Dietary Intake among a group of Children with Acute Lymphoblastic Leukemia (ALL)

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Abstract: **Background:** Children with acute lymphoblastic leukemia (ALL) are at elevated risk for nutrition-related morbidities both during and after therapy. Children who are malnourished are at increased risk for infection, reduced quality of life, and poor neurodevelopmental and growth outcomes. **Objectives:** This study carried for assessment of the dietary intake of group of children of ALL. **Subjects and Methods:** This study is a cross sectional descriptive one for which the study population was recruited from hematology oncology unit in Zagazig University hospitals. The study included 21 Children undergoing treatment for ALL. Their age ranged from 3-11 year both boys and girls was included. The population sample was interviewed by using special questionnaire of the Hematology Oncology unit. Anthropometric measurements were performed. Dietary Assessment was performed using 24H dietary recall, food frequency of selected food items, FVS and DDS. Our patients were subjected to laboratory investigation including fasting and post-prandial blood sugar, liver and kidney function tests. **Results:** There was accepted level of consumption of the caloric intake. The majority of patients were within the RDI for all other macronutrients with specific decrease intake of essential fatty acid. Despite adequate caloric intake, the majority of patients had low dietary intakes of vitamin E,C, niacin, folic acid, calcium, selenium and vitamin D. Meanwhile accepted dietary intakes were observed for some vitamins and some minerals,. There was fair consumption of food variety and accepted level of consumption of different food groups. **Conclusion**: This study was successful in identifying priority nutrients for dietary intervention (total caloric intake, essential fatty acid intake, antioxidants (vitamin, C, E, selenium) and bone forming nutrients (vitamin D and calcium) and folic acid in selected group of ALL children.
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1. Introduction

Cancer is a disorder of cell growth and regulation, leadingto abnormal cell division and production (Grant B., 2008). This dysregulation results in unlimited, dysfunctional cell production (Cohen, 2011). Pediatric acute lymphoblastic leukemia (ALL) is the most frequently occurring cancer in children and adolescents. Symptoms may include bleeding and bruising problems, feeling tired, fever, bone pains and an increased risk of infections (Heuberger, 2011). Management of ALL is directed towards control of bone marrow and systemic disease. Additionally, treatment must prevent leukemic cells from spreading to other sites, particularly the central nervous system (CNS). Improvements in survival have been most apparent for acute lymphoblastic leukemia (National Cancer Institute, 2013). Current pediatric treatment protocols yield a cure rate approaching 90%.Children with acute lymphoblastic leukemia are at elevated risk for nutrition-related morbidities both during and after therapy (Lados E., 2013). Children who are malnourished are at increased risk for infection, reduced quality of life, and poor neurodevelopmental and growth outcomes (Picot et al., 2012). The treatment protocols used in pediatric oncology patients are more aggressive than those used in adults as they exhibit elevated substrate needs due to the disease and its treatment. At the same time, children have increased requirements of nutrients. There is important pathophysiological mechanisms that contribute to the development of malnutrition and growth failure in childhood cancer. (Skipworth R., 2007). American cancer society advocate the importance of balanced diet with increased caloric and protein intake, Getting enough protein is important during treatment. As it is necessary for immune health, growing new cells and the preservation of lean body mass. Children being treated for cancer may need even more calories for tissue healing and energy(American cancer society, 2012). Many experimental and clinical studies have indicated that free radicals are involved in the biochemical mechanisms that underlie hematologic disorders [Corm S et al. (2009) and Al-Gayyar et al., (2007)]. Concluded that leukemia patients produce larger amounts of ROS than nonleukemia patients. Micronutrients of interest antioxidants may minimize therapy-relate side effect with reduction of oxidative stress (Ladas, 2013). Zinc, is a trace element that is a constituent of more than 200 enzymes, plays an important role in nucleic acid metabolism, cell

replication, tissue repair and growth. Copper is an essential nutrient that is widely distributed in food and water and a component of several metalloenzymes that are required for oxidative metabolism, including cytochrome oxidases (Ursula, 2006**)**. In children with acute lymphoblastic leukemia there is abnormalities in mineral homeostasis and bone mass, biomarkers of bone formation (osteocalcin, bone specific alkaline phosphatase were observed to be suppressed, while bone resorption was elevated together with the effect of chemotherapeutic drugs such as steroids (Atkinson SA., 2008). Nutrients related to bone metabolism have been a target area of research due to the observation of increased incidence of bone fractures during and after treatment for ALL in malnourished children (Kaste et al., 2001). Balanced and healthy diet that includes plenty of fruits and vegetables, whole grains, lean sources of protein, low-fat dairy foods and healthy fats.) are recommended by Americain cancer society (2012). The assessment of nutritional status among pediatric patients is important for the planning and execution of nutritional strategies that strive to optimize the quality of life and growth among children with ALL. The present study aimed to evaluate the dietary intake among a group of children with acute lymphoblastic leukemia.

Objectives:

1- Assessing dietary intake of the ALL children's.

2- find the relation between children dietary intake and the dietary recommendation for ALL of the American cancer society.

3- Identify potential areas of high priority for nutrition intervention.

2. Subjects and methods

A puperposivesample of 21 patients of both sexes with acute lymphoblastic leukemia their age range between 3 and 11 years from Heamatology oncology pediatric department in Zagazig University in EL Zagazic Governorate. The study duration 6 months from, June 2015 till December 2015. The participants were diagnosed as ALL patients based mainly on bone marrow aspiration and immunophenotyping. The study was carried in post induction phase of treatment. They received CCG protocol that composed of 6 stages ofthe chemotherapeutic agents (Methotrexate, oncovein, mercaptopurien, dexamethasone, cycloposphamide and Ara C).

1. Questionnaire of Heamatology Oncology Unit

All the cases were subjected to interview questionnaire of Heamatology Oncology Pediatric Department in Zagazig University Hospital.

2-Anthropometric Measurements

Weight and height was recorded according to the standardized methods (who., 2007).

Height was categorized as: Normal (-2 to +2SD), Short stature <-2SD, and Tall if >+2SD.

Wight was categorized as: Normal (-2 to +2SD), Wasting (<-2 SD), and Over weight (>+2SD).

Assessment of Body Mass Index for age:

For age from 3-11 years old, the Z score body mass index was used for boys and girls. The following categories of weight status were determined according to WHO Z score body mass index growth chart reference for children (2-19) years old) released by WHO in 2007.

BMI was categorized as: Normal (>-2 to <+1), Over weight (>+1 SD), Obese (>+2SD) and Thinness (<-2 SD).

3-Dietary assessment:

Data on nutritional status had been collected using specially designed questionnaires to cover required information on: Food intake (24 hours recall), and Dietary pattern "Food frequency" for selected items.

The energy and nutrient content of the 24 hour was computed through the compiled food composition tables of the NNI (2006).

Dietary dequacy:

The nutritional value of foods items consumed was compared to the recommended dietary allowances "RDAs" of WHO, FAO (2002). Iron estimation was based on its bioavailability according to the daily diet content of heam iron source in grams (meat, poultry and fish) or ascorbic acid (mg) as follows: Low bioavailability: <30gm of heam iron source or <25 mg of ascorbic, Intermediate bioavailability: 30-90 gm of heam iron source or 25-75mg of ascorbic acid and High bioavailability: >90gm of heam iron source or >75mg ascorbic acid (Sight and life /Newsletter/ 2002).

Food Variety Score

Food Variety Score (FVS) was defined as the number of different food items eaten during the registration period. The total number of foods included in FVS was independently of the quantity consumed. This included all the food items (Savige GS., 1997).

The summary table of variety scores, shown as percentages

Total Food Variety Score	Dietary adequacy
30 +	*very good*
25 - 29	*Good*
20 - 24	*Fair*
10 - 19	*Poor*
0 – 9	*very poor*

Diet Diversity Score

Diet Diversity Score (DDS) was defined as the number of food groups consumed by each child (DDS with only eight values was tested for normality) DDS adapted from (Sounda a, 2006) which include 12 food items). In Egypt, we divide food groups into 8 groups, as we used to add tuber and root to cereals, fish and eggs to meat and miscellaneous to sugar. Each food group was used given the number 1 if used, or Zero if not used. The sum of the scores zero or one was calculated and divided by the 8 (total number of food groups). If the percentage is above 75%, the level of consumption is accepted. If below 50% consumption, it will be unaccepted level of consumption.

Data analysis

Statistical Package for the Social Sciences (SPSS version 20.0) was used to conduct all the statistical analyses.

3. Results:

This study included 21 patients with acute lymphoblastic leukemia. Of those patients, 11 were boys (52.4%) and 10 were girls (47.6%). Their ages range between 3 and 11 years with no statistical difference between boys and girls. No statistical differences were found between boys and girls regarding weight, height (table 1).

Table 1: Summary of the subjects' characteristics.

Characteristics	Girls (n =10)	Boys (n =11)	Total (n = 21)
Age (years)	6.5 ± 2.1	7.75 ± 2.98	7.68 ± 3.05
Weight (kg)	21.7 ± 5.98	23.75 ± 7.10	22.77 ± 7.27
Height (cm)	113.7 ± 15.64	106.75 ± 12.01	114.4 ± 14.28

Values are expressed as mean ± SD.

Table (2): **Percent distribution of Individual according to sex, age groups weight height Z score**

Weights and heights of patients were blotted on Weight and heights growth charts. The patient was considered stunted when <-2 SD below normal matched height, wasted when <-2 SD below normal weight for matched height. Using BMI Z score, the patient was considered thinny when <-2 SD below normal age. In the current study 38.09% were stunded, 33.3% were wasted,and28.5were thinny respectively.

Table (2). Factors

	NO	%
Sex		
Male	11	52.4
Female	10	43.6
BMIZ		
Normal:>-2SD – <2 SD	11	52.3%
Thinness: <-2SD	6	28.5%
Overweight: > 2 SD	4	19%
WHZ		
Normal: > -2SD -<2 SD	11	57.1%
Wasting: < 2SD	7	33.3%
Overweight: > 2 SD	2	9.5%
HAZ		
Normal:> -2SD - <2 SD	12	57.1.
stunting: < 2SD1	8	38. 09
Tall:> 2 SD	1	4.7%

Dietary adequacy was interpreted according to the following categories: 50% (unsafe level of consumption), >50-75% (unaccepted level of consumption), >75-100% (accepted level of consumption), >100-120% adequate level of consumption and >120% (over consumption). The current data showed that there was unsafe level of consumption of vitamin E, C, selenium, folate vitamin D, fibers and cupper, unaccepted level of consumption of calcium and omega 3, and accepted level of consumption of total calories and protein, fat, iron, magnesium, vitamin A and B, adequate level of consumption of phosphorus and zinc, with over consumption of simple carbohydrate potassium and sodium and omega 6 (table 4).

Table (3). Dietary adequacy among the studied group

Nutrient	Mean± Std. Deviation	%RDA
Cals (kcal)	1444.27±412.937	81.41%
Prot (g)	56.45±19.160	77.82%
Carb (g)	195.50±63.867	150.39%
Fib (g)	8.82±5.586	35.25%
Fat (g)	48.55±20.215	86.25%
Vit A (µg)	417.55±837.674	85.65%
B1 (mg)	.73±.703	91.25%
B2 (mg)	.77±.528	96.25%
Niacin	.50±.40	35%
Vit C (mg)	14.09± 80.522	41.75%
Calc (mg)	567.68±272.189	73.24%
Copp (mg)	.73±.550	14.798%
Iron (mg)	7.77±6.298	81.79%
Magn (mg)	103.50±44.962	87.53%
Phos (mg)	752.27±258.885	102.11%
Pot (mg)	606.77±163.298	151.69%
Sod (mg)	2452.95±1010.619	199.42%
Zinc (mg)	7.68±2.662	105.39%
Omeg3(g)	.331±.233	50.51%
Omeg6 (g)	10.898±3.321	450.03%
Vit E(µg)	1.21±1.0	17.93%
Selenium(µg)	107.11±58.1	38.32%
folate(mcg)	116.09±38.217	44.23%
vit D (mcg)	1.68±0.853	33.6%

Food variety and dietary diversity

The children consumed 20 different food items in total during the registration period, corresponding to a theoretical maximum of the Food Variety Score (FVS) of 75.0 The mean FVS was (20.1) using FVS ranges (12 – 30) our patients score was fair with no statistical differences between boys and girls.

Dietary Diversity (DDS): Number of food groups eaten by the patients are defines as Dietary Diversity Score (DDS). Mean value of Dietary Diversity Score (DDS) for our patients was 5.8. DDS theoretical range was 1 to 8. No statistical differences between boys and girls were recorded and the level of consumption of different food groups was accepted (table 5).

Table(4): Food variety and dietary diversity

Characteristics	Girls (n =10)	Boys (n =11)	Total (n = 21)
Age (years)	6.5 ± 2.1	7.75 ± 2.98	7.68 ± 3.05
Food Variety Score (FVS)*	20.8 ± 1.4	20.1 ± 3.1	20.2 ± 3.9
(DDS Dietary Diversity Score	0.78 ± 0.11	0.77 ± 0.10	0.77 ± 0.10

4. Discussion:

Adequate nutrition during cancer plays a decisive role in several clinical outcome measures, such as treatment response, quality of life and cost of care. (Bauer j., 2005) American Institute for Cancer Research, 2012 recomend increase caloric intake of cancer children.

.Our results showed that the patients' consumption of total calories was less than the caloric requirement of normal children. But within the accepted range, our result was in line with Bonds, 1992 reported that Low caloric intake in the studied group of ALL children. Incontrast to these studies, the results of (Ladas, 2013). Contrary to expectations, total caloric intake in the majority of patients exceeded the DRIs with a smaller percentage of patients below the DRI for calories. This difference may contribute to different stage of assessment and large study population. Though there was point of concordance there was reduced energy intake in patients from the upper age range (6 to 10 years). Children with cancer may need extra protein and more calories (American Institute for Cancer Research, 2012). Fortunately the majority of our patients had accepted level of consumption for total protein and fat intake with increased total carbohydrate intake our result was supported by the result (Ladas et al., 2013). They found that the protein intake was over two times the

RDA among children with ALL. Halton et al., (1998) also reported that dietary intake in the majority of children was above the Canadian Recommended Nutrient Intake (RNI). Unfortunatel your study showed that the majority of the children had adequate carbohydrate intake but with increased intake of simple carbohydrate in contrast to the cancer society recommendation. In addition, they had low intake of essential omega 3 fatty acids, such as linoleic acid. Unaccepted level of consumption was noticed despite its important contribution in building cells and anti-inflammatory process. Our result was in line with (Ladas et al, 2013 and, Ursula, 2006). Despite adequate macromolecules intake, the majority of patients had low dietary intakes of (vitamins: C, E and, niacin) some minerals calcium, cupper, selenium) our result regarding decrease intake of cupper and selenium was in line with (Ursula, 2006) regarding cupper and selenium but not in the zinc intake this could be explained by the observed increased protein intake. Antioxidants are important point of interest (ladas, 2013). Some study explored the effect of dietary intake of antioxidants on therapy-related side effects and survival in children with cancer (Kennedy et al., 2004). The authors found children with higher, dietary intake of beta-carotene and vitamin C experienced reduced hematologic or non-hematologic side effects. Higher vitamin E intakes were more likely to have rapid response to treatment. These finding supported our results regarding antioxidant nutrients intake. (C, E andselnium). Comprehensive reviews of the role of Bone-metabolizing nutrients in All children been published (Ladas et al., 2004; Tylavsky et al., 2010). They Observed diminished intake of vitamin D and calcium in their studies this was supportive evidence of our finding as we found that the majority of patients were below the DNI for calcium, and vitamin D. Some studies have suggested a role of B vitamins in the development of neuropathy, a side effect of therapy for ALL (Abbas et al., 1997; Ang et al., 2008). To date, no studies have explored dietary intake of B vitamins during cancer therapy in children with ALL. Folate, in particular, is a nutrient of high interest due to the inclusion in the DNA repair and the role of methotrexate for the treatment of ALL (as anti-folate drug) (Robien, 2003). Our result showed decrease intake of folic acid this was in line with Chlebowski, 2003. According to American Institute for Cancer Research, 2012; All children must receive a variety of all food groups, fruits and vegetables, whole grains, and lean protein our result showed that the intake from all food items was Fair. The decreased caloric intake and bone metabolizing nutrients was reflected on the patients nutritional status among our studied children as there was 33.3% wasting, 28.2% thininess and stunting 38.09%. Similarly, malnutrition was recorded by (Ursula, 2006) who demonstrated that malnutrition prevalence was of 30% among ALL children. Another supportive evidence came from (Hingorani et al., 2011). Who found that his studied children was either underweight or overweight in different stages of cancer therapy. A better understanding of variations in dietary intake during cancer therapy and the degree to which children deviate from the DRIs is a necessary first step in developing standardized guidelines for clinical intervention that are evidence-based rather than derived from clinical experience.

Conclusion

This study was successful in identifying priority nutrients for dietary intervention (Essential fatty acid intake, and vitamin E,C folic acid vitamin D and calcium. Vitamin A there is excess intake of polyunsaturated fatty acid with reverse of the ratio of omega 3 and omega 6.

Recommendation

The preliminary findings of dietary inadequacy and over consumption of some nutrients support the need for nutritional screening and monitoring of ALL children Optimizing dietary intake through nutritional education and appropriate use of nutritional support where necessary.

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