Research Article

Assessment of Nutrition Screening Tools in Pediatric Oncology: A Systematic Review

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ABSTRACT

Introduction: The global prevalence of children with cancer continues to increase, reaching 186.6 per 1 million children aged 0-19 years. Children with cancer face challenges in fulfilling nutrition due to increased energy needs due to disease and treatment side effects. Nutritional assessment using nutrition screening tools is currently highly variable and varies across health institutions. This study aims to critically describe the assessment of nutritional screening tools in ensuring suitability and sensitivity as well as advantages and disadvantages in identifying the nutritional needs of children with cancer. **Methods:** PRISMA was used as a guide in preparing a systematic literature review based on inclusion criteria to determine research articles, search strategies, and research findings. Databases used in this study included Pubmed and Science Direct. **Results**: The use of appropriate nutrition screening tools is essential for assessing the nutritional status of pediatric patients with cancer. Appropriate nutrition screening tools have a positive impact on the nutritional fulfillment of children with cancer. There are five different nutrition screening tools in assessing the sensitivity of nutrition screening tools in children with cancer and their advantages and disadvantages. The sensitivity of the Screening Tool for Childhood Cancer (SCAN) and the Pediatric Yorkhill Malnutrition Score (PYMS) was highly accurate in correctly identifying children with cancer at risk of malnutrition. **Conclusions:** This finding is expected to be a recommendation for health workers in choosing the right nutrition screening tool to monitor the nutritional status of pediatric patients with cancer during treatment.

Keywords: Cancer, Children, Nutrition, Screening tool, Sensitivity

Introduction

The prevalence of cancer in the pediatric population, although relatively low compared to adults, is still a significant health problem worldwide. Based on the annual incidence rate of cancer in children and adolescents is 186.6

per 1 million children from birth to 19 years of age [1].

This suggests a large number of cases occur in the pediatric population. It is further reported that in the United States, there were 171,432 cases of pediatric cancer during the period 2003-2014, with an incidence of 173.7 cases per 1 million people. These statistics highlight the significant burden of pediatric cancer. In addition, the prevalence rate of cancer patients who have children ranges from 14% to 24.7%, indicating the potential impact of pediatric cancer on families [2].

Children with cancer face unique nutritional challenges due to increased energy requirements caused by the disease and its treatment [3]. These challenges are further exacerbated by treatment side effects such as nausea, vomiting, and decreased appetite, which contribute to the risk of malnutrition [4].

The impact of malnutrition in children with cancer is significant, as it can affect their tolerance to chemotherapy, treatment outcomes, and overall survival [5]. Furthermore, malnutrition in these children is dynamic and tends to become more pronounced during subsequent treatment, suggesting the need for ongoing nutritional support [6]

The importance of early nutritional interventions in improving the prognosis and quality of life of children with cancer is well documented. Timely nutritional assessment and appropriate interventions have been shown to reduce complications and improve treatment response [7]. Feasibility studies have shown that early nutritional interventions are feasible in children and adolescents undergoing cancer treatment, suggesting the potential for positive outcomes [8].

In addition, existing literature emphasizes the importance of monitoring risk-based toxicities, such as increased rates of ototoxicity and hematological toxicity in adolescents with brain tumors, as well as increased nausea, vomiting, and anorexia in patients treated for lymphoma and rhabdomyosarcoma [9]. This underscores the important role of early nutritional intervention in managing and reducing treatment-related toxicities in pediatric oncology.

The impact of early nutrition intervention on the quality of life of pediatric cancer patients is closely related. A study reported that the total quality of life score in pediatric cancer patients was relatively good, potentially due to the satisfactory prognosis and short chemotherapy period, indicating the potential positive influence of the early intervention on the quality of life of pediatric cancer patients [10].

Nutritional screening tools play an important role in identifying children with cancer who are at risk of malnutrition. These tools are important for prioritizing patients who require further nutritional interventions. The application of nutrition screening tools has been shown to identify a large proportion of children, adolescents, and young adults with cancer who are at risk of malnutrition in the early stages of treatment, leading to the classification of malnourished individuals who require intervention [11]. Nutritional assessment using nutrition screening tools for children with cancer varies widely between institutions, with some assessing the nutritional status of children and adolescents with cancer at the time of diagnosis [12]. This diversity in practice underscores the need for standardized nutritional care in pediatric oncology [13].

This study aimed at the importance of critically assessing existing nutritional screening tools to ensure their appropriateness and sensitivity in identifying and addressing the nutritional needs of children with cancer. It is important to conduct systematic reviews and validation studies to determine the validity, reliability, and practical utility of these tools, specifically in the context of pediatric oncology, thereby addressing the limitations of existing screening tools and improving the nutrition services provided to children with cancer.

Methods
Sources of Data
This Systematic review research employed the PRISMA method to describe the assessment of nutrition screening tools in pediatrics with cancer. The article search was conducted in December 2023 using electronic databases consisting of 2: Pubmed and Science Direct. Then, filtering articles consisted of 6 stages: first

from duplicate articles, second from background articles, third from wrong study design, fourth from the wrong population, fifth from foreign language, and sixth by reading the complete articles based on the inclusion criteria in this research.

Inclusion Criteria

The criteria included in the article search consisted of both quantitative and qualitative research articles describing the assessment of nutrition screening tools in pediatrics with cancer. The article publications were restricted from 2013 to2023 written in English. Articles excluded fromthe criteria were systematic reviews, literature reviews, and meta-analyses.

Search Strategy

In search of relevant articles, the researchers used a number of keywords, including "nutrition screening tool," "nutrition screening," "children with cancer," and "pediatric oncology."

Data Extraction

Two reviewers independently extracted the collected data, and the results were then cross-checked. The extracted information included the article title, author names, sample or respondent characteristics, research methods, research objectives, primary and secondary outcomes reported, and conclusions. A meta-analysis was not conducted due to the anticipated variability of the included studies. Instead, the data were synthesized qualitatively and presented in narrative and tabular forms.

Study Assessment

The study assessment in this research used Rayyan software through an efficient and effective approach in systematic reviews. Rayyan helps researchers quickly and accurately screen articles, eliminating duplicates and assessing relevance based on title, abstract, study design, population, and language. This process makes study assessment more structured, allowing researchers to focus on the most relevant studies.

Result and Discussion
Study Selection

In this study, 238 articles were found after searching by entering the keywords above. Of the total 238 articles, 22 articles were detected to be duplicated, and 166 articles were excluded based on topic incompatibility in the title and abstract. Then, 39 further articles were excluded based on study design incompatibility, inappropriate population, not using English, and articles not being in full text. The next step was to read the full text of the articles based on the inclusion criteria, and 11 articles were selected.
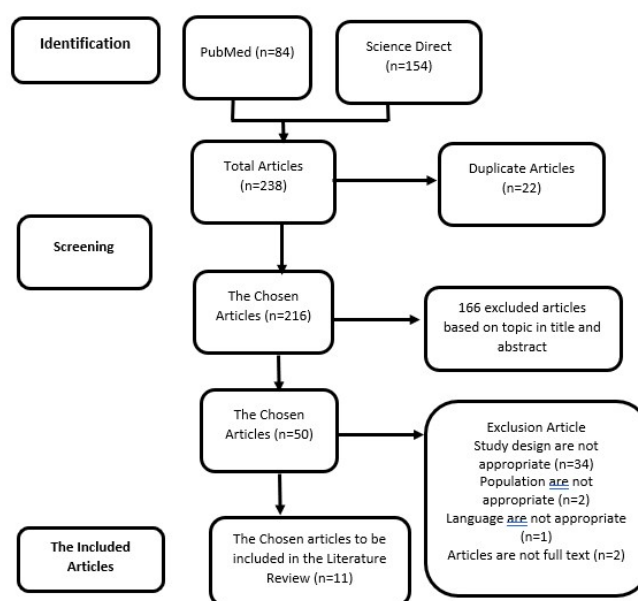
Figure 1. PRISMA Flow Diagram

The assessment of nutrition screening tools in assessing nutritional status in children with cancer (oncology) is one important aspect that requires attention from various parties, especially nurses, nutritionists, and parents with cancer children. An explanation of this will be discussed based on 11 selected journals, which will be described below.

The Importance of Accurate Nutrition Screening in Assessing the Nutritional Status of Pediatric Patients with Cancer

This study emphasizes the importance of proper nutrition screening to assess the nutritional status of pediatric patients with cancer. It is an important concern that pediatric oncology patients are at high risk of malnutrition and protein energy deficiency, especially during the first three months of treatment. This study also shows that different nutrition screening tools and recommended screening algorithms for pediatric oncology patients are urgently needed.

Clinical guidelines specifically designed for nutritional screening, monitoring, and management of pediatric cancer patients are essential. Awareness of the clinical relevance and benefits of nutrition in pediatric oncology is low. Efforts to improve nutrition screening, assessment, and intervention in Aotearoa, New Zealand, include the creation of screening standards and referral criteria. This study recommends the creation of screening standards and referral criteria to improve nutrition screening, assessment, and intervention for pediatric oncology patients.

Nutritional screening is essential to assess the nutritional status of pediatric patients with cancer. Proper nutrition screening helps identify nutritional risks and provide appropriate nutrition services to patients. It allows health professionals to determine the prevalence of malnutrition in this population and to identify patients at risk of malnutrition.

Nutrition screening tools help create awareness among healthcare professionals about nutrition assessment and follow-up of cancer patients. Collaborative efforts between doctors, nurses, and dietitians can help simplify nutrition screening, specifically using nutrition screening tools, and make it an efficient and sustainable system in hospitals to impact children with cancer positively. Appropriate nutrition screening tools should be used during the care of pediatric oncology patients to monitor their nutritional status effectively.

Nutrition Screening in Children with Cancer: Assessment of Tool Sensitivity

Nutrition is critical in the treatment and prognosis of pediatric cancer patients. Proper nutrition helps patients improve tolerance to treatment, enhance immune function, and gain a better quality of life.

To get the best outcome for these vulnerable patients, it is imperative to assess their nutritional status with appropriate screening tools. This study will discuss the importance of nutritional screening in children with cancer, with a special emphasis on evaluating the sensitivity of the tools. Five different nutrition screening tools are outlined in the literature, and they will be thoroughly discussed in this study.

Screening Tool for Childhood Cancer (SCAN) is a nutrition screening tool used to assess the nutritional status of pediatric oncology patients. This screening tool is used to identify patients at risk of malnutrition, providing a means to assess and meet their nutritional needs.

The sensitivity of the SCAN in identifying children at risk of malnutrition is 100%. SCAN has high accuracy in correctly identifying children at risk of malnutrition. Validation of SCAN against pediatric the Subjective Global Nutritional Assessment (SGNA) showed SCAN to have 'excellent' accuracy (0.90, 95% CI 0.78e1.00; p<0.001), 100% sensitivity, 39% specificity, 56% positive predictive value, and 100% negative predictive value.

The advantages of using the SCAN include the fact that the SCAN has been validated to have excellent accuracy in identifying children at risk of malnutrition, with high sensitivity and negative predictive value. This screening tool is a simple and quick tool to identify children with cancer who are at risk of malnutrition. Tool

validity has been shown to be valid in identifying patients at risk of malnutrition.

Disadvantages of using the SCAN: The specificity of the tool is relatively low, meaning it may not accurately identify all children who are not at risk of malnutrition. The limitation of SCAN is that it may not provide comprehensive information about the patient's nutritional status. The tool may rely on subjective measures and may not take into account other factors that could affect nutritional status.

Pediatric Yorkhill Malnutrition Score (PYMS) is a malnutrition screening tool used to assess the nutritional status of pediatric oncology patients. In a study comparing malnutrition screening tools in pediatric oncology patients, it was found that the PYMS was used to determine the prevalence of malnutrition in this patient population. The study reported that 30.6% of patients had a low to moderate risk of malnutrition, and 69.4% had a high risk of malnutrition, according to the PYMS screening tool. Additionally, it was found that PYMS has a higher sensitivity for detecting malnutrition than other screening tools. The use of PYMS helped create awareness among healthcare providers about nutritional assessment and follow-up of cancer patients.

The sensitivity of PYMS was reported at 92.68%, indicating that PYMS was effective in detecting malnutrition in this patient population. This suggests that PYMS is an important tool for identifying malnutrition in pediatric oncology patients and emphasizes the importance of monitoring patients' nutritional status throughout their treatment.

The advantages of using the PYMS include its higher sensitivity to detect malnutrition in pediatric oncology patients. This suggests that PYMS is effective in identifying patients at risk of malnutrition, allowing for timely intervention. In addition, the use of PYMS provides valuable insights into the nutritional status of pediatric oncology patients, which is critical to their overall care and treatment.

However, a potential weakness of PYMS is that it does not cover all aspects of nutritional assessment, as evidenced by the different results when compared to other malnutrition screening tools such as the *Screening Tool for Risk on Nutritional Status and Growth* (STRONGkids). This suggests that while the PYMS may be sensitive in certain areas, it may not provide a comprehensive picture of the patient's nutritional status. It is important to consider using multiple assessment tools to ensure a thorough evaluation of the patient's nutritional needs.

STRONGkids is a nutritional risk screening tool used to evaluate the nutritional status of children with cancer. Based on research by Glatt et al. (2020), this screening tool was applied to assess the risk of malnutrition in children with cancer in Mainland China. The tool categorized participants into low 31 (25.8%), medium 32 (26.7%), and high 57 (47.5%) malnutrition risk groups.

The advantages of using STRONGkids include the evaluation process being simple, predictive, and effective in saving time, as it only takes 3 to 5 minutes to evaluate malnutrition risk. This suggests that the tool is efficient and can be easily incorporated into the routine screening process for children with cancer. This study recommends the use of STRONGkids for nutritional risk screening at hospital admission in children with cancer.

On the other hand, weaknesses of STRONGkids may include limited sensitivity in assessing the evaluation of differences in nutritional status. The tool categorizes participants into low, moderate, or high risk of malnutrition without providing detailed insights into specific nutritional deficiencies. In addition, this assessment may lack the comprehensiveness provided by other tools, such as the SGNA.

The advantages of using Nutritional Risk Screening-Pediatric Cancer (NRS-PC) include better classifier properties in identifying children with lower muscle mass. It is recommended as the first step in screening patients with high BMI. However, the drawback is that this screening tool may not be sensitive enough in patients with normal BMI. In addition, these results were not significantly different in different phases of the disease.

Tabel 1. Characteristic of articles

No.	Title / Author / Journal	Design and Samples	Research purposes	Outcomes (other research outcomes / Secondary outcomes)	Results (Conclusion)
1.	*Comparison of malnutrition and malnutrition screening tools in pediatric oncology patients: A cross-sectional study* (Bicakli & Kantar., 2021) *Nutrition* [14]	*Cross-sectional study* Samples : 170 pediatric oncology patients with a mean age of 8.7 y (range: 5 months to 18 years) Consisting of pediatric oncology patients at the Ege University Hospital Pediatric Oncology Clinic, Izmir, Turkey, between January 2017 and January 2019	To determine the prevalence of malnutrition. To compare nutritional evaluation tools	The prevalence of malnutrition was assessed using two screening tools, STRONGkids (SK) and Pediatric Yorkhill Malnutrition Score (PYMS). According to SK, 59.4% had a moderate risk, and 40.6% had a high risk of malnutrition. PYMS indicated that 30.6% had a low to moderate risk, while 69.4% had a high risk. PYMS demonstrated higher sensitivity compared to SK (92.68 and 78.05, respectively).	Pediatric oncology patients have a high risk of malnutrition PYMS has higher sensitivity for detecting malnutrition The nutritional status of pediatric oncology patients should be monitored using appropriate screening techniques throughout their treatment
2.	Nutritional status of children and adolescents with cancer in Scotland: A prospective cohort study (Iniesta,et.al., 2019) *Clinical Nutrition ESPEN* [15]	*A prospective cohort study* Samples : 82 children aged less than 18 years who were diagnosed with cancer Langerhans Cell Histiocytosis between August 2010 and February 2014 Consisting of children and adolescents with cancer in the South East	To evaluate malnutrition prevalence and growth/body composition changes in pediatric cancer patients over 36 months. It seeks to establish growth/body composition patterns, compare arm anthropometry and bioelectrical impedance analysis (BIA), and investigate nutritional status effects on clinical outcomes and	Nutritional Assessment: 67% of recruited patients were referred to a dietitian for undernutrition, weight loss, or poor appetite, with enteral and parenteral nutrition interventions based on subjective global assessment. Changes in Growth and Body Composition: Analysis of growth (BMI and height-for-age centiles) and body composition (fat-free mass and fat mass) revealed significant differences over intervals (0-3	Children undergoing cancer treatment face initial risks of undernutrition and protein-energy malnutrition (PEM), followed by potential overnutrition. Regular arm anthropometry and bioelectrical impedance analysis (BIA) assessments, at least three times during treatment, are crucial for effective nutritional

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		Scotland regional center	treatment intensity.	months, 0-9 months, and 0-18 months). Factors Affecting Nutritional Status: Factors such as diagnosis, treatment risk, age at diagnosis, nutritional treatment, and energy intake were analyzed using a mixed multilevel model, with significant factors included in the conditional model at a 0.1 significance level.	monitoring. There is an urgent need for the development of tailored clinical guidelines for screening, monitoring, and managing the nutritional needs of pediatric cancer patients.
3.	Validation of the SCAN nutritional screening tool for childhood cancer. Spanish version (Munoz et al., 2022) *Nutrition Friendly* [16]	A cross-sectional study Samples : Ninety-six patients were children with cancer between the ages of 1 and 17 years, with a mean age of 8 years. 53% being women and 47% being men	To assess the nutritional status of pediatric patients with cancer To determine the prevalence of malnutrition in this population To evaluate the effectiveness of a nutritional screening tool called SCAN-SP in identifying patients at risk of malnutrition.	The majority of patients (82.3%) were classified as "at risk of malnutrition" based on the SCAN-SP tool. The mean scale score of the SCAN-SP tool was 5, with a minimum score of 1 and a maximum of 10. Patients with childhood cancer experiencing malnutrition were 2.4 times more likely to be classified as "at risk" compared to those without malnutrition. The questionnaire used in the study, the SCAN-SP scale, showed high reliability in identifying nutritional risks in childhood cancer patients.	The validity and reliability of the SCAN-SP The SCAN-SP scale (Nutrition Screening Tool) is a diagnostic scale used for measuring nutritional status. The evaluation process includes paraclinical indicators, nutritional-focused physical examination, food history, and anthropometric assessment. The significance of nutritional assessment in identifying risks and providing appropriate nutritional services
4	Nutritional Screening and Assessment, and Quality of Life in Children with	*Cross-sectional study* Samples :	To apply STRONGkids and the SGNA for evaluating nutritional status	Nutritional status evaluated by SGNA: 53 participants (44.2%) were well-nourished, while 53 participants	STRONGkids is a simple, predictive, and time-saving tool that is strongly

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	Cancer: A Cross-Sectional Study in Mainland China Ouyang, N., Lu, X., Cai., R., Liu, M., Liu, K. (2021) Journal Of Pediatric Nursing [17]	120 children with cancer from 2 to 18 years old Consisting of children with cancer leukemia, lymphoma, or solid tumors in mainland China		(44.2%) were moderately malnourished, and 14 (11.6%) participants were severely malnourished. The combined prevalence for malnutrition was 55.8%. Malnutrition risks assessed by STRONGkids, 31 (25.8%), 32 (26.7%), and 57 (47.5%) participants were at low, moderate, and high malnutrition risk, respectively. The evaluation with STRONGkids took only 3 to 5 min, and the SGNA evaluation took nearly 25 min for every patient.	recommended for screening nutritional risk on admission. SGNA is an effective and comprehensive measurement tool to evaluate children's nutritional status after they are considered to have nutritional risks.
5	Implementation of a nutrition screening tool to improve the nutritional status of children with cancer in Singapore's largest pediatric hospital (Han et al, 2021) *BMJ Open Quality* [11]	*Pre and post-implementation cohort study* Samples: Children with cancer. A total of 267 records were audited between July and December 2018 after the implementation of SCAN. Consisting of children with cancer in Singapore	To improve the identification of children with cancer at high risk of malnutrition so that nutritional intervention and rehabilitation can commence early for these children	No significant differences were found in median age at admission and gender between pre-implementation and post-implementation groups. However, improvements were noted in the dietitian referral rate for high malnutrition-risk children, increasing significantly from 36.4% to 85.7%. Additionally, the timeliness of dietitian referrals improved, with a median decrease from 3 days to 1 day from admission. Early dietitian intervention within 48 hours was associated with a	The collaborative partnership among the doctors, nurses, and dietitians have helped to streamline and simplify nutrition screening, making it an efficient and sustainable system in our hospital

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				significant improvement in percentage weight change over three months.	
6	*Nutrition screening, assessment, and intervention practices for children with cancer in Aotearoa, New Zealand* Lovell, et al. 2023) *Nutrition* [18]	*A cross-sectional survey* Samples: Two specialist treatment centres and 14 Shared Care Centers (SCCs) that provide care to childhood cancer patients in Aotearoa, New Zealand (NZ) was conducted.	To investigate dietetic resources and current nutrition screening, assessment, and intervention practices in pediatric oncology centers in Aotearoa, New Zealand.	In Aotearoa, New Zealand, only two specialist treatment centers had dedicated dietetic oncology full-time equivalents (FTE), primarily focused on inpatient care. Outpatient/day stay dietetic coverage, and the use of standardized nutrition screening and assessment tools were limited. While weight and height measurements were common, there was inconsistency in their frequency and recording. Awareness of the importance of nutrition in pediatric oncology was low. Suggestions for improvement include establishing standardized screening and referral criteria.	The critical role of nutritional status in pediatric cancer stresses tailored nutritional therapy and the importance of enteral nutrition, especially in low- and middle-income countries. They advocate for multidisciplinary nutrition review, global guidelines development, and holistic nutritional assessment. Additionally, they emphasize cultural considerations and explore traditional medicine's potential in pediatric oncology care.
7.	Different nutritional screening tools and recommended screening algorithms for pediatric oncology patients (Gallo et al., 2021) *Clinical Nutrition* [19]	Retrospective Analysis Study Samples : 109 pediatric oncology patients aged 3 to 18 years Consisting of children with cancer at the 2nd Department of Pediatrics, Semmelweis	To validate SCAN and NRS-PC, compare them with bio-impedance measures for identifying pediatric oncology patients with reduced muscle mass, and develop a screening algorithm. It also assesses malnutrition risks and nutritional status	Muscle Mass Relationship: NRS-PC better-identified children with lower muscle mass compared to bio-impedance analysis. Treatment Phase Performance: NRS-PC performed consistently across treatment phases. BMI Comparison: NRS-PC and SCAN had similar classifier properties across BMI categories,	NRS-PC outperforms SCAN in identifying children with lower muscle mass. For high BMI patients, NRS-PC screening is recommended initially. For low BMI patients, bio-impedance measures offer better insight into muscle mass

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		University (Budapest, Hungary) who were inpatients between 2017 and 2018	over a 6-month treatment period at regular intervals.	with SCAN better for low BMI and NRS-PC for normal BMI. Risk Group Comparison: NRS-PC classified risk similarly in terms of gender, age, and relapse proportion but varied by disease phase and BMI category.	and nutritional risk. More data is required to ascertain the sensitivity of NRS-PC in normal BMI patients.
8	Assessment of Nutritional Status and Malnutrition Risk at Diagnosis and Over a 6-Month Treatment Period in Pediatric Oncology Patients With Hematologic Malignancies and Solid Tumors (Yoruk et al., 2019) Journal of pediatric hematology/oncology [20]	Prospective observational cohort study Samples : 74 pediatric oncology patients with hematologic malignancies and solid tumors Consisting of children with cancer at Istanbul Medeniyet University Goztepe Training and Research Hospital Pediatric Hematology and Oncology Department.	To assess malnutrition risks and nutritional status over a 6-month treatment period measured at regular intervals.	The rate of patients with high risk for malnutrition at diagnosis was 28.4% by Screening Tool for Risk of Impaired Nutritional Status and Growth tool (STRONGkids) and 36.5% by Pediatric Yorkhill Malnutrition Score (PYMS) Body mass index (BMI) z-scores at diagnosis showed 12.3% undernutrition (< -2 SD) and 6.8% overnutrition (> 2 SD), which changed to 6.7% and 11.1% in the sixth month, respectively.	BMI z-scores remained steady in the third and sixth months compared to the initial STRONGkids and PYMS screening categories. Both tools aid in raising awareness among health professionals for nutritional assessment and follow-up in cancer patients. Variations in undernutrition and overnutrition trends between solid tumors and ALL highlight the need for timely BMI change detection to initiate preventive actions.
9.	Nutritional screening and assessment of pediatric cancer patients: A quality improvement project (baseline results)	A Clinical Audit Samples: 185 Patients aged from 0-18 years and undergoing treatment for diagnosed	To audit current nutritional practices for pediatric cancer patients against established standards, aiming to identify areas for improvement and	One hundred eighty-five patient records were audited, covering 22 inpatients (IP), 54 day-care (DC), and 109 outpatient (OP) cases. Areas below 70% of the standard included height and	Baseline nutritional practice was successfully established, identifying areas for practice improvement in the RHSC Paediatric Oncology and

No.	Title / Author / Journal	Design and Samples	Research purposes	Outcomes (other research outcomes / Secondary outcomes)	Results (Conclusion)
	(Glatt, 2020) Clinical Nutrition ESPEN [21]	malignant childhood cancer (ICCC-3 or Langerhans Cell Histiocytosis)	enhance clinical outcomes.	weight documentation for DC; head circumference for IP; arm anthropometry assessment across all locations; initial PYMS screening and re-screening in IP; malnutrition screening in DC and OP; and initial/re-assessment for serum vitamins D, A, E, B12, and parathyroid hormone levels.	Haematology Department. This will be implemented in the next step of the audit to optimize patient care.
10	Nutritional assessment and dietetic resource for children and young people with cancer in the United Kingdom (Henry et al.2022) Pediatric Blood & Cancer [22]	A Clinical Survey Samples: 26 patients with cancer, newborns to 25 years old Consisting of children with cancer at Principal Treatment Centers (PTC) in the United Kingdom	To assessment of dietetic resources and nutritional in children and teenagers/young adults (CTYA)	13/18 (72%) children and one of 11 (9%) teenagers/young adults (TYA) met national standards for dietetic resources; one of 18 (6%) pediatric and six of 11(54%) teenagers/young adults (TYA) had no such resource	Barriers to adequate nutritional assessment and treatment for all patients include resource limitations (particularly TYA), training for staff, and uncertainty about detailed evaluation of nutritional status. There is a need to harmonize screening and assessment of nutritional status in CTYA with cancer.
11	Evaluation of the nutrition screening tool for childhood cancer (SCAN) (Murphy et al.,2016) Clinical Nutrition [13]	Observational Study Samples: 58 children with cancer from 5 to 18 years Consisting of children in	To evaluate the nutrition screening tool for childhood cancer (SCAN)	The validation study of SCAN against pediatric SGNA demonstrated 'excellent' accuracy (0.90, 95% CI 0.78-1.00; p < 0.001), with 100% sensitivity, 39% specificity, 56% positive predictive value, and 100% negative predictive value.	This study shows that SCAN is a simple, quick, and valid tool that can be used to identify children with cancer who are at risk of malnutrition.

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		Queensland, Australia		In Study 2, subjects classified as at risk of malnutrition according to SCAN showed significantly lower values for weight Z score (p = 0.001), BMI Z score (p = 0.001), and fat mass index (FMI) (p = 0.04) compared to the 'not at risk of malnutrition' group.	

Discussion

Childhood cancer can have a significant impact on the nutritional status of affected individuals, affecting aspects such as metabolism, nutrient absorption, and food tolerance. Although advances in cancer therapy have improved survival rates, leading to an increasing population of long-term survivors [23]. There are concerns regarding the nutritional well-being of children with cancer. Children who develop cancer are at risk of developing chronic health conditions, with more than 40% experiencing at least one severe chronic disease [24]. In addition, children with cancer may face challenges such as impaired glucose tolerance and hypertriglyceridemia as late complications of treatment [25].

Poor nutritional status can significantly impact the prognosis and therapeutic response of childhood cancer. Nutritional status may reflect broader socioeconomic disadvantage and affect adherence to therapy [4]. In addition, poor nutritional status in children with cancer can lead to negative treatment outcomes and increased mortality [11] [26] Nutritional status at the time of diagnosis can predict overall survival, cancer-free survival, recurrence, and treatment-related toxicity in children with cancer [27].

Accurate nutritional screening and assessment is essential for pediatric cancer survivors to reduce the risk of malnutrition and related complications. Identifying nutritional patterns in this population is critical to improving long-term health outcomes [28]. Poor dietary intake and poor eating behaviors have been observed in young childhood cancer survivors [29]. Thus highlighting the need for interventions to address nutritional deficiencies. In addition, children with cancer may face long-term endocrine and metabolic problems, thus emphasizing the importance of monitoring and managing their nutritional needs [30].

Accurate nutritional screening is essential to identify and address nutritional problems in pediatric cancer patients early. Research highlights interest in nutritional screening tools in pediatrics to identify children at risk of malnutrition [31]. Other studies, however, show a lack of evidence for malnutrition screening and intervention in pediatric cancer treatment, indicating potential limitations in current screening practices [9].

Emphasizing the importance of early diagnosis of nutritional risk or malnutrition in pediatric oncology aims to guide clinical approaches and interventions [32].This is in contrast to a study that found inconsistencies in approaches to nutrition assessment, intervention, and follow-up for pediatric cancer patients [33]. The gap in utilization and effectiveness of screening tools was further affirmed by noting the gap between recommended

practices and the actual use of validated screening tools in pediatric facilities [34].

Nutritional screening in children with cancer is essential for early detection of malnutrition or undernutrition. Research has highlighted the importance of tools such as the Screening Tool for Risk of Nutritional Status and Growth (Strong Kids) and the Pediatric Yorkill Malnutrition Score (PYMS) in identifying children at risk of malnutrition [35]. Malnutrition in children with cancer has been associated with reduced chemotherapy tolerance and poorer health outcomes [36].

Despite the importance of nutritional screening, there is a need for further research to determine the most effective methods of nutritional assessment and intervention in pediatric cancer patients, considering their impact on quality of life, treatment toxicity, and survival rates [26]. The prevalence of malnutrition in children with cancer is a major concern due to its potential impact on treatment outcomes, such as overall survival, treatment tolerance, and quality of life [37]. Early detection through nutritional screening is essential to address malnutrition and improve patient outcomes promptly.

Evaluation of nutritional screening tools is essential to identify the effectiveness, efficiency, and usefulness of the screening tools used. Some tools show sensitivity and specificity values above 90%, which are quite time-efficient in the screening process. Still, there are screening tools that have problems in the validation process and are not time-efficient enough. This is in line with research [38]. Studies have shown varying results in nutritional risk assessment among different patient populations, suggesting differences in the performance of screening tools [39]. In addition, the effectiveness of screening tools may vary depending on the patient population, as seen in studies evaluating tools for cancer patients [40]. Some tools may not be suitable for clinical use based on established limitations [34].

It is important to consider the practicality and ease of use of nutrition screening tools. The ideal tool should be easy to use, can be performed by members of the healthcare team, and facilitate appropriate referral for further assessment [41]. In addition, the development of new screening tools aims to improve sensitivity, specificity, and accuracy in identifying nutritional risks promptly [42]. The use of simple and efficient validated tools is essential in various healthcare settings, including acute care and ambulatory care [43].

Nutrition screening tools play an important role in identifying individuals at risk of malnutrition. Still, there are challenges in their validation process and differences in their performance across different patient populations. The development of easy-to-use and effective screening tools is important to improve early detection of nutritional risk and ensure timely intervention for at-risk individuals.

Strange & Limitation

This article provides valuable insights into the prevalence of malnutrition in pediatric oncology patients and compares the sensitivity of different screening tools in identifying malnutrition. In addition, the article offers recommendations on the use of specific screening tools based on their sensitivity and ease of use.

However, the article has some limitations. This study only used two databases; further study could explore more databases. The article's findings may be limited to the five instruments, another potential instrument was not explored.

Implications

The implementation of efficient nutritional screening tools like STRONGkids and NRS-PC in pediatric oncology can lead to early identification of malnutrition risks, enabling tailored nutritional interventions and improved clinical outcomes. This proactive approach may enhance the overall management of pediatric cancer patients and contribute to better long-term health outcomes.

Standardized screening practices and optimized nutritional interventions based on these tools could potentially reduce malnutrition-related complications and improve the quality of care provided to children with cancer. Ongoing research in this area aims to refine further nutritional screening practices and interventions for enhanced patient outcomes in pediatric oncology.

Conclusion

The prevalence of malnutrition in pediatric oncology patients is high, with a significant proportion of moderate to high-risk patients based on different screening tools. There are *Screening Tool for Childhood Cancer* (SCAN) and Pediatric Yorkhill Malnutrition Score (PYMS) that are recommended to have excellent accuracy and have been proven valid with various advantages and disadvantages in identifying patients at risk of malnutrition.

There is a need for appropriate screening techniques to monitor the nutritional status of pediatric oncology patients during treatment. Clinical guidelines specifically designed for nutritional screening, monitoring, and management of pediatric cancer patients are needed.

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