7.7	0.5-8.4	8

4. Conclusion

The aim of this study was to assess the nutritional status for children with cerebral palsy under the age of 10 years old in Khartoum state. The study showed that the majority of children (75.7%) weights were less than normal (severely underweight) according to the values of growth chart for children with CP which is used as a method for measurement of children (underweight, normal weight, ideal weight, overweight and obese). In addition, food frequency questionnaire and 24 hour recall was used to assess the food consumed by the children and food processor program to determine the amount of nutrients in food consumed by the children with CP. Children with CP have a very severe problems and deficiencies in macro and micronutrients due to feeding difficulties. There were differences in their intake due to difficulties in feeding practice, which resulted in many problems related to muscles, mouth or GIT disorders. Adequate calorie intake is recommended according to the type and severity of the disease. As a result, severe weight loss, which is due to various complications related to low socioeconomic status and low

educational level of the parents and the limitation of nutritionists in their health centers to provide proper health and nutrition care for them.

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