Dietary profile of pediatric cancer patients at baseline

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Abstract: **Nutritional status of the subjects at baseline and during treatment of cancer plays a vital role in clinical outcomes and response for cancer treatment. This study was planned to prospectively assess the dietary intake of consecutive de novo pediatric cancer patients enrolled for treatment at a tertiary care center. Dietary assessment of the subjects (n=626) was done using Food Frequency and Amount Questionnaire (FFAQ). This information was then used to calculate daily intake of the foods/ food groups by each subject and was compared with the reference for respective age group for the same food and food groups. Results revealed that more than 70% of the subjects were consuming cereals, pulses and milk and milk products <RDI. Similarity Roots and tubers, other vegetables, Green leafy vegetables (GLV), and fruits were consumed <RDA by majority of the subjects (86.10%, 92.00%, 71.20% and 87.50% respectively). Girls consumed significantly more of cereals, pulses, milk, roots and tubers, GLV and fruits compared to boys. Cereals, pulses and milk and milk products intake was higher in older children (5-10 years and >10 years) as compared to younger (< 5 years). Vegetables and fruits intake was significantly higher in younger children (<5 years) as compared to children of 5-10 years and >10 years. Milk and other vegetables intake was higher in hematological malignancies (HM) patient's comparative to solid tumor (ST) patients and this difference was found to be significant (p= 0.024, p= 0.036). Majority of the pediatric cancer subjects consumed less than RDI of all most all the food groups at baseline. Significant associations were found between dietary pattern, age, gender and type of cancer in pediatric cancer subjects.**

Keywords: **Cancer, Children, Baseline dietary profile.**

I. INTRODUCTION

Management of malnourished children with cancer is very challenging. Malnutrition can lead to various clinical complications and consequences and increased risk of infection during the course of treatment of cancer [1]. Consequences due to malnutrition may be short term as well as long term. Short-term consequences include muscle and fat wasting with changed body composition, decreased tolerance to treatment and also lead to anemia and hypoalbuminemia and higher susceptibility to infections. Growth impairment, impaired neurodevelopment, abnormal bone density, decreased quality of life and increased risk for secondary cancers may be the long term consequences of malnutrition [2].

Adequate nutrition at baseline and during the course of treatment of cancer plays a vital role in several clinical outcomes. Importance of nutrition in children and adolescents with cancer is still an underestimated topic within pediatric oncology [3], [4]. Every child responds in different way to the treatment of cancer. Child may go through phases where they require extra nutrients and also more energy and protein dense food items to maintain their weight and promote their growth, repair and muscle maintenance. It is important to include a variety of healthy foods such as seasonal fruits and vegetables, protein rich food items and alternatives (e.g. chicken, fish, eggs and legumes), dairy foods, multi grains and cereals. Motivation of children to eat regular family foods and participate in meal time routines are also very important [5]. And also, good dietary practices are a key of good health and good nutritional status.

Prevalence of cancer is increasing day by day and malnutrition is a big concern in the treatment of cancer. The prevalence of under-nutrition in children in resource-poor countries like India is very high and accounts for increased infant and child mortality rates [6]. In India, 36% of the children below five years of age are under weight, 38% stunted and 21% wasted (NFHS- 4, 2015-16). With this background, this study was carried out to assess the dietary profile and dietary intake at baseline of children with cancer and also to analyze the association of different variables.

II.   METHODOLOGY

Research settings:

This study was conducted with newly diagnosed pediatric cancer patients during their visit at Medical and Surgical Paediatric oncology clinic, Rotary Cancer Hospital (Dr.BRA, IRCH), All India Institute of Medical Sciences (AIIMS), New Delhi. A prospective analytical cross sectional survey was conducted during October 2012 to May 2016 to assess consumption of foods/ food groups in their daily diet. Approval of the ethical clearance was taken from the concerned committee of the institution and informed consent was obtained from guardian of the subjects prior to enrollment.

Subject size:

A total of 626 subjects were enrolled at baseline in the study. Subjects included newly diagnosed paediatric cancer patients ≤ 18 years and registered at Dr. BRAIRCH in Medical Oncology and Paediatric Surgical Tumour Clinics/Outdoor patient departments(OPD). Exclusion criteria: subjects > 18 years, not willing to participate, previously treated and with any other comorbidities if diagnosed by doctors.

Assessment of dietary pattern and dietary intake:

Questionnaire cum interview schedule and Food frequency questionnaire (FFQ) was originally designed to provide qualitative and quantitative information about food consumption and their patterns. This was designed to assess habitual dietary pattern and quantity of the specific food consumed by asking the parents/caretaker of the subjects about the frequency and the amount which was consumed over a reference period. FFQ was based on the extensive list of the food items which was commonly consumed by the study group. Parents/caretakers in front of their children were interviewed with the help of FFQ to garner the information regarding the dietary pattern and the quantity of the food groups consumed. The responses were recorded as daily, twice in a week, weekly, fortnightly, monthly, rarely.

The food frequency questionnaire (FFQ) covered major food groups (Cereal, pulses, milk, fruits, roots and tubers, Green leafy vegetables, other vegetables, sugar, fats and oils). FFQ was used with portion size to obtain quantitative data regarding dietary intake for the individual, thus referred to as food frequency and amount questionnaire (FFAQ). Thus, the checklist of FFQ consisted of two components: food list and a frequency response section with consumed quantity of foods. With the help of standardized cups and katories, information regarding amount of the food consumed was collected.

Total amount of each food and each food group consumed was calculated and converted into per day consumption. These were then translated into raw weights and the total food group intake for all the subjects separately. And this information was used to calculate total intake for each subject.

Statistical analysis:

Descriptive statistics were used to consolidate the large data regarding food intake and Chi-square test was used to analyze association between variables. The significance level of all tests were determined at $p<0.05$. Statistical analyses were performed using IBM SPSS version 22.

III.   RESULTS

Results regarding dietary patterns of the subjects showed that majority of the children consumed wheat and rice as their staple food. Dietary patterns of the subjects showed that 27.79% children were vegetarians, 72.21% were non-vegetarian among which 11.51% were eggitarian. Major meals were consumed 3 times a day by 59.26% children, 26.20% children consumed 2 times a day and 14.54 % subjects consumed only once a day. Majority of the children (68.21%) consumed only one minor meal in a day in addition to major meals. Only 31.79 % subjects consumed two to three minor meals per day.

To analyze the consumption patterns of food groups, the subjects were divided as consuming more than and equal to RDI and less than RDI as per their age (ICMR, 2011). Table 1 depicts percentage distribution of the children with cancer for different food groups intake. As high as more than 70% of the subjects were consuming cereals, pulses and milk and milk products <RDI. Only 26.19% of the subjects consumed cereals ≥ RDI and 25.90% consumed pulses more than RDI. Similarity Roots and tubers, other vegetables, Green leafy vegetables(GLV), and fruits was consumed <RDA by majority of the subjects (86.10%, 92.00%, 71.20% and 87.50% respectively). Only 28.80% subjects were eating other vegetables ≥ RDI and 13.90% were eating roots and vegetables ≥ RDI. Very few subjects (8.00%) was consuming GLV in their diet ≥ RDI. Sugar and fat consumption was ≥ RDI in majority (93.60% and 92.80% respectively) of the subjects.

TABLE I: CONSUMPTION PATTERN OF PEDIATRIC CANCER PATIENTS

Intake	Food groups (N%)								
	Cereal	**Pulses**	**Milk**	**Roots and Tubers**	**Green leafy veg.**	**Other veg.**	**Fruits**	**Sugar**	**Fats and oils**
<RDI	462 (73.80)	464 (74.10)	453 (72.40)	539 (86.10)	576 (92.00)	446 (71.20)	548 (87.50)	40 (6.40)	45 (7.20)
≥RDI	164 (26.19)	162 (25.90)	173 (27.60)	87 (13.90)	50 (8.00)	180 (28.80)	78 (12.50)	586 (93.60)	581 (92.80)
Total	626 (100)	626 (100)	626 (100)	626 (100)	626 (100)	626 (100)	626 (100)	626 (100)	626 (100)

Association between variables:

To analyze association of foods/food groups consumption patterns, subjects were categorized as per their gender viz girls and boys, age group of the subjects (<5, 5-10 and >10 years) and their cancer type viz hematological malignances (HM) and solid tumors (ST). Further for each category of the variables, consumption pattern was classified as <RDI and ≥RDI (Table 2,3 and 4).

Significantly more of girls consumed more than RDI of cereals, pulses, milk, roots and tubers, GLV and fruits compared to boys (p = 0.001, 0.001, <0.001, <0.001, 0.011, 0.029 respectively). Other vegetables and sugar consumption was higher in boys compared to girls although this difference was not found to be significant. Fat and oils consumption was also significantly higher (p = 0.030) in boys (Table 2,3 and 4).

Results for association between age and food group consumption showed that cereals, pulses and milk and milk products intake was higher in children of >10 years as compared to younger one (< 5 years) and this difference was found to be highly significant (p=0.000, 0.000 and 0.033 respectively). Vegetables and fruits intake was significantly higher in younger children (<5 years) as compared to children of 5-10 years and >10 years. No significant difference was found between sugar and fats and oils consumption between the age groups (Table 2,3 and 4).

Association was analyzed for consumption pattern of various food groups as per the type of cancer in children. More of the children consumed <RDA for almost all food groups who were suffering with solid tumors (ST) as compared to the children with hematological malignancies (HM). However different was found to be significant only for milk and other vegetables (p= 0.024, p= 0.036 respectively) (Table 2,3 and 4).

TABLE II: ASSOCIATION OF CEREALS, PULSES, MILK AND MILK PRODUCTS CONSUMPTION WITH GENDER, AGE AND TYPE OF CANCER

Variables		Cereal (N%)			Pulses (N%)			Milk (N%)		
		<RDI	**≥RDI**	**p**	**<RDI**	**≥RDI**	**p**	**<RDI**	**≥RDI**	**p**
Gender	Boys	347 (77.6)	100 (22.4)	0.001**	348 (77.8)	99 (22.1)	0.001**	331 (74.0)	116 (26.0)	0.000***
	Girls	115 (64.2)	64 (35.7)		116 (64.8)	63 (35.1)		102 (57.0)	77 (43.0)	
Age in years	<5	147 (87.5)	21 (12.5)		148 (88.10)	20 (11.9)		127 (75.6)	41 (24.4)	
	5-10	112 (75.7)	36 (24.3)	0.000***	112 (75.7)	36 (24.3)	0.000***	106 (71.6)	42 (28.4)	0.033*
	>10	203 (65.5)	107 (34.5)		204 (65.8)	106 (34.2)		200 (64.5)	110 (35.5)	

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		<RDI	≥RDI	p	<RDI	≥RDI	p	<RDI	≥RDI	p
	6 M-18	462 (73.8)	164 (26.2)		464 (74.1)	162 (25.9)		433 (69.2)	193 (30.8)	
Cancer Type	HM	267 (76.3)	83 (23.7)	0.067NS	267 (76.3)	83 (23.7)	0.097NS	245 (72.6)	96 (27.4)	0.024*
	ST	195 (70.7)	81 (29.3)		197 (71.4)	79 (28.6)		179 (64.9)	97 (35.1)	
	Total	462 (73.8)	164 (26.2)		464 (74.1)	162 (25.9)		433 (69.2)	193 (30.8)	

N S - Not significant at p≤ 0.05 *-Significant at p<0.05 ** -Significant at p<0.005   ***- Significant at P≤0.001

TABLE III: ASSOCIATION OF VEGETABLES CONSUMPTION WITH GENDER, AGE AND TYPE OF CANCER

Variables		Roots and Tubers N(%)			Green Leafy Vegetables N(%)			Other Vegetables N(%)		
		<RDI	≥RDI	p	<RDI	≥RDI	p	<RDI	≥RDI	p
Gender	Boys	401 (89.7)	46 (10.3)	0.000***	419 (93.7)	28 (6.3)	0.011*	315 (70.4)	132 (29.5)	0.282 NS
	Girls	138 (77.0)	41 (23.0)		157 (87.7)	22 (12.3)		131 (73.1)	48 (26.9)	
Age in years	<5	131 (78.0)	37 (22.0)	0.000***	144 (85.7)	24 (14.3)	0.001**	112 (66.7)	56 (33.3)	0.016*
	5-10	126 (85.1)	22 (14.9)		144 (97.3)	04 (2.7)		119 (80.4)	29 (19.6)	
	>10	282 (91.0)	28 (9.00)		288 (92.9)	22 (7.1)		215 (69.4)	95 (30.6)	
	6 M-18	539 (86.1)	87 (13.9)		576 (92.0)	50 (8.0)		446 (71.2)	180 (28.8)	
Cancer Type	ST	304 (86.9)	46 (13.1)	0.308 NS	327 (93.4)	23 (6.6)	0.093 NS	260 (74.3)	90 (25.7)	0.036*
	HM	235 (85.1)	41 (14.9)		249 (90.2)	27 (9.8)		186 (67.4)	90 (32.6)	
	Total	539 (86.1)	87 (13.9)		576 (92.0)	50 (8.0)		446 (71.2)	180 (28.8)	

N S - Not significant at p≤ 0.05 *-Significant at p<0.05 ** -Significant at p<0.005   ***- Significant at P≤0.001

TABLE IV: ASSOCIATION OF FRUITS, SUGARS AND FATS AND OILS CONSUMPTION WITH GENDER, AGE AND TYPE OF CANCER

Variables		Fruits (N%)			Sugar (N%)			Fats and oils (N%)		
		<RDI	≥RDI	p	<RDI	≥RDI	p	<RDI	≥RDI	p
Gender	Boys	339 (89.3)	48 (10.7)	0.029**	28 (6.3)	419 (93.7)	0.482 NS	26 (5.8)	421 (94.2)	0.030*
	Girls	149 (83.2)	30 (16.8)		12 (6.7)	167 (93.3)		19 (10.6)	160 (89.4)	
Age in years	<5	130 (77.4)	38 (22.6)	0.000***	11 (6.5)	157 (93.5)	0.984 NS	11 (6.5)	157 (93.5)	0.024*
	5-10	132 (89.2)	16 (10.8)		9 (6.1)	139 (93.9)		18 (12.2)	130 (87.8)	
	>10	286 (92.3)	24 (7.7)		20 (6.5)	290 (93.5)		16 (5.2)	294 (94.8)	
	6 M-18	548 (87.5)	78 (12.5)		40 (6.4)	586 (93.6)		45 (7.2)	581 (92.8)	
Cancer Type	ST	311 (88.9)	39 (11.1)	0.158 NS	23 (6.6)	327 (93.4)	0.484 NS	26 (7.4)	324 (92.6)	0.460 NS
	HM	237 (85.9)	39 (14.1)		17 (6.2)	259 (93.8)		19 (6.9)	257 (93.1)	
	Total	548 (87.5)	78 (12.5)		40 (6.4)	586 (93.6)		45 (7.2)	581 (92.8)	

N S - Not significant at p≤ 0.05 *-Significant at p<0.05 ** -Significant at p<0.005   ***- Significant at P≤0.001

IV. DISCUSSION

Results of the present study showed that, at baseline, majority of the children (>70%) consumed cereals, pulses, milk and milk products and also fruits and vegetable, less than the recommended reference intake (RDI). Only sugars and fats and oils were consumed ≥RDI by majority of the subjects. Similar studies were carried out by Story et al in 2002 and Jones et al in 2010. They also found lower intake of most of the food groups in children with cancer (7,8). This indicates that lower intake of the foods/food groups are of big concern for cancer patients for their healthy being and also for treatment outcomes. Many studies have indicated that children with cancer are particularly vulnerable to malnutrition, because they exhibit elevated substrate needs due to the disease and its treatment. [9], [10], [11], [12].

Finding of this study showed that significantly higher percentage of girls consumed cereals, pulses, milk and milk products, roots and tubers, GLV and fruits more than RDI than boys at baseline. More of the boys consumed other vegetables, sugars and fats and oils more than RDI but the difference was not significant. Similar findings that significantly lower intake of vegetables and fruits and higher intakes of sugar and fats in boys in comparison to girls have been reported in the literature [13].

Findings of this study indicate association of age with the dietary pattern in children with cancer. Significantly more of older children (>10 years) consumed more than RDI of cereal, pulses and milk and milk products as compared to younger (< 5 years). However, vegetables and fruits intake, more than RDI was reported by more of younger children. Similar findings have been reported in the studies carried out in Brazil and America [14], [15]. A study reported that pediatric cancer patients have poor intake of fruits and vegetables as well as increased consumption of foods containing added sugars as per the recommendations of the 2015-2020 Dietary Guidelines for Americans [16] and similar results have been found in this study.

There are associations between dietary intake and type of cancer as per the results of this study. Dietary intake was better in HM patient's comparative to ST patients. Tah et al, (2012), in their study reported that children with solid tumors consumed lower energy and other nutrients compared with hematological malignancies [17], and this is in line with the findings of this study.

V. CONCLUSION

Findings of the study revealed that significantly higher percentage of the subjects consumed less than recommended reference intake (RDI) of all most all the food groups except sugar and fats and oils. Food consumption pattern showed association with gender, age and type of cancer. Cereals, pulses, milk and milk products, roots and tubers, GLV and fruits were consumed ≥ RDI by more of the girls than boys. Other vegetables, sugars and fats and oils were consumed ≥ RDI by more of boys as compared to girls. Cereal, pulses and milk intake was higher in older children (>10 years). Vegetables and fruits intake was found to be higher in younger children (< 5 years). Dietary intake was better in HM patient's comparative to ST patients.

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