International Journal of
Health Sciences
(IJHS)

Prevalence of Malnutrition among Pediatric Celiac Disease

CARI Journals

International Journal of Health Sciences
ISSN: 2710-2564 (Online)
Vol. 6, Issue No. 1, pp 1 - 15, 2023
www.carijournals.org

Prevalence of Malnutrition among Pediatric Celiac Disease

Safia S. Elramli (Assistant Professor)

Nutrition department, faculty of Public Health, University of Benghazi)

safiaelramli2015@gmail.com

Souad El-mani (Lecturer)

Nutrition Department, faculty of Public Health, University of Benghazi)

Salma Elketaani, Malak Omran (Public Health Students)

Abstract

Purpose: Celiac Disease (CD) is an autoimmune systemic disorder triggered by gluten in genetically susceptible individuals, which can lead to chronic malabsorption. Considering the changes in the manifestations of CD.The present study was designed to determine the nutritional status and prevalence of malnutrition of celiac disease in children and to investigate the nutritional markers, anthropometric parameters such as body mass index (BMI), meal patterns ,and routine laboratory in celiac disease children

Methodology: This cross-sectional study aimed to evaluate the children with CD who had referred to Pediatric gastroenterology Clinic between 2021 and 2022. Totally, 40 children were eligible, and their weight, height, and Body Mass Index (BMI) were extracted by interview. The anthropometric indices were presented based on the criteria of the Center for Disease Control and Prevention (CDC) and World Health Organization (WHO). Biochemical tests were obtained during the study period from medical files of the studied patients. Data were analyzed using descriptive statistics. The Chi-Square test was applied to examine the study data.

Findings: Data shows that 52% of CD children were well-nourished while the remaining 45%, 3%had moderate -to-severe malnutrition. Regarding the height for age and weight for age 20% of the participants had short stature, 80% were normal stature, in addition ,40% of the patients had sever wasting for age and 43% had normal weight for age. Based on the CDC's criteria 20%,65%, 10%, and 20% low BMI, normal BMI, overweight, and obese for age respectively. In addition, results show that most of CD children had normal hemoglobin level with low level of vitamin D. Regarding to meals pattern of CD children result revealed that the most kind of food daily intake was milk and white bread while there was not daily consumed of ice cream and whole wheat bread.

Conclusion: To sum up, the results clearly indicated that growth failure and low height, weight, and BMI were less prevalent among the studied group of children with CD. Early diagnosis of celiac disease is very important to prevent long-term complications, early initiation of nutritional intervention and treatment is important. Currently, the only effective treatment is a lifelong gluten-free diet.

Keywords*:* *children, Celiac disease, malnutrition, nutrition status, prevalence of undernutrition*

Introduction

Celiac disease (CD) is defined as an immune mediated disorder caused by the ingestion of gluten and related proteins, occurring in genetically predisposed individuals, and characterized by a variable combination of elevated titers of celiac-specific autoantibodies, an inflammatory enteropathy with variable degrees of severity, and a wide range of gastrointestinal and/or systemic complaints(1). CD is a multifactorial disorder affected by the interaction between gluten ingestion and immune response as well as environmental and genetic factors (1). The epidemiology and prevalence of celiac disease and the amount and accuracy of the data has dramatically improved (2). it is estimated that the current prevalence of celiac disease is 3 to 13 per 1000, with a higher prevalence among first degree relatives of known CD patients (3). Worldwide assessments have demonstrated that CD affected almost 1 % of the European population (3). Based on serological evaluations in Iran, the prevalence of CD was reported 1 out of 167 children. However, the prevalence of CD has been found to be higher in a variety of diseases, such as irritable bowel syndrome (IBS), diabetes, and neurological disorders (11, 12, and 3.7%, respectively) (3). The risk of another autoimmune disease is three to 10 times higher in patients with celiac disease compared to the general population (4). The most common accompanying disease is type 1 DM since it has common genetic factors and pathogenic mechanisms with celiac disease. The prevalence of celiac disease was reported to be 2.4%-16.4% in children with type 1 DM (5). There is consensus about initial screening for celiac disease in newly diagnosed DM patients, but it is not clear when and how often to screen for celiac disease and initiate a gluten-free diet in asymptomatic patients (5). There is a close relationship between Down syndrome and celiac disease. The prevalence of celiac disease in patients diagnosed with Down syndrome is reported to be 5%-12%(6).The North American Society for Pediatric Gastroenterology, Hepatology and Nutrition and The European Society for Pediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN) recommend screening tests for celiac disease in children with Down syndrome due to the increased risk of developing celiac disease(6).

Patients with newly diagnosed CD often have nutrient deficiencies, especially involving iron, calcium, zinc, folic acid, vitamin D, and other fat-soluble vitamins, as a result of malabsorption following damage to the small intestine mucosa that occurs in celiac disease. Strict adherence to the GFD facilitates regeneration of intestinal villi, enabling proper absorption of nutrients (7). However, some authors have reported an unbalanced diet in terms of macro and micronutrients in celiac patients and, in this situation, nutritional deficiencies associated with GFD are more so caused by the diet than the disease mechanism (7) Improperly balanced GFD can make deficiencies worse rather than improve them, which is extremely dangerous for children during their development. Children with untreated celiac disease were usually shorter than their healthy peers, which is a consequence of nutritional deficiencies (8). CD individuals also have a higher prevalence of underweight, as well as a lower presence of obesity, as compared to non-celiac peers (8). However, some patients on a gluten-free diet develop obesity. The incidence of excess body weight in pediatric patients with celiac disease on a gluten-free diet range from 9.4% to 21%. The

increasing prevalence of excess body weight in CD patients can be explained by the global trend towards weight gain in the children general population, but also inappropriate nutritional education of patients and their parents after diagnosis. Unfortunately, there are not many studies on this topic (9). Our study aimed to a assess the nutritional status and the prevalence of malnutrition among pediatric celiac disease.

Methodology

Study Design, Setting and Subjects

It was cross-sectional study random sample conducted at gastro unit of Benghazi Medical Centre and Benghazi Pediatric Hospital – Libya, to determine the prevalence malnutrition among pediatric celiac disease aged from 6 to16 years old. The study will be carried out over 4 months period from February 2022 to June 2022 and included 40 children (32% boys , 68% girls) with mean age 10years. The target of study consisted of children with celiac disease both boys and girls with Libyan nationality. All enrolled patients should have completed a minimum of three months diagnosis with celiac disease. Our study was excluding the Patients had metabolic diseases that has an impact on BMI or suffer any other illness which affect BMI e.g. Anorexia or Bulimia, , Patients who were hospitalized for more than two weeks or had signs of active infection were excluded from the study. Patients from other nationality other than Libyan nationality or children younger than 6 years old were excluded.

Participants' characteristics

The researchers extracted the participants' demographic and anthropometric information from interview or data records. Data including age, age onset of celiac disease, related comorbidities [Type 1 Diabetes Mellitus (DMT1), family history of celiac disease, clinical symptoms, weight, height, and Body Mass Index (BMI) were collected after diagnosis and at their visit to collect sample, and dietary history . Height was measured by a stadiometer to the nearest 0.1 cm without shoes. Weight was also measured by scale . Anthropometric indices, including weight, height, and BMI (weight (kg)/height (m^2)) ,were presented based on the criteria of the Center for Disease Control and Prevention (CDC) and World Health Organization (WHO).). Based on the CDC criteria for stature and weight for age, values less than the 5th percentile, between the 5th and the 95th percentiles, and higher than the 95th percentile were classified as unfavorable, normal, and high, respectively. In addition, BMI values < the 15th percentile, between the 15th and the 85th percentiles, and ≥ the 95th percentile were categorized as underweight, normal weight, and overweight and obese, respectively (29). In addition , Mid-arm circumference were collected , based on the CDC criteria the Interpretation was <12.5 cm sever PEM, 12.5-13.5 cm Mild to moderate PEM, >13.5 cm no PEM(10)

Assessment of nutritional status

a. **Clinical manifestations assessment**

A questionnaire was used to assess the prevalent symptoms among the children with CD, including diarrhea, flatulence, abdominal pain, abdominal distention, constipation, Fatty stool . loss of appetite ,nausea , hair loss, skin dryness, weight loss, Poor Hight gain ,anemia, and Pubertal delay .

b. Body mass index (BMI)

calculated from a subject's height and weight, is widely used for categorizing underweight, normal weight, overweight and obesity. By current definition a BMI < 15 th is defined as underweight.

c. Pediatric Subjective Global Nutritional Assessment (SGNA)

The Pediatric Subjective Global Nutrition Assessment (SGNA) provides a framework for comprehensive nutrition assessment including a nutrition-focused medical history combined with a physical examination to determine a global quantifiable rating of well nourished, moderately malnourished, or severely malnourished. Current methods of assessing nutritional status in children rely on a combination of objective anthropometric, dietary, biochemical, and immunologic measures. Although epidemiologically useful, these measures have several shortcomings that hamper their effectiveness in clinical practice, and no single objective marker has the sensitivity and specificity to be a reliable index of protein-energy malnutrition or predictive of nutrition-related complications. The degree of malnutrition is evaluated by means of a structured evaluation form focusing on nutrient intake, physical activity, and body composition (3). Patients are asked about weight changes during the last 6 months, eating behavior, gastrointestinal symptoms, and nutrition-related functional symptoms. The physical examination includes an evaluation of the patient's muscle mass and subcutaneous fat mass for detection of any fat and muscle wasting. Following these procedures, the nutritional status is classified into three categories by a composite scoring system: normal nutritional status, moderate malnutrition, and severe malnutrition (10).

D. Dietary assessment : FFQ is commonly used for nutritional assessment in large epidemiologic studies, because it measures long-term diet, is quick and comparatively inexpensive to administer, and provides quantitative information on nutrients and foods [31]. There were three major steps in FFQ application. First, we prepared a list of commonly children's food Secondly, based on this list we developed a long FFQ. And then, in this study tested the long FFQ in the field and shortened and applied to the subjects and entered information from the FFQ of the participants into SPSS for Windows .After that in this study, calculated the frequency of intake of a portion of each food on the FFQ .

E. Blood parameters : Biochemical and immunological laboratory blood tests were taken at the beginning and at each follow-up visit. Serum level of hemoglobin , S. iron ,Folate, Vitamin D,s. calcium, S. triglyceride , Blood cholesterol level, CRP, Albumin**.**

Statistical analysis

All analyses were performed using the SPSS software, version 21. Data are descriptive, interval therefore statistical test including frequency, mean, maximum, minimum, standard deviation to assess normality of distribution one-way ANOVA, the P value of equal to or less than 0.05 will be considered statistically significant. . The total number of patients 40 minimal age 6 years old, the maximum 17 years old, 32% was boys , 68% was girls.

Significance of study

early diagnosis and treatment of coeliac disease of CD in pediatric group is significantly reduces the risk of long-term complications such as failure to thrive, osteopenia, infertility, and malignancy..

the result of study has possible act as guide to increase awareness about important of periodically nutritional assessment of children with celiac disease to reduce the risk of malnutrition and failure to thrive.

Results

The aim of this study was to assessment the nutritional status and prevalence of malnutrition among celiac disease children. A total of 40 Celiac disease children that follow gastro clinic at Benghazi Medical Centre were recruited for the study, the age ranges was between (6-17years).

Demographic characteristic and anthropometric data of the children with celiac disease

Participants

The study results indicated that out of 40 subjects , 32% boys , 68% girls , the mean age was 10 +/- 3Sd most distributed age ranged from 6-10 years, as demonstrated in figure(4.1 &4.2.)

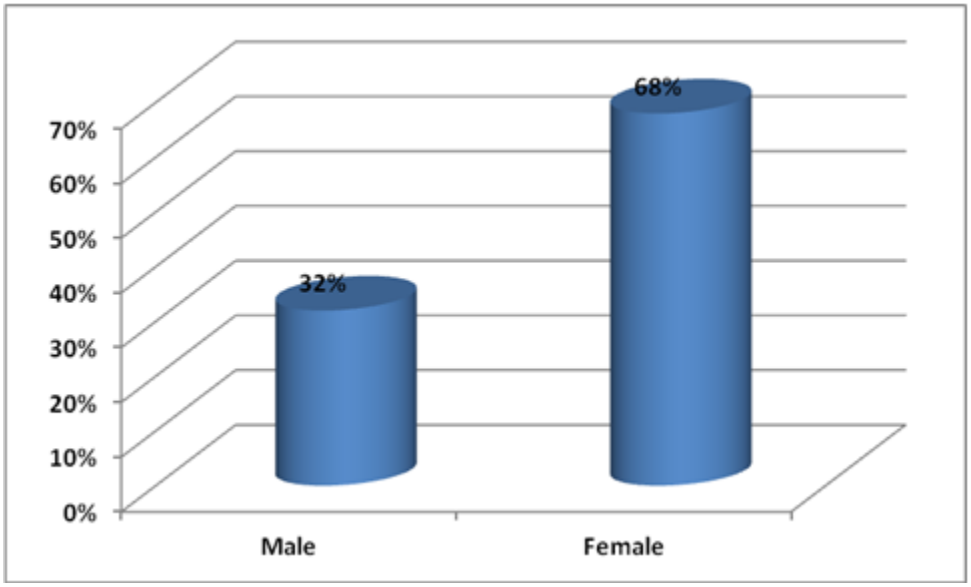


Figure (4,1) **distribution of sex**

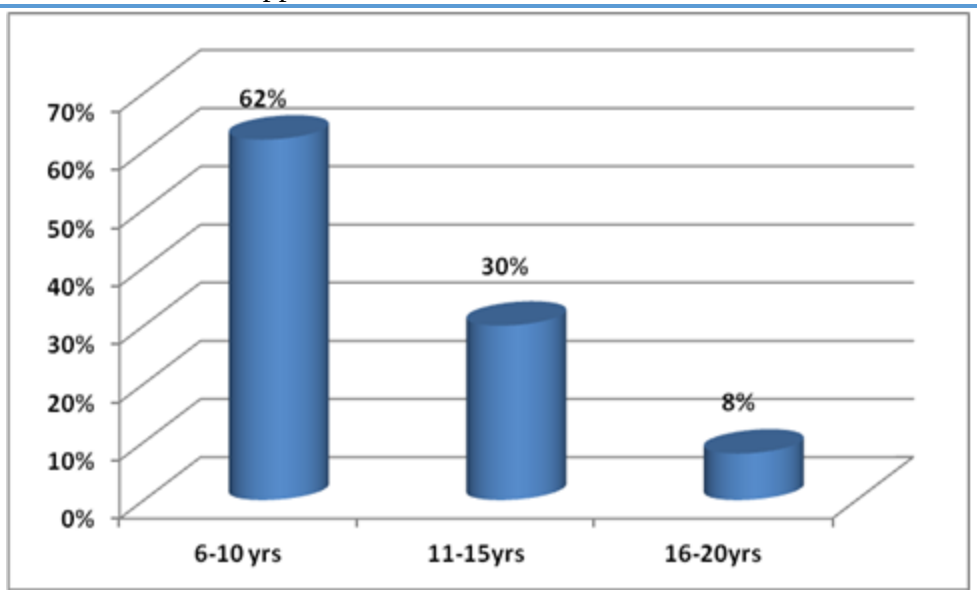


Figure (4,2) **distribution of age**

Height for age values in the children with CD

According to the results represented in (figure 4.3) based on the CDC percentiles of height for age 80% patients have normal , and 20% were moderate.

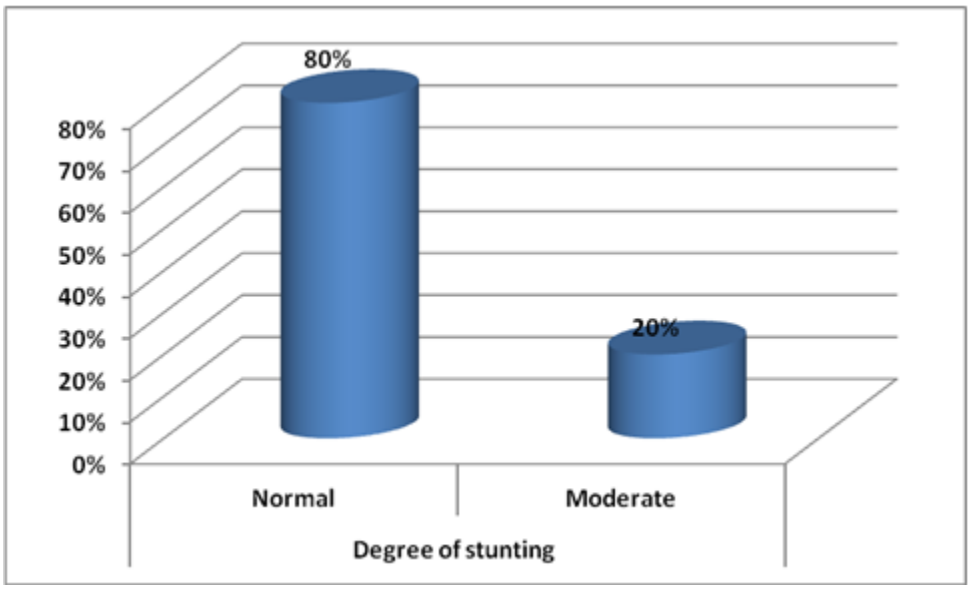


Figure (4,3) distribution of height for age in the children with celiac disease according to the criteria of CDC

Weight for age values in the children with CD

Based on the results presented in figure(4.4) , 43%, 15%, 2% , and 40% patients were in the normal, mild , moderate and sever degree of wasting (weight for age) respectively.

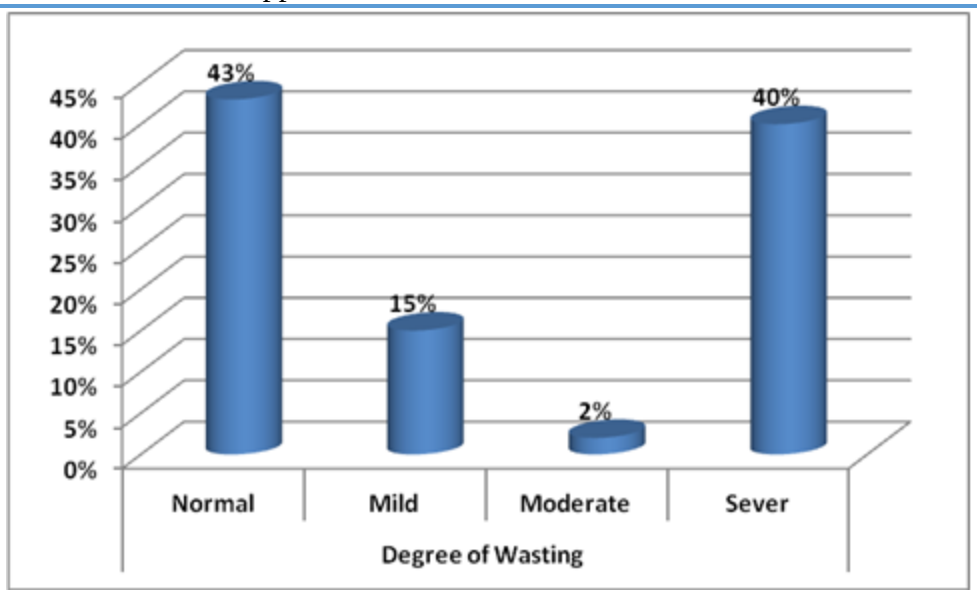
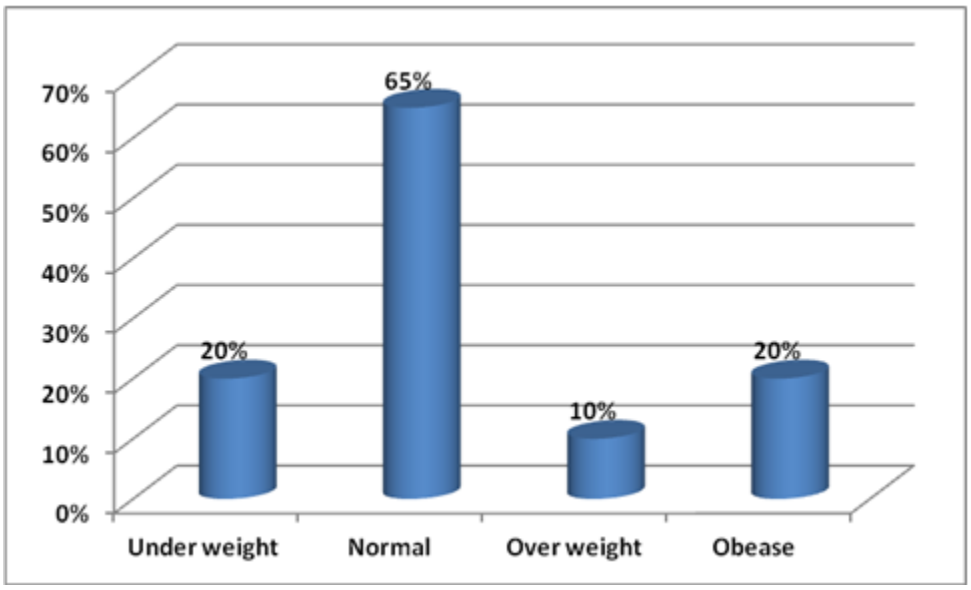


Figure (4,4) distribution of weight for age in the children with celiac disease according to the criteria of CDC

.BMI for age values in the children with CD

Evaluation of BMI based on the criteria of CDC has been shown in figure(4,5) According to the percentiles 20%, 65%, 10% ,and 20% patients were considered underweight, normal, overweight, and obese, respectively.



figure(4,5) **distribution of BMI for age in the children with celiac disease according to the criteria of CDC**

Assessment of nutritional status of celiac disease children

Prevalence of malnutrition using Pediatric Subjective Global Nutritional Assessment(SGNA)

Pediatric Subjective Global Nutritional Assessment (SGNA) score that was originally developed to assess nutritional state and is one of the methods suggested to assess nutritional status in CD children. The SGNA comprises of two criteria, and includes nutrition focused medical history, physical examination(loss of subcutaneous and muscle wasting). . A score rating normal , moderate , and sever malnourished.

The nutritional status of the CD children indicated that (52%) were well-nourished while the remaining (45%, 3%) had moderate -to-severe malnutrition as shows in [Figure 4,6] below.

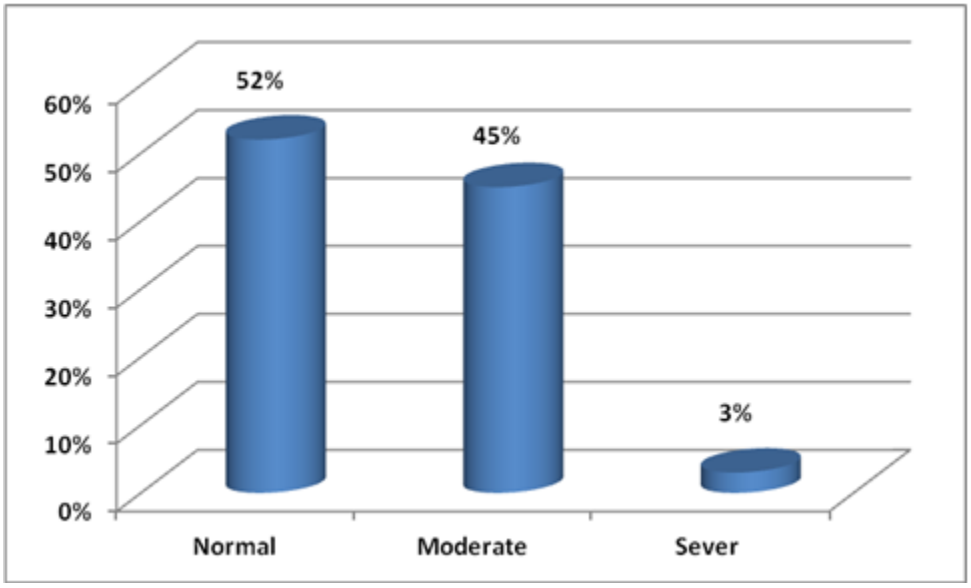


Figure (4,6) Prevalence of malnutrition among CD children

biochemical parameters in the studied group

Concerning the hemoglobin and vitamin D level in CD children. Result revealed that 60% of CD children had normal hemoglobin level, however, 40% with low level of hemoglobin as illustrated in figure (4,7). Low levels of vitamin D were observed among the most CD children which was 65% , while 35% were with the normal level of vitamin D. The figure below shows the previously mention (4,8)

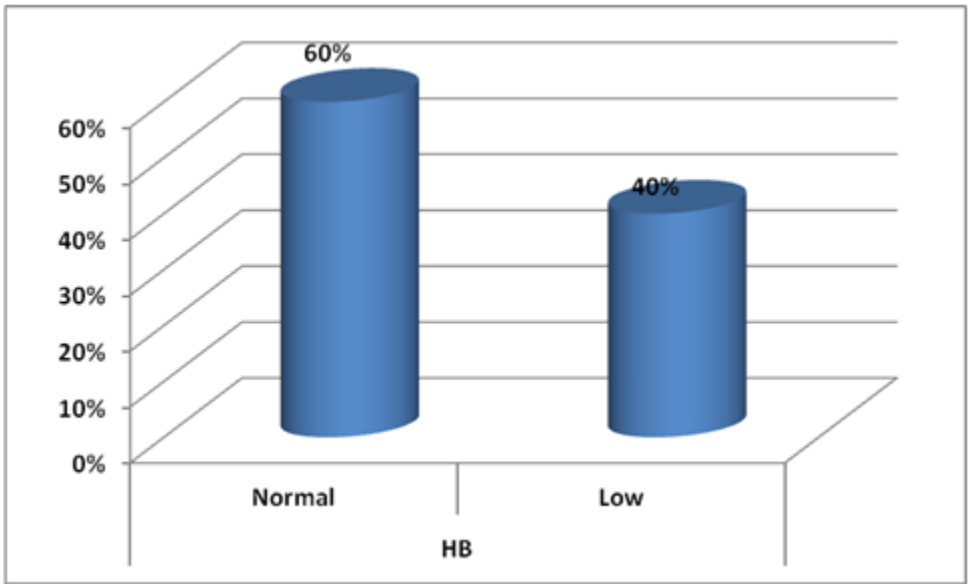


Figure (4,7) hemoglobin level among celiac disease children

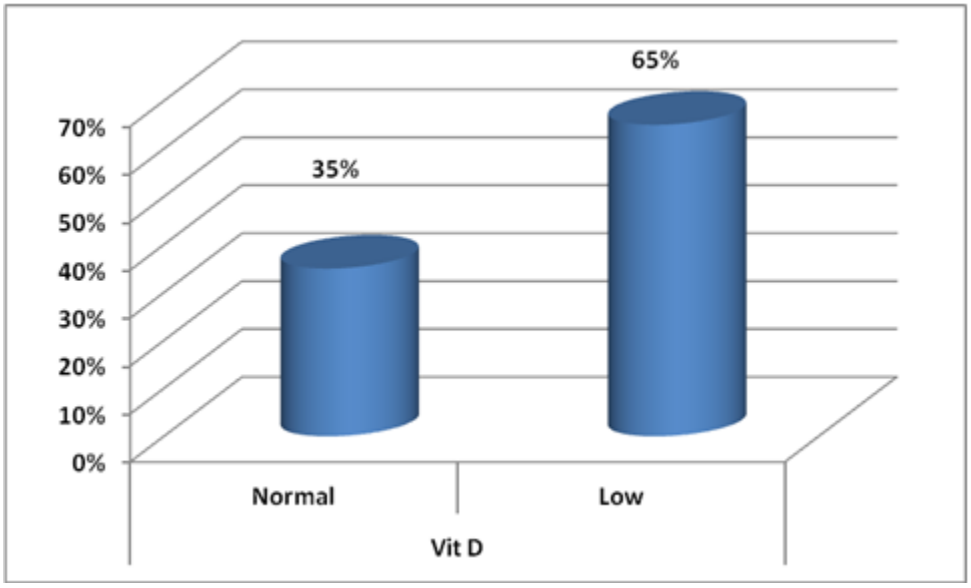


Figure (4,8) vitamin D level among celiac disease children

Pattern of meal

The figure (4.9) below shows that most kind of food daily intake was milk which about 88% ,however, 82% not consumed of ice cream. Regarding the chocolate milk and flavored yogurt, the daily consumed was 30%,28% respectively.

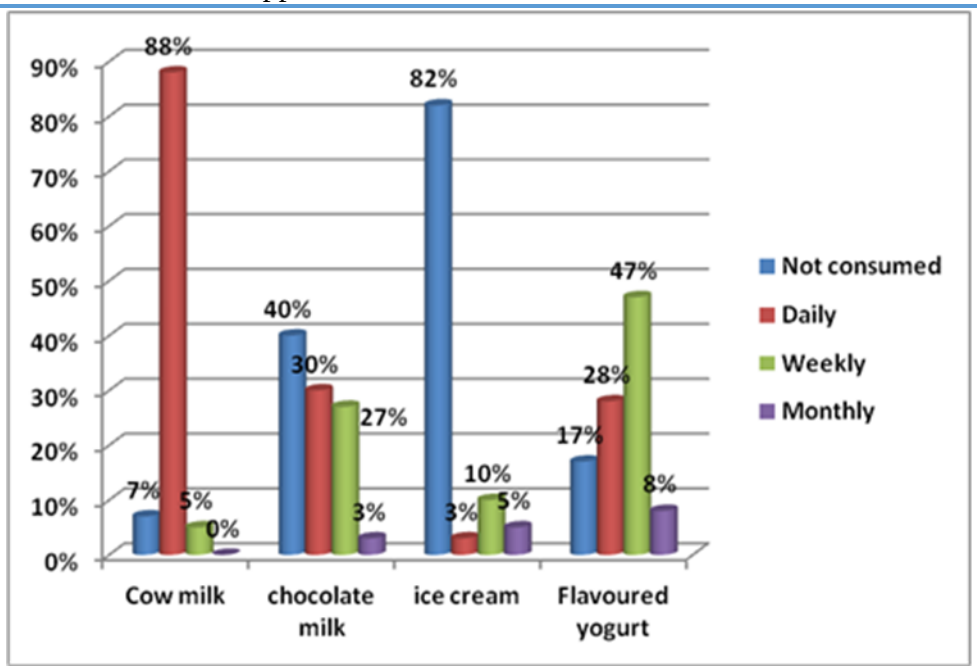
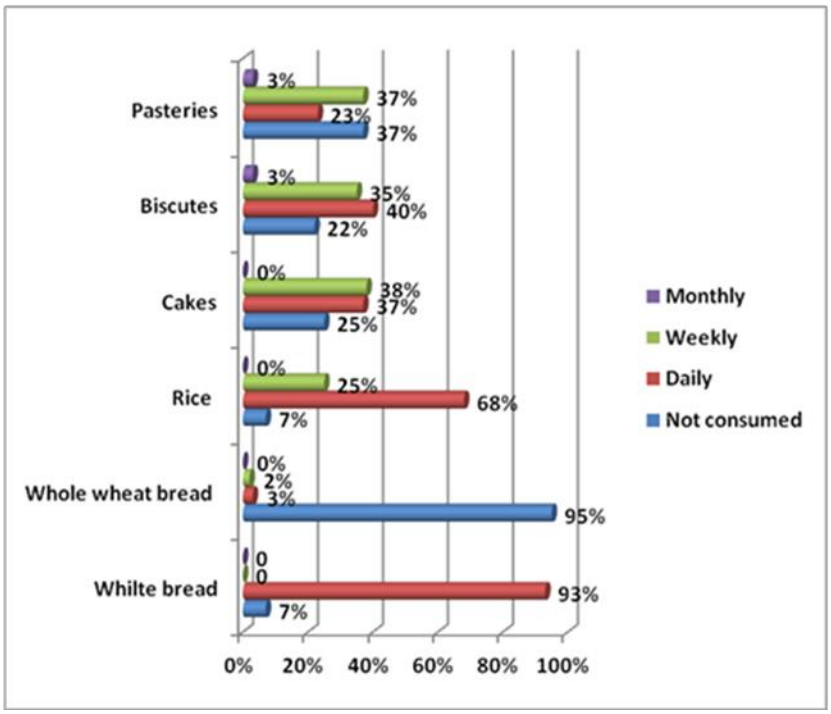


Figure (4,9) milk and dairy product consumption among CD children

Regarding the cereal's intake among CD children ,(figure 4,10) below reveals that the highest percent

(93%) of daily cereal consumed by children was white bread ,followed by 63% rice and 40% biscuit were daily consumed, about 37% and 23% were daily consumed of cakes and pastries respectively. On the other hand , about 95% of CD children not consumed of whole wheat bread



Figure(4,10) cereals consumption among CD children

Discussion

The present cross-sectional study provided information about prevalence of malnutrition among pediatrics CD. Most of the children with celiac disease were in the normal range and a small proportion of them were malnourished. Based on the CDC's criteria and WHO , 20% of the participants had short stature, 80% were normal stature,20%,65%, 10%,and 20% low BMI, normal BMI, overweight , and obese for age, respectively. In addition, according to the CDC's categorization, 40% of the patients had sever wasting for age and 43% had normal weight for age. However, few people were overweight and obese, which was unpredictable in people with CD. Nowadays, growth failure and short stature have been reported as the most common (11). In some children, the only manifestation of CD is impaired growth, which makes the disease diagnosis difficult (12). Moreover, there is evidence that CD can affect children's stature and cause growth retardation beyond growth hormone deficiency (13). According to the results of the present research, only 20% of the children had short stature based on the criteria of both CDC and WHO . However, results were also obtained in some other studies, Giovenale et al. evaluated 7066 children with short stature at the age of 2–14 years and came to the conclusion that 44 children (0.63%) had CD (14). In addition, Assiri performed a study on children in Saudi Arabia and indicated that 10.9% of those with short stature had CD, while 4.3% of them were suspicious to have CD (15). In the same line, Jaweria Masood et al. assessed 300 children with short stature and demonstrated that 120 ones suffered from CD (16). Farooq et al. also disclosed that 12% of the children with atypical CD had short stature and 30% had anemia together with short stature (17). The results of the current study showed that approximately 45% moderate malnourished, 3% sever malnourished of the children with CD in terms of SGNA. Bardella et al. maintained that weight, BMI, lean mass, and fat mass were significantly lower in patients with CD compared to the controls (18). Furthermore, Barera et al. indicated that the patients with untreated CD had lower fat mass and body weight compared to their matched participants in the control group (19). Moreover, Dehbozorgi et al. indicated that 31 and 29% of the children with CD suffered from low body weight and low BMI for age, respectively (20). In the present study also, approximately 10% – 20% of the patients were overweight and obese respectively based on CDC's criteria. Although it has been assumed that patients with CD are likely to be underweight, some evidence has suggested that these patients were increasingly overweight or obese at the time of diagnosis (8–40%) in western countries, and that CD could coexist with obesity in both children and adults (17). The results of the study by Calcaterra demonstrated that among 200 overweight and obese children, 4% of them suffered from CD (21). Nenna et al. also reported that among 1527 overweight/obese children and adolescents, 11.1% were positive for celiac disease (22). Another study in Saudi pediatric population showed that in 119 cases diagnosed with CD, 48% had normal growth or were overweight/obese (23). Singh et al. indicated in their study that 21 out of the 210 cases (9.1%) were overweight and obese (24). Additionally, Valletta et al. showed that 3% of the children with CD were obese and had z-scores higher than + 2 (25). According to a compensatory hypothesis,

nutrients absorption might increase by preserved intestinal cells after a while and lead to excess energy intake (26). Hence, celiac patients with normal or increased body weight should not be excluded at the diagnosis stage. Our result revealed that 40% of CD children had low hemoglobin level, while 65% of CD children with Low levels of vitamin D were observed. The results of studies from different countries in different age groups have consistently shown that celiac patients are at risk of various nutritional deficiencies. These deficiencies are largely the result of damage to the intestinal mucosa and malabsorption, but during the course of gluten free diet(GFD), deficiencies are mainly caused by an improperly balanced diet. Dietary complications in patients with CD on GFD can be caused by the poor nutritional value of commercial gluten-free products, and a complicated selection of food products. Deficiencies seen in celiac patients using GFD include fiber, iron, folic acid, niacin, vitamin B12,vitamin D, and riboflavin(27). studies by Sánchez et al. revealed that , too low iron and hemoglobin level is also observed and, if we consider the fact that people with celiac disease often develop anemia, this nutrient should be under special control (28). According to the dietary intake of CD children the most dairy daily intake was milk (full cream)about 88% ,however, 30%,28% of chocolate milk and flavored yogurt were daily consumed , while 82% of CD children was not consumed of ice cream . Concerning carbohydrates, an increase daily consumption of white bread was revealed while 63% rice and 40% biscuit were daily consumed by CD children. The first observation has been reported in previous studies, where was described in CD children a higher amount of fats intake related to the wrong choice of natural foods. However , BARDELLA et al. shows that CD children in fact ate less foods containing carbohydrates such as bread, pizza or pasta without an increase of alimentary items of the same group (rice, corn and potatoes) but with an augment of intake of foods such as meat, eggs and legumes (29) , this study was different from our result. Study was done by Mariani etal. reported similar findings to our result , study was highlighted the major intake of CD children versus the control subjects, it found out that the snacks were consumed was with a high content of milk and white bread (30)

Conclusion

This study clearly showed that common presentation of CD in pediatrics was well-nourished, some cases of overweight and obesity were detected . our study, the find relevant differences in the food intake by CD children , most kind of dairy product daily intake was milk and daily cereal consumed by children was white bread, vitamin D deficiency and anemia were prevalent as well. Considering the ascending trend of CD incidence, appropriate nutritional evaluation of these patients is essential in early ages for proper diagnosis and management. Based on these interesting preliminary results we estimate that further investigations, such as a randomized multicenter study on the long-term effects of CD with particular attention to the imbalance in daily food intake, are to be conducted. Moreover, future studies are required to apply solutions to reduce CD-related complications.

References

1. Ludvigsson, J. F., Leffler, D. A., Bai, J. C., Biagi, F., Fasano, A., Green, P. H., ... & Ciacci, C. (2013). The Oslo definitions for coeliac disease and related terms. *Gut*, *62*(1), 43-52.
2. Greco, L., Timpone, L., Abkari, A., Abu-Zekry, M., Attard, T., Bouguerrà, F., ... & Terzic, S. (2011). Burden of celiac disease in the Mediterranean area. *World journal of gastroenterology: WJG*, *17*(45), 4971..
3. Dehghani, S. M., Haghighat, M., Mobayen, A., Rezaianzadeh, A., & Geramizadeh, B. (2013). Prevalence of celiac disease in healthy Iranian school children. *Annals of Saudi medicine*, *33*(2), 159-161.
4. Sahin, Y., Cakir, M. D., Isakoca, M., & Sahin, D. A. (2020). Prevalence of celiac disease in children with type 1 diabetes mellitus in the South of turkey. *Iranian Journal of Pediatrics*, *30*(1). Weiss B, Pinhas-Hamiel O. Celiac Disease and Diabetes: When to Test and Treat. J Pediatr Gastroenterol Nutr. 2017;64:175–179. [PubMed] [Google Scholar]
5. Liu, E., Wolter-Warmerdam, K., Marmolejo, J., Daniels, D., Prince, G., & Hickey, F. (2020). Routine screening for celiac disease in children with down syndrome improves case finding. *Journal of pediatric gastroenterology and nutrition*, *71*(2), 252-256.
6. Wierdsma, N. J., van Bokhorst-de van der Schueren, M. A., Berkenpas, M., Mulder, C. J., & van Bodegraven, A. A. (2013). Vitamin and mineral deficiencies are highly prevalent in newly diagnosed celiac disease patients. *Nutrients*, *5*(10), 3975-3992.
7. van der Pals, M., Myléus, A., Norström, F., Hammarroth, S., Högberg, L., Rosén, A., ... & Carlsson, A. (2014). Body mass index is not a reliable tool in predicting celiac disease in children. *BMC pediatrics*, *14*(1), 1-6.
8. Brambilla, P., Picca, M., Dilillo, D., Meneghin, F., Cravidi, C., Tischer, M. C., ... & Zuccotti, G. V. (2013). Changes of body mass index in celiac children on a gluten-free diet. *Nutrition, Metabolism and Cardiovascular Diseases*, *23*(3), 177-182.
9. Clinical Growth Charts. Available from: https://www.cdc.gov/growthcharts/clinical_charts.htm. Accessed 8 Nov 2020
10. Cornean, R. E., Gheban, D., Simionescu, B., & Margescu, M. (2018). Celiac disease among adolescents. Poor growth and delayed puberty. *Int J Celiac Dis*, *2*, 52-7.

11. Tümer, L., Hasanoglu, A., & Aybay, C. (2001). Endomysium antibodies in the diagnosis of celiac disease in short-statured children with no gastrointestinal symptoms. *Pediatrics International*, *43*(1), 71-73.
12. Catassi, C., & Fasano, A. (2004). Celiac disease as a cause of growth retardation in childhood. *Current opinion in pediatrics*, *16*(4), 445-449.
13. Giovenale, D., Meazza, C., Cardinale, G. M., Sposito, M., Mastrangelo, C., Messini, B., ... & Bozzola, M. (2006). The prevalence of growth hormone deficiency and celiac disease in short children. *Clinical medicine & research*, *4*(3), 180-183.
14. Assiri, A. M. A. (2010). Isolated short stature as a presentation of celiac disease in Saudi children. *Pediatric reports*, *2*(1), e4.
15. Masood, J., Rehman, H., Anjum, Z. M., Iqbal, I., Zafar, S., & Ayesha, H. (2020). Prevalence of celiac disease in idiopathic short stature children presenting in OPD of children hospital, Faisalabad. *Annals of Punjab Medical College*, *14*(1), 9-12.
16. Farooq, A., Sheikh, T. K., Bashir, H., & Haroon, S. (2020). Celiac Disease in children and the impact of late diagnosis. *Methodology*, *12*(3), 136-40.
17. Bardella, M. T., Fredella, C., Prampolini, L., Molteni, N., Giunta, A. M., & Bianchi, P. A. (2000). Body composition and dietary intakes in adult celiac disease patients consuming a strict gluten-free diet. *The American journal of clinical nutrition*, *72*(4), 937-939.
18. Barera, G., Mora, S., Brambilla, P., Ricotti, A., Menni, L., Beccio, S., & Bianchi, C. (2000). Body composition in children with celiac disease and the effects of a gluten-free diet: a prospective case-control study. *The American journal of clinical nutrition*, *72*(1), 71-75.
19. Dehbozorgi, M., Honar, N., Ekramzadeh, M., & Saki, F. (2020). Clinical manifestations and associated disorders in children with celiac disease in southern Iran. *BMC pediatrics*, *20*(1), 1-7.
20. Calcaterra, V., Regalbuto, C., Manuelli, M., Klersy, C., Pelizzo, G., Albertini, R., ... & Cena, H. (2020). Screening for celiac disease among children with overweight and obesity: toward exploring celiac iceberg. *Journal of Pediatric Endocrinology and Metabolism*, *33*(8), 995-1002.
21. Nenna, R., Mosca, A., Mennini, M., Papa, R. E., Petrarca, L., Mercurio, R., ... & Vania, A. (2015). Coeliac disease screening among a large cohort of overweight/obese children. *Journal of pediatric gastroenterology and nutrition*, *60*(3), 405-407.
22. Al-Hussaini, A., Troncone, R., Khormi, M., AlTuraiki, M., Alkhamis, W., Alrajhi, M., ... & Elchentoufi, A. (2017). Mass screening for celiac disease among school-aged children: Toward exploring celiac iceberg in Saudi Arabia. *Journal of pediatric gastroenterology and nutrition*, *65*(6), 646-651.

23. Singh, I., Agnihotri, A., Sharma, A., Verma, A. K., Das, P., Thakur, B., ... & Makharia, G. K. (2016). Patients with celiac disease may have normal weight or may even be overweight. *Indian Journal of Gastroenterology*, *35*(1), 20-24.
24. Valletta, E., Fornaro, M., Cipolli, M., Conte, S., Bissolo, F., & Danchielli, C. (2010). Celiac disease and obesity: need for nutritional follow-up after diagnosis. *European journal of clinical nutrition*, *64*(11), 1371-1372.
25. Diamanti, A., Capriati, T., Basso, M. S., Panetta, F., Di Ciommo Laurora, V. M., Bellucci, F., ... & Francavilla, R. (2014). Celiac disease and overweight in children: an update. *Nutrients*, *6*(1), 207-220.
26. Penagini, F., Dilillo, D., Meneghin, F., Mameli, C., Fabiano, V., & Zuccotti, G. V. (2013). Gluten-free diet in children: an approach to a nutritionally adequate and balanced diet. *Nutrients*, *5*(11), 4553-4565.
27. Sánchez, E., Laparra, J. M., & Sanz, Y. (2012). Discerning the role of Bacteroides fragilis in celiac disease pathogenesis. *Applied and environmental microbiology*, *78*(18), 6507-6515.
28. Bardella, M. T., Fredella, C., Prampolini, L., Molteni, N., Giunta, A. M., & Bianchi, P. A. (2000). Body composition and dietary intakes in adult celiac disease patients consuming a strict gluten-free diet. *The American journal of clinical nutrition*, *72*(4), 937-939.

29.Mariani, P., Viti, M. G., Montouri, M., La Vecchia, A., Cipolletta, E., Calvani, L., & Bonamico, M. (1998). The gluten-free diet: a nutritional risk factor for adolescents with celiac disease?. *Journal of pediatric gastroenterology and nutrition*, *27*(5), 519-523.