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The prevalence of malnutrition and the nutritional status in children with cerebral palsy and its causes in Madinah Maternity and Children Hospital.

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Abstract

Background: Cerebral palsy is a condition marked by impaired muscle coordination, typically caused by damage to the brain before or at birth. Poor growth and malnutrition are important secondary health conditions impacting the health of children with CP.

Objectives: To evaluate the nutritional status of children with CP in general and to assess the relationship between disease complication and malnutrition, the severity of malnutrition and the severity of the disease, in specification.

Results: Out of the 119 studied patients 84.9% were underweight for weight per age while only 2.5% were overweight with the remaining subjects within the normal range, also most of the patients who have delayed growth (81.5%) and feeding difficulty (78.2%) were underweight. These symptoms were found among the studied group; chewing, swallowing and suckling difficulties, aspiration, vomiting, seizures and dental caries. It was observed that malnutrition is more prevalent in CP patients with associated medical complications, in patients suffering from chest infection, aspiration pneumonia and the majority of patients with seizures were under weight, implementing a positive relationship between disease status and nutritional status. Regarding the route of feeding 21% were on NGT feeding, 12% on gastrostomy tube feeding and 58% consumed food orally, additionally more than half were totally dependent on feeding (58.8%) while only 3.4% partially dependent which might have worsened their nutritional/ medical status. Reasons of hospital admission were also studied and 31.1% regular follow up, 23.5% chest infection, 17.6% seizures, 5% pneumonia and 22.7% due to other various reasons such as fever.

Conclusion: Malnutrition is significantly prevalent among CP children in MCH in Almadinah Almunawarah, KSA and more focus has to be paid regarding the nutritional status of these children, furthermore this is considered the first study in Saudi Arabia to examine the relationship between CP and malnutrition. Thus, hospitals that apply the recommended approach derived from this result will be able to improve CP patient life quality and prevent further disease complications.

Keywords: Cystic fibrosis, Gallstones, Ultrasound, Cystic Fibrosis Transmembrane Conductance Regulator (CFTR), Arab, Saudi Arabia, Cholelithiasis.

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Introduction

Cerebral Palsy (CP) is a non-progressive neurological disorder, which occurs during the brain development. Individual with this disorder were most likely born with it although some acquire it later in life. It affects body movement, coordination, muscle's control, tone and balance [1,2].

Poor growth and malnutrition is a significant secondary health conditions that influence the wellbeing of children with CP. Poor growth of children with CP could be due to factors such as malnutrition and abnormal endocrine function, which have other negative health on the patient [3]. The Potential for malnutrition exists because of dysphagia, increased energy requirements, feed dependence and the inability to close lips or suck properly [2].

Risk factors

The main cause of CP is brain injury that happens during brain development before, during or after birth. Factors that may cause brain injury include: gene mutation, maternal infections like TORCH infection. Fetal stroke, traumatic head injury, Lack of oxygen to the brain (asphyxia) related to difficult labor or delivery. Other factors of pregnancy and birth: Breech births, complicated labor and delivery, Low birth weight, multiple babies, premature birth, Rh incompatibility [1].

Symptoms

Muscles are too stiff or too floppy, stiff muscles, ataxia, tremors, athetosis, seizures, delay in motor skill milestone, difficulty swallowing, sucking and excessive drooling, speech delay or speaking difficulty, difficulty with vision and hearing and intellectual disabilities [4,5].

Types of cerebral palsy

- CP is classified according to the gross motor function

into:

- Spastic (pyramidal) CP: most common type. Patients with spastic CP develop tight muscles in some parts of the body that are unable to relax [6].
- Non spastic (extrapyramidal) CP: it includes dyskinesia and ataxic CP [6].
- Mixed CP: Some children have symptoms of more than one type of CP [4].
- Total body CP: affects the entire body to some degree. Complications of cerebral palsy and other medical problems are more likely to develop when the entire body is involved rather than isolated parts [6].
- Diagnosis
- Brain Scans
- Electroencephalogram
- Electromyography, Nerve conduction studies.

Laboratory tests

Additional tests: If the child is diagnosed with CP, they'll likely be referred to specialists for assessments of other conditions often associated with the disorder. These tests may identify: poor nutritional status, vision impairment, hearing impairment, speech delays or impairments, intellectual disabilities, other developmental delays, movement disorders [7].

Treatment

CP patients need a multidisciplinary team to overlook their treatment [8]. Medications that are prescribed are to lessen the tightness of muscles that may improve functional abilities, treat pain and manage complications related to spasticity or other CP symptoms [9].

Therapies

Many nondrug therapies can help a person with CP enhance functional abilities such as nutritional therapy, physical therapy, occupational therapy, speech and language therapy [10,11].

Surgical procedures: To insert a gastrostomy tubes for malnourished CP patients, orthopaedic surgery. Children with severe contractures or deformities may need surgery on bones or joints to place their arms, hips or legs in their correct positions [12].

Nutrition intervention

Those with CP who may benefit from nutrition and dietary therapy include individuals with: Aspiration, Gastrointestinal problems such as: Bowel obstruction, intestinal dysmotility, irritable bowel syndrome, flatulence, esophagitis, constipation, delayed gastric emptying and enuresis.

Swallowing Chewing and Sucking difficulties, Choking, bladder control, dental caries/tooth decay, growth impairment, immobilization and inadequate oral intake, which will all lead to failure to thrive [13].

The Main objectives are to alleviate malnutrition resulting from the patient's inability to close lips, suck, bite, chew, or swallow. The low resting energy expenditure found in malnourished children with CP is partly due to a low energy intake prompting independence through using adaptive feeding devices [14], practitioners look for ways to improve the quality of patient's life such as self-feeding skills.

This can involve appropriate space between servings to allow for natural swallowing, or feeding smaller portions more often throughout the day. In some cases, individuals with l CP must rely on a feeding tube for partial or total nutrition intake [13], assessing appropriate energy and nutrients needs, correcting nutrients deficiencies, developmental delays, altered growth rate, and loss of bone density. Preventing Pneumonia and Gastro esophageal refluxes (GERD) and pressure ulcers and monitoring for sodium deficiencies and dehydration on children receiving hyper caloric formulas [15].

Breast milk is recommended for infants with CP [16] the energy requirements will vary depending on the functional capacity, ambulatory status, severity of disease, and fat free mass. In preschool-age children with CP, energy requirement decrease as ambulatory status declines and more limbs are involved [17], when the patient is spastic or with severely limited activity, the energy requirement decreases and for arthetoid patients over the age of 18 the energy requirements are increased. The gastrostomy tubes are considered a reasonable alternative for poor weight gain and feeding and swallowing problems [15].

To help keep bones strong, children with CP need to get enough calcium, phosphorus and vitamin D. Other important minerals for bone health include magnesium, copper, zinc, and manganese [18].

Sometimes a child with CP can't eat enough to get all the nutrients needed. In these cases, formulas are recommended or other types of supplements. Formula can be added to the diet to boost energy and protein amounts, along with vitamins and minerals [19].

Adjusting timing of meal times may involve smaller, more frequent meals throughout the day. Sufficient time is required between bites or drinks to allow for natural swallowing. Sometimes meals are scheduled around medication needs to avoid stomach upset, curve appetites, and address drowsiness [13].

If an individual with CP has trouble with asphyxiation, reflux, or pneumonia, it is important to avoid foods that are more likely to exasperate these conditions, like nuts, seeds, and hard or stringy foods. Diets can be accustomed to patient needs such as to provide more energy, balance metabolism, compensate for deficiencies, and improve digestion. Vitamin, mineral and food supplements may assist those with malabsorption or who tire when eating. High fiber diets curb constipation. Prune and apricot juices may provide natural laxative qualities. Some foods enhance absorption of vitamins and calcium [13].

Literature Review

In a previous studies regarding the relationship between malnutrition and CP, a cross sectional study done by CP clinic on

Yangon children hospital on 173 child aged from 1 month to 12 years with all types of CP, weight and height were measured and the results revealed that 136 out of 173 child were malnourished [20]. Another study conducted by the department of food and nutrition in the university of Delhi, India found that feeding difficulties is one of the main factors of malnutrition among children with CP and one of these common feeding problems is difficulties in self-feeding, chewing and swelling [21].

A research conducted by children hospital in oxford university hospital suggest that there are many causes of malnutrition in children with CP and the reduction of nutrient intake comes primarily including prolonged feeding time, excessive spillage of food, vomiting and communication defects. They also suggest that there are complications of under nutrition among children with CP, including growth defect, impaired immune function and increased risk of infection [22].

Children with CP are unable to maintain a normal nutritional state. Seven children aged 2-16 years old with severe CP and growth failure were compared with children of the same weight regarding the efficiency of eating. Children with CP took 2-12 times longer to chew and swallow a standard amount of mashed food and 1-15 times longer for solid food than did their weight-controls. The degree of behaviour in feeding characteristics was higher in children with CP than in controls. Even long meal times does not compensate for the severity of feeding impairment [23].

Also, the previous studies in developing countries assess the growth pattern and nutritional status of children with CP and summarizing the essential factors responsible for high prevalence of under nutrition among them. Comparing anthropometric parameters between nondisabled children and CP children significant reductions were found. This deviation from normal growth can be attributed to inadequate dietary intake, decreased weight bearing, feeding problem and non-nutritional factors like socioeconomic status, disease severity, age and abnormal endocrine function. Concerning the nutritional status in developing countries under nutrition was more prevalent; while several studies conducted in developed countries have shown a high prevalence of overweight and obesity among this population. This could be attributed to a decrease in the motor function because of the underlying condition and an increase in the gastrostomy feeding owing to availability of better health care facilities [24].

There's a relationship between the nutritional status and societal participation in children with CP. In one study conducted on 235 participants found that the indicators of malnutrition were common. Poor nutritional status associated with increased health care utilization (hospitalizations, dietician visits) and decreased participation in usual activities by the child and parent. Malnutrition is more prevalent in children with moderate or severe CP and accompanied with poor health status and limitations in societal participation [25].

Also, there was found a relationship between feeding dysfunction, poor growth and health status in children with CP. Children with moderate to severe CP, feeding dysfunction correlated with poor health and nutritional status. Even children with only mild feeding dysfunction, requiring chopped or mashed foods may be at risk for poor nutritional status [26].

In another study severely disabled children received nutrition supplements more frequently than those with less severe disability (71% *vs*.16%). Tube feeding and use of nutrition supplements was reflected in higher concentrations of micronutrients in blood and serum Low intake of micronutrients as well as micronutrient deficiency was common in this group of children with CP. Children with neurological disabilities should have their nutritional status evaluated in order to ascertain sufficient intake of micronutrients [27].

Children with severe CP often have lower mineral intakes than healthy children. Nutritional status was determined among primarily tube-fed children (aged 2 to 17 years) with CP based on blood and urine samples, anthropometry, and 3-day food records. The conclusion was that sodium deficiencies were likely prevalent among the children. The findings from this small observational study suggest that sodium intakes for tube-fed children with CP should be maintained near the AI for their age. Hydration status of children receiving hypercaloric formulas should be monitored [28].

As per the evaluation of growth characteristics of 57 children with feeding gastrostomies attending the CP clinic, all children had severe neuromotor and orofacial involvement and mental retardation; Children with gastrostomies placed in the first year of life were most likely to exceed the fifth percentile for height and weight. The mechanisms of growth retardation in children severely affected by cerebral palsy are not known, with poor nutrition to be the major contributor. Gastrostomy feeding in children severely affected by CP can improve nutritional status but does not eliminate growth retardation. The importance of growth and adequate nutrition in reducing morbidity in children with severe neuromotor involvement remains to be established [29,30].

Objectives

- To identify the first presenting symptoms.
- To assess relation between the disease and malnutrition
- To assess the severity of malnutrition
- To assess the severity of the disease

Hypothesis

Malnutrition is prevalent is patients with CP in Saudi Arabia and it adversely affects the health outcome of the patients and increase their complications.

Research Methodology

Study design

This is a retrospective study.

Subjects

Subjects were recruited from patient's file at the Maternity and children's hospital, the clinic and the inpatients wards by filling out yes and no questionnaires regarding the subject's history. Consent was pre-requisite from the hospital's administration.

Methods

In a Retrospective study information was collected from the medical records by data collection sheet for 119 CP patients from 2012 to 2016, also data was obtained from patients at the Dietician clinic and inpatient wards at MCH in Almadinah Almunawarah by a data collection sheet. The data collection sheet was built partially on previous studies on clinical presentation of cerebral palsy and malnutrition.

The data collection sheet will be covering the following topics: socio-demographic variables (Age, sex), variables related to clinical presentation of the disease (Associated symptoms, nutritional status, clinical sign & complication) and others variables include diet history, feeding route and nutritional deficiency. (The data collection sheet will be in the appendix). The investigators will establish coding of the data.

Preparations

- A list of the names and numbers of the CP patients' files was obtained from the hospital's IT administration office.
- Files were recruited from the files storeroom in the hospital
- Questionnaires were distributed among the data collectors as well as the files and the questionnaires were filled out.
- 119 patients were enrolled according to inclusion and exclusion criteria.

Techniques, tools and equipment's

Data collection was done through questionnaire. The questionnaire was divided into three sections that include: (1) personal data and values of growth measurement of the patient like: Wight, height, head circumference and birth weight. (2) Second section is Yes and No questions about symptoms and complication may the CP patients have suffered from, these symptoms are: constipation, diarrhoea, vomiting, pneumonia, seizures, swelling difficulties, sucking difficulties, chewing difficulties and abdominal pain. (3) The last section is open question about patient diet, nutritional state, social and developmental state and lab data.

Ethical issues

Approval to conduct the current study was obtained from head of the IRB committee, Dr. Atef Albooq at MCH in Almadinah Almunawarah, and the consent to collect data from the patient's records was obtained. All data was kept confidential.

Statistical analysis

The encoded answers were entered into Microsoft Excel and copied to SPSS program. Descriptive analysis was done using statistical package for social sciences (SPSS-17). The comparative outcomes of results were analysed by using T-test for paired samples for continuous data. The minimal level of significance was set at P 0.005.

Results

In this study, 119 cerebral palsy patient's medical records were reviewed. The mean age of the reviewed records was 71.1 ± 46.3 months, more than half of which were females 52.9% and 47.1% were males (Figure 1).

Weight status

Out of the 119 studied patients 84.9% (N=101) were underweight for weight per age while only 2.5% (N=3) were overweight with the remaining subjects (N=15) within the normal range with no significant difference between males and females (Figure 2).

Most of the patients who had delayed growth (81.5%). Similarly in feeding difficulty 78.2% were underweight, out of which 88.5% underweight and 3.8% overweight subjects with the remaining having a normal weight for age in Figure 3.

Documented symptoms

The following associated symptoms was found among the studied group; chewing difficulty 70.3%, swallowing difficulty 63%, chocking 58%, suckling difficulty 37%, aspiration 49.6%,

GERD 31.9%, constipation 42.9%, vomiting 31.1%, seizures 79.8%, dental caries 16.8% and 6.7% of the subjects had food allergy (N=8) all of which were under weight and the same applies for subjects with abdominal pain 7.6% (N=9) (Figures 4 and 5).

It was observed that malnutrition is more prevalent in CP patients with other medical complications, in patients suffering from chest infection 89.3% were underweight while only 10.7% of which had a normal weight for age. Also in patients with aspiration pneumonia 50% were under weight, 33.3% had normal weight and 16.7% were overweight. It was also found that the majority of patients with seizures were underweight 90.5% and 4.8% were in the normal age group and overweight. In other associated medical complication such as renal

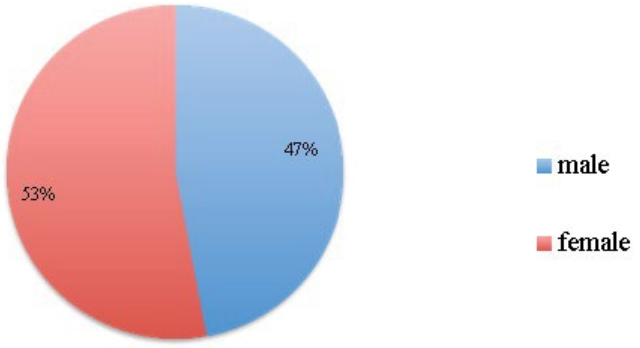

Figure 1. *Gender distribution among the studied group.*

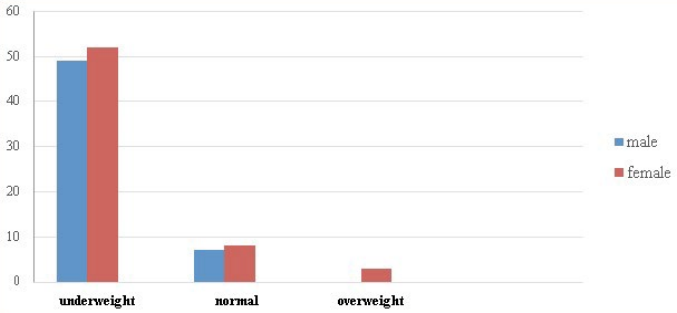

Figure 2. *Weight per age among the studied group.*

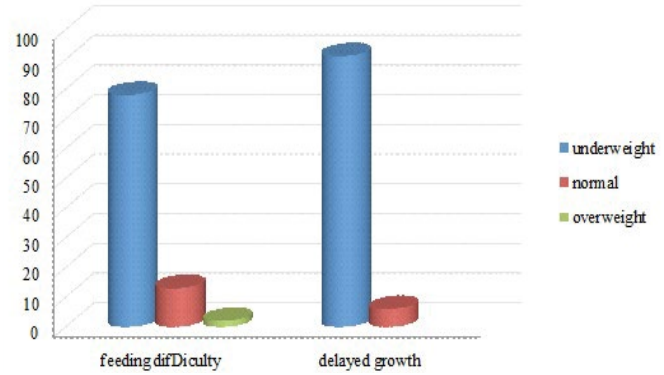

***Figure 3**. Delayed growth and feeding difficulty presented in figures.*

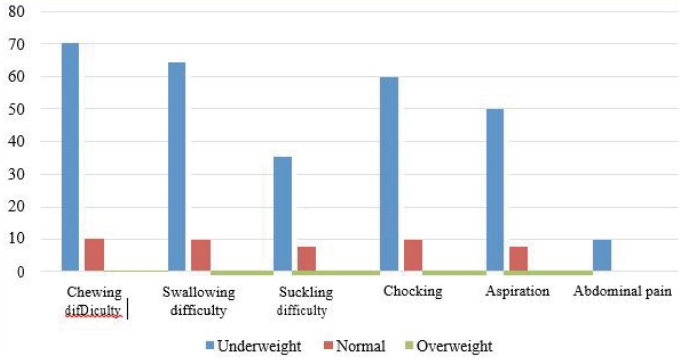

***Figure 4.** Associated symptom per weight group.*

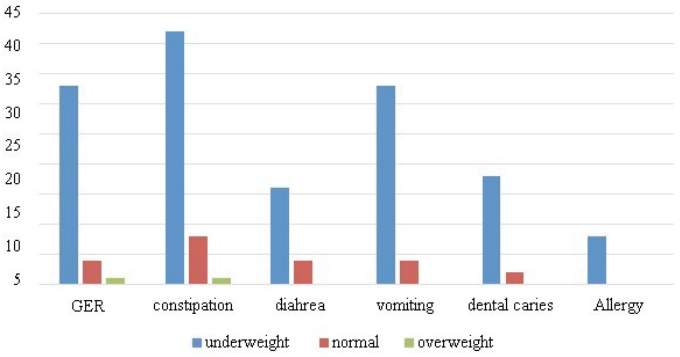

***Figure 5.** Associated symptoms per weight group.*

impairment, urinary tract infection (UTI) and gastroenteritis etc., underweight meaning malnutrition was more prevalent 85.2% (Figure 6).

Rout of feeding

In the studied subjects 21% were on nasogastric tube feeding (NGT), 12% were on gastrostomy tube feeding and 67% were consuming their food orally (Figure 7).

Feeding dependency

Out of the 119 studied patients more than half are totally dependent on feeding (58.8%) while only 3.4% are partially dependent (Figure 8).

Reason of hospital admission

Regarding the reasons of hospital admission 31.1% were regular follow up, 23.5% chest infection, 17.6% seizures, 5% pneumonia and 22.7% due to other various reasons such as fever and UTI, in patients suffering from chest infection 89.3% were underweight while only 10.7% of which had a normal weight for age. Likewise in patients suffering from aspiration pneumonia 50% were under weight, 33.3% had normal weight and 16.7% were overweight. Also the majority of patients with seizures were underweight 90.5% and 4.8% were in the normal age and overweight group respectively. In other associated medical complication such as renal impairment, UTI and gastroenteritis etc., malnutrition was 85.2% (Figure 9).

Discussion

This study was conducted in Maternity and Children Hospital in Almadinah Almunawarah, KSA. In this retrospective study,

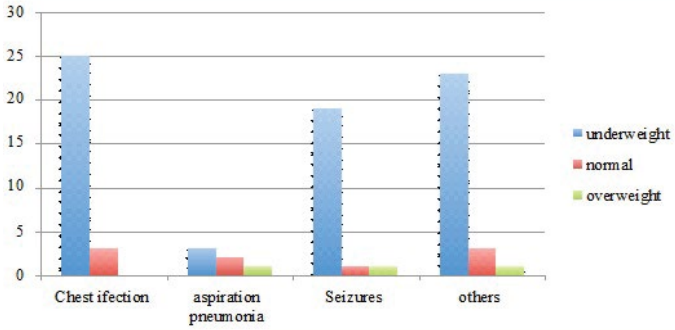

***Figure 6.** Weight status with associated medical complications.*

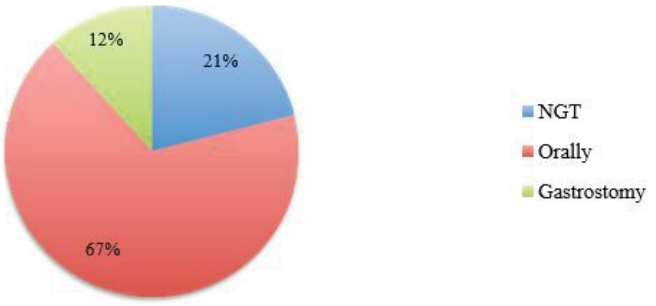

***Figure 7.** Rout of feeding among the study group.*

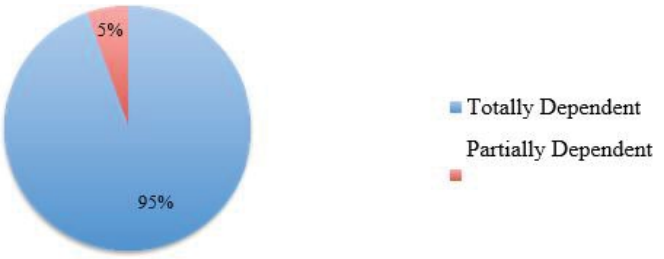

***Figure 8.** Feeding dependency.*

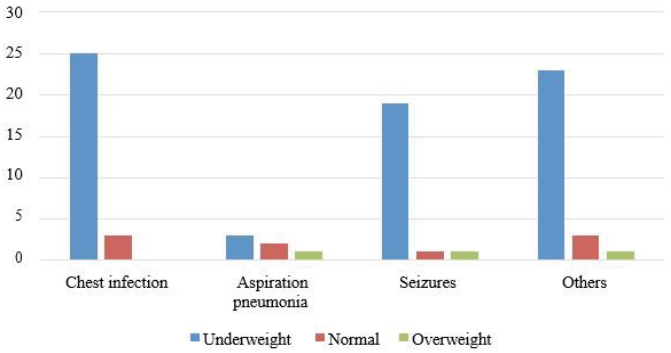

***Figure 9.** Reason of admission per weight status.*

119 cerebral palsy patient's medical records were reviewed. The mean age of the reviewed records was 71.1 ± 46.3 months, more than half of the patients were females 52.9% while 47.1% were males.

Results of anthropometric measurement showed a high proportion of malnutrition (84.9%) in children with CP and out of which 81.5% had delayed growth. When comparing this result with results from previous studies in developed and developing countries it was found that malnutrition in children with CP in developing countries such as Indonesia was 76%30, 78.6% in Myanmar and 86% in India [31]. Whereas in developed countries the percentage of malnutrition in CP patients was 15% in Egypt [32] 38% in United Kingdom [33] and 41.3% in Taiwan [34]. These variations in the results could be due to the use of different assessment methods of the nutritional status because there is no standardly acceptable diagnostic criteria to assess the nutritional status of children with CP. In this study we used weight for age to classify malnutrition. This difference between malnutrition incidence in CP patients in developed and developing countries could have been affected by the access for health care such as taking good treatment, regular checkups, visiting the dietitian clinic, the degree of support for feeding problems and the adequacy of food provision [33].

Some reports found that overweight was also a problem as 5.4% to 18.2% children with CP were overweight [35-37]. Contrast to this, there was only 2.5% overweight children in the current study reflecting that under nutrition is a major problem in our setting.

No association was found between gender and malnutrition in this study, whilst other studies in Turkey, Taiwan and Mexico implied that females with CP were more susceptible for malnutrition and claimed that there was a gender discrimination against disabled girls in nutrition [34,37,38]. Which may reflect the non-discrimination between male and female in our sociocultural environment.

Screenings for feeding problems is of utmost importance since it impairs the child's capability to meet their nutritional requirements and to determine the suitable feeding route. Feeding problems were identified based on gathering information from patient medical recorded; Feeding difficulties such as chewing, swallowing difficulties, choking and aspiration pneumonia was found in 78.2%, out of which 88.5% were under weight and 3.8% were overweight with the remaining having a normal weight for age. This result indicates that CP children are not able to meet their nutritional requirement in order to grow properly and prevent further diseases progression such as micro/macro nutrient deficiency, so it can be suggested to use ancillary feeding methods to meet their nutritional requirement.

Out of the 119 subjects the following associated symptoms were found; chewing difficulty 70.3%, swallowing difficulty 63%, chocking 58%, aspiration 49.6%, suckling difficulty 37%, GERD 31.9% and vomiting 31.1%. Other measured parameters included constipation 42.9%, seizures 79.8% and dental caries 16.8% which could be an indicator of micronutrient deficiency.

It was observed that malnutrition is more prevalent in CP patients with other medical complications, in patients suffering from chest infection 89.3% were underweight while only 10.7% of which had a normal weight for age. Also in patients with aspiration pneumonia 50% were under weight, 33.3% had normal weight and 16.7% were overweight. It was also found that the majority of patients with seizures were underweight 90.5% and 4.8% were in the normal age and overweight group respectively. In other associated medical complication such as renal impairment, UTI and gastroenteritis etc., malnutrition defined by low weight for age was dominant 85.2%. This may be due to low appetite and low food intake during the disease progression.

Only 6.7% of the subjects had food allergy and all of which were malnourished, likewise 7.6% of the patients suffering from abdominal pain were malnourished, which might have affected their feeding ability and appetite leading to malnutrition.

Regarding the route of feeding 21% of the subjects were on nasogastric tube feeding, while 12% were on gastrostomy tube feeding and the remaining consumed their food orally, measurement of feeding efficiency early on provides the basis for identification of children who cannot be consume adequate nutrient to meet their requirements without supplementary feeding.

Out of the 119 studied patients more than half were totally dependent on feeding (58.8%) while only 3.4% were partially dependent, which may also be a reason of malnutrition because the children have to wait for their caregiver to feed them thus lessening their food intake.

Concerning the reasons of hospital admission 31.1% were regular follow up 23.5% chest infection, 17.6% seizures, 5% pneumonia and 22.7% due to other various reasons such as UTI, anemia and gastroenteritis.

Conclusion and Recommendations

In conclusion malnutrition and feeding problems are quite prevalent in children with CP at MCH in Almadinah Almunawarah. It is associated with disease complications such as feeding problems and nutrient deficiency and other associated health problems and higher dependence on caregivers for feeding. Nutritional support should be an integral part of the management of these children and nutritional intervention should be provided to ensure adequate growth, to improve quality of life, to reduce disease complications and to optimize functional status and further studies are needed to determine the nature of these associations and how to manage nutrition in children with CP.

Therefore, the finding of this study will rebound to the benefit of society considering that nutritional status plays an important role in the health of CP patients and this is considered the first study in Saudi Arabia to examine the relationship between CP and malnutrition. Thus, hospitals that apply the recommended approach derived from the results of this study will be able to help the patients effectively and to improve their quality of life.

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