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ORIGINAL ARTICLE

Assessment of Nutritional Status in Children with Cancer and Effectiveness of Oral Nutritional Supplements

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ABSTRACT

Background: Malnutrition can significantly affect cancer outcomes, but it may be managed through oral nutritional supplements.

Objective: The aim of this study was to assess the nutritional status of children with cancer and the effectiveness of oral nutritional supplements.

Materials and Methods: This multicentre study was carried out at MMC, DHQ hospital Kohat, AWKUM, KUST following approval from the ethical board of the institutions. The study duration was six months from March 2023 to September 2023. A total of 50 children with newly diagnosed cancer who could ingest an oral diet and were receiving cancer therapy were included. At diagnosis, children with malnutrition received nutrition intervention from a registered dietitian. They were randomly assigned to receive either protein- and energy-dense isocaloric supplements or hypercaloric supplements such as Resource Junior. The nutritionist monitored the supplements intake. Participants were monitored up for 6 months, with nutritional assessments performed at the third and sixth month. Participants' serum samples were tested for plasma albumin, protein, and prealbumin at the time of diagnosis, and again at the third and sixth month. Data were analyzed using SPSS version 18 and presented as mean ± standard deviation.

Results: A total of 50 children recently diagnosed with cancer were enrolled out of which were 30 males (60%) and 20 females (40%). Malnutrition was diagnosed in 48% of individuals who met at least one of the following criteria: BMI <5th percentile, weight-for-height <90%, triceps skinfold thickness or mid-upper-arm circumference <5th percentile, or >5% weight loss prior to illness onset. Malnutrition was observed in 34% of patients with intra-abdominal tumors. In the second three months following diagnosis, the number of malnourished patients reduced from 50% to 22%, with statistical significance (P=.006). The number of patients with WFH <90% and BMI <5th percentile decreased significantly (P = .003 and P = .04, respectively).There was a significant variation in mean blood prealbumin levels between the first, third, and sixth months (P=005). Serum albumin levels increased significantly from the first to 3rd and 6th months (P <.001).

Conclusion: The current study concluded that malnutrition is a major complication among children with cancer, and oral nutritional supplements are beneficial in preventing weight loss in malnourished individuals.

Keywords: Assessment; Nutritional status; Children; Cancer.

INTRODUCTION

Poor nutrition affects all phases of life, including childhood[1],"and has been related to decreased survival rates in low- and middle-income countries .[2] Malnutrition can have a significant impact on the outcome of serious diseases, including cancer. Pediatric cancer patients may have weight loss & malnourishment due to oncologic pathology and treatment regimens including chemotherapy and radiation therapy.[3]Cancer-related weight loss & malnutrition may be caused by low calorie intake and inflammation.[4] Low intake of calories causes fat mass loss, whereas inflammation causes muscle mass loss. Cachexia, potentially caused by protein deficiency, is also a risk factor in these individuals.[5] These characteristics impact tolerance to treatment modalities such chemotherapy and radiation, leading to increased treatment dropout rates .[6-8] This can negatively impact treatment outcomes and survival rates.[9-10] BMI, a metric based on weight and height, is a commonly used indicator of nutritional status alongside traditional measurements like ideal body weight (IBW) and weight-for-height (WFH). Negative BMI Z scores suggest malnutrition, whereas positive ones indicate over nutrition .[11-12] The World Health Organization (WHO) recognizes BMI as a valuable and cost-effective tool for evaluating nutritional status.[13, 14] Both under- and over-nutrition can lead to poor clinical outcomes, including higher recurrence and death rates in cancer patients. [15] Some pediatric cancer survivors, including those with all and brain tumors, may experience weight gain owing to cancer therapy.[16] Enteral feeding is secure and helpful for pediatric cancer patients, promoting weight growth and improving nutritional status. However, the relationship between oral eating and cancer benefits has not been completely studied.[17] Therefore the current study was carried out the find out the nutritional status in children with cancer and effectiveness of oral nutritional supplements."

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MATERIAL AND METHOD

This multicentre study was carried out at MMC, DHQ hospital Kohat, AWKUM, KUST following approval from the ethical board of the institutions. The study duration was six months from March 2023 to September 2023. A total of 50 children with newly diagnosed children cancer who could ingest an oral diet and were receiving cancer therapy were included while individuals who were receiving enteral tube feeding or parenteral nutrition, mechanical ventilation and had concurrent illnesses were excluded. Each participant was needed to provide sociodemographic information from their parents, as well as anthropometric measures and biochemical profile tests. At diagnosis, all patients had their anthropometric measurements taken, including their physique, height, body mass index , weight for age (WFA), WFH, mid-upper-arm circumference (MUAC), and triceps skinfold thickness (TSFT). Additionally, demographic information, main illness, patient status, infectious complications, and therapy type were noted. The patients' weights were assessed on a calibrated digital scale while they wore only underwear. Height was measured with a calibrated stadiometer in the upright position and an infantometer in the laying position. Data on weight and height were represented as standard deviation scores (SDS) based on WHO child development criteria. Body mass index (BMI) was calculated as weight (kg)/height (m2) and compared to age and gender-matched charts. Weight for age was computed as a percentage of the patient's weight compared to the weight of a healthy kid of the same age. We computed weight for height by comparing the patient's weight to that of an average-weight kid of the same height. To measure mid-upper-arm circumference, the arm was relaxed and hung besides the trunk. A mark was made halfway between the tip of the acromion and olecranon processes, and a non-stretchable measuring tape was passed around the arm. Malnutrition was defined as meeting at least one of the following criteria: BMI <5th percentile (p), ideal body weight (WFH) <90%, TSFT or MUAC <5p, or >5% weight loss prior to illness onset [12]. At diagnosis, children with malnutrition received nutrition intervention from a registered dietitian. They were randomly assigned to receive protein- and energy-dense isocaloric (Pediasure; Abbot, Zwolle, Holland) or hyper caloric oral supplements (Pediasure plus [Abbot] or Resource junior [Nestle, Creully, France]. Pediasure contains 201 kcal (843 kJ) of calories, 5.6 g of protein, and 10 g of fat per 200-mL bottle. Pediasure plus has 302 kcal (1265 kJ) of energy, 8.4 g of protein, & 14.9 g of fat. Resource junior has 300 kcal (1262 kJ) of energy, 6 g of protein, & 12.4 g of fat. Each patient got an oral supplement with at least forty percent of their suggested daily energy allowance for WFH. The nutritionist assessed whether the supplement was taken frequently. Participants were monitored up for 6 months, with nutritional assessments performed at the third and sixth months. Participants' serum samples were tested for plasma albumin, protein, and prealbumin at the time of diagnosis, and again at the third and sixth months. During the laboratory examination, no individuals experienced serious sickness, toxicity, or infections. Children with measurements below normal were identified as at risk of malnutrition. Data was analyzed descriptively employing standard deviations, ranges, & mean and median values. The Kolmogorov-Smirnov test was used to ensure that all variables were normal. Categorical variables were examined applying the chi-square test. Patients' nutritional status was compared to anthropometric or biochemical measures using parametric (ttest, analysis of variance) & nonparametric (Mann-Whitney and Fisher's exact tests) tests, assuming normal distribution.

Analysis of variance was used to calculate the frequency of malnutrition among individuals from the first to third to sixth months. Anthropometric and biochemical characteristics were compared between the first and sixth months using the Wilcoxon rank-sum test or 2-sample t-test, assuming normal distribution. The Kaplan-Meier technique was used to estimate overall survival (OS). Overall survival was determined by the patient's death date or last interaction if still alive. All analyses were carried out via SPSS 18 for Windows (SPSS, Chicago, IL, USA). P-values <.05 were considered statistically significant.

RESULTS

A total of 50 children recently diagnosed with cancer were enrolled out of which male were 30 (60%) and female were 20 (40%). The mean age of the study population was 7.8±5.8 years. Out of the 50 individuals 15 (30%) had Hodgkin lymphoma, 8 (16%) had Non-Hodgkin lymphoma, 9 (18%) had Neuroblastoma, 5 (10%) Ewing Sarcoma and Rhabdomyosarcoma. Majority of the participants were belonged to rural areas 38 (76%). Approximately 60% of the participants had advanced disease. The demographic features of the study population is shown in table 1. Initial anthropometric assessments revealed lowered rates of malnutrition based on weight or height compared to Body mass index, weight for height, or arm anthropometry. Among the participants, 8 (16%) had a weight or height of less than 2 SD, whereas 15 (30%) had a body mass index, 20 (40%) had mid-upper-arm circumference, & 12 (24%) had triceps skinfold thickness less than 5p. Malnutrition was diagnosed in 48 % of individuals who satisfied at least one of the following criteria: BMI less than 5p, weight for height less than 90%, triceps skinfold thickness or mid-upper-arm circumference less than 5p, or greater than 5% weight loss prior to illness onset. There was no significant difference in the prevalence of malnutrition among participants based on gender, main illness, stage, or area of residence. Malnutrition was observed in 34% of patients with intraabdominal tumors, although there was no significant difference in malnutrition between those with and without the tumor at diagnosis. There was a non-significant reduction among individuals with mid-upper-arm circumference and triceps skinfold thickness <5p at assessment and after 3 months as presented in table 2.

In the second three months following diagnosis, the number of malnourished patients reduced from 50%) to 22%, with statistical significance (P=.006). The number of patients with WFH < 90p and BMI < 5p decreased significantly (P=.003 and P=.04, respectively). WFA showed a substantial rise between the first, third, and sixth months (P <.001). Significant increases were seen between the first and sixth months for weight for height, BMI, triceps skinfold thickness, and mid-upper-arm circumference (P=.003, P=.003, P=.007, and P<.001, respectively) as presented in table 3. At the third and sixth months, there was no significant change in BMI, WFH, MUAC, or TSFT between patients who received isocaloric or hypercaloric supplements. Infectious problems were more common in malnourished individuals over the first three months. 30% of well-nourished individuals at diagnosis recovered from more than one infectious episode, compared to 86% of malnourished patients at diagnosis (P=.001). Malnourished individuals had higher rates of infectious episodes at diagnosis and in the third month, according to regression analysis (P<.001). Malnourished children had similar overall survival rates to well-nourished children at diagnosis and the third month. However, survival rates at the sixth month were significantly lower (OS: 40% [SE=0.4] and 86% [SE=0.2], respectively; P=.003). All participants had blood prealbumin levels below normal at the zero, 3rd, & 6th months. There was no significant variation in serum albumin, protein, and prealbumin levels by gender, main illness stage, or location of residency at evaluation. In addition, there was no significant relationship between serum prealbumin as well as albumin levels in individuals who were malnourished or not at the time of assessment. There was a significant variation in mean blood prealbumin levels between the first, third, and sixth months (P=005).

Table 1: Demographic Features of the Study Population n= 50

Characteristic n(%)	Frequency /percentage
Age	(year, mean±SD) 7.8±5.8
Gender	
Male	20 (40%)
Female	30 (60%)
Diseases	
Hodgkin lymphoma	15 (30)
Non-Hodgkin lymphoma	8 (16)
Neuroblastoma	9 (18)
Ewing Sarcoma	5 (10)
Rhabdomyosarcoma	5(10)
Brain tumors	3 (6)
Osteosarcoma	1 (2)
Nasopharynx cancer	1 (2)
Willms tumor	1 (2)
Hepatoblastoma	1 (2)
Langerhans cell histiocytosis	1 (2)
Stage	
I–II	20 (40)
III–IV	30(60)
Place of residence	
Rural	12 (24)
Urban	38 (76)
Therapy	
Chemotherapy	30 (60)
Chemotherapy and surgery	10 (20)
Chemotherapy and radiotherapy	10 (20%

Serum albumin levels increased significantly from the first to 3rd and 6th months (P <.001). At the third month, malnourished individuals had significantly lower prealbumin levels compared to non-malnourished patients (mean = 0.19 g/L vs. 0.14 g/L; P=.04). Malnourished patients had significantly lower blood albumin levels at 6 months compared to non-malnourished patients (mean=4.5 g/dL vs. 4 g/dL; P=.02). Serum total protein levels did not vary between the first, 3rd, and 6th month's as presented in Table 4.

Table 2: Nutritional Status of Individuals Upon Screening and Comparison with 3rd and 6th Months

Variables	Month zero n (%)	3 months n(%)	6 months n(%)	P
Weight<−2 SD	8(16)	9(18)	9(18)	<.001
Height<−2 SD	4(8)	5(10)	5(10)	<.001
Body mass index <5p	15(30)	11(22)	6(12)	.003
weight for age below 90 percent	23(46)	18(36)	21(42)	<.001
weight for height below 90 percent	21(42)	11(22)	8(16)	.015
mid-upper-arm circumference<5p	20(40)	19(38)	22(44)	<.001
triceps skinfold thickness<5p	12(24)	9(18)	10(20)	.003
C= The variations in prevalence of individuals with malnutrition from the first to the third to the sixth months were estimated using analysis of variance.				

Table 3: Changes in Mean Z Scores of Anthropometric Parameters From 0 to 3 to 6 Months After

Diagnosis				
Variables	Month zero (95% CI)	Month 3rd (95% CI)	Month 6th (95% CI)	P
Weight x	−0.75(−4.2,1.9)	−0.7(−4.3,2)	−0.73(−5.5,1.8)	<.001
Height x	0.52(−4.4,2.3)	−0.47(−3.2,2.2)	−0.76(−3.5,1.3)	<.001
Body mass index	−0.93(−5.5,2.25)	−0.78(−4.6,1.6)	−0.44(−6.5,3.05)	.003
weight for age z	89.1(51,144)	89.7(50,144)	90.2(41,145)	<.001
weight for height x	94.6(64,139)	96.3(67,134)	99.5(56,127)	.03
mid-upper-arm circumference x	−1.16(−5,1.05	−0.7(−3,1.9)	−0.78(−6.6,1.1)	<.001
triceps skinfold thickness x	−0.42(−1.9,1.2)	−0.36(−1.8,1.9)	−0.15(−3.6,2.7)	.006

X= The differences of anthropometric parameters between 0th and 6th months were calculated using Wilcoxon rank-sum test.
z= The differences of anthropometric parameters between 0th and 6th months were calculated using 2-samplettest.

Table 4: Lab Diagnosis of the Participants at Zero, 3rd, and 6th Months D

Biochemical parameters (reference values)	month zero	3rd month	6 months	P
Prealbumin (0.2–0.4 g/L)	0.19±0.08 0.0	0.18±0.06	0.19±0.07	.005
Albumin (2.4–4.9 g/dL)	5.09±0.7	5.3±0.4	5.4±0.5	<.001
Protein (6.6–8.7 g/dL	6.6±0.96	6.8±0.8	7.0±0.7	>.0

D =The alterations of biochemical factors between zero and 3rd and between zero and 6th Months were calculated through 2-samplettest.

DISCUSSION

A total of 50 children recently diagnosed with cancer were enrolled to evaluate the nutritional status and effectiveness of oral nutritional supplements. In the current study malnutrition was diagnosed in 48 % of individuals who satisfied at least one of the following criteria: Body mass index less than 5p, weight for height less than ninety percent, triceps skinfold thickness or mid-upper-arm circumference less than 5p, or greater than 5% weight loss prior to illness onset. Malnutrition was observed in 34% of children with intraabdominal tumors but it was decreased at the 6th month by giving oral nutritional supplement. Our study findings are not similar to the study conducted by Sala et al[18], and Colomer et al[19], they reported 50-60% prevalence of malnutrition respectively. The incidence of malnutrition based on weight can be altered by body composition, fluid condition, and tumors that mask actual body weight.[20] A research from Turkey pertains 62 kids with solid tumors, nobody of them was categorized as underweight by WHO weight for height criteria, yet 27% of them exhibited malnutrition upon the criteria of arm anthropometry.[21] Children with intra-abdominal solid tumors showed substantially reduced MUAC and TSFT compared to those with extra-abdominal solid tumors. The body first uses nutritional resources stored in muscle protein and fat, resulting in an early drop in MUAC & TSFT values.[22] In the current study, 30% of children had BMI below 5p, 46% had WFH below 90%, 40% had MUAC below 5p, and 24% had TSFT below 5p at the time of diagnosis. Our findings aligns with Tazi et al., who discovered that weight/height Zscores or BMI had a lower prevalence of malnutrition than arm anthropometry. Researchers found that MUAC is a more accurate indicator of nutritional health then weight or BMI since it is unaffected by tumour size, edoema, or amputation.[23] In our study the third and sixth months, there was no significant change in BMI, WFH, MUAC, or TSFT between patients who received isocaloric or hypercaloric supplements. Bayram et al reported Omega-3 fatty acids supplement increased weight gain in 51 children with cancer.[24] In the current study participants had blood prealbumin levels below normal at the zero, 3rd, & 6th months. There was no significant variation in serum albumin, protein, and prealbumin levels by gender, main illness stage, or location of residency at evaluation. Our study findings are similar to Kurug¨ ol et al.[25] This research is one of the few randomised clinical trials to examine the impact of oral nutritional supplements on children with cancer. The study's limitations include a limited sample size, different malignancies, and variations in diagnostic and treatment regimens.

CONCLUSION

The current study concluded that malnutrition is a major complication among cancer children. Nutritional evaluation is crucial for optimum treatment outcomes. Protein- and energy-dense oral nutritional supplements are beneficial in preventing weight loss in malnourished individuals.

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