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A study on the changes in the biochemical parameters during the treatments of childhood cancer

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ABSTRACT

Introduction: Cancer is a rare disease in children, although it causes the leading death rate in within in the age group of 1–15 years. Certain genetic conditions or syndromes such as chromosomal abnormalities, DNA repair disorders, congenital anomalies, hereditary immune deficiency states, and other hereditary influences increase the risk of childhood cancer. **Objective:** The objective of this study was to study the changes in the biochemical parameters during the treatment of childhood cancer and to study the nutrition-related problems during treatment, to study the influence of diet during treatment. **Methodology:** This was a cross-sectional study in which 90 patients with various types of cancer were selected between 1 and 15 years of age group. Their anthropometric measurements were assessed and biochemical parameter was noted. Diet history of maximum 3 days was taken using 24-h recall method. **Results and Discussion:** The actual intake of nutrients did not meet the recommended dietary allowances and due to the side effects of the treatment made them malnourished. Therefore, protein-rich diet was suggested. To meet the micronutrients level, supplements were given during the treatment. The prevalence of malnutrition and dysphagia symptoms was found extensionally higher in children and thereby their no improvement on the nutritional status as the subjects were malnourished. **Conclusion:** The decreased levels of hematological values showed that there was no strong association between the treatment and its values.

Key words: Biochemical parameters, cancer, chemotherapy childhood cancer, radiation

INTRODUCTION

Cancer in children can occur in any parts of the body, including the blood and lymph node system, brain and spinal cord (central nervous system), kidney, and other organ and tissues. It starts when there is an uncontrolled growth of the cells, these cells form a mass called a tumor. A tumor can be of malignant or benign; a cancerous tumor is malignant that is it can grow and spread to other parts of the body, a benign tumor is the one which may not spread to distant parts of the body.

Children diagnosed with cancer are highly vulnerable to malnutrition because they exhibit elevated substrate need due to the disease and its treatment. At the same time, children have increased requirements of nutrients to attain appropriate growth and neurodevelopment, the adequate nutritional plays a key role in the clinical outcome of treatment response and quality of life.[1] Among children, cancer has remained as a major public health issue and represents a significant burden of disease in a developing country such as India in the range of 1.6–4.8% <15 years. More than 80% of all childhood cancer cases are occurring in low- and middle-income countries.[2] The proportion of childhood cancer relative to cancers in this age group varied between 0.7% and 4.4% for 2012–2015, this is slightly lower than previous reported proportion of.05%–5.8% of childhood cancers for 2006–2011.

A risk factor is anything that increases a person's chance of fall prey to tumors growth. Specific causes have not been found for each individual type of childhood cancer.[3] The reason for increasing risk remains unexplained as the etiopathogenesis of childhood cancer is poorly understood, prenatal and perinatal exposures may have a part to play in its pathogenesis. Thematernal age and delivery, history of miscarriage, maternal anaemia, maternal overweight and smoking found to have a positive association with some childhood cancer. A pooled analysis of register linkage data from the US states found that the risk of childhood cancer increased with increasing maternal age, while paternal age appeared to have no effect on the risk.[5] On the other hand, younger maternal age was associated with an increased childhood cancer risk.[6]

Invariably, cancer may be hard to detect in children. At times, they do not show any of the symptoms nor causes but a different medical condition.[7] Not all cancer cells grow at the same rate, or have the same characteristics. The types of cancer that occurs most often in children are different from those of adult. Childhood cancer is uncommon but remains the leading cause of disease-related death in children. The diagnosis of a childhood malignancy is often very difficult in the early stages of diseases. Because symptoms are often vague or insidious.[8]

The treatment of childhood cancer is complex, involving the consideration of many factors including characteristics of the

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cancer (type, site, stage, and histology). Most children with cancer are treated using chemotherapy, radiation therapy surgery, or combination of two or more therapies. Chemotherapy is cytotoxic drugs interposing with the process of cell division. These drugs cause apoptosis by direct interposing with DNA or by targeting the necessary proteins for cell division.[9] Chemotherapy works throughout the body in the prevention of new cancer growth by means of killing cancer cell or inhibiting cell growth by interrupting the growth of cancer cell, there is a chance to reduce the cancer metastasizing or spreading to other areas in the body. The use of chemotherapy drug, however, has an impact on children body, common side effects of chemotherapy include fatigue, nausea, vomiting, hair loss, dysgeusia (altered taste), sensitivity to food temperature, and dysphagia (difficulty in swallowing).[10] The classification of chemotoxic drugs is according to either their biochemical properties or by their cell cycle effects. The most commonly administered chemotherapeutic agents were dactinomycin, L-asparaginase, cyclophosphamide, 6-mercaptopurine, methotrexate, prednisone, and vincristine.[11] Radiation therapy is another agent used to kill cancer cell. Electrically charged particles in the form of ions are deposited into the cells; it passes through sequent genetic alterations by damaging the DNA and inhibiting their action of proliferation and division or directly destroys the cancer cell. Radiation also causes similar side effects such as fatigue, nausea, vomiting, and hair loss.[12] Usually used dosages range from 30 Gy to 80 Gy for tumoricidal effect and 20–50 Gy on adjacent tissues. Surgery is the removal of the tumor, either cancerous or non-cancerous and some surrounding healthy tissues during an operation. Side effects of surgery depend on the location and type of the tumor whether it has metastasized.

Objectives

The objectives of this study are as follows:

- To study the changes in the biochemical parameters during pre- and post-treatment.
- To study the nutrition-related problems during treatment.
- To study influence of diet during treatment.

MATERIALS AND METHODS

It was a clinical-based cross-sectional study. 90 patients hospitalized with various types of cancer between 1 and 15 years of age group were selected as study subjects. Parents extended their full cooperation forgiven out the necessary details regarding their children health condition.

Demographic Details

A structured questionnaire was prepared and used to collect general information which consists of identity including economic status of the parents, religion, number of family members and children, types of family, food habits such as vegetarian or non-vegetarian, likes and dislikes, food allergy, etc.

Anthropometric Assessment

The anthropometric measurement includes in this study was height and weight. The percentage of weight was calculated to know the nutritional status and based on the Gomez classification samples were categorized into normal, mild malnutrition, moderate malnutrition, and severe malnutrition.

Gomez classification for malnutrition:

>90→ Normal
89–75 → Mild malnutrition
74–60 → Moderate malnutrition
<60 → Severe malnutrition.

Biochemical Assessment

The biochemical parameters were recorded from their summary sheet with their consent. It includes pre- and post-hemoglobin level, pre- and post-white blood count (WBC) and platelet count, and the WBC differential count. The graphical representation Figure 2b shows up the treatment plan and their side effects for the cancer patients. Among the total subjects who have undergone with various treatment, it was found that 16–20% of them have literally undergone a combination of there is specifically it is stated that it is mainly genetic influence chemo/radiation/surgery. As per the side effects concern, namely malnutrition with 14% and 16% of the study subjects found to be nauseated and anaemic and it is obvious.

Clinical Assessment

Samples clinical history, types of childhood cancer, condition, present problems, diagnosis, treatment plan, duration of the diseases, and the treatment-related problems were taken.

Diet Recall

Using 24 h diet recall method, 3 days dietary intake was taken from the study subjects and the macronutrients, i.e., calorie, protein, and fat, and micronutrients such as calcium, zinc, iron, Vitamin C, and Vitamin E were calculated using Microsoft Excel. The study populations were counseled and dietary guidelines were suggested to their parents based on the health condition.

Interpretation of Data

The individual data obtained were made into data sheet using Microsoft Excel and SPSS (v 16.0) software was used. The mean, standard deviation, and percentage were calculated, the correlation was performed for the nutrients intake among the variables to indicate the dependence on one another. Biochemical analysis was compared between pre- and post-treatment using paired *t*-test.

Table 1 summarizes the results for frequency of sociodemographic data such as gender, age, religion, type of family, family size, number of children, socio economic status (SES), and type of diet. The most prevalence age group prone to the disease among the study population is between 6 and 10 years of age, very clearly it shows that as age increases risk for cancer also increases; hence, more of precaution must be taken. The study shows that 60% of the boys are more likely to develop malignant tumors than girls largely with the profound economic status, i.e., of low SES.

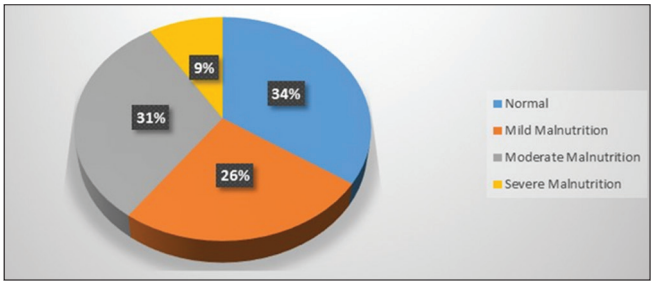

Figure 1 : Percentage of nutritional status of subjects

Table 2 summarizes the mean anthropometric measurements of boys and girls. It is found in common in both the genders belongs to the age group of 6–10 years have an admirable height, i.e., boys 126.9 ± 25.09 and girls 126.42 ± 23.76 than the standard compared to the raw counterparts. It is then followed by the age group of 11–15 years and 1–5 years age, respectively.

Figure 1 represents the percentage of nutritional status of subjects in the pie chart; the percentage of weight was calculated to know the nutrition status, based on the Gomez classification. The grades of malnutrition, i.e., mild, moderate, and severe it has wide range of spectrum. 9% of the subjects were severely malnourished, 26% of them were mild affected, and only 34% of the cancerous subjects were in normal condition.

Table 1: Frequency of sociodemographic data

Variables	Characteristics	*n* (%)
Gender	Boys	54 (60)
	Girls	36 (40)
Age	1–5	24 (26)
	6–10	37 (41)
	11–15	29 (32)
Religion	Hindu	64 (71)
	Christian	25 (27)
	Muslim	1 (1)
Type of family	Nuclear	84 (93)
	Joint	6 (6)
Family size	2–4	45 (50)
	5–10	45 (50)
	11–15	29 (32)
Number of children	1	7 (8)
	2	38 (42)
	>2	45 (50)
SES	High	3 (3)
	Medium	78 (87)
	Low	9 (10)
Type of diet	Vegetarian	4 (4)
	Non-vegetarian	86 (96)

The graphical representation shows up the treatment plan and their side effects for the cancer patients. Among the total subjects who have undergone with various treatment, it was found that 16–20% of them have literally undergone a combination of chemo/radiation/surgery. As per the side effects concern, namely malnutrition and anemia (66%), 3/4th of the study population (83%) were nauseated and it is very obvious that all in all had an elevated body temperature. As children were grown, it was observed that those subjects who were aware of the disease condition were psychologically disturbed than dose who were totally unaware and 65% of the subjects were relatively at a higher risk of death and in its association had decreased survival and tumor response and delayed in therapy.[14]

A perusal of Table 3 indicates the different types of cancer. Leukemia is the most common one, i.e., 35%, followed by neuroblastoma (13%), AML (7%), and Hodgkin's lymphoma (6%), respectively. Although it was difficult to rule out the risk factor, there is specifically it is stated that it is mainly genetic influence (gene mutation).

Table 4 summarizes the mean and SD, there is a complete clarity in the table between the pre- and post-treatment on the differential count as they were extremely significant so this is mainly due to the drug and radiation given during the course of treatment.

The mean and SD of biochemical parameters are represented in Table 5. Of the total study population (boys), the difference in the Hb and WBC is extremely significant compared to the platelets. In contrast (girls), age group between 1 and 5 had difference in Hb and WBC had highly significant compared to the age group of 6–10 years, had significant (extreme).

The mean and SD of hematological levels is comparatively lower than that of pre-treatment, and it is quite alarming that the study population was severely anemic after the completion of treatment, so it shows that there was no significant association between treatment and hematological level.

Table 6 summarizes the percentage adequacy of the nutrients in comparison with recommended dietary allowances (RDAs).

Table 2: Mean anthropometric measurements of boys and girls

Age (yrs)	*n*	Boys				*n*	Girls			
		Height		Weight			Height		Weight	
		Standard	Mean±SD	Standard	Mean±SD		Standard	Mean±SD	Standard	Mean±SD
1–5	15	93.88	89.933±2.4	14.5	14.8±10.2	09	92.68	86.22±1.8	13.8	12.05±6.8
6–10	21	126.9	117.61±3.9	25.68	25.09±6.7	15	126.42	127±6.6	25.42	23.76±6.6
11–15	18	153	148±7.9	41.94	33.55±9.2	12	153	149.9±4.6	43.14	34.58±7.4

SD: Standard deviation

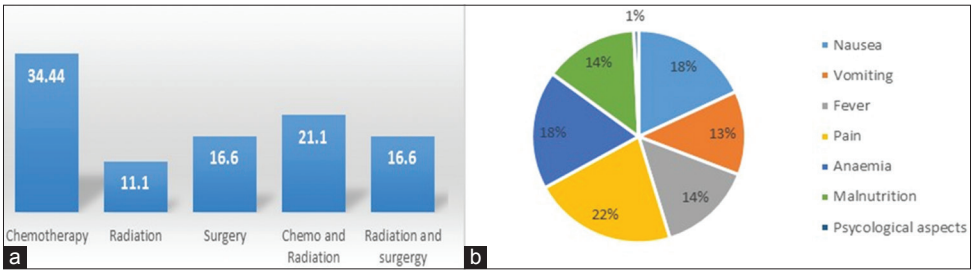

Figure 2: (a and b) Percentage of treatment plan and their side effects

Table 3: Percentage of types of childhood cancer

Types of childhood cancer			
Types	**Boys**	**Girls**	**Total (%)**
All	21	10	31 (34.44)
AML	3	4	7 (7.77)
Osteosarcoma	1	4	5 (5.55)
Neuroblastoma	9	3	12 (13.33)
Lymphoblastic lymphoma	4	1	5 (5.55)
Wilms' tumor	2	1	3 (3.33)
Ewing sarcoma	2	4	6 (6.66)
Medulloblastoma	2	1	3 (3.33)
Rhabdomyosarcoma	1	4	5 (5.55)
Anaplastic ependymoma	2	2	4 (4.44)
Hodgkin's lymphoma	5	1	6 (6.66)
Craniopharyngioma	0	1	1 (1.11)
Thymoma	1	0	1 (1.11)
CCSK kidney	1	0	1 (1.11)

Table 4: Result for mean of differential WBC count

Differential WBC count	Reference %	Pre	Post	*P* value
Neutrophils	40–80	60.17±11.87	41.91±10.37	
Lymphocytes	20–40	31.36±5.56	25.04±5.5	
Eosinophils	1–4	2.71±0.89	2.01±1.36	
Basophils	0–2	1.12±0.67	0.655±0.494	
Monocytes	2–10	5.49±2.33	3.58±1.63	0.000***

NS: Non-significant, ***Extremely significant, **: Highly significant, *: Significant

In spite of being non-vegetarian, the overall energy intake was inadequate, only with 75% of the recommendation. But the daily intake of protein was equivalent to standard recommendations, which is obvious as the calorie from protein met 13-15% of the total diet. The Figure 3a-c adequate protein intake is essential during all stages of cancer treatment, recovery, and long-term survival[13,15] very supporting it is recorded that there is a severe micronutrients deficiency as usual, the eating problems such as swallowing, vomiting, and nausea due to the treatment given.

The above graphs show the coefficient correlation between total energy and the macronutrients, i.e. carbohydrates, protein, and fat. It is mainly influenced by the carbohydrate content of food, as it is chief source and makes the bulk of the diet followed by protein which is also represented in the previous table with a marginal adequacy level.[4] The least energy source is by fat with a very negligible fat which may not impair much on the contribution for the energy although it is adequate level gone beyond the level.

SUMMARY AND CONCLUSION

The mean and standard deviation of pre- and post-hematological parameters calculated and compared using paired *t*-test. This shows that there was a significant decrease in the hematological parameters after the treatments this was considered the treatment given to the subjects such as chemotherapy and radiation therapy. These therapies have an adverse effect on kidney and liver function. The decreased levels of hematological

Table 5: Results for mean of biochemical parameters (pre and post)

Biochemical parameters	Boys			Girls		
	Pre	Post	*P* value	Pre	Post	*P* value
Hemoglobin (years)	**Mean±SD**	**Mean±SD**		**Mean±SD**	**Mean±SD**	
1–5	8.82±1.60	8.18±1.24	0.000***	9.57±0.98	8.87±0.67	0.002**
6–10	9.93±1.44	9.06±1.06		10±1.60	9.37±1.55	0.000***
11–15	11.07±2.54	10.17±2.43		12.08±1.60	11.07±1.40	0.002**
WBC (years)						
1–5	8.82±1.60	8.18±1.24	0.000***	1.91±832.8	1.60±536.2	0.002**
6–10	3.46±747.51	2.73±557.9		5.11±1240.8	4.63±1068.5	0.000***
11–15	7.07±1694.4	6.02±1671.1		9.95±2797	8.78±2132	0.019*
Platelet (years)						
1–5	2.75±0.97	2.38±0.86	0.000***	1.64±0.377	1.52±0.356	0.000***
6–10	2.27±0.224	2.07±0.89		2.98±1.12	2.68±1.10	0.000***
11–15	2.90±1.04	2.45±0.946	0.001**	3.50±1.08	2.50±0.746	0.004**

NS: Non-significant, ***: Extremely significant, **: Highly significant, *: Significant. SD: Standard deviation

Table 6: Percentage adequacy of nutrients intake

Age group									
Nutrients	**1–5 (years)**			**6–10 (years)**			**11–15 (years)**		
	RDA	**Actual intake**	**% Adequacy**	**RDA**	**Actual intake**	**% Adequacy**	**RDA**	**Actual intake**	**% Adequacy**
Energy (kcal)	1200	956.25	79	1700	1288	75	2500	1922	79
Protein (g)	19	19	100	30	24.9	83	50	48.4	96
Fat (g)	26	33.8	130	30	39.4	131	40	85.4	130
Iron (mg)	11	6	54	16	10	62	30	20	66
Calcium (mg)	600	474	79	600	423	70	800	600	79
Zinc (mg)	11	4.7	42	8	5	62	11	7.5	78
Vitamin C (mg)	40	30	75	40	20	50	40	24.3	77
Vitamin A (μg)	3200	2550	79	4800	2375	74	4800	4000	79

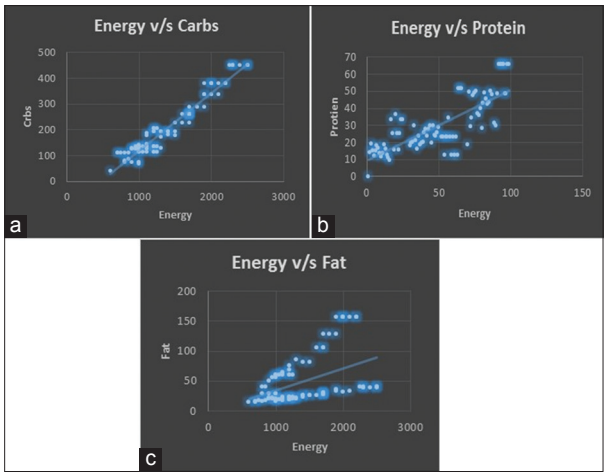

Figure 3 : (a-c) Correlation coefficient between total energy intakes with other macronutrients

values showed that there was no strong association between the treatment and its values.

The actual intake of nutrients did not meet the RDA and also due to the side effects of the treatments, made them to malnourished. Therefore, protein-rich diet was suggested. To meet the micronutrients level, supplements were given during the treatment. The prevalence of malnutrition and dysphagia symptoms was found extensionally higher in children and thereby no improvement on the nutritional status as the subjects were malnourished.

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