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ORIGINAL ARTICLE

Nutritional Intervention in Egyptian Pediatric Patients with Cancer Undergoing Chemotherapy Treatment

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ABSTRACT

Background: When it comes to pediatric cancer, nutrition could have a role in nearly every aspect of cancer control for supportive care, treatment, and recovery. The purpose of this work was to improve the nutritional status of pediatric patients with cancer and to evaluate the impact of nutritional counseling and support among these children.

Methods: This interventional study was carried out on 54 children; they were categorized into two groups (27 in each group): the interventional group (group 1) that included patients who had cancer and undergone chemotherapy with complete nutritional intervention, and the nonintervention group (group 2) that included patients who had cancer and undergone the chemotherapy and refuse to complete nutrition intervention. All patients were subjected to nutritional status and anthropometric assessment at diagnosis and during treatment, to detect clinical outcome. Biochemical assessment was done for all patients, including CBC. direct bilirubin, ALT and AST, albumin and pre-albumin, creatinine, and electrolyte test (Ph, Mg, K^+, and Na^+).

Results: Statistically significant increases were revealed in the degree of malnutrition among the group 2 compared to the group 1 on the 30th, 60th day, and 90th day of follow-up ($p<0.05$), also statistically significant increases were revealed in the visits of dietitian and administration of nutritional supplements in cases of the interventional group when compared to group 2 during different times of treatment and follow up ($p=0.01$, 0.006 respectively). Statistically significant decreases were found in the mean Hb, HT, and creatinine ($p=0.02$, 0.01, and <0.001, respectively) and statistically significant increases in direct bilirubin at the 45th day of follow-up among the nonintervention group compared to the interventional group ($p<0.001$).

Conclusion: Nutritional intervention could have a positive effect on anthropometric measures, quality of life, biochemical analysis and hematological findings at different times of follow-up among studied children with cancer

Keywords: Children Cancer, Nutritional Status, Malnutrition, Morbidity and mortality.

INTRODUCTION

Cancer can develop in children in the same ways it does in adults, with some key distinctions. There is a high rate of cure for childhood malignancies, which might come unexpectedly without early symptoms [1]. When caring for children with cancer, nutrition plays an essential role. For healthy growth and

development, one must consume sufficient and suitable nourishment. Improving quality of life, decreasing toxicity, and increasing survival rates are all possible outcomes of proper diet [2]. In children diagnosed with cancer, proper diet is crucial. Every aspect of pediatric cancer care from prevention and epidemiology to biology, treatment, supportive care, recovery, and survival is impacted by nutrition [3]. Nutritional status (NS) was likely impaired throughout cancer treatment for children who were diagnosed with the condition [4].

However, there is a lot of variability within diagnostic categories and between wealthy and developing nations when it comes to the data that is available about the prevalence of low nutritional status, and these data are derived at different stages of the disease [4]. It isn't easy to draw direct comparisons between studies due to the wide variety of diagnoses, treatment modalities, and protocols used [5]. It is also challenging to provide an accurate estimate of the prevalence of cancer-related malnutrition because there are different definitions of malnutrition, different methodologies used to evaluate nutritional status based on anthropometric measurements, and different criteria and cut-off points [5].

This work aimed to improve the nutritional status of pediatric patients with cancer and to evaluate the impact of nutritional counseling and support among these children at the Pediatric Oncology Unit in Zagazig University Children's Hospital.

METHODS

From March to August 2021, this interventional study was performed on 54 children between 2-15 years old undergoing chemotherapy for cancer who attended the inpatient and outpatient clinic of Oncology Unit at the Pediatric Department at Zagazig University Children's Hospital.

They were categorized into two groups: The interventional group (group 1) consisted of 27 cancer patients whose parents agreed for the nutritional intervention and were receiving chemotherapy. They were 14 boys (51.9%) and 13 girls (45.8 percent) with an average age of 7.97±3.32 years old. The control group (group2) consisted of 27 cancer patients who received chemotherapy but refused to finish the nutritional intervention with an average age of 7.19±3.09 years, ranging from 2-13 years old; they were 19 (70.4 %) male and 8 females (29.6 %).

Inclusion Criteria: newly diagnosed children with cancer who have undergone their treatment at the Pediatric Oncology unit.

Exclusion Criteria: Children with metabolic or nutritional disorders, also those with other conditions that could impact their nutritional status, such as diabetes mellitus or renal failure, patients who did not give their consent, or receiving palliative care, or had a cancer diagnosis that did not require chemotherapy.

This study followed the guidelines [the World Medical Association's Code of Ethics (Declaration of Helsinki) for human studies]. All parents of participants provided informed and written consent. The Institutional Review Board has approved this research (#6701).

Parents of cases were invited for a face-to-face questionnaire at the inpatient and outpatient clinic of Oncology Unit of Pediatric department at Zagazig University Hospital. Patients underwent history taking (age, sex, cancer type, medication, and type of treatment). Clinical examination (weight, height, estimation of BMI, MUAC) according to z score international, laboratory investigations also were done.

Patients were monitored for three months. Over the next three months, patients were checked in every two weeks. In each visit Individualized dietary counselling and anthropometric assessment were done. Follow up was done at diagnosis of cancer and during its treatment to detect clinical outcome.

Nutritional Assessment and Follow-up

Diet regimen was described to each patient to supply energy, macro and micronutrient requirements. Because of malnutrition is difficult to be reversed in oncology patient suffering of metabolic derangement, we initiated nutritional therapy to any patient whose 3 days retrospective dietary recall of energy and macro- and micronutrients intake were less than 60% of his requirements.

Routes of nutritional therapy included (combinations of) the following: -

1-oral feeding

a- Normal foods which included diets which were fortified by energy and proteins, food with modification of its texture or its nutrients components and foods characterized by selective taste steering.

b- Complete oral nutritional supplement (ONS) (standard ONS and high energy high protein ONS)

2- Tube feeding was used to patients when oral intake of food and or ONS less than 60% of requirements.

3-parenteral nutrition.

Incomplete ONS (fish oil, vitamins eg, vit B, D and minerals eg: ca also protein containing products) and immune nutrition eg:- glutamine were used according to every patient status.

Anthropometric Assessment

Anthropometric measurements of all patients were performed according to their age to know what percentile they should fall under for the various scales such as height to age (H/A), weight to age (W/A), weight to height (W/H), body mass index (BMI/A), and (MUAC/Age). MUAC evaluate the patient fat and muscle status to detect acute malnutrition and response to nutritional therapy even before weight change. Caculation of BMI was done, and the patient growth and nutritional status was determined by comparing the values with the age and gender specific WHO tables.

Biochemical Assessment was done to all patients including CBC, Direct bilirubin, ALT and AST, Albumin and pre-albumin, Creatinine, Electrolyte test (Ph, Mg, K^+, and Na^+).

Statistical Analysis

The information was input into SPSS (version 22.0, 2011; SPSS, Inc., Chicago, IL). Descriptive statistics were used to assess the baseline variables. Using chi-square and Fisher's exact tests, we compared the proportions. The two groups' medians were compared at baseline and three months using the Mann-Whitney U test. Following the "last observation carried forward" method of missing value imputing, we conducted an intention-to-treat analysis.

RESULTS

Group 1 (interventional group) was 27 participants. Their ages ranged from 3.5 to 15 years, and there were 14 males (51.9 %) and 13 females (45.8 %) with a mean age of 7.97±3.32 years. the average family size of (4-5) members was 18 (66.7%). On the other side, group 2 (non-interventional group) was 27 participants their ages ranged from 2-13 years old, and they were19 boys (70.4 %) and 8 females (29.6 %) with an average age of 7.19±3.09 years. In terms of treatment modalities, all studied patients in both groups were treated by chemotherapy (table 1).

The mean BW decreased significantly among the group 2 compared to the group 1 on the 45th day, 60th day, 75th day, and 90th day (p=0.04, 0.006. 0.002, and 0.001, respectively). Also, the body weight decreased by 18.22% by the end of the follow-up (p<0.001) (Table 2).

A statistically significant decrease in mean MUAC and decrease in frequency of ≥ 25th percentile MUAC for age were found among the group 2 compared to the group 1 on the 60th day and 90th day of follow-up. A statistically significant decrease in mean MUAC and MUAC for age percentile was found with increased follow-up time in the group 2 (p=0.01) (p=0.008) respectively. A statistically significant decrease was found in mean BMI and decrease in the frequency of ≥ 50th percentile BMI for age among the group 2 compared to the group 1 at the 30th, 60th day, and 90th day of follow-up, also a statistically significant decrease was found in the mean BMI and BMI for age percentile with increase follow up time in the nonintervention patients (Table 3).

The degree of malnutrition (according to Z score for BMI) significantly increased among the noninterventional patients compared to the interventional ones on the 30th, 60th day, and 90th day of follow-up (p<0.05). Also, a statistically significant increase was found in the malnutrition degree with an increase in the follow-up time in the group 2 (p<0.05) (Fig. 1).

The results demonstrated a statistically significant decrease in mean Hb, HT, AST, and creatinine (p<0.001, 0.001, 0.01, and 0.009, respectively) and an increase in direct and indirect bilirubin at baseline follow-up among the group 2 compared to the interventional group (p<0.001). However, on the 45th day of follow-up, there was a significant decrease in mean Hb, HT, and creatinine (p=0.02, 0.01, <0.001 respectively) and an increase in platelets and direct bilirubin (p= 0.001, <0.001 respectively) among the group 2 compared to the group 1. Meanwhile, at 90th days of follow-up, there was a significant decrease in mean HT and creatinine (p=0.02, 0.002, respectively) and an increase in WBCs, platelets, and direct bilirubin (p=0.01, <0.001, and <0.001 respectively) at 90th days of the follow-up among the group 2 compared to the interventional group (Tables 4).

As regards the nutritional status of the studied children, statistically significant increases were revealed in the visits of dietitian and administration of nutritional supplements in cases of the group1 compared to the group 2 during different times of treatment and follow-up (p=0.01, 0.006 respectively) (Table 5).

Table (1): Demographic and medical characteristics of the study group

Variable	**Interventional Group (*n*=27)**		**Control Group (n=27)**		***Sign. Test***	***P value***
Age: (years) *Mean ± SD Range*	7.97±3.32 3.5-15		7.19±3.09 2-13		t = 0.90	0.37 NS
	No	**%**	**No**	**%**		
Sex: *Female* *Male*	13 14	48.1 51.9	8 19	29.6 70.4	χ^2 =1.95	0.16 NS
Family size: *4-5* *6-7* *>7*	18 7 2	66.7 25.9 7.4	16 11 0	59.2 40.7 0	χ^2 = 3.01	0.22 NS
Cancer type: *Acute lymphocytic leukemia* *Burkits lymphoma* *Hodgkin lymphoma* *Neurobalstoma*	19 2 3 3	70.4 7.4 11.1 11.1	15 7 0 5	55.6 25.9 0 18.5	6.75	0.08 NS
Type of treatment: *Chemotherapy*	27	100	27	100	----	----

Table (2): Weight, MUAC, and BMI at different time of follow up among the studied groups:

Variable	**Interventional Group (*n*=27)**	**Control Group (n=27)**	***t***	***P value***
Weight				
Baseline: (kg) *Mean ± SD*	25.19±8.57	22.89±10.44	0.88	0.38 NS
15th day: (Kg) *Mean ± SD*	25.09±8.8	22.74±9.27	0.95	0.34 NS
30th day: (Kg) *Mean ± SD*	24.93±8.6	21.75±8.6	1.36	0.18 NS
45th day: (Kg) *Mean ± SD*	24.91±8.5	20.21±7.81	**2.12**	**0.04***
60th day: (Kg) *Mean ± SD*	25.37±8.59	19.41±6.53	**2.87**	**0.006***
75th day: (Kg) *Mean ± SD*	25.32±8.69	18.61±5.74	**3.35**	**0.002***
90th day: (Kg) *Mean ± SD*	25.46±8.75	18.72±5.58	**3.37**	**0.001***
F	2.29	**13.73**		
P	0.14 NS	**<0.001****		
% of change	+1.07%	-18.22%		
MUAC				
Baseline: (cm) *Mean ± SD*	17.69±1.48	16.89±2.66	**1.36**	**0.18 NS**
30th day: (cm) *Mean ± SD*	17.71±1.42	16.54±2.7	**1.98**	**0.06 NS**
60th day: (cm) *Mean ± SD*	18.19±1.72	15.35±1.32	**6.78**	**<0.001****
90th day: (cm) *Mean ± SD*	18.41±1.81	15.28±0.76	**8.26**	**<0.001****
F	2.13	**4.65**		
P	0.15 NS	**0.01***		
% of change	4.07%	-9.53%		
BMI				
Baseline: (kg/m²) *Mean ± SD*	16.22±1.69	15.31±1.94		1.92
30th day: (kg/m²) *Mean ± SD*	16.37±1.82	15.28±1.77		**2.23**
60th day: (kg/m²) *Mean ± SD*	16.25±1.74	15.07±1.79		**2.46**
90th day: (kg/m²) *Mean ± SD*	16.48±1.78	14.88±1.69		**3.39**
F	3.35	**5.74**		
P	0.07 NS	**0.004***		
% of change	1.6%	-2.81%		

SD: Standard deviation t: Independent t test **F:** Repeated measure ANOVA test
NS: Non significant (P>0.05) *: Significant (P<0.05) **: Highly significant (P<0.001)

Table (3): MUCA and BMI for age among the studied groups at different time of follow up:

Variable	Interventional Group (n=27)		Control Group (n=27)		***t***	***P value***
MUAC for Age	**No**	**%**	**No**	**%**	χ^2	***P value***
Baseline:						
<5th	4	14.8	3	11.1		
5th-<25th	9	33.3	11	40.7	0.43	0.93 NS
25th -<50th	8	29.6	8	29.6		
≥ 50th	6	22.2	5	18.5		
30th day:						
<5th	4	14.8	3	11.1		
5th-<25th	9	33.3	11	40.7	1.32	0.72 NS
25th -<50th	6	22.2	8	29.6		
≥ 50th	8	29.6	5	18.5		
60th day:						
<5th	2	7.4	8	29.6		
5th-<25th	9	33.3	11	40.7	**7.69**	**0.04***
25th -<50th	8	29.6	6	22.2		
≥ 50th	8	29.6	2	7.4		
90th day:						
<5th	1	3.7	8	29.6		
5th-<25th	10	37.1	11	40.7	**9.38**	**0.02***
25th -<50th	8	29.6	6	22.2		
≥ 50th	8	29.6	2	7.4		
Fr	2.70		**15.36**			
P	0.19 NS		**0.008***			
BMI for Age	**NO**	**%**	**NO**	**%**	χ^2	***P value***
Baseline:						
<10th	4	14.8	3	11.1	0.81	0.94
10th-<25th	5	18.5	5	18.5		NS
25th -<50th	11	40.7	11	40.7		
50th- <75th	5	18.5	7	25.9		
75th-95th	2	7.4	1	3.7		
30th day:						
<10th	2	7.4	5	18.5		
10th-<25th	3	11.1	11	40.7	16.89	0.002*
25th -<50th	15	55.6	4	14.8		
50th- <75th	2	7.4	6	22.2		
75th-95th	5	18.5	1	3.7		
60th day:						
<10th	4	14.8	16	59.3		
10th-<25th	2	7.4	0	0	16.54	0.002*
25th -<50th	11	40.7	4	14.8		
50th- <75th	6	22.2	7	25.9		
75th-95th	4	14.8	0	0		
90th day:						
<10th	2	7.4	16	59.3		
10th-<25th	2	7.4	0	0	21.81	<0.001**
25th -<50th	9	33.3	4	14.8		
50th- <75th	7	25.9	7	25.9		
75th-95th	7	25.9	0	0		
Fr	1.98		**16.03**			
P	0.81 NS		**0.009***			

SD: Standard deviation t: Independent t test **F:** Repeated measure ANOVA test
NS: Non significant (P>0.05) *: Significant (P<0.05) **: Highly significant (P<0.001)

Table (4): Baseline of laboratory findings among the studied groups:

Variable	Interventional Group (*n*=27)	Control Group (n=27)	*t*	*P value*
Hb: (gm/dl) *Mean ±SD*	9.89±1.26	8.70±0.87	**4.03**	**<0.001 ****
RBCs: ($x10^6/mm^3$) *Mean ± SD*	3.52±0.36	3.57±0.88	0.30	0.76 NS
WBCs: ($x10^3/mm^3$) *Mean ± SD*	2.74±1.20	3.10±2.64	0.64	0.52 NS
Platelets: ($x10^3/mm^3$) *Mean ± SD*	185.26±95.98	161.37±194.57	0.57	0.57 NS
Ht: (%) *Mean ± SD*	29.39±3.47	25.81±3.80	**3.61**	**0.001***
D. Bilirubin: (mg/dl) *Mean ± SD*	0.13±0.06	0.26±0.07	**8.19**	**<0.001 ****
Ind. Bilirubin: (mg/dl) *Mean ± SD*	0.20±0.15	0.38±0.18	**3.87**	**<0.001 ****
ALT: (U/L) *Mean ± SD*	26.47±9.13	35.72±27.10	1.68	0.10 NS
AST: (U/L) *Mean ± SD*	31.32±18.10	20.31±11.29	**2.68**	**0.01***
Albumin: (gm/dl) *Mean ± SD*	4.26±0.27	4.17±0.59	0.73	0.47 NS
Pre-albumin: (gm/dl) *Mean ± SD*	15.56±1.31	15.38±1.42	0.48	0.63 NS
Urea: (mg/dl) *Mean ± SD*	8.49±3.91	10.40±7.08	1.23	0.23 NS
Creatinine: (mg/dl) *Mean ± SD*	0.29±0.09	0.22±0.10	**2.7**	**0.009***
Ca^+: *Mean ± SD*	8.30±1.09	8.15±1.14	0.49	0.62 NS
Ph: *Mean ± SD*	2.70±0.85	2.59±0.90	0.48	0.63 NS
Mg: *Mean ± SD*	1.74±0.31	1.71±0.33	0.43	0.67 NS
K: *Mean ± SD*	3.46±0.77	3.44±0.86	0.06	0.95 NS
Na: *Mean ± SD*	131.48±5.58	131.00±6.00	0.31	0.76 NS
Laboratory findings at 45th day of follow up				
Hb: (gm/dl) *Mean ± SD*	9.64±1.25	9.00±0.80	**2.26**	**0.02***
RBCs: ($x10^6/mm^3$) *Mean ± SD*	3.58±0.43	3.42±1.12	0.71	0.48 NS
WBCs: ($x10^3/mm^3$) *Mean ± SD*	3.10±1.80	3.94±2.01	1.63	0.11 NS
Platelets: ($x10^3/mm^3$) *Mean ± SD*	201.56±117.30	352.85±196.77	**3.43**	**0.001***
Ht: (%) *Mean ± SD*	29.69±4.18	26.96±3.69	**2.54**	**0.01***
D. Bilirubin: (mg/dl) *Mean ± SD*	0.15±0.08	0.24±0.09	**3.85**	**<0.001****
Id. Bilirubin: (mg/dl) *Mean ± SD*	0.21±0.14	0.17±0.09	1.33	0.19 NS
ALT: (U/L) *Mean ± SD*	36.26±23.85	45.11±42.05	0.95	0.35 NS
AST: (U/L) *Mean ± SD*	30.31±22.42	36.69±29.21	0.90	0.37 NS
Albumin: (gm/dl) *Mean ± SD*	4.38±0.18	4.34±0.23	0.70	0.49 NS
Pre albumin: (gm/dl) *Mean ± SD*	15.72±1.12	15.80±1.05	0.26	0.79 NS
Urea: (mg/dl) *Mean ± SD*	13.24±15.63	8.45±5.79	1.49	0.14 NS
Creatinine: (mg/dl) *Mean ± SD*	0.30±0.09	0.21±0.09	**3.73**	**<0.001****
Ca^+: *Mean ± SD*	8.86±0.92	8.88±0.93	0.09	0.93 NS
Ph: *Mean ± SD*	3.14±0.87	3.21±0.89	0.31	0.76 NS
Mg: *Mean ± SD*	1.84±0.22	1.85±0.22	0.17	0.86 NS
K: *Mean ± SD*	3.97±0.49	3.84±0.44	1.03	0.31 NS
Na: *Mean ± SD*	134.33±1.41	134.11±1.45	0.57	0.57 NS
Laboratory findings at 90th day of follow up				
Hb: (gm/dl) *Mean ± SD*	9.76±1.19	9.39±0.78	1.36	0.18 NS
RBCs: ($x10^6/mm^3$) *Mean ± SD*	3.48±0.66	3.74±0.79	1.35	0.18 NS
WBCs: ($x10^3/mm^3$) *Mean ± SD*	3.10±1.79	4.39±1.81	**2.61**	**0.01***
Platelets: ($x10^3/mm^3$) *Mean ± SD*	199.04±116.56	430.48±120.11	**7.19**	**<0.001****
Ht: (%) *Mean ± SD*	29.59±4.18	26.96±3.69	**2.46**	**0.02***
D. Bilirubin: (mg/dl) *Mean ± SD*	0.14±0.08	0.24±0.09	**4.08**	**<0.001****
Id. Bilirubin: (mg/dl) *Mean ± SD*	0.20±0.13	0.17±0.09	1	0.32 NS
ALT: (U/L) *Mean ± SD*	36.95±23.93	45.11±42.05	0.88	0.39 NS
AST: (U/L) *Mean ± SD*	29.25±22.02	36.69±29.21	1.06	0.30 NS
Albumin: (gm/dl) *Mean ± SD*	4.43±0.24	4.52±0.37	1	0.32 NS
Pre albumin: (gm/dl) *Mean ± SD*	15.77±1.03	15.80±1.05	0.11	0.92 NS

Variable	Interventional Group (*n*=27)	Control Group (n=27)	*t*	*P value*
Urea: (mg/dl) *Mean ± SD*	13.24±15.63	8.45±5.79	1.49	0.14 NS
Creatinine: (mg/dl) *Mean ± SD*	0.30±0.09	0.22±0.09	**3.28**	**0.002***
Ca^{+}: *Mean ± SD*	8.88±0.93	8.88±0.93	0.02	0.99 NS
Ph: *Mean ± SD*	3.30±0.89	3.21±0.89	0.38	0.71 NS
Mg: *Mean ± SD*	1.87±0.23	1.85±0.22	0.22	0.83 NS
K: *Mean ± SD*	3.84±0.44	3.84±0.44	0.02	0.99 NS
Na: *Mean ± SD*	134.00±1.49	134.11±1.45	0.28	0.78 NS

Hb : hemoglobin, RBCS : Red blood cells, WBCS: white blood cells, Ht: hematocrit, AST: aspartate aminotransferase , ALT: alanine transaminase
SD: Standard deviation t: Independent t test NS: Non significant (P>0.05)
*: Significant (P<0.05) **: Highly significant (P<0.001)

Table (5) Nutritional intervention, morbidity and mortality of treatment among the studied groups:

Variable	Interventional Group (*n*=27)	Control Group (n=27)	Sign. Test	*P value*
Dietitian visit:	20 (74.1%)	11 (40.7%)	χ^2=6.14	0.01*
Administration of nutritional supplements:	20 (74.1%)	10 (37.1%)	χ^2=4.96	0.006*
Nasogastric tube insertion:	16 (37.1%)	3 (11.1%)	χ^2=0.33	0.03*
Time (days) to any nutritional intervention *Median (IQR)*	14 (3 – 90)	22 (2 – 85)	MW=2.02	0.04*
Time (days) to nasogastric tube insertion intervention *Median (IQR)*	9 (2 – 65)	16 (2 – 64)	MW=2.13	0.02*
Time (days) to initiating oral supplements intervention *Median (IQR)*	12 (1 – 70)	22 (3 – 52)	MW=2.20	0.02*
Morbidity and mortality				
Number of RBCs transfusion: *Mean ± SD*	2.34±0.42	2.13±0.39	*t* = 1.90	0.06 NS
Number of platelets transfusion: *Mean ± SD*	1.23±0.41	1.46±0.50	*t* = 1.85	0.07 NS
Number of febrile neutropenia: *Mean ± SD*	1.02±0.30	1.13±0.39	*t* = 1.16	0.25 NS
Duration of febrile neutropenia: (day) *Mean ± SD*	8.12±2.75	6.93±2.14	*t* = 1.77	0.08 NS
Mucositis ≥ grade 2: *N (%)*	6 (22.2%)	4 (14.8%)	χ^2 =0.49	0.48NS
Mortality: *N (%)*	0 (0%)	0 (0%)	---	---

MW: Mann Whitney test χ^2: Chai square test **IQR**: Inter quartile range NS: Non significant (P>0.05) *: Significant (P < 0.5)

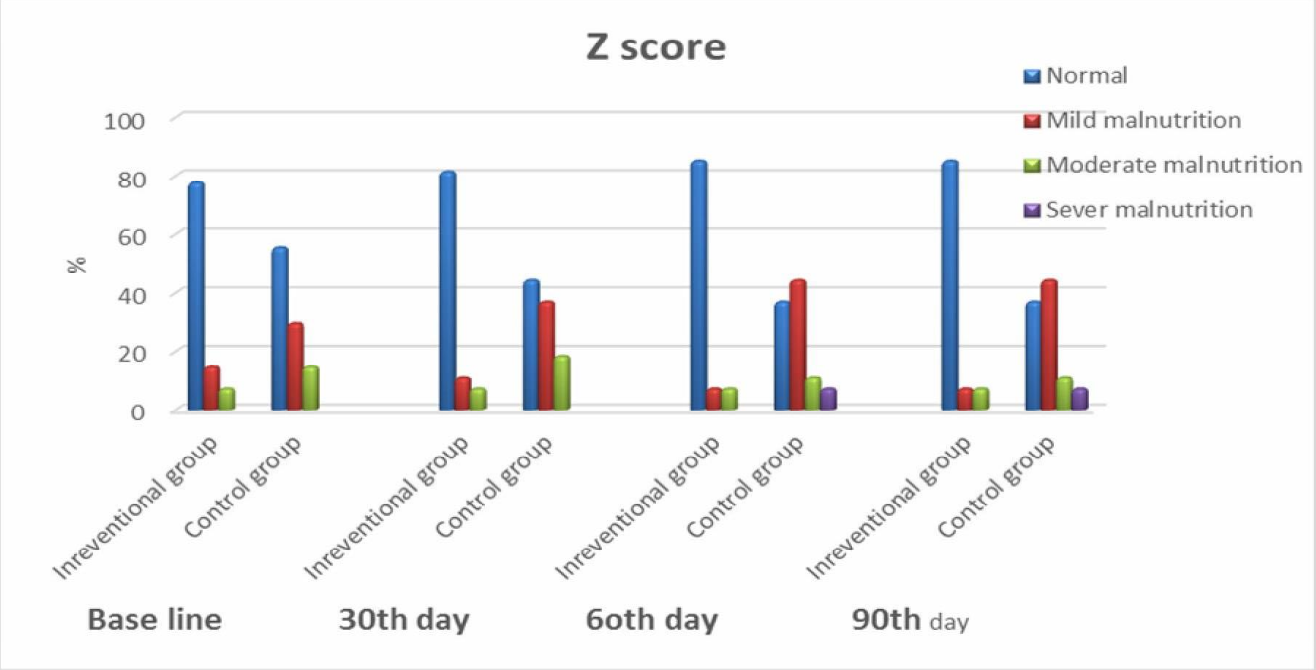

Figure (1): Nutritional status according to Z-score for BMI at different time of follow up among the studied groups.

DISCUSSION

Many difficult problems are frequent in cancer patients as loss of cell mass of the body and loss of the weight. Malnutrition is serious and frequent problem. The causes of it are numerous as loss of appetite, disturbance of gastrointestinal tract function and continuous inflammatory process of the body. Dietary counselling and nutritional support (oral, enteral and parenteral nutrition) aim to adequate intake of macro and micronutrients to decrease disturbance of metabolic process of the body, to prevent muscle mass loss, decrease risk of interruption or reduction of chemo or radiotherapy protocols of treatment and improve quality of life.

The types of cancer in our study are various. The most common type in group 1 is acute lymphocytic leukemia (ALL) where 19 patients (70.4%) had ALL, three patients (11.1%) had Hodgkin lymphoma and 3 patients (11.1%) had neuroblastoma while Burkitt lymphoma (BL) patients were 2 (7.4%). Also, most of the patients 15 (55.6%) in group 2 had ALL. While 7 patients (25.9%) had BL and 5 patients (18.5%) had neuroblastoma. All patients in both groups treated by chemotherapy. In the present study no statistically significant difference was found in the types of cancer or type of treatments among both studied groups. This is in line with the study of Dos et al. [8]

A study of 70 children with cancer by Vazquez et al. [9] found that acute lymphoblastic leukemia (ALL) was the most common diagnosis (58.5% of patients), followed by small solid tumors (33% of patients) and other rare diseases (8.5% of patients) such as phenotypic leukemia, acute myeloid leukemia, or histiocytosis.

In the comparison between the studied groups according to weight for length, there was 51.9 % of children in the interventional group had been plotted on 25th – 50th percentile, followed by 40.7 % had ~ 75th – 90th and 7.4 % had ~ < 25th, versus 44.4 % of children in the group 2 had 25th – 50th, followed 40.7 % had 75th – 90th, and 14.8 % had < 25th respectively. Statistically, there was no significant difference between the studied groups regarding baseline anthropometric measurements. These findings agreed with the studies of Viani et al. [7] and ElSawy. [10].

A statistically significant decrease was revealed in the mean BW among the group 2 compared to the interventional group on the 45th day, 60th day, 75th day, and 90th day (p=0.04, 0.006. 0.002, and 0.001, respectively), the body weight decreased by 18.22% by the end of the follow-up (p<0.001). These findings were in

accordance with the study of Kadenczki et al. [12], which clarified that During therapy, patients experienced a loss of body weight, with median values showing a substantial decrease.

The current study revealed that a statistically significant decrease was found in the mean MUAC, and a decrease in the frequency of ≥ 25th percentile MUAC for age was found among the group 2 compared to the interventional group at the 60th day and 90th day of follow-up ($p<0.001$). A statistically significant decrease in mean MUAC and MUAC for age percentile was found with increased follow-up time in the control group ($p=0.01$).

A statistically significant decrease was found in mean BMI and decrease in the frequency of ≥ 25^{th} percentile BMI for age among the noninterventional group compared to the interventional group at the 30^{th}, 60^{th} day, and 90^{th} day of follow-up, also a statistically significant decrease was found in the mean BMI and BMI for age percentile with increase follow up time in the non interventional group, These results were in agreement with Viani et al. [7] and Kadenczki et al. [12]

Body mass index has been found to be the gold standard for detecting dietary deficiencies. But when it comes to evaluate nutritional status in children with cancer during cancer therapy, a child's body mass index may stay the same, but their fat-free mass could change at a rate equivalent to that of their newfound fat. MUAC evaluate the patient fat and muscle status and can detect acute malnutrition and response to nutritional treatment even before weight change. [13, 14].

Kadenczki et al. [12] confirmed that undernutrition negatively affected survival rates in cancer children. It would be ideal to use the easiest way to identify undernutrition as soon as feasible. Without the means to measure body composition precisely, it appears appropriate to track changes in BW and define BW degradation in percentages. The findings of this study highlighted the significance of constantly monitoring the nutritional condition of children with cancer, as undernutrition is strongly linked to survival.

However, in the study by Viani et al. [7], BMI identified a more significant proportion of under- and overweight patients at diagnosis in cancer patients than MUAC. The reason for this remains a mystery, but the patient's hydration level could have impacted it, as vomiting is a common symptom in these instances. The data could have been skewed because of a change in the annualized Frisancho percentiles for children over the age of 5, which could lead to an underestimating of nutritional status in children aged 5-6 (given that the mean age for children with hematological or CNS malignancies was 7.1 years). Since the mean ages of the groups with hematological cancers were likewise greater than 5 years, it is possible that they were also affected by this shift in perspective. [7, 14]

Patients with cancer reported experiencing weight loss in the ElSawy. [10] research. However, the nutritional assessment was primarily based on weight loss, with a prevalence of 40–80% after therapy, according to Maia-Lemos et al. [5]. Patients diagnosed with carcinomas, lymphomas, and bone tumors had a statistically significant difference between their typical reported weight and their current weight. Nearly three-quarters of pediatric cancer patients they were reported experiencing a decrease in body weight.

The degree of malnutrition was significantly higher in the noninterventional group compared to the interventional group on the 30th, 60th, and 90th day of follow-up, according to the assessment of BMI according to Z-score at different follow-up intervals among the examined children, there was a statistically significant increase in malnutrition degree with increased follow-up time in the control group. According to Kadenczki et al. [12] demonstrated that Children diagnosed with cancer who were undenutrition according to their body mass index (BMI) Z-score (HR:4.54, 95 percent CI:1.48-13.97, $p = 0.0081$) and percent of their ideal body weight (IBW) (HR:2.71, 95 percent CI:1.45-5.07, $p = 0.002$) had a significantly worse five-year overall survival rate (OS).

Because there may be no universally accepted threshold for decreased nutritional status, it is possible that research will not be directly comparable. Some studies used the -2 Z-score as the cutoff for aberrant body mass index (BMI), while others used the 5th or 10th centiles as the cutoff for suboptimal BMI [15; 17]. Hence, body mass index (BMI) should be solely considered one of several indicators of malnutrition in children with cancer.

The current study demonstrated a statistically significant decrease in mean Hb, HT, AST, and creatinine ($p<0.001$, 0.001, 0.01, and 0.009, respectively) and an increase in direct and indirect bilirubin at baseline follow-up among the control group compared to the interventional group ($p<0.001$). However, at 45^{th} days of follow-up, there was a significant decrease in mean Hb, HT, and creatinine ($p=0.02$, 0.01, <0.001 respectively) and an increase in platelets and direct bilirubin ($p=$ 0.001, <0.001 respectively) among the control group compared to the interventional group. Meanwhile, there was a significant decrease in mean HT and creatinine ($p=0.02$, 0.002, respectively) and an increase in WBCs, platelets, and direct bilirubin ($p=0.01$, <0.001, and <0.001 respectively) at 90^{th} days of the follow-up among the control group compared to the interventional group. These findings were in agreement with the study of ElSawy. [10] who demonstrated that there was a significant difference in laboratory findings regarding the nutritional status of children with cancer.

According to nutritional intervention, our results demonstrated a statistically significant increase in the frequency of dietitian visits and also the number of patients who agreed for administration of complete oral nutritional supplement (standard pediatric enteral formula, high energy and high protein formula) and nasogastric tube feeding among the intervention group compared to the control group. These findings are in line with those of Diakatou et al. [4], who found that nutritional evaluation and early intervention in children with cancer could decrease treatment-related side effects and the likelihood of nutritional morbidity. This risk factor is, fortunately, possibly controllable.

Gokcebay et al. aimed to evaluate the nutritional condition of cancer-stricken youngsters and explore how oral nutritional supplements affected their biochemical parameters, anthropometric measurements, and overall outcome. Their study proved that an effective way to prevent malnourished children from losing weight is to give them oral nutritional supplements that are large in energy and protein [18].

Children at risk for stunted growth and development due to cancer do not receive the proper nutrition, as pointed out by Barr et al. [19]. Both pre- and post-diagnosis malnutrition enhance the likelihood of adverse events during radiation and chemotherapy treatments. Nutritional status is at risk across all treatment modalities, which may have a negative impact on clinical outcomes.

For example, there is a strong correlation between poor nutrition and the development of some juvenile cancers (e.g., acute myeloid leukemia (AML) and lymphomas (33% frequency), brain and spinal tumors (26% prevalence), and Wilm's tumor stages III and IV (5% prevalence). A patient's nutritional condition diminishes, and their risk of malnutrition increases dramatically as a result of rigorous treatment protocols (surgery, stem cell transplant, chemotherapy, radiation therapy) for Ewing sarcoma and osteosarcoma (prevalence 4%) [20].

CONCLUSION

Children with cancer should receive appropriate nutritional counselling and support (oral, tube feeding and parenteral nutrition or combinations) as soon as cancer diagnosis and during its treatment.The goal of providing enough energy, macronutrient especially protein and micronutrients are improving the nutritional status and growth of the patients, minimizing the disturbance which occur in body metabolism, preventing loss or even increase skeletal muscle mass, reducing anticancer treatment toxicity and optimize life quality.

REFRENCES

1.Siegel RL, Miller KD, Fuchs HE, Jemal A. Cancer Statistics, 2021. CA: Cancer J. Clin. 2021; 71(1):7–33.

2.Rogers PC. Nutritional Status as a Prognostic Indicator for Pediatric Malignancies. J. Clin. Oncol. 2014; 32:1293–4.

3.Rogers PC. Importance of Nutrition in Pediatric Oncology. Indian J Cancer. 2015; 52: 176.

4.Diakatou V, Vassilakou T. Nutritional Status of Pediatric Cancer Patients at Diagnosis and Correlations with Treatment, Clinical Outcome and the Long-Term Growth and Health of Survivors. Children. 2020; 7(11), 218.

5.Maia-Lemos PS, Ceragioli-Oliveira FL, Monteiro-Caran EM. Nutritional Status at Diagnosis in Children with Cancer in Brazil. Pediatr Ther. 2016; 6: 295.

6.Totadri S, Trehan A, Mahajan D, Viani K, Barr R, Ladas EJ.et al. Validation of an algorithmic nutritional approach in children undergoing chemotherapy for cancer. PBC. 2019; 66:e27980.

7.Viani K, Barr RD, Filho VO, Ladas EJ. Nutritional status at diagnosis among children with cancer referred to a nutritional service in Brazil. Hematol Transfus Cell Ther. 2021; 43 (4): 389-95.

8.Dos Maia Lemos PS, Ceragioli Oliveira FL, and Monteiro-Caran EM. Nutritional Status at Diagnosis in Children with Cancer in Brazil. Pediatr Ther. 2016; 6:3.

9.Vázquez de la Torre MJ, Stein K, Vásquez Garibay EM, Kumazawa Ichikawa MR, Troyo Sanromán R, Salcedo Flores AG,et al. Patient-Generated Subjective Global Assessment of nutritional status in pediatric patients with recent cancer diagnosis. Nutr Hosp. 2017; 34(5):1050-8

10.ElSawy NA. Nutritional Status, Anthropometric and Biochemical Profile of Down Syndrome Children with Cancer at King Abdullah Medical City Hospital in Makkah. Asian Oncol. Res. J. 2019; 2 (1): 1-10

11.Stephens DM, Boucher K, Kander E, Parikh SA, Parry EM, Shadman M,et al. Hodgkin lymphoma arising in patients with chronic lymphocytic leukemia: outcomes from a large multi-center collaboration. Haematologica. 2023; 106(11):2845-52.

12.Kadenczki O, Nagy AC, Kiss C. Prevalence of Undernutrition and Effect of Body Weight Loss on Survival among Pediatric Cancer Patients in Northeastern Hungary. Int J Environ Res Public Health. 2021; 4: 1478.

13.Brinksma A, Roodbol PF, Sulkers E, Hooimeijer HL, Sauer PJ, van Sonderen E,et al. Weight and height in children newly diagnosed with cancer. PBC. 2015a; 62(2):269-73.

14.Brinksma A, Roodbol PF, Sulkers E, Kamps WA, de Bont ES, Boot AM,et al. Changes in nutritional status in childhood cancer patients: A prospective cohort study. Clin. Nutr. 2015b; 34:66–73.

15.Bonaccorsi G, Baggiani L, Bassetti A, Colombo C, Lorini C, Mantero S,et al. Body composition assessment in a sample of eight-year-old children. Nutrition. 2009; 25: 1020-8.

16.Murphy AJ, White M, Viani K, Mosby TT. Evaluation of the nutrition screening tool for childhood cancer (SCAN). Clin Nutr. 2016; 35:219-24.

17.World Health Organization (WHO). Nutritional growth in Cancer Children. (Accessed on November 2020)]; Available online: https://www.who.int/nutgrowthdb/about/introduction/en/index4.html.

18.Gürlek Gökçebay D, Emir S, Bayhan T, Demir HA, Gunduz M, Tunc B. Assessment of Nutritional Status in Children with Cancer and Effectiveness of Oral Nutritional Supplement. Pediatr. Hematol. Oncol. 2015; 32(6):423-32.

19.Barr RD, Stevens MCG. The influence of nutrition on clinical outcomes in children with cancer. PBC. 2020; 67 (3):e28117.

20.Ward ZJ, Yeh JM, Bhakta N, Frazier AL, Atun R. Estimating the total incidence of global childhood cancer: a simulation-based analysis. Lancet Oncol 2019;20(4):483-93.

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