

Indicators of malnutrition in children with cancer: A study of 690 patients from a tertiary care cancer center

Srivastava R, Pushpam D, Dhawan D, Bakhshi S

Department of Medical Oncology, Dr. B. R. A. Institute Rotary Cancer Hospital, All India Institute of Medical Sciences, New Delhi, India

Correspondence to: Prof. Sameer Bakhshi, E-mail: sambakh@hotmail.com

Abstract

BACKGROUND: Large data pertaining to indicators of malnutrition in children with cancer is lacking from India. In view of this, we prospectively analyzed consecutive *de novo* childhood patients with cancer presenting at a tertiary care center. **MATERIALS AND METHODS:** Height and weight of each child ($n = 690$) were compared with World Health Organization child growth standards-2006 for that particular age and sex to get weight-for-age, height-for-age, and weight-for-height indices and below 2SD of the reference median on these indices were considered as underweight, stunted, and wasted, respectively. Body mass index (BMI) for age was also analyzed for thinness and obesity. **RESULTS:** Prevalence of malnutrition based on Z-score for weight-for-age, height-for-age, weight-for-height, and BMI-for-age was 30%, 31%, 35%, and 41%, respectively. Weight-for-age (underweight) was significantly associated ($P = 0.018$) with solid tumors. Height-for-age, weight-for-age, and BMI-for-age were significantly associated ($P = 0.007$, $P = 0.016$, and $P \leq 0.001$, respectively) with rural community. **CONCLUSION:** Malnutrition was observed in approximately one-third of children with cancer. Malnutrition is associated with solid tumors and those coming from rural community. Wasting has a higher prevalence in children with cancer in <5 years of age group.

Key Words: Body mass index, stunting, underweight, wasting

Introduction

Malnutrition can lead to a reduced response to cancer treatment, increased side effects, and possibly reduced survival. Consequences of malnutrition in patients with cancer include increased risk of infections, poor wound healing, poor quality of life, and perhaps increased referral to tertiary care centers.^[1] Malnutrition is particularly of concern as it has been shown to independently lead to increased hospital readmissions and in-hospital mortality, even after adjusting for disease type and severity.^[2] For these reasons, nutrition status of young children has been shown to be one of the most sensitive indicators of food security, vulnerability, and overall socioeconomic development of a country. Since malnutrition is seen among the pediatric and adolescent population (0–18 years), different indicators have been developed to assess nutritional status of varying age groups in this population.

Malnutrition is often seen at the point of diagnosis in childhood malignancy or may develop during the course of treatment. Strategies for optimal diagnosis and management of nutritional problems in children with cancer are limited in the published literature. Identification of children who may be malnourished or at nutritional risk can be achieved through improved approaches for risk stratification and classification. Once recognized, various strategies have been demonstrated to reduce malnutrition, diminish treatment related toxicities, and improve survival.^[3]

The frequency of undernourishment in children and adolescents with cancer is arbitrary, reported prevalence of malnutrition in pediatric patients with cancer varies widely, ranging from 8% up to 60% depending on type of cancer, treatments, methods used to determine under nutrition, for example, body mass index (BMI), Z-scores/percentile, weight/length Z-scores/percentile, and other operational

definitions.^[1,2] There are very limited studies where nutritional status has been assessed at baseline of cancer children and adolescents.^[4] The Indian data which are available are mostly focused on childhood leukemia.^[5,6] In view of this gap of knowledge, the present study was planned to assess nutritional status at diagnosis and its relationship with demographics in children with cancer.

Materials and Methods

Patient enrollment

This was a descriptive study conducted in the pediatric oncology outpatient of the cancer center at All India Institute of Medical Sciences, New Delhi, from October 2012 to May 2014. The study was approved by the Ethics Committee of the Institution and informed consent was obtained from guardian prior to enrollment. The inclusion criterion for the study was pediatric newly diagnosed cancer patient ≤ 18 years at diagnosis registered in Medical Oncology and Pediatric Surgical Tumor Clinics. Patients who were either treated outside or presented as relapse disease were excluded from this study. Cancer type was divided into two major categories: Hematological malignancies and solid tumors. Other demographics included age, sex, and type of community, that is, rural and urban. Statutory towns and areas having population more than 5000 were defined as urban area whereas rest was rural area for this study. It was modified from census definition.^[7]

Assessment of nutritional status

Nutritional status was assessed by anthropometric assessment of the subjects including height in centimeters (cm), weight in kilograms (kg), and BMI at the time of diagnosis. Height of the subjects was taken with the help of a height measuring scale and the standing body height was measured to the nearest 0.1 cm. Weight was measured by analog weighing machine for study subjects and rounded off to the nearest 0.1 kg, with child wearing light clothes. BMI, a reliable indicator of body fat, was calculated from formula of child's weight (kg)/height (cm).^[2]

Height and weight of each child were compared with World Health Organization (WHO) child growth standards-2006.^[8,9] WHO Z-score classifications were used for nutritional assessment of the study children. WHO Anthro software (version 3.2.2, January 2011) for

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0–5 years children and WHO AnthroPlus software for 5–19 years children were used for calculating Z-score of children and adolescents of the study. After calculating scores, nutritional status of children was classified into three categories: (1) Undernourished, (2) adequately nourished, and (3) over nourished. Following categories were classified as per below given indicators:

Stunting (low height-for-age)

Child was said to be adequately nourished if its height-for-age was within 2 standard deviations ($-2SD$) of the median height-for-age. If the height falls below $2SD$ ($<-2SD$), then the child was classified as undernourished.

Wasting (low weight-for-height)

Child was said to be adequately nourished if its weight-for-height was within $-2SD$ of the median weight-for-height of the reference population. If the weight-for-height falls below $2SD$ ($<-2SD$), then the child was classified as undernourished.

Underweight (low weight-for-age)

If the weight-for-age falls below $2SD$ ($<-2SD$), but within $3SD$ below the reference median ($-3SD$), then the child was classified as moderately underweight. If the weight-for-age falls below $3SD$ of the reference median ($<-3SD$), then the child was classified as severely

underweight. Children were classified in the normal category if its weight-for-age was within $-2SD$.

Overweight (high body mass index-for-age)

Child was considered in overnourished category, if BMI-for-age was more than $1SD$ ($>+1SD$). Children were classified inadequately nourished category if its BMI-for-age was within $-2SD$. If the child's BMI-for-age falls below $2SD$ ($<-2SD$) of the reference median, then the child was classified as undernourished.

Statistical analysis

Descriptive statistics used in the study were frequencies, percentage, and ratio. Descriptive analysis was done for type of cancers, demographic characteristics of children with cancer and nutritional status as per WHO standards. For inferential statistics, Chi-square test was used to find a relationship between nutritional status and demographic profile. The level of significance was set at 0.05. IBM SPSS (version 19, Armonk, NY: IBM Cor.) was used for statistical analysis.

Results

Baseline data of 690 patients were collected. Median age of children was 9.04 years (range 6 months - 18 years). Six hundred ninety children with cancer (boys: 482 and girls: 208) were assessed for nutritional status. Hematological malignancies constituted 59% of the total cases and rest were solid tumors. Majority of the children (60%) belonged to the rural community and rest 40% were from the urban community.

Nutritional status of cancer children

The prevalence of malnutrition based on Z-score for weight-for-height, height-for-age, weight-for-age, and BMI-for-age was 30%, 31%, 35%, and 41%, respectively [Table 1]. Only 3% of children were obese as per BMI.

Relationship of demographic profile with nutritional status

In the age group of 0–10 years, under nutrition as per weight-for-age was significantly associated with solid

Table 1: Nutritional status of cancer children (based on WHO/NCHS references)

Nutritional status indicators	Age group (years)	n (%)		
		Under nourished	Adequately nourished	Over nourished
Wasting (weight-for-height) $n=220$	0-5	66 (30)	154 (70)	-
Stunting (height-for-age) $n=690$	0-18	213 (31)	477 (69)	-
Underweight (weight-for-age) $n=383$	0-10	132 (35)	251 (65)	-
BMI-for-age $n=462$	6-18	191 (41)	257 (56)	14 (3)

BMI=Body mass index; NCHS=National Center for Health Statistics; WHO=World Health Organization

Table 2: Relationship of baseline nutritional status with demographic profile of children with cancer

Demographics profile	Weight-for-height (wasting) Age group (0-5 years) ($n=220$)			Height-for-height (stunting) Age group (0-18 years) ($n=690$)			Weight-for-age (underweight) Age group (0-10 years) ($n=383$)			BMI-for-age Age group (6-18 years) ($n=462$)		
	Adequately nourished ($n=154$) n (%)	Under nourished ($n=66$) n (%)	P	Adequately nourished ($n=477$) n (%)	Under nourished ($n=213$) n (%)	P	Adequately nourished ($n=253$) n (%)	Under nourished ($n=130$) n (%)	P	Adequately nourished ($n=271$) n (%)	Under nourished ($n=191$) n (%)	P
Sex												
Male	104 (68)	49 (74)	0.322	337 (49)	145 (68)	0.578	183 (73)	91 (70)	0.632	189 (70)	135 (70)	0.149
Female	50 (32)	17 (26)		141 (21)	67 (32)		70 (27)	39 (30)		82 (30)	56 (30)	
Type of cancer												
Hematological	86 (56)	39 (59)	0.656	287 (60)	122 (57)	0.538	162 (64)	67 (51)	0.018	172 (63)	109 (57)	0.314
Malignancies solid tumors	68 (44)	27 (41)		191 (40)	90 (43)		91 (36)	63 (49)		99 (37)	82 (43)	
Community												
Urban	72 (47)	23 (35)	0.102	208 (43)	69 (33)	0.007	112 (45)	41 (31)	0.016	124 (46)	54 (28)	0.001
Rural	82 (53)	43 (65)		270 (57)	143 (67)		141 (55)	89 (69)		147 (54)	137 (72)	

BMI=Body mass index

tumors ($P = 0.018$). Stunting, underweight, and BMI were under found to be significantly associated with the rural community with $P = 0.007$, 0.016 , and 0.001 , respectively. No significant relationship was seen with gender of the children [Table 2].

Discussion

In our study, wasting was observed in approximately one-third of children under the age of 5 years. Large data from Indian population suggests prevalence of wasting to be 20%.^[10] This clearly suggests cancer as disease resulting in malnutrition which is relatively higher as compared to age-matched general population. Detailed age group data of stunting in age group 0–18 years, underweight 0–10 years, and BMI 6–18 years are lacking. Hence, comparison of nutritional status between normal population and children with cancer cannot be made. Therefore, inference that cancer affects stunting, causes underweight, and impacts BMI cannot be made on the basis of current data.^[11,12]

We observed that malnutrition was significantly associated with the rural community. This is in accordance with study by Lisa *et al.* where they studied that in rural population malnutrition was more prevalent in 36 developing countries. This was explained on the basis of socioeconomic determinants women education, gender equality, and sanitation.^[13] We also observed that in 0–10 years age group malnutrition was significantly associated with solid tumors. In other groups, the proportion of patients with malnutrition was of higher in solid tumors as compared to hematological malignancies, although it did not achieve statistical significance. We hypothesize that this is due to delayed presentation of solid tumors.

To conclude, this is the largest study in India which has evaluated indicators of malnutrition with pediatric and adolescent with respect to cancer demographics. The data from this study may be used as a background study to plan other nutrition-related study in children with cancer. Based on this, approximately, one-third of our patient has malnutrition. An active surveillance and intervention

for correcting malnutrition should be done at the time of initiation of chemotherapy in children with cancer.

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