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Reviewing Nutritional Status Assessment: Methods And Applications

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Abstract:

Introduction: Nutritional status (NS) is crucial for the treatment and prognosis of cancer patients. This study seeks to investigate different methods and tools employed for the purpose of determining the nutritional status of people under treatment of cancer. This study also aims to understand, consequently, the correlation between nutritional status and cancer treatment outcome by conducting a thorough analysis of existing literature and suggesting potential areas for future research. Extensive research has shown a significant link between nutritional status and the outcomes of cancer treatment. Malnutrition, especially cachexia, is linked to unfavorable treatment results and higher mortality rates. Nutritional interventions like oral nutritional supplements, enteral nutrition, and parenteral nutrition have been proven to enhance treatment response and decrease toxicity in cancer patients. The relationship between nutritional status and cancer treatment outcomes involves intricate and multifaceted mechanisms. The nutritional status can impact the immune system, inflammation, and metabolism, consequently influencing cancer progression and treatment response. While starvation can impair immune function and encourage the spread of cancer, receiving adequate dietary nourishment can strengthen the immune system's ability to recognise and eliminate cancer cells.
Objective: i, To understand the different methods employed for the evaluation of the nutritional status in people on cancer treatment. ii, To understand the intricate connection between nutritional status and cancer treatment and management.
Methodology: A systematic literature review was performed by searching through PubMed, Scopus, and Web of Science databases. Studies published from 2000 to 2023 were considered. The keywords searched for included "malnutrition," "nutritional status," "pediatric oncology," and "childhood cancer."
Conclusion: This systematic review emphasizes the substantial influence of nutritional status on cancer and its treatment. Specific nutritional assessment techniques can improve the traceability of patients that require intervention and specific interventions can enhance treatment response and decrease toxicity, resulting in improved survival rates. However, additional research is required to determine the most efficient nutritional assessment strategies. By comprehending these connections, clinicians can create customized nutritional strategies to enhance cancer treatment results and improve patient quality of life.

Keywords: Mal-nutrition, Cancer, Nutrition, Public health

Introduction:

Malnutrition frequently affects cancer patients and can have adverse effects on treatment outcomes and quality of life. Optimal nutritional status prior to and during cancer treatment has been linked to increased therapy tolerance and enhanced survival rates. However, the precise connections between various nutritional elements and the effectiveness of cancer treatment need more investigation. Research on the nutritional status of pediatric cancer patients has been going on for a while now, and issues related to nutrition are also being acknowledged. Research on malnutrition related to childhood cancer has been available since the 1970s, but the assessment procedures and management techniques have been inconsistent, resulting in many undernourished children not being promptly recognized and therefore not receiving apposite nutrition therapy and treatment. The overall condition of wellbeing of childhood cancer patients is vital as it can influence the advancement of the disease and the chances of survival during and after the treatment course. The nutritional status at the time of diagnosis and during the treatment can also impact morbidity and mortality incidences. Nutrition related problems can impact cancer patients' quality of life and can even make them more susceptible to negative treatment outcomes and also to other chronic diseases. Therefore, emphasis should be laid on the significance of identifying the appropriate methods and tools for the efficient evaluation of nutritional status and implementing scientific management and providing nutritional support to this specific group.

Objective:

i. To analyze the current literature to understand different assessment tools and methods for determining the nutritional status in cancer patients.
ii. To analyze current literature to shed light on the intricate connection between nutritional status and cancer treatment and management, focusing on its influence on the efficacy of treatment and patient outcomes.

Methodology:

A comprehensive literature search was conducted using various databases including PubMed, Scopus, Web of Science, the Cochrane Library, and MEDLINE to find systematic reviews, meta-analyses, randomized controlled trials, and observational studies published between the years 2000 and 2023. The search strategy found the keywords "childhood cancer," "pediatric oncology," "nutritional status," and "malnutrition." The reference list of all pertinent articles was reviewed, and potentially relevant corresponding articles were searched individually. Specific focus was laid on recent articles, meta-analyses, and systematic reviews from various countries to determine potential influence.

Results:

Pediatric cancer includes a wide range of diagnoses with differences in outcomes, prognosis, treatment planning, and tumour features. Various factors such as tumour location, histological type, biological behavior, and age at the onset of the disease, as well as pain and strain of the disease, inflammatory mechanisms, hormonal deregulations, psychological bearing, diminished physical activity, medications and medication linked dietary-intake alterations can all impact nutritional makeup of an individual. Some patients experience weight loss at the time of disease diagnosis, which raises the risk of suboptimal nutritional status during cancer treatment. Studies conducted in the past as well as in the present times have thoroughly investigated weight changes in children with cancer. The nutritional status at the time of diagnosis is extremely important since it has a significant impact on how well the patient responds to treatment and how likely they are to recover. Nutritional status in pediatric cancer patients is often continually changing, and impaired nutritional status often occurs during later stages of treatment. Nutritional issues during treatment can result in decreased chemotherapy tolerance, changes in drug metabolism, weakened immunity, heightened infection susceptibility, increased treatment-related morbidity, low event-free survival and diminished quality of life. The strength and quality of the data pertaining to these implications can differ. Malnutrition during childhood cancer treatment has significant clinical consequences, impacting both mortality and survival rates as well as the quality of life of pediatric patients, specifically in developing countries like India. Undernutrition is associated with higher rates of complications, relapses, and slower recovery, which may impact overall survival. Therefore, the proper nutritional diagnosis becomes pivotal in oncology practice. Several methods have been employed for the assessment of nutritional status, including the anthropometric measurements – weight, height, skin-fold thickness and arm circumference, biochemistry, clinical assessment- nails, hair, eyes, skin, and tongue, and dietary investigation – food dairy, 24 hours dietary recall, and food frequency. Different researchers have employed these methods in combination or individually for the assessment of nutritional status across the clinical settings and studies.

Small et al. conducted a retrospective review on the growth and nutritional status, assessed by BMI, of children diagnosed with Neuroblastoma (NBM), between January 1985 to December 2005, at the Sydney Children's hospital Network (SCHN), Australia. Of 154 children, 11.6% were overweight (BMI >85th percentile) and 24.0% were underweight (BMI <15th percentile), at the time of diagnosis. All children saw a drop in their BMI z-score six months following diagnosis, with the exception of those with stage 4 of the disease. The BMI z-score increased after a year, and after two years, it was noticeably higher than baseline. The percentage of underweight children fell to 8.7% while the percentage of overweight children rose to 27.5% at the time of the last study follow-up (range 3 – 7 years). Although the overall survival rate was 61.2%, survival was not predicted by BMI. There were no significant variations in gender or age at diagnosis among children categorized as underweight, standard weight, or overweight.

Maia Lemos et al., conducted a cross-sectional observational study in Brazil (2016), where they evaluated the nutritional status of 1154 patients diagnosed with childhood malignant neoplasms in Brazil, from March 2005 to March 2012. A majority of the study participants, specifically about 67.63% had an appropriate BMI upon diagnosis. Based on BMI, triceps skinfold thickness (TSFT), mid-upper arm circumference (MUAC), and arm muscle circumference (AMC), the overall prevalence of malnutrition was 10.85%, 27.32%, 24.55%, and 13.66%, respectively. With the exception of retinoblastoma and Wilms' tumor, all tumor groups experienced moderate to severe average weight loss.

Villanueva et al., (2019) examined the nutritional status of 1060 childhood cancer patients at UNOP (National Children's Cancer Center) Guatemala, between January 2015 and December 2017. NS was assessed using MUAC, TSFT, and serum albumin (ALB) levels. Children were categorized based on their nutritional status as adequately nourished, moderately depleted, or severely depleted. Leukemia made up 51% of all diagnoses, solid tumours accounted for 33%, lymphomas for 11%, and brain tumours for 5%. When assessed for nutritional status, 47% (n = 495) of patients were classified as severely depleted, 19% (n = 207) as moderately depleted, and 34% (n = 358) as adequately nourished. The study also found that SES, leukemias and lymphomas were strong predictors or poor NS at diagnosis.

A retrospective observational study was conducted in India by Shah et al., including 1693 newly diagnosed patients, under treatment for cancer from November 2008 to December 2013 at Tata Memorial Hospital, Mumbai. The prevalence of malnutrition at the time of diagnosis, as defined by World Health Organization (WHO) criteria, was very high, ranging from 40% to 80% subject to the assessment method used. The prevalence was higher when MUAC was the assessment criteria for malnutrition, and lower when BMI was the criteria for assessment. The prevalence of malnutrition was 38% in line with BMI, 57% in line with TSFT, 76% in line with MUAC, 69% in line with AMC, and 81% in line with arm TSFT +MUAC. Including BMI and serum albumin (ALB) in arm anthropometry raised the percentage of individuals identified as severely malnourished by 2% and 1.5% respectively. There was no significant variation in undernutrition rates among different disease groups. Conversely, 8 patients (0.5%) in this study were overweight, and 14 patients (0.8%) were obese, a significantly lower rate compared to certain other studies conducted.

Another study by Radhakrishnan et al. carried out in India, retrospectively analysed data on weight collected at the time of diagnosis, midway of treatment and end of treatment for patients with solid tumors, lymphomas, and acute myeloid leukemias (AML) and records were gathered for patients with solid tumours, lymphomas, AML (acute myeloid leukemia), and ALL at the time of diagnosis, at the conclusion of induction, and at the conclusion of the patient's treatment. The investigation comprised 295 pediatric cancer patients treated at the Cancer Institute, Chennai, between January 2013 and May 2014. The weight records of the research participants were plotted using the WFA (weight for age) growth chart graphs from the Centres for Disease Control and Prevention (CDC) as a reference. At the time of diagnosis, 52% of patients (153 out of 295) had weights in the third to 97th centiles, indicating appropriate nutrition. Out of 285 people, 44% (130) were undernourished, while 4% (12) were obese. During treatment, 49% (137 out of 295) were nutritionally normal, 46% (130 out of 282) were malnourished, and 5% (15 out of 282) were fat. 63% (96 out of 152) of the patients had nutritionally normal status at the completion of treatment, 27% (41 out of 152) had malnutrition, and 10% (15 out of 152) had obesity. There was no significant difference in nutritional status between hematological malignancies and solid tumors at diagnosis, midpoint of treatment, or end of treatment.

Yoruk et al. (2018) conducted a prospective observational cohort study in Istanbul, including 74 pediatric oncology patients newly diagnosed with hematological malignancies (n = 56) or solid tumours (n = 18). Anthropometric measurements used for the assessment of nutritional status in the study sample comprised body weight, height, BMI, BMI-for-age percentile, MUAC, TSFT, and z-scores for WFA, HFA, BMI-for-age, weight-for-height-for-age, MUAC-for-age, and TSFT-for-age. Upon diagnosis, 09 out of 74 patients (12.3%) were undernourished based on BMI for age z-score below -2 standard deviations. Six patients (10.9%) had hematological malignancies, and three of them (16.7%) had solid tumours. Furthermore, BMIs below the fifth percentile for the patients' age indicated that 10 out of 74 (13.7%) were undernourished. Solid tumors comprised 22% of the patients, while hematological malignancies made up 10% of the patients. In addition, a total of five patients (6.8%) had an increased body mass index (BMI for age z > 2 SD).

Triarico et al. included 126 newly diagnosed pediatric cancer patients in their research, which was carried out in Italy between August and April of 2018. Nutritional risk at diagnosis for each patient was evaluated using STRONGKids (Screening Tool for Risk on Nutritional-status and Growth). Anthropometric measurements, including weight, height, and BMI z-scores, were also assessed. Analysis revealed that at diagnosis, 90 patients (71.4%) had a moderate risk of undernutrition, while 36 patients (28.6%) were at high risk of undernutrition. Four patients (3.1%) had severe malnutrition, two (1.6%) had moderate malnutrition, and six patients (12.7%) had mild malnutrition based on BMI Z-scores. At 3 months, 18 patients (14.3%) had at least mild malnutrition (BMI Z-score ≤-2), followed by 17 patients (13.5%) at 6 months. At 3 months after diagnosis, 58 patients (46%) reported a weight loss of ≥5%, with no patients losing ≥10%. 12 patients (9.5%) had a BMI Z-score decrease of ≥1. At 6 months, there was a weight loss of ≥10% and a BMI Z-score decrease of ≥1 was found respectively in 28 patients (22.2%) and in 32 patients (25.4%) at 6 months. The study outcomes show a strong association between malnutrition in the initial phase of therapy (3-6 months after diagnosis) and lower survival.

In the Netherlands, Loeffen et al. (2015) researched malnutrition in a diverse childhood cancer population under treatment at UMCG (University Medical Centre Groningen). 269 children (<18 years of age) with cancer, undergoing treatment for different types of malignancies, from October 2004 to October 2011, were included in the study. BMI z-scores were taken as a measure to assess nutritional status. At diagnosis, 14 children (5.2%) were identified as undernourished (BMI z-score < −2), 229 children (56.9%) were found to be well nourished, and 19 children (7.1%) were classified as over-nourished (BMI z-score > 2). Compared to children who were well-nourished, malnourished children had a significantly decreased survival rate (hazard ratio [HR] = 3.63, 95% confidence interval [CI] = 1.52–8.70, p = 0.004).

Pribnow et al. carried a retrospective analysis on newly diagnosed patients with acute lymphoblastic leukemia (ALL), acute myeloid leukemia (AML), Wilms' tumour, Hodgkin's lymphoma (HL), or Burkitt lymphoma (BL), between January 2004 and December 2007 in Nicaragua. A total of 282 patients were taken up in the study. Anthropometric measurements including weight, height or length measurements, Body Mass Index (BMI), Mid-Upper Arm Circumference (MUAC), Triceps Skinfold Thickness (TSFT), and also serum albumin (ALB) levels were taken as the measures for the assessment of nutritional status. Upon diagnosis, 67% of patients were classified as malnourished, with 19.1% patients having moderate malnutrition, and 47.9% patients having severe malnutrition based on TSTF, MUAC, BMI and Serum Albumin categorizations. Patients with Wilms' tumour had an undernutrition rate of 85.7%, while those with BL had a rate of 75%, and those with HL had a rate of 58.3%. Patients with high-risk malignancies were more likely to have worse nutritional status regardless of diagnosis. This was seen when severely undernourished patients (62.7% of those with high-risk disease) were compared to well-nourished patients (37.3% of patients with high-risk disease) (p = 0.08). Comparable patterns are also noted in high-income countries (HICs) and can be linked to the burden of disease.

In Poland, Potubok et al. (2017) studied 734 patients with different pediatric neoplastic diseases, aged 1 to 25 years, diagnosed from 1986 to 2014 at the Wroclaw Medical University. Patients were categorized into groups based on the type of neoplasms: acute lymphoblastic leukemia (ALL), acute non-lymphoblastic leukemia (ANLL), Hodgkin's lymphoma (HL), non-Hodgkin's lymphoma (NHL), neuroblastoma (NBM), Wilms' tumour (WT), and mesenchymal malignant tumour (MMT). Body weight and height were assessed, and Body Mass Index (BMI) was computed upon diagnosis. When cancer was initially identified in the subjects, a total of 475 patients had a normal weight (10th to 90th percentile, BMI SDS -1.6 to 1.6), 13.8% (101) were overweight, and 21.5% (158) were underweight (≤ 10th percentile, BMI SDS <-1.6). 8% (57) of the patients exhibited a height deficiency ($\leq 10^{th}$ percentile, BMI SDS ≤-1.6), with 10% (34) being boys and 9% (23) being girls. 2% (15) of the patients exhibited both underweight and short stature. There were no significant differences in height deficiencies among the diagnoses. Individuals in the ALL group had a higher prevalence of being overweight (OW) compared to the other participants in the study, with an 18.6% overweight (OW) rate of 1.82 (95% CI 1.26–2.63, p = 0.002) for the risk ratio. RR = 0.36, 95% CI 0.15–0.87, p = 0.021) showed that children with MMT were less likely than other patients to be overweight, with only 5.4% of them meeting this criteria. Girls diagnosed with acute lymphoblastic leukemia (ALL) were more frequently malnourished compared to other patients, with a relative risk of 1.72 and a 95% confidence interval of 1.08–2.75, p = 0.03. The prevalence of undernutrition and obesity among the other neoplasm groups did not differ significantly.

Raquel et al. in the UK conducted a study enrolling 82 patients from the year August 2010 to January 2014, with a median age of 3.9 years and 56% of whom were males. The prevalence of undernutrition, overweight, and obesity at diagnosis was 13%, 7%, and 15%, respectively. The TSFT found that undernutrition had the highest prevalence at 15% and obesity had the lowest at 1%. BMI had a statistically significant effect with a p-value of less than 0.001 and a 95% confidence interval of 1.31–3.47. FM (assessed by means of bio-electrical impedance analysis (BIA) significantly increased after 3 months of treatment (p < 0.05; 95% CI 0.006–0.08), while FFM (fat free mass) (assessed by BIA) significantly decreased during the first three months (p < 0.05; 95% CI -0.78 to -0.01), and these trends persisted until the study's conclusion. High-treatment risk was a significant factor in causing undernutrition in the first three months of treatment (p = 0.04; 95% CI -16.8 to -0.4). Solid tumours had the highest prevalence of undernutrition with a BMI of 17%. According to this study, undernutrition peaked during the first stages of therapy, and no patient remained undernourished by the end of the study. On the other hand, overnutrition increased over time. Undernutrition was most common in children with solid tumor diagnoses, whereas overnutrition was more common in those with brain tumors and other related diagnoses (LCH). While FFM% (BIA) considerably reduced at 3 and 9 months, overall BMI and FM% (BIA) significantly rose at 3 and 18 months and at 3 and 9 months, respectively. Undernutrition upon diagnosis was highly correlated with an event (relapse, transitioning to palliative care, or death), and within the first three months of therapy, undernutrition was significantly influenced by high treatment risk.

In a study conducted by Orgel et al. in USA, a group of 2,008 children who were being treated for high-risk ALL were examined in order to establish the impact on EFS (event-free survival), of the total length of time between the end of induction and the start of maintenance medication that they were receiving therapy at a severe weight (either obese or underweight). Throughout the course of 13,946 treatment sessions, the association between weight category and occurrence and patterns of TRT (treatment related toxicity) was tested and assessed. The z score and percentile were computed in accordance with the guidelines supplied by the CDC (centres for disease control and prevention) to determine the individual's weight status. BMI (body mass index) was utilized for children aged 2 to 20 years, while the weight for length method was utilized for children under the age of 2 years. The categories of extreme weight were

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determined by the Centres for Disease Control and Prevention (CDC) based on the percentile thresholds of body mass index (BMI) for children who were either underweight (less than the 5th percentile) or obese (greater than or equal to the 95th percentile). The reference group consisted of children who were normal or overweight (with a BMI between the 5th and 95th percentile). The patients who were alive and clinically disease free at the time of the last documented contact had a median follow-up period of 8.5 years from the time they entered the study. Within the entire sample of children who participated in this study, 14 of them (0.8%) were fat, which is a reflection of the socio-economic influence on nutritional status. These results suggest that addressing weight is a risk factor that could improve pediatric ALL event-free survival (EFS) and morbidity.

Zhang et al. conducted a retrospective cohort research in the United States of America in 2014, involving 83 children who were diagnosed with ALL between 1985 and 2010. At various periods in time during and after treatment, as well as on an annual basis for the first five years after treatment, the patient's body mass index (BMI) was evaluated. Nutritional status was assessed using BMI z-scores and BMI percentiles by CDC (centre for disease control and prevention, 200) for children aged 2 to 20 years. For patients aged < 2 years, weight for length (WFL) z-scores and percentiles were considered. The proportion of patients with a body mass index (BMI) greater than the 85th percentile who were overweight or obese rose from 20% to almost 40% after the diagnosis and therapy. In particular, 26.7% of children who were considered to be of normal weight became overweight (OW) or obese (Ob) by the time treatment was completed, and 36.1% of children remained overweight (OW) or obese (Ob) five years after treatment. In the group of individuals who were overweight or obese at the time of diagnosis, 81.3% and 66.7% of them continued to be overweight (OW) or obese (Ob) at the conclusion of treatment and five years after treatment, respectively. The overall increase in body mass index (BMI) z-score from the time of diagnosis until the moment therapy was completed was related with a chance of being overweight (OW) or obese (Ob) that was more than three times higher five years following treatment. According to the findings of the study, patients diagnosed with pediatric ALL were not only at risk of becoming overweight (OW) or obese (Ob) early on in the treatment process, but these changes in weight status continued throughout the treatment process and even after the treatment gets over.

Sala et al. in the year 2012, published a study, conducted by a consortium of pediatric hemato-oncology investigators from Central America (AHOPCA), aimed to assess the nutritional status of children and adolescents with cancer at diagnosis and its impact on clinical outcomes. The research involved 2954 patients aged 1-18 years, diagnosed between 2004 and 2007, across several countries in Central America and the Dominican Republic. Anthropometric measurements, including weight, height, mid-upper arm circumference (MUAC), triceps skin fold thickness (TSFT), and serum albumin levels, were used to categorize nutritional status into three groups: adequately nourished (serum albumin levels > 3.5gm/dl and TSFT and MUAC >10th percentile), moderately depleted (serum albumin levels of 3.2 to 3.5 gm/dl, and TSFT and MUAC of 5th to 10th percentile) and severely depleted (serum albumin levels <3.2 gm/dl, and TSFT and MUAC <5th percentile). The findings revealed a high prevalence of malnutrition, with 18% of patients moderately depleted and 45% severely depleted based on arm anthropometry alone. This proportion increased to 59% when serum albumin was included in the assessment. The study also revealed that malnourished children were more likely to abandon therapy and had a lower event-free survival rate compared to adequately nourished children. The study concluded that arm anthropometry is a sensitive measure of nutritional status in children with cancer and that malnutrition at diagnosis is associated with poor clinical outcomes. The authors suggest that simple, cost-effective nutritional interventions could potentially improve survival prospects for these children.

Table 1. Features of the Studies Reported to have evaluated the Nutritional Status in Cancer Patients.

	Country, Year	*Author*	*Study Design*	*Study Sample Size*	*Type of Cancer*	*Nutrition Related Problem*	*Assessment Methods*
1	***Australia, 2015***	***Small et al.***	***RS[1]***	***154***	***NBM[2]***	***MN[3]***	***Anthro[4]***
2	***Brazil, 2016***	***Maia Lemos et al.***	***CSOS[5]***	***1154***	***V[6]***	***UN[7]***	***BMI[8], TSFT[9], MUAC[10], AMC[11]***
3	***Guatemala, 2019***	***Villanueva et al.***	***RCS[12]***	***1060***	***V***	***UN***	***TSFT, MUAC, WFA[13], HFA[14]***
4	***India, 2014***	***Shah et al.***	***ROS[15]***	***1693***	***V***	***MN***	***BMI***
5	***India, 2015***	***Radhakrishan et al.***	***RS***	***295***	***V***	***MN***	***WFA***

6	*Istanbul, 2018*	*Yoruk et al.*	*POCS*[16]	*74*	*V*	*MN*	*BMI, TSFT, MUAC, WFA, HFA*
7	*Italy, 2019*	*Triarico et al.*	*RS*	*126*	*V*	*UN*	*STRONGkids*[17]
8	*Netherlands, 2015*	*Loeffen et al.*	*RS*	*269*	*V*	*MN*	*BMI*
9	*Nicaragua, 2017*	*Pribnow et al.*	*RS*	*282*	*V*	*UN*	*BMI, TSFT, MUAC, Alb.*[18]
10	*Potland, 2017*	*Potubok et al.*	*RCS*	*734*	*V*	*MN*	*BMI*
11	*UK, 2019*	*Raquel et al.*	*PCS*[22]	*82*	*V*	*UN, OW*[23]*/Ob*[24]	*BIA*[25]*, Arm Anthro, BMI*
12	*USA, 2014*	*Orgel et al.*	*RCS*	*2008*	*ALL*[26]	*MN*	*BMI*
13	*USA, 2014*	*Zhang et al.*	*RCS*	*83*	*ALL*	*OW/Ob*	*BMI*
14	*Various, 2012*	*Sala et al*	*RS*	*2954*	*V*	*SD*[27]*, MD*[28]	*BMI, TSFT, MUAC, Alb.*

[1] **RS** – Retrospective Study,
[2] **NBM** – Neuroblastoma,
[3] **MN** – Malnutrition,
[4] **Anthro** – Anthropometry,
[5] **CSOS** – Cross-sectional Observational Study,
[6] **V** – Various Diagnoses,
[7] **UN** – Under nutrition,
[8] **BMI** – Body Mass Index,
[9] **TSFT** – Tricep Skin-fold Thickness,
[10] **MUAC** – Mid Upper Arm Circumference,
[11] **AMC** – Arm Muscle Circumference,
[12] **RCS** – Retrospective Cohort Study,
[13] **WFA** – Weight for Age,
[14] **HFA** – Height for Age,
[15] **ROS** – Retrospective Observational Study,
[16] **POCS** – Prospective Observational Cohort Study,
[17] **STRONGkids** – Screening Tool for Risk on Nutritional Status and Growth.
[18] **Alb.** – Serum Albumin,
[19] **IS** – Interventional Study,
[20] **H** – Height,
[21] **W** – Weight,
[22] **PCS** – Prospective Cohort Study,
[23] **OW** – Over-weight,
[24] **Ob** – Obese/Obesity,
[25] **BIA** – Bio-electrical Impedance Analysis,
[26] **ALL** – Acute Lymphoblastic Leukemia,
[27] **SD** – Severely Depleted,
[28] **MD** – Moderately Depleted.

Conclusion:

Nutritional status of pediatric cancer patients is vital throughout the course of the disease, more so to ensure efficient response to treatment. The cancer and the advancement of the disease result in various changes like altered metabolism due to the oxidation of energy substrates which in turn lead to nutritional changes like the loss of body protein and other nutrient losses, which contribute to malnutrition. Moreover, the initiation of anticancer treatments impacts energy homeostasis leading to various adverse effects. Malnutrition, encompassing under nutrition, overweight, and obesity, is associated with negative consequences from diagnosis to long-term survival. Nutrition status at the time of diagnosis is a crucial prognostic factor that impacts treatment response and the potential for recovery. The effect of impaired nutrition on clinical results and cancer outlook is linked to the inability to tolerate treatment because of nutrient deficiency and a weakened immune system. Heightened susceptibility to infection and changes in drug processing cause delays and discontinuation of treatment, leading to elevated relapse rates and reduced survival rates. Furthermore, under nutrition during treatment is associated with a higher incidence of complications, leading to an increase in treatment-related mortality and a decrease in event-free survival. Various techniques exist for the clinical evaluation of Nutritional Status. When performed in clinical practice, Anthropometry, MUAC, TSFT, WTH ratio and BCM offer more detailed insights. The most suitable indicator should be the one that would prevent a malnourished child from being undiagnosed. In the above mentioned literature, the most used tool for the assessment of nutritional status by the researchers has been BMI (calculated by the formula weight in kgs/ height in m^2), followed by arm anthropometry (including TSFT, MUAC and AMC). Significant progress has been made in the treatment and post-treatment nutrition management and care of pediatric oncology, over the years. However, clear nutritional guidelines for assessing and treating children with cancer are still deficient. In the future, scientific research should focus on developing specific guidelines for nutrition related to cancer and its treatment. Early monitoring and adjustment of pediatric cancer patients' nutritional status, along with prompt nutritional intervention, could enhance their treatment response, clinical outcome, survival, and quality of life.

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