

# Role of Nutrition Therapy in Pediatric Oncology: An Overview

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**Abstract: Pediatric cancer is of various forms is the primary cause of death in children. Children undergoing cancer treatment are particularly vulnerable to malnutrition due to the challenge of maintaining adequate nutrient intake necessary for growth and development. Since malnutrition can happen at any point throughout a patient's course of treatment, detailed dietary recommendations and proactive management techniques are required. In pediatric oncology, it is essential to manage nutrition well in order to avoid malnutrition and its negative consequences, which can impair quality of life and the effectiveness of therapy. Different forms of malnutrition make the situation more difficult and the treatment procedure more difficult. Therefore, standardized nutritional screening and evaluation should be performed often during therapy and follow-up. Rigorous dietary modifications and intake pattern inclusion in pediatric oncology therapy is critical to boosting recuperation, promoting treatment tolerance, and guaranteeing improved long-term health results. Like other supportive care procedures, nutritional strategies are important and should be used with the same amount of discipline. Optimizing nutritional status before, during, and after treatment can improve quality of life and long-term survival for patients and survivors of pediatric cancer.**

**Keywords: Assessment and screening tools, Nutrition, Pediatric oncology.**

## I. INTRODUCTION

Cancer is a disease that can strike any portion of the body and occurs at any age. In industrialized nations, the most common cause of disease-related mortality in children is still pediatric cancer [1]. Cancer that mostly affect children include leukemias, lymphomas, soft tissue and bone sarcomas, central nervous system malignancies, neuroblastomas, retinoblastomas, rhabdoid tumors, liver tumors, kidney tumors, germ cell tumors, and other uncommon malignancies.

Children with cancer are mostly at risk for malnutrition because of not getting enough nutrients to support growth and development is challenging when the illness is being treated

or the cancer is being treated. During any phase of treatment, including the initial diagnosis and in between treatments malnutrition can be detected. Consequently, it is essential to establish appropriate guidelines for follow ups and therapy at various levels. Additionally, there should be precise dietary suggestions for treatment after diagnosis so that active intervention can help achieve the desired results.

Nutritional strategies are an essential component of pediatric oncology that should be integrated with the same rigor as other supportive care measures in order to prevent malnutrition and improper nutrient intake, which can lead to various levels of illness and adverse late effects. For children with cancer to receive all the necessary nutrients for development and growth in health as well as for better treatment toleration, good nutrition is crucial to their health from the very beginning of their illness and throughout treatment [1]. A child receiving cancer treatment may benefit from eating the right foods in the right amounts to ensure proper nutrition and a speedy recovery.

## II. MALNUTRITION IN PEDIATRIC ONCOLOGY

Pediatric cancer patients frequently experience malnutrition, and after treatment, otherwise healthy children may have decreased nutritional status. During cancer therapy, employed in pediatric cancer treatment, combination of chemotherapy and radiation can aggravate the negative side effects because it can lower immunity, which can lead to greater infection rates, decreased physical function, more neuropathy, and overall lower quality of life [4]. In addition, it also exacerbates the side effects which might include nausea, vomiting, and anorexia as well as other metabolic alterations including weight loss or muscle loss. Since, being a catabolic state, cancer causes metabolic alterations including raise calorie intake, anorexia, liposis and protein turnover. Endocrine disruptions observed in these children with cancer cachexia have resulted in additional negative effects on energy levels and standard of living. They encourage endogenous muscle protein catabolism because of their counter-regulatory effects on protein metabolism, corticosteroids - which are commonly used in therapy-exacerbate cachexia. Consequently, weight loss and a loss of

lean body mass occur, often with decreases of more than 5 % after the first month of treatment. Also following cerebral spinal irradiation, Glucagon, cortisol, growth hormone, catecholamines, and insulin levels are all on the rise, while thyroid hormones and insulin levels are falling in people with relative insulin resistance. However, the resulting decrease in energy use does help to preserve the limited supply of metabolic substrates [5].

Nutritional deficiencies are frequently observed at diagnosis or during follow-up care. Malnutrition affects 8% of children when they are diagnosed with cancer. Various studies define malnutrition differently; some base it on height below the 50<sup>th</sup> centile or weight for height, while others use BMI z-score of less than -2 or weight for height. Additionally, only 5% of centers routinely evaluate dietary intake, and only 84% regularly employ triceps skin fold thicknesses which is a part of nutritional assessment in pediatric cancer screening, are not widely used nor standardized in this regard. Alternative

measurements, such as anthropometry, are not in pediatric cancer assessment [3].

Children with a known nutritional deficiency at diagnosis—typically connected to advanced-stage malignancies or solid tumors— as well as individuals with poor tumor histology and location are more likely to suffer from malnutrition [6]. Particularly in developing nations, undernourished children with cancer are far more likely to experience severe malnutrition. The lowered nutritional status can have a number of adverse effects, such as impair drug metabolism, reduced bone mineral content, delayed wound healing, weakened immune system, more hospital admissions and longer hospital stays [1]. In particular, poor weight loss has specifically been linked to lower survival rates in children with newly diagnosed acute myeloid leukemia, acute lymphoblastic leukemia and stage IV neuroblastoma. Additionally, survivors of prevalent pediatric cancers are at longer-term risk. They are susceptible to endocrine, cardiovascular, and obesity-related illnesses [6].

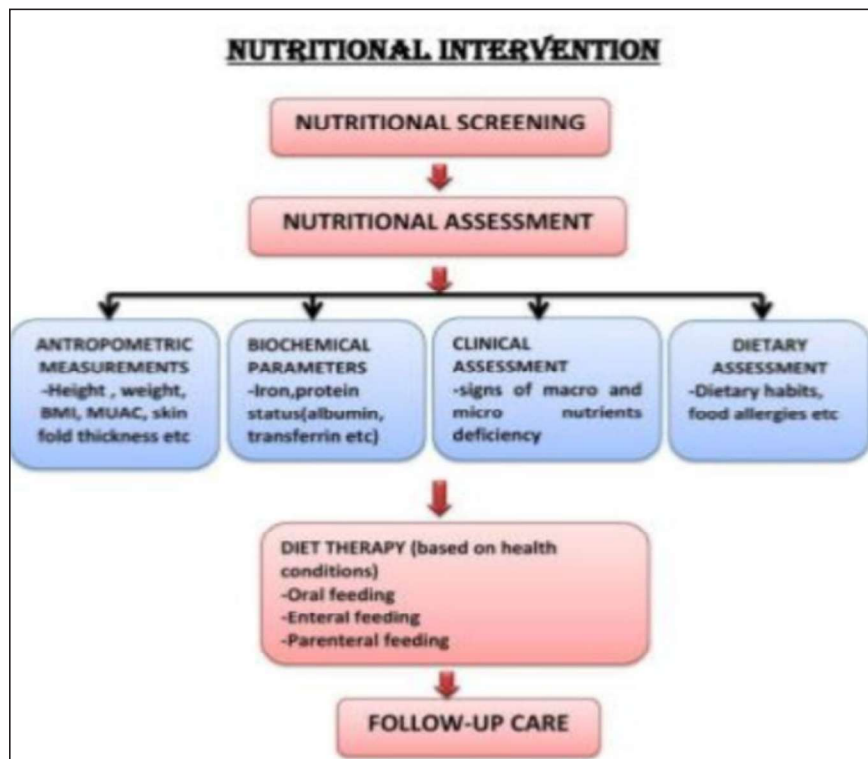


Fig. 1: Asystematic Diagram of Nutritional Intervention Follow-Up

### III. NUTRITION SCREENING AND ASSESSMENT

Children's growth is significantly influenced by their nutritional state. Disease-related malnutrition in pediatric patients are a dynamic, complex process aided by a number of variables, including inflammation, increased energy expenditure, decreased nutrient intake, and poor nutrient utilization [7]. All patients should have their nutritional status evaluated using a

standardized method at diagnosis, and it should be done again at regular intervals during treatment as well as at follow-up [3].

The Joint Health Organization Accreditation committee (JCAHO) proposes a rapid nutrition screening procedure to find people who might be malnourished or at risk for nutrition-related problems. Since, many of the side effects of the various cancer therapies included altered appetite, decreased weight, and impaired levels of nutrient and food tolerance. Early

diagnosis of nutritional risk in pediatric patients allows us to take proactive intervention measures to enhance their health and save their lives [1]. A lower response to cancer treatment, more side effects, and potentially lower survival rates can all be caused by malnutrition.

Undernutrition has too many negative effects on children with cancer, such as a higher risk of infections, a slower rate of wound healing, a poor lifestyle, and possibly more referrals to tertiary care facilities [8]. The frequency of malnutrition is higher in cancer patients and is more unpredictable, as evidenced by the 80-60% malnutrition rate among children with cancer. It all depends on how the cancer is treated and what kind of cancer it is, as well as how the test is conducted under nutritional conditions employing calculations such as body mass index, weight/length Z score/percentile, and others under nutritional conditions. Children's malnutrition can best detect using arm anthropometry, such as MUAC and TSF,

since it provides more pertinent information [3].

Patients who may be malnourished can be easily identified by measuring their pre-albumin levels. And also, the following evaluation instruments are used by numerous healthcare organizations throughout the world to determine nutritional status: STAMP is a screening technique used to look for signs of childhood malnutrition. The Nutrition Risk Score is another name for the NRS. PNRS is also known as the pediatric nutritional risk score. The Pediatric Yorkshire Malnutrition Score for children is known as PYMS; a STRONG kid is a screening tool for nutritional status and development impairment risk; PNST is an acronym for the Pediatric Nutrition Screening Tool; and SGNA stands for Subjective global nutrition assessment. Nutritional assessment should be assessed by using different parameters namely anthropometric measurements, biochemical parameters, clinical and dietary assessment [2].

#### IV. ASSESSMENT METHODS USED FOR NUTRITIONAL STATUS

<i>Author, Year (Location)</i>	<i>Study Design</i>	<i>Patients (N)</i>	<i>Diagnosis</i>	<i>Assessment Method</i>	<i>Nutritional Related Problems</i>
Maurya <i>et al.</i> , 2022, Lucknow, India	Prospective observational studies	73	Acute leukemia	BMI	Malnutrition
Rajesh <i>et al.</i> , 2000, India	Prospective observational studies	25	Acute lymphoblastic leukemia	BMI, MUAC, skinfold thickness	Malnutrition
Rashakrisnan <i>et al.</i> , 2015 Chennai, India	Retrospective study	295	All types of Cancers	Weight for age (based on CDC)	Undernutrition
Ganguly <i>et al.</i> , 2022, New Delhi, India	Longitudinal cohort study	535	Hematological and Solid malignancies	Height for age, Weight for age, BMI for age	Malnutrition
A. Roy, 2021 Kolkata, India	Retrospective cohort study	159	Acute lymphoblastic leukemia	Weight for age scores (WHO)	Malnutrition

#### V. ANTHROPOMETRIC MEASUREMENTS

Plotted on WHO growth charts; the body mass index (BMI), weight, height and mid upper arm circumference (MUAC) make up the basic nutritional assessment. According to the WHO, malnutrition is defined as having a body mass index (BMI) of  $\pm 2$  Z score; however, tumor mass fluid imbalance and possible amputations or surgical procedures can all have an impact on these values, making them insufficient for a trustworthy assessment in cancer patients. Dual energy X-ray Absorptiometry (DXA), Bioelectrical Impedance Analysis (BIA), Tricep Skin Fold Thickness (TSFT) and other objective, dependable techniques could be compared over time to determine body composition more accurately [3].

#### VI. BIOCHEMICAL PARAMETERS

The following biochemical tests can provide further information about a patient: vitamin levels, bone health, iron studies, and sign of inflammation (serum c-reactive protein [CRP]), liver enzymes, serum urea, creatinine and organ function and protein status (serum albumin, pre-albumin, transferrin, and creatinine), and deficiencies in diet (certain levels of vitamins and minerals).

An albumin value of less than 32 g/L is considered low, and it is frequently used as nutritional assessment index. But it is influenced by liver function, inflammation, and the state of hydration. Although they are scarce in most centers, more specialized laboratory tests, such as transferrin receptor dosage

or retinol binding protein, can be used to measure malnutrition over time in children who are severely malnourished (2).

## VII. CLINICAL ASSESSMENT

A child must have a routine clinical assessment to check signs of vitamin and/or mineral deficits and malnutrition. The detection of malnutrition symptoms, such as muscle atrophy, loss or excess subcutaneous fat, edema, dry mucous membranes, and hair changes, depends on the clinical evaluation of cancer patients. And children suffering from undernutrition, it is crucial to look for signs of edema, vitamin and mineral deficiencies, and recent weight changes [3].

Medical professionals should also take into account conditions like severe mucositis, loss of appetite, vomiting, diarrhoea, constipation, and indigestion that can impact a patient's ability to consume food orally. Additionally, an extended hospital stay can seriously harm a patient's social life, mental health, and nutritional status [9]. They can also be extremely stressful for children and their families.

## VIII. DIETARY ASSESSMENT

A comprehensive dietary history covering macro- and micronutrient intake, family dynamics, present eating patterns, dietary aversions, allergies or intolerances and a nutritional evaluation requires good food hygiene. An analysis of the quantity and variety of foods consumed, along with a comparison of these metrics with age-appropriate dietary guidelines, constitute a comprehensive evaluation of diet quality. Intervention may also be necessary if there is a decline in nutritional status brought on by poor oral intake, as this can impact immune function and organ dysfunction [7]. A diet history of the patient is much needed for performing nutritional assessment. Complete evaluations are the best accomplished by qualified professionals such as clinical nutritionists and dietitians, who should monitor the patient throughout the course of treatment and beyond.

## IX. DIETARY MANAGEMENT

Early and proper nutritional intervention helps promote therapeutic tolerance, minimize stunting, improve quality of life, and shorten hospital stays for children in the hospital [2]. The patient, along with their family and caregivers, should understand that maintaining daily activities, energy, and functional capacity is crucial to better overcoming treatment outcomes.

Due to the several factors that simultaneously affect appetite and dietary intake, nutritional therapies for children with cancer are difficult [8]. A paradigm shift in the management of diet during therapy is truly needed, because new research shows that being overweight during treatment for acute lymphoblastic leukemia raises the risk of relapse and chronic illness.

Traditionally, the emphasis has been on optimizing calories since children typically experience weight loss during the initial, intensive stage of treatment. Acute Lymphoblastic Leukemia [ALL] and malignancies of the central nervous system are the two most prevalent cancer types in children, actually have lower calorie intake during therapy while higher fat intake, according to emerging evidence. As a result, the quality of dietary intake should be prioritized over the quantity of calories consumed.

According to ESPEN guidelines, the daily intake of protein should be greater than 1 g/kg and, up to 1.5 g/kg if possible, because consuming more protein aids in maintaining muscle mass. In doses comparable to the recommended dietary allowance, multivitamin, multimineral supplements are suggested by the American Institute for Cancer Research, The American Cancer Society and the European Society for Clinical Nutrition and Metabolism (ESPEN), because many patients suffer from restricted diets and the negative effects of therapy [6].

Nutritional interventions will change based on the medical background, cancer type and stage, and treatment response of each patient. Oral nutrition is always the first priority in clinical practice. Since oral nutrition plays a major role in the patient's daily routine and significantly increases their level of autonomy, it is the recommended feeding method. Whereas artificial nutrition should be taken into consideration if/when oral nutrition is insufficient. The following criteria must be met in order to escalate nutritional measures: a) food intake below 50% of requirements is expected for more than 10 days as a result of surgery, chemotherapy, or radiation therapy; b) for longer than ten days, 50% of needs are anticipated due to radiation, chemo therapy or surgery; c) it is expected that patients who are undernourished unable to consume or absorb enough nutrients for an extended period of time due to antineoplastic therapy; and d) if the tumour mass itself obstructs the passage of food through the upper gastrointestinal system and oral intake. For the purpose of preserving gut integrity, minimizing bacterial translocation, and lowering the risk of infectious complications, enteral nutrition should be chosen. Tumours obstructing chest, neck and head, when oral or EN cannot ensure proper nutrition, PN should be considered.

PN is not recommended for patients undergoing RT or chemoradiotherapy, and it should only be taken into consideration in cases where oral or EN cannot guarantee adequate nutrition [10]. During cancer therapy such as chemotherapy, radiotherapy, it has a high chance of developing complications like oral mucositis, dysphagia and diarrhoea. So nutritional counseling is mandatory.

Furthermore, to minimize infections in pediatric oncology patients by restricting entrance of germs into the gastrointestinal system, a Neutropenic Diet – which avoids raw

vegetables and fresh deli meats- is frequently prescribed in practice. Nevertheless, in a randomized study, patients who adhered to the FDA's food safety recommendations and those who followed the neutropenic diet did not have different infection rates.

## X. FOLLOW-UP

Follow-up care for cancer patients include regular checkups with a healthcare professional after treatment is finished. Based on nutritional risk, a regular assessment, it is advised that undernourished patients have monthly evaluations while obese people have quarterly evaluations. Patients without risk factors can be evaluated every six months for the first year of follow-up and then annually. Monthly assessments are recommended for undernourished patients, quarterly assessments for obese patients. It assists in managing side effects brought on by treatment and keeping an eye on cancer recurrence. It also lowers the rate of rehospitalization and helps to improve cancer outcomes [3].

## XI. CONCLUSION

Malnutrition, which is defined as both overnutrition and undernutrition, affects both survival and quality of life and is a prevalent problem in children who have cancer. Adverse outcomes during childhood cancer treatment and beyond into survivorship are associated with poor nutritional status. To prevent various outcomes, it is advisable to undergo nutritional risk screening and assessment both upon admission and on a regular basis in cancer patients facilitating the timely identification of malnourished patients and the implementation of nutritional interventions aimed at averting nutritional decline and muscle atrophy. And also in pediatric oncology, nutritional strategies are crucial and should be implemented with the same level of rigor as other supportive care techniques. Enhancing quality of life and long-term survival for patients and survivors of childhood cancer can be achieved by tailoring and optimizing nutritional status before, during, and after treatment.

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