

**ORIGINAL RESEARCH**

# Impact of Early Incorporation of Nutrition Interventions as a Component of Cancer Therapy in Paediatric Oncology Patients: A study from a tertiary care centre from North India

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**ABSTRACT**

It is indisputable that adequate and appropriate nutrition is fundamental to the health, growth, and development of infants, children, and adolescents, including those with cancer. Nutrition has a role in most of the accepted components of the cancer control spectrum, from prevention through to palliation. Nutritional status in children with cancer is an important prognostic factor. Assessment consisting of anthropometry, biochemistry, clinical, and diet that needs to be done on diagnosis and regularly to ensure that patient's nutritional status does not deteriorate. In developing countries, assessment will depend on the availability of all resources, but monitoring is essential. The development of malnutrition during treatment is possible and the reasons are multi factorial. Nutrition plays a deciding role and a key factor in children with cancer and can influence their outcome. **Materials and methods:** This, first of its kind study on understanding the impact of nutritional intervention on pediatric oncology patients was conducted in the medical oncology department of Sher-I- Kashmir Institute of Medical Sciences (SKIMS), Soura, Srinagar, J&K – India, from May 2018 to September 2022. Anthropometric measurement, demographic profiles, and etiological analysis were done and collected pre and post intervention. Food frequency tables were also put forward. Besides these, personal interviews and observation methods were also used. **Results:** Nutritional interventions had a measurable positive outcome on the nutritional profiles of the pediatric oncology patients in SKIMS, Soura, Srinagar – India. The grades of nutritional status substantially improved from 51.20%, 12.30%, 6.59%, 3.51%, 7.03%, 6.15%, 14.90%, 2.63%, 2.19% of the well-nourished, mildly malnourished, moderately malnourished, severely malnourished, mild thinness, moderately thinness, severe thinness, overweight and obese to 61.53%, 9.89%, 4.39%, 2.19%, 6.37%, 4.39%, 7.69%, 1.97%, and 1.53% respectively, clearly indicating that with appropriate dietary advice and interventions there is a significant impact on improving the grade of malnutrition.

**Keywords:** Nutrition, Pediatric Cancer, Anthropometry, Nutritional Intervention

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**INTRODUCTION**

Nutrition is the set of integrated processes by which cells, tissues, organs, and the whole body acquire the energy and nutrients for normal structure and function, which is achieved at body level through dietary supply, and the capacity of the body to

transform the substrates and cofactors necessary for metabolism. All these domains (diet, metabolic capacity, body composition and level of demand for energy and nutrients) are influenced by levels of physical activity and can vary according to different physiological and pathological or disease states.

Nutrition is an important thing to consider when you're getting cancer treatment. Eating healthy foods before, during, and after treatment can help you feel better and stay stronger.

Adequate nutrition during cancer plays a decisive role in several clinical outcome measures, such as treatment response, quality of life, and cost of care. However, the importance of nutrition in children and young adults with malignancies is still an underestimated topic within pediatric oncology. The importance of our work is to reinforce and indicate that malnutrition in children with cancer should not be accepted at any stage of the disease or tolerated as an inevitable process. Unique to our manuscript is the close collaboration, the exchange of knowledge and expertise between pediatric oncologists and a nutritional specialist, as well as the comprehension of the mechanisms during cancer cachexia and malnutrition. The survival of children with cancer has substantially increased over the last decades. Major reasons for this are, among others, progress in the early detection, refined multimodality treatment, and enhancements of supportive care, including prevention and efficient management of infections. Furthermore, multicenter trials guarantee a high degree of complete data and quality assurance. However, despite continuous progress in the field, the disease itself and associated therapies carry the burden of an array of adverse late effects. The literature suggests that up to 46% of children and young adults with cancer experience malnutrition due to numerous tumor- and treatment-related factors (3–5). It is recognized that a diminished nutritional status may be a contributing factor for decreased immune function, delayed wound healing, and disturbed drug metabolism influencing prognosis (6, 7). Children with cancer are particularly vulnerable to malnutrition because they exhibit elevated substrate needs due to the disease and its treatment. At the same time, children have increased requirements of nutrients to attain appropriate growth and neurodevelopment (8). It has been demonstrated that adequate nutrition plays a decisive role on several clinical outcome measures such as treatment response, quality of life, and cost of care. There is a limited data about the nutritional status of the children with cancer from India and almost no literature about the same from Jammu & Kashmir. In order to bridge this huge deficit of available information we planned to conduct a study regarding the nutritional status of kids with cancer and see the effects of various nutritional interventions on it [1].

#### AIMS AND OBJECTIVES

The aims of the study were:

1. To understand the age, disease patterns, and treatment phase of the study population.
2. To elaborate on various nutritional practices implemented for the study population.

3. To access the impact of nutritional intervention on the nutritional status of the study population.

#### MATERIAL AND METHODS

The study was conducted at the pediatric unit of the Department of Medical oncology, Sher-i-Kashmir Institute of Medical Sciences (SKIMS), Soura, Srinagar, India, Srinagar. The data of pediatric oncology patients <18 years of age treated from May 2018 to September 2022 was analyzed. Details on age, gender, diagnosis, and anthropometry were collected. Anthropometric measurements were taken within 24 to 48 hours of admission for every patient, which include weight (wt), height (ht), MUAC (mid-upper arm circumference) (for solid tumours and patients below 5 years of age and OFC (occipital frontal circumference)/ HC (head circumference) (up to the age of 3 years). Weight (wt) (up to 18 years of age), height (ht) (up to 18 years of age), occipital frontal circumference (OFC)/ head-circumference (HC) (up to 3 years of age), mid-upper arm circumference (MUAC (up to 5 years of age and in case of solid tumours) at the time of admission (within 24–48 hours), and after 15 days in case of long hospital stays, and monthly for OPDs.

Anthropometric assessment was the key step to identify the grade of malnutrition in the kids. Patients falling between -1 SD to 1 SD on the WHO standards were classified as well-nourished. Those between -2 SD to -1 SD were mildly mal-nourished, between -3 SD to -2 SD were moderately malnourished, and those below -3 SD were classified as severely malnourished. Similarly, for children under 5 years, the BMI above 2 SD was classified as over-weight, whereas for children above 5 years, a BMI above 2 SD indicated obesity. For patients below 5 years of age and those with a solid tumour, the grade of nutrition was assessed based on MUAC and above 5 years based on BMI. 24 hours dietary recalls were collected pre and post-intervention to gauge the impact of the interventions done. The patients' caregivers also filled food frequency tables to give a better insight into the food choices and habits of the patient. Other than these, personal interviews and observation methods were used to assess the changes in the food habits of the patients.

#### INTERVENTION

Nutritional intervention is an umbrella term that comprises all the steps undertaken to resolve or improve the nutrition diagnosis, designed specifically for each patient.

- Nutritional Assessment or Screening- Each child admitted, new or on follow-up, or relapsed was assessed in a systematic ABCD order at each visit.

1. Anthropometric assessment for each patient was done as described.
2. Biochemical assessment was done to monitor the conditions as neutropenia, TLS markers, hyper/hypokalemia, hyper/hypoglycemia, etc.

3. Clinical assessment for features like oedema, ascites, dehydration, purpura, xerosis, etc. was done to get a better picture of any micro or macro nutrient deficiency.
4. Dietary assessment- 24-hour dietary recall method was most commonly used to assess the dietary intake of the children in both IPD (daily) and OPD.

**Grading for Nutritional Status-** After the kids were screened in the order of ABCD, each child was graded to assess their nutritional status. The anthropometric measurements of each kid were plotted on standardized growth charts devised by IAP and WHO, which were then converted to z-score charts by WHO for different indices viz., WFA, WFH, HFA, BMIFA, HCFA, for different ages, for both the sexes. For MUAC, WHO cut-offs were used up to the age of 5 years; thereafter Frisancho cut-off charts were referred to. This defines the degree of malnutrition for each child. To track the growth of the patients along the span of their treatment, each child was allotted their growth charts, which were updated monthly. [Green indicates good nourishment, yellow moderate acute malnutrition (MAM), and red indicates severe acute malnutrition (SAM)]

**Nutritional Intervention** included nutritional counselling and diet prescription to all patients. Nutritional counselling for conditions like hypo/hyperglycemia, hypo/hyperkalemia, hypo/hypertension, TLS, mucositis, diarrhea, vomiting, and certain drug and nutrient interactions was done. Diet prescriptions specified the mode (oral/enteral/parenteral), amount, type (liquid, soft, normal, iso/hypo/hypercaloric, high/low protein, high/low fiber), and frequency of the nutrition per the requirement of each kid. The nutrient requirements were calculated by the REE equations by WHO. Each kid in the IPD and OPD was prescribed a diet per their requirements, considering their digestive and absorptive capacities, familial food preferences, eating patterns, local availability, and socio-economic conditions. In cases where the patients were kept NPO, and had health conditions that contra-indicated the administration of oral and enteral nutrition and warranted parenteral nutritional intervention, TNA (3 chambers) PN bags, amino-acid infusions, and lipids infusions were provided to the kids for nutritional support/rehabilitation/repletion per their specificity and requirements. In such cases, ESPHAGEN guidelines were referred to for the calculation of different nutrient requirements. The "7-10 days rule" is a valuable guide to avoid over-utilization of parenteral nutrition and also to prevent "re-feeding syndrome"[2].

In addition to this,

Nutritional Supplements were provided free of cost, on a monthly basis to the patients under treatment.

The grade of malnutrition progress on overall patients was found to be:

Improved: 230 (61.53%)

These supplements include hyper caloric and protein supplements

**In-meals-** To meet increased nutrient requirements of kids, some in-meal snacks and energy drinks were provided, in addition to the daily hospital diet provided to the IPD kids.

These include thick-skinned fruits like- orange and bananas, and milkshakes, soymilk, lassi, electrolyte drink, peanuts, and chikkis.

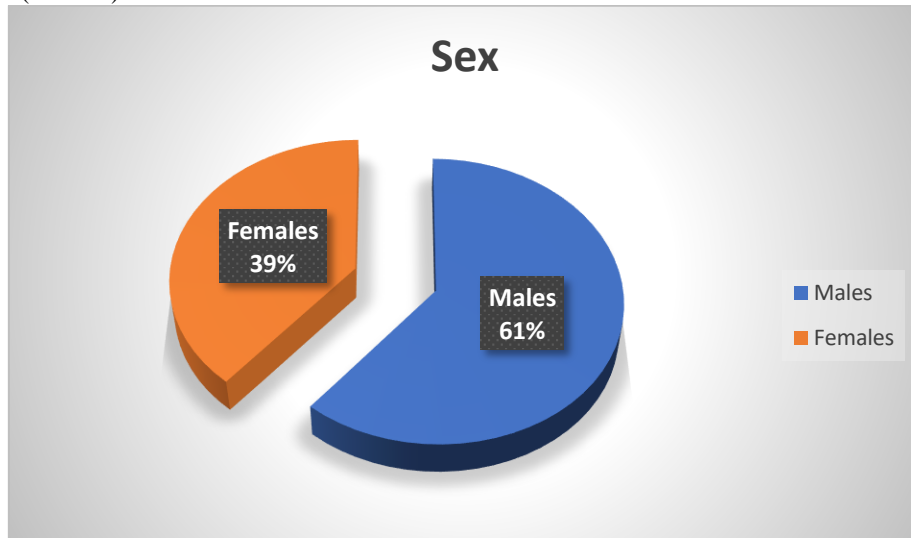
**Monthly rations-** To help the kids' families bear the burden of the whole process, monthly rations were provided to the family of the kids under treatment [5-8].

## RESULTS

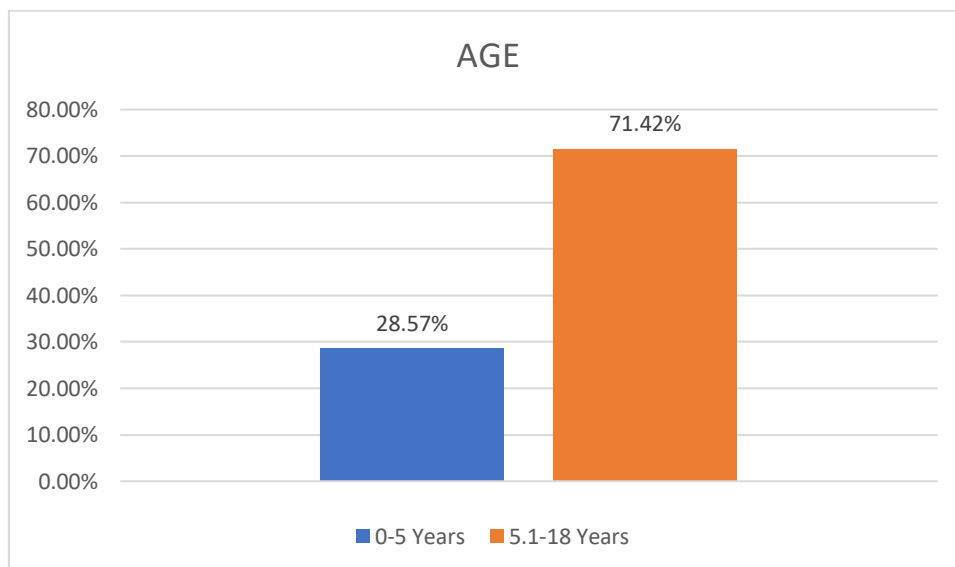
The study was conducted between 1st May 2018 to 30th September 2022. A total of 455 pediatric oncology patients who were under treatment in the pediatric oncology unit of department of medical oncology SKIMS, Soura, Srinagar, India. Of these 455 patients, 278 (61%) patients were Males, and 177 (38.9%) females (fig. 1); 130 (28.57%) were under 5 years old, and 325 (71.42%) were over 5 years old (fig. 2). 52 (11.4%) hailed from the urban areas and 403 (88.57%) were from rural regions (fig. 3). The disease profile of the patients uncovered 204 (44.83%) patients were leukemias, 62 (13.62%) were lymphomas and 153 (33.62%) were solid tumors. Of all the leukemias, 183 (40.21%) were ALLs and 21 (4.61%) were AMLs. Among lymphomas, 27 (5.9%) were Hodgkin's disease, 35 (7.6%) were NHLs. Among solid tumors, Ewing's Sarcoma were 37 (8.13%), Neuroblastomas were 34 (7.4%), Osteosarcomas were 17 (3.7%), Rhabdomyosarcoma were 16 (3.5%), Retinoblastoma were 10 (2.19%), Hepatoblastoma were 6 (1.3%), PNET were 6 (1.3%), Wilms Tumor were 27 (5.93%). The remaining 3.5% (16) were uncommon solid tumors and others were 4.3% (20).

The percentage of well-nourished children at the time of admission was 51.20% (233), children with mild acute malnutrition were 12.30% (56), children with moderate malnutrition 6.59% (30), those with severe malnutrition were 3.51% (16), children with mild-thinness were 7.03% (32), children with moderate-thinness were 6.15% (28), children with severe-thinness were 14.90% (38), those over-weight were 2.63% (12) and obese were 2.19% (10). Post-intervention and dietary counselling, the percentage of well-nourished children went up to 61.53% (280), of children with mild acute malnutrition was 9.89% (45), moderately malnourished children were 4.39% (20), severely malnourished children were 2.19% (10) and children with mild-thinness were 6.37% (29), children with moderate-thinness were 4.39% (20), children with severe-thinness were 7.69% (35), those over-weight were 1.97% (9) and obese were 1.53% (7).

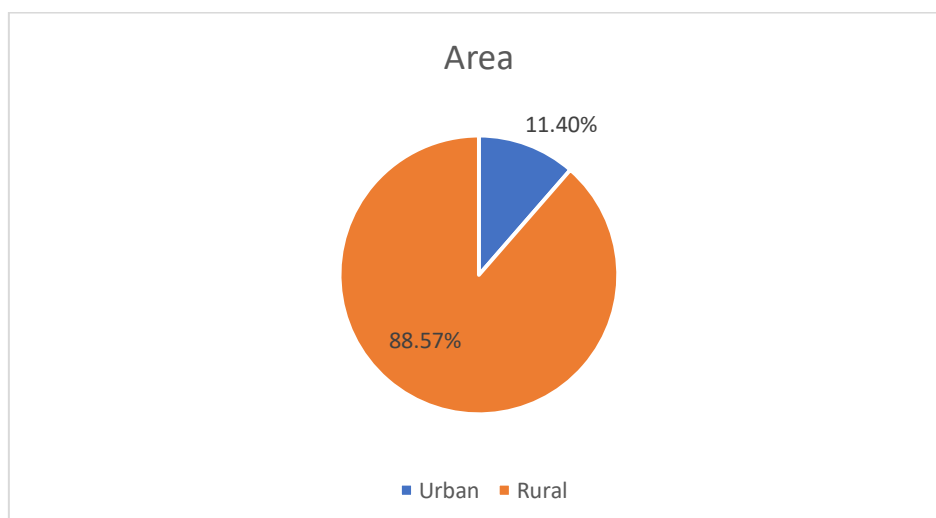
Negative: 175 (38.42%)



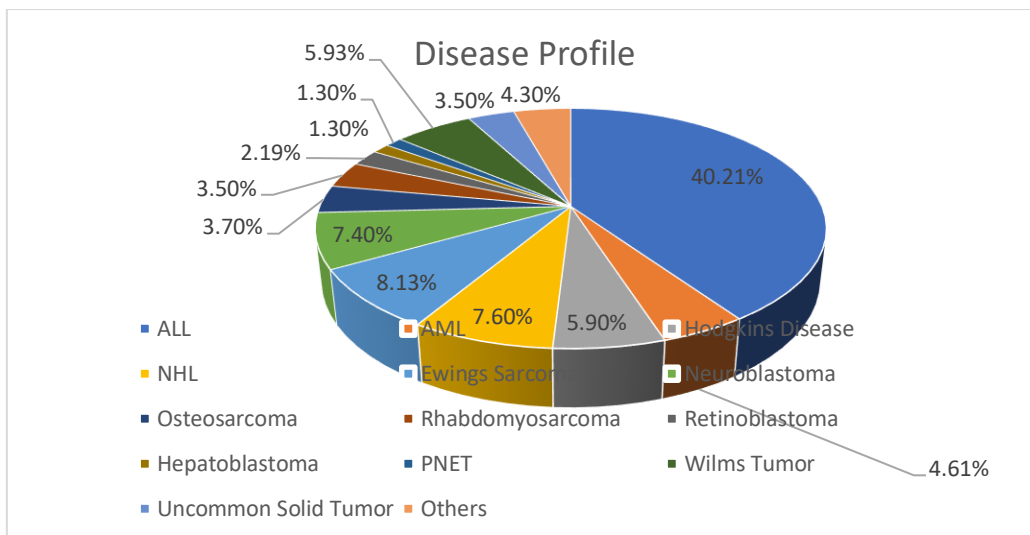
**Fig 1: Classification (percentage) on basis of the sex**



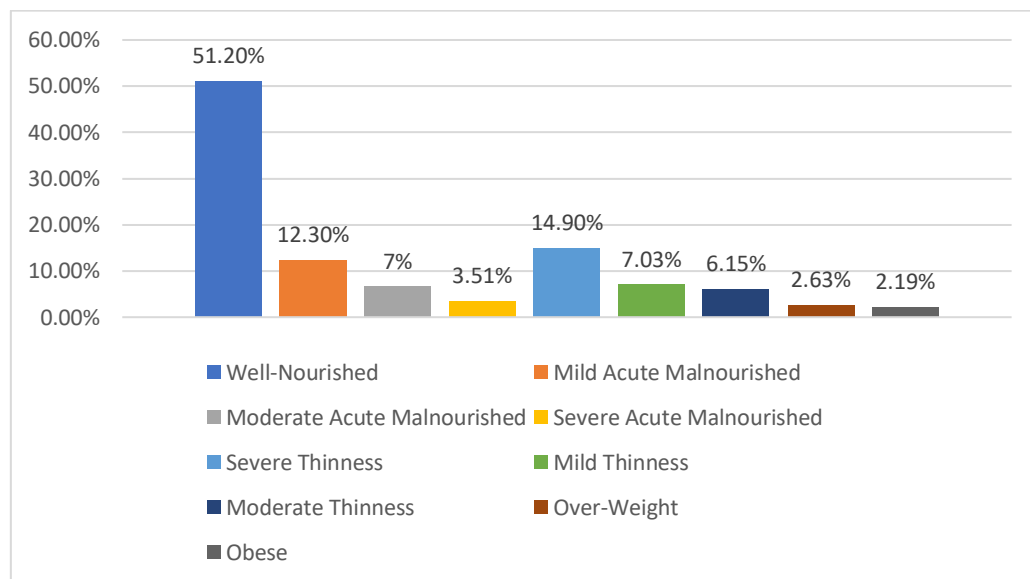
**Fig 2: Classification (percentage) based on Age**



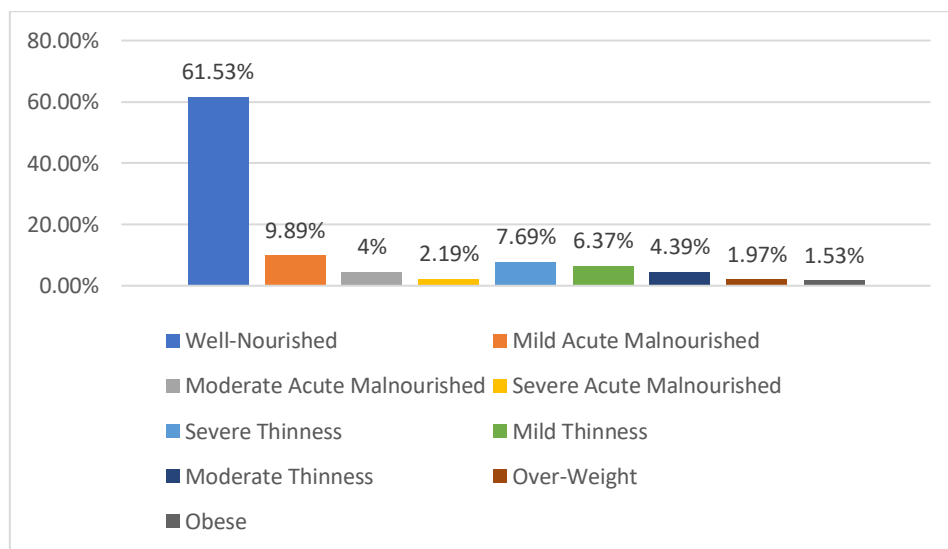
**Fig 3: Classification (percentage) based on residence**



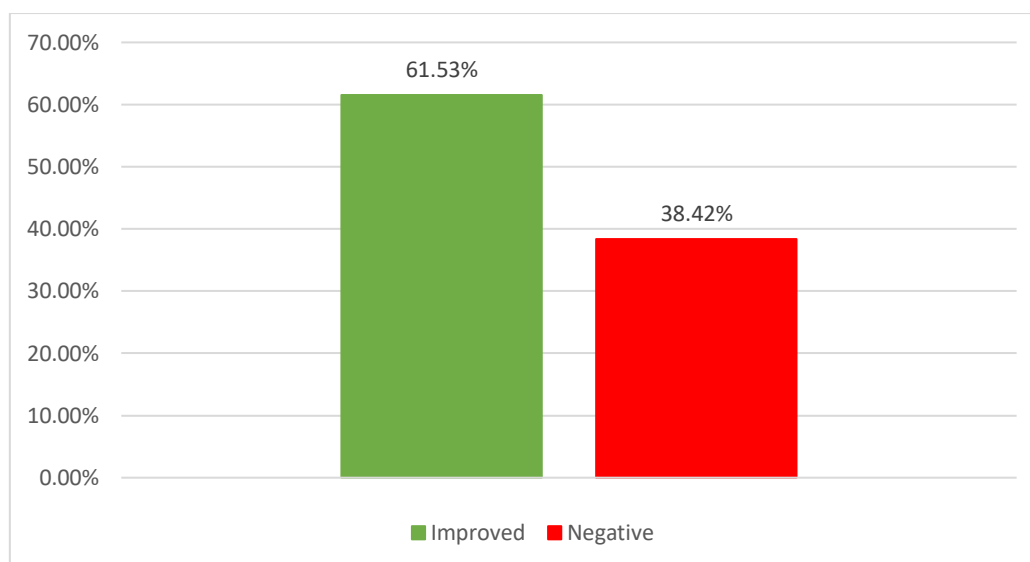
**Fig 4: Classification (percentage) based on disease occurrence**



**Fig 5: Nutritional status pre-intervention of the population under study**



**Fig 6: Nutritional status post-intervention of the population under study**



**Fig 7: Grade of Malnutrition Progress**

## DISCUSSION

Nutrition is essential to well-being from conception through adulthood. That optimal nutrition is essential to the well-being of children during stages of growth is obvious and well documented. Fundamentally, what makes the clinical practice of pediatrics different from that of adult medicine is that the fetus, child, and adolescent are all going through a process of growth and development. During this period, the spectrum of diseases and their pathology is different from that observed in adulthood. This is also manifest in the different prevalence and biology of cancers presenting in newborns, infants, children, and adolescents. Inappropriate/inadequate nutrition results in being underweight, overweight, and/or micronutrient depleted. This may occur in children with cancer prior to diagnosis, at diagnosis, during therapy, and after treatment. Deficiencies of macro and micronutrients give rise to well-described clinical pathological morbidities such as kwashiorkor (protein deficiency), marasmus (energy/protein deficiency), rickets (vitamin D deficiency), blindness (vitamin A deficiency), anemia (iron, folate and B12 deficiency), and many more nutritional-related pathologies. There is a spectrum of nutritional status that spans that of significant deficiency with overt clinical signs, insufficiency without overt signs but a degree of physiological impairment, nutritionally replete, overconsumption leading to obesity due to excess calories, and clinical toxicity due to excess use of supplements, e.g., excess vitamin A resulting in encephalopathy or excess iron and hemochromatosis. Malnutrition is an adversarial prognostic element in kids with cancer, and its incidence is highly variable[3]. Most children with cancer come from low- and middle-income backgrounds, where there are many barriers to optimizing treatment. Nutritional support for pediatric patients with cancer is a challenge. Nonetheless, this challenge can and should be commenced by getting the best out of the

obtainable means and resources. External aids, like charitable foundations, can also largely contribute to ameliorating the battle against Cancer. Heretofore, pediatric oncology patients faced tremendous challenges, more so in the form of access to and know-how about adequate nutrition, and thus resultant lack of motivation for treatment. These are challenges common to most oncology treatment centers in low and middle-income countries (LMICs) like ours, primarily those where access to pediatric oncology care itself may have been deficient [4]. In a study from North India, it was totaled that 34% of fathers of minors with cancer lost their livelihoods and nonmedical costs were 2.5 times the average per capita income. Families exhausted up to approximately 7 times of their monthly incomes over a term of 1 month on an unanticipated illness like cancer. This program was unique in its scale and ambition, and our results show a quantum jump in the improvement of outcomes, both quantitatively and qualitatively. Our department has a dietetic unit providing all the nutritional support and interventions to the patients of the pediatric oncology unit of Sher-I-Kashmir Institute of Medical Sciences, Soura, Srinagar, India. All the aid and assistance aforementioned are provided, with special focus on the patients belonging to the underprivileged section of society.

The holistic programs and practices were unique in scale and ambition, and the results of this study have reflected both qualitative and quantitative improvement in the overall patient profiles. The principal picture of the impact of the interventions can be seen in the nutritional status of the pediatric patients under study. According to a study conducted in Turkey in January 2002, on 47 pediatric patients the overall cases of malnutrition were 29.8%, the percentage went up to 38.3% during the treatment. By the end of the treatment, it was 18.5% [6]. However, on the other hand the results of our study show an

improvement in the percentage of malnutrition by 10.4% in the period of 1 year. According to a prospective observational study reported that 51.1% of all cancer patients presented nutritional impairment, and 64% of patients showed reduction in weight 6 months after diagnosis (14 October 2019)[9]. In our study, the percentage of well-nourished children at the time of admission was 51.20% (233), children with mild acute mal-nutrition were 12.30% (56), children with moderate malnutrition 6.59% (30), those with severe malnutrition were 3.51% (16), children with mild-thinness were 7.03% (32), children with moderate-thinness were 6.15% (28), children with severe-thinness were 14.90% (38), those overweight were 2.63% (12) and obese were 2.19% (10). The dietary recalls at the time of admission of the patients met an average of 40% of the energy/ caloric requirements and 60 % of the protein requirements of the patients. Post intervention and dietary counseling, the percentage of well-nourished children went up to 61.53% (280), of children with mild acute malnutrition was 9.89% (45), moderately malnourished children were 4.39% (20), severely malnourished children were 2.19% (10) and children with mild-thinness were 6.37% (29), children with moderate-thinness were 4.39% (20), children with severe-thinness were 7.69% (35), those over-weight were 1.97% (9) and obese were 1.53%. The dietary recall of the children post counseling and interventions also showed an upward trend, largely. The caloric intake made up to 70% of the requirements on an average whereas the protein intake through diet averaged around 85%.

Therefore, clearly nutritional intervention at the time of detection of the disease can be instrumental in improving the nutritional status through the span of treatment. Another area of significant impact is the improvement in the quality of foods consumed and the quantity consumed to suffice to the requirements of the patients. Nutritional assessment and guidance should start soon after the diagnosis and should continue throughout the treatment, even to the survivorship phase. This will aid in preventing or reversing nutritional deficiencies, preserve lean body mass, minimize nutrition-related side effects and improve the quality of life of future survivors[7].

Idyllically, we'd suggest that all the patients be provided with repetitive follow-up assessments as constant nutritional monitoring consults are important to provide the caregiver with basic nutrition education. However, this may not be feasible for many pediatric cancer care set-ups, since repeated visits require means and resources, and trained personnel. It is recommended that depending on institutional nutritional infrastructure, nutritionally at-risk patients should be followed up as a priority, when possible, on a consistent schedule[8]. Childhood cancer survivors are known to have a predisposition toward obesity and metabolic syndrome, Sarcopenic obesity has been identified in approximately 40% of

survivors of acute lymphoblastic leukemia[10]. As there are large populations of pediatric cancer patients presenting to numerous institutions in India, there is a recognizable opportunity to undertake well-designed studies, including nutritional care and intervention trials. To be sure, India could lead the way in these endeavors and even rise to the challenge of measuring health-related quality of life in this context, and the way ahead may well be through the charitable foundations and NGOs[11].

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