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Nutritional Status of Pediatric Patients with Cancer in Iran: A Single Center Study

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ABSTRACT

Background: As children have a higher metabolic rate and higher calorie needs for growth, they are more susceptible to nutritional depletion than adults. We aimed to assess the nutritional status of children with cancer who were referred to the outpatient clinic of hematology and oncology clinic at Sheikh Children Hospital, Mashhad, Iran.
Methods: The nutritional status of the children with cancer was assessed by anthropometric indices and nutritional risk screening tool. We used BMI-for-age (BMIFA), height-for-age (HFA) and weight-for-height (WFH) to define malnutrition. The anthropometric indices (BMIFA, HFA, and WFH) were categorized according to z-scores. STRONGkids tool was applied for screening risk of malnutrition.
Results: 61 pediatric patients with cancer were assessed. Of the studied patients, 77% were boys (47 patients) with a mean age of 8.4 years (6 months to18 years). Acute lymphoblastic leukemia (ALL) was the most prevalent cancer (64%). 26.2% of the patients had malnutrition according to BMI for age z-score index (underweight), 24.5% according to weight for height (WFH) index (wasting) and 21.3% according to HFA index (stunting). The STRONGkids classified 34.4% of patients as high risk, and 65.6% as moderate risk of malnutrition.
Conclusions: Malnutrition was prevalent among pediatric cancer patients in this study, so appropriate nutritional screening and management should be implemented for improving the nutritional status of children with cancer.

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Introduction

Malnutrition in children with cancer is a considerable problem.[1] As children have a higher metabolic rate and higher calorie needs for growth, they are more susceptible to nutritional depletion than adults.[2] The prevalence of malnutrition among children with cancer varies from 8% to 43% in developing countries.[3] Although intensive multimodal therapies such as chemotherapy, surgery, radiation and stem cell transplantation improve survival of children with cancer, therapy-related side effects may lead to deterioration of nutritional status and quality of life.[4]

Children who suffer from malnutrition have poor outcomes compared with well-nourished children.[5] Malnutrition is related to decreased response to the treatment and higher risk of severe infections. Moreover, reduced protein-calorie intake may influence the sensitivity to chemotherapeutic agents and immune status.[6, 7] The reason of malnutrition in pediatric cancers is multifactorial including increased metabolic rate, anorexia, treatment-related factors and release of pro-inflammatory cytokines which lead to malnutrition by inducing muscle wasting.[8-10] Malnutrition may still be prevalent even in the remission state.[11]

The major side effects of chemotherapy which affect nutritional status of the patients include nausea, vomiting, anorexia, lethargy, diarrhea, esophagitis, dysphagia, and constipation.[12] For screening the nutritional status in children, several tools have been developed. In Iranian

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hospitalized children, the STRONGkidstool is considered to be correlated with anthropometric measurements more than the other tools including "Pediatric Yorkhill Malnutrition Score" (PYMS) and "screening Tool for the Assessment of Malnutrition in Pediatrics" (STAMP).[13] STRONGkids tool also considers clinical symptoms which is the strength of this tool for analysis in children.[13]

To our knowledge, there are few studies demonstrating nutritional risk in children with cancer in Iran. In a study conducted in Iran, Gholampour and colleagues evaluated the nutritional status of 100 children admitted to different departments of a tertiary pediatric hospital. Results of their study showed a 23% prevalence of malnutrition in hematology department.[14]

The aim of this study was to assess the prevalence of malnutrition risk in children with cancer who were referred to the outpatient clinic of hematology and oncology, Doctor Sheikh Children's hospital, Mashhad, Iran.

Patients and Methods

We performed a clinical audit in children who were referred to the hematology and oncology clinic, Dr. Sheikh Children's Hospital, Mashhad, Iran, during one month from 15th December 2015 to 15 th January 2016. All children aged 1 month to 18 years old with pathologically approved malignancy were examined in this study. The patients were either in active phase of treatment or during remission. Informed consent was obtained from all parents before assessment. A checklist was filled out for each participant by an experienced dietician, which consisted of three parts: demographic information, nutritional assessment, and cancer-related information. Nutritional assessment included anthropometric measurements and nutritional risk screening tool. Cancer-related information included type of cancer, date of diagnosis, type of treatment and clinical symptoms including anorexia, nausea, vomiting, dry mouth, early satiety, taste alterations, altered sense of smell, sore mouth, diarrhea, swallowing problem, constipation, and pain. We also asked patients whether they had received any nutritional counseling so far.

For anthropometric measurements, participants wore light clothing without shoes. Weight was measured with a digital scale (Seca334) for infants and a mechanical scale for older children (Seca760, Germany) and recorded to the nearest 0.1 kg. Height was measured with a stadiometer (Seca 213, Germany) and recorded to the nearest 0.1 m. Length was measured in children younger than 2 years of age using an infantometer (Seca417, Germany) with a flat horizontal surface and a fixed head-board and a moving foot-board. Body mass index (BMI) was calculated by weight divided by square of height kg/m^2.

For nutritional assessment, we used BMI-for-age (BMIFA), height-for-age (HFA) and weight-for-height (WFH) to define malnutrition. The anthropometric indices (BMIFA, HFA, and WFH) were categorized according to z-scores based on World Health Organization (WHO) charts in children.[15] We used Epi Info™ 7 to calculate z-scores. We considered anthropometric indices less than -2 z-score as malnutrition and less than -3 z-score as severe malnutrition.

STRONGkids is a simple tool for identifying risk of malnutrition, validated by Hulst et al. for children aged 1 month to 18 years old.[16] It includes items which assess diminished muscle mass and fat by subjective clinical evaluation, the presence of a high-risk disease, nutritional intake and loss (reduced food intake, diarrhea and vomiting), and weight loss or poor weight gain. A specific score is allocated for each item. The items are summed up which show the risk of malnutrition. The scores range between 0 and 5. A score of 0 indicates a low risk of malnutrition, a score between 1 and 3 indicates a moderate risk of malnutrition, and scores of 4 and 5 show a high risk of malnutrition.

SPSS software version 12 (SPSS, Inc.) was used for data analysis. To check the normal distribution of the variables, Kolmogorov–Smirnov test was used. Descriptive statistics were used to explain the prevalence of malnutrition based on anthropometry and nutritional screening tool. Chi square test was used for comparison of data between two qualitative variables. For assessing the relationships between anthropometric measurements and STRONGkids, Spearman's correlation was used. P-value < 0.05 was considered significant.

Results

A total of 61 children with cancer were participated in this study. 77% were male (47 patients) and mean age was 8.4 years (6 month to 18 years). The characteristics of children participated in this study are shown in Table 1. Acute lymphoblastic leukemia was the most common malignancy (64%) among the studied population.

Only 11.5% of patients (n=7) had received nutrition counseling before the assessment.

The nutritional status based on anthropometric indices is shown in Table 2. In this study, 26.2% of patients had malnutrition according to BMIFA (16.4% were severely underweight and 9.8% were moderately underweight).

Table 1: Characteristics of the children with cancer

Characteristics	Total
Sex	
Male	47 (77%)
Female	14 (23%)
Diagnosis	
ALL	39 (64%)
AML	1 (1.6%)
Non-Hodgkin's lymphoma	6 (9.8%)
Ewing sarcoma	2 (3.3%)
Osteosarcoma	3 (4.9%)
Neuroblastoma	3 (4.9%)
Wilms tumor	4 (6.6%)
Germinal tumors	1 (1.6%)
CNS tumors	2 (3.3%)
Type of Treatment	
Chemotherapy	27 (44.3%)
Chemotherapy and radiotherapy	12 (19.7%)
Chemotherapy and surgery	1 (1.6%)
Chemotherapy, radiotherapy, and surgery	2 (3.3%)
Completion of treatment	19 (31.1%)

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Table 2: The prevalence of malnutrition according to anthropometric z-scores

Number of patients	BMI for age z<-3 Severely underweight	BMI for age -3<z<-2 underweight	WFH z <-3 severely wasted	WFH -3<z<-2 wasted	HFA z <-3 severely stunted	HFA -3<z<-2 stunt
61	10(16.4%)	6 (9.8%)	9(14.7%)	6(9.8%)	4(6.6%)	9(14.7%)

WFH: Weight for height; HFA: Height for age

Table 3: Eating problems in different phases of treatment of pediatric cancers

Eating problems	Active treatment	Remission state	P value
Anorexia			
Yes	19 (45.2%)	2 (10.5%)	0.01*
No	23 (54.8%)	17 (89.5%)	
Nausea			
Yes	13 (31%)	4 (21.1%)	0.5
No	29 (69%)	15 (78.9%)	
Taste alterations			
Yes	7 (40.5%)	0 (0%)	0.02*
No	35 (59.5%)	19 (100%)	
Dry mouth			
Yes	5 (11.9%)	2 (10.5%)	1
No	37 (88.1%)	17 (89.5%)	
Early satiety			
Yes	13 (31%)	1 (5.3%)	0.04*
No	29 (69%)	18 (94.70.9%)	
Altered sense of smell			
Yes	18 (42.9%)	1 (9.3%)	0.002*
No	24 (57.1%)	18 (94.7%)	
Sore mouth			
Yes	6 (14.3%)	1 (5.3%)	0.2
No	36 (85.7%)	18 (94.7%)	
Diarrhea			
Yes	3 (7.13%)	1 (5.3%)	0.6
No	39 (92.9%)	18 (94.7%)	
Swallowing problem			
Yes	1 (2.4%)	0 (0%)	0.6
No	41 (97.6%)	19 (100%)	
Constipation			
Yes	9 (21.4%)	0 (0%)	0.02*
No	33 (78.6%)	19 (100%)	
Pain			
Yes	8 (19%)	1 (5.3%)	0.1
No	34 (81%)	18 (94.7%)	

Table 4: Prevalence of risk of malnutrition according to the STRONGkids

Risk of malnutrition	Active treatment (n=42)	Remission state (n=19)
Moderate risk	24 (57.1%)	16 (84.2%)
High risk	18 (42.9%)	3 (15.8%)

According to WFH and HFA index, 24.5% (14.7% severe wasting and 9.8% moderate wasting) and 21.3% (6.6 % severe stunting and 14.7% moderate stunting) of the patients had malnutrition, respectively.

The most prevalent eating problems were anorexia (34.4%), altered sense of smell (31.2%) and nausea (27.8%). As Table 3 indicates, eating problems were more prevalent during active phase of treatment in comparison to remission state of the patients. Anorexia, taste problems, early satiety, altered sense of smell and constipation were significantly higher during active treatment compared with remission state (P<0.05).

The STRONGkids tool classified 65.6% of the patients as moderate risk and 34.4% as high risk for malnutrition (Table 4). None of the patients were in low risk group since all patients scored 2 for the second question of STRONGkids (Is there an underlying disease or an expected surgery with a risk of malnutrition). Patients during active treatment had significantly higher risk of malnutrition in comparison with patients in remission state (42.9% vs. 15.8%, P=0.02). Risk of malnutrition identified by of STRONGkids correlated with WFA z-score (P=0.002).

Discussion

The present study showed that 26.2% of children aged

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1 month to 18 years with cancer had malnutrition based on BMIFA, 24.5% based on WFH, and 21.3% based on HFA index. The issue of malnutrition in children with cancer is an important issue and numerous studies have confirmed malnutrition in pediatric patients with malignancy with different frequencies reported.[16, 17] In a study in Casablanca, Tazi and colleagues found that 33% of children hospitalized with cancer had malnutrition at the time of diagnosis according to BMIFA and 20% according to HFA.[17] Although the prevalence of underweight children was lower in our study (26.2%), the prevalence of stunting was almost the same (21.3%) as the mentioned study.[17] In another study from Brazil, the frequency of malnutrition was 13.3% based on BMIFA and 10% based of HFA in children hospitalized with cancer at the time of diagnosis,[18] which is much lower than that reported in the present study. The variations in the prevalence of malnutrition (based on BMIFA) among different studies can be explained by the difference in body compositions, therapeutic measures, and size of tumors,[19] as well as the difference in the type of the neoplasm and timing of the treatment.[20]

Defining malnutrition based on anthropometric variables has been suggested by WHO, but using this definition for assessment of malnutrition in children with cancer can be biased, as cancerous children may have edema or large abdominal masses, which can mask the diagnosis of malnutrition, if this method is used.[21] Accordingly, different assessment tools have been designed to overcome this bias, among which $STRONG_{kids}$ tool is considered to be correlated with anthropometric measurements more than the other tools, including PYMS and STAMP.[13] Calculating the risk of malnutrition in children with cancer using $STRONG_{kids}$ in the present study showed that most (65.6%) had a moderate risk and 34.4% high risk; none were low risk. In a study conducted by Gholampour and co-workers 17% of children admitted to a hematology department were classified as low risk, 75% as moderate risk, and 8% as high risk group, making a total of 83% risk of moderate and severe malnutrition, while according to WFH, HFA, and WFA z-scores, 31.4%, 19.2% and 28% of children were identified as moderately and severely malnourished, respectively.[14] The results of this study, in agreement with findings of the present study, showed the inaccuracy of considering malnutrition in cancerous children based on anthropometric variables and the accuracy of its assessment by $STRONG_{kids}$ in Iranian children. However, the rate of moderate and severe malnutrition in the study by Gholampour et al. (83%) was lower than that in the present study (100%). In our study, we had no case of low risk, as all patients scored 2 for the presence of malignancy (underlying illness with a risk of malnutrition). In another study in Italy by Triarico et al., evaluating 126 children, aged 3-18 years, newly diagnosed with cancer, showed that 28.6% were classified as "high risk" based on $STRONG_{kids}$,[22] which was lower than that in the present study. The frequency of children at high risk of malnutrition in our study, much higher than the previous studies,[14, 22] indicate the necessity of paying greater attention to this issue in cancerous children. The high percentage of children at risk of malnutrition in present study can also be related to the fact that only 11.5% of patients received nutrition counseling before our assessment. In another study on adult outpatient cancer patients, Geirsdottir et al. found that only 17% of their study population received nutrition counseling.[23] These results confirmed that malnutrition is underestimated in clinical procedures of cancer patients.

The accuracy of this assessment tool for diagnosis of malnutrition in children with other diseases have been confirmed previously.[24, 25] In the Dutch national survey on 424 children hospitalized with high risk disease, 38% were classified as low risk, 54% as moderate risk, and 8% as high risk group, making a total of 62% risk of moderate and severe malnutrition.[24] In another study in Indonesia, 25.6% of children hospitalized with chronic diseases had moderate malnutrition and 6.2% had severe malnutrition.[24] These results confirm that of the present study, considering appropriateness of $STRONG_{kids}$ for diagnosis of malnutrition in children. This tool is considered an easy and fast assessment tool as it does not require measurement of weight and height, while other tools such as STAMP and PYMS require anthropometric measurements.[26]

Assessing the correlation between the $STRONG_{kids}$ and anthropometric variables in our study showed that it only correlated with WFA z-scores, but not with BMIFA, WFH and HFA z-scores. The results of studies are inconsistent considering the correlation of $STRONG_{kids}$ with anthropometric measurements. Gholampour et al. found no correlation between the risk stratification of $STRONG_{kids}$ with any of the three indices, WFH, WFA, and BMIFA z-scores in children hospitalized with cancer.[14] Other studies have shown a significant and negative association between $STRONG_{kids}$ and WFH in children hospitalized with a critical disease.[22,27] Ling and colleagues showed that $STRONG_{kids}$ correlated with all anthropometric measures.[28]

Another finding in the present study was identification of anorexia, altered sense of smell, and nausea as the most common eating problems, while the frequency of different eating problems were greater during treatment in comparison to remission state. These findings refer to the adverse effects of chemotherapy on the children's nutritional status.[29, 30]

This study was performed on outpatient children with malignancy. More research needs to be performed on larger groups of patients to evaluate the nutritional status of pediatric patients with different types of cancer in hospitalized children.

One of the limitations of the present study was that we only evaluated outpatient children with cancer. Thus, the results cannot be generalized to all children with cancer and inpatients has to be evaluated in other studies.

Conclusion

The results suggested that malnutrition is prevalent in children with cancer and these children are at high risk of severe malnutrition, which refers to the necessity of paying greater attention to this issue and implementation

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of early nutritional screening and management strategies for these children. The low frequency of children who received nutritional counseling before this study suggest the necessity of implementing a referring system for nutritional counseling for these children. This study was performed on outpatient children with malignancy. More research needs to be performed on larger groups of patients to evaluate the nutritional status of pediatric patients with different types of cancer in hospitalized children.

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Conflict of Interest: None declared.

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