Incidence of malnutrition with newly diagnosis on children with cancer

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Abstract

Objective(s): This longitudinal study aims to determine the incidence of malnutrition and track the dynamic changes in anthropometric indicators (Weight, BMI, MUAC, and Skinfold thickness) among newly diagnosed children with cancer undergoing chemotherapy in Baghdad city in Iraq. **Methods:** A longitudinal descriptive study was conducted at the Hematology Center of the Child Protection Teaching Hospital in Medical City, Baghdad, from May 1st to December 31st, 2025. A purposive sample of 130 children newly diagnosed with various types of cancer (hematology and solid tumor) who were monitored across three time points: at diagnosis (Baseline), at three months, and at six months of treatment. Data were collected through direct anthropometric measurements using tools like slim guide skinfold calipers; WHO MUAC tapes. The data processed using SPSS version 26, employing descriptive statistics and repeated measures ANOVA to identify significant nutritional trends. **Results:** At diagnosis, a significant proportion of children exhibited sub-clinical nutritional deficits. The results of post-induction showed a significant progressive decline in Weight ($p < 0.001$) and BMI ($p < 0.01$). Significantly the most acute reduction in Mid-Upper Arm Circumference (MUAC) and triceps skinfold thickness demonstrated ($p < 0.001$), reflecting a rapid depletion of muscle mass and fat stores. When comparing diagnostic subgroups, children with hematological malignancies (like leukemia); children experienced more severe nutritional derailment than those with solid tumors. **Conclusion:** The study concludes that malnutrition with cancer is not merely a baseline condition but a dynamic and worsening complication of chemotherapy in Iraqi children. The significant decline MUAC suggests it is a more sensitive early warning indicator than traditional of child weight monitoring. There is a critical need for an integrated "Nutrition-Oncology" protocol that shifts the clinical focus from reactive feeding toward proactive, nurse-led nutritional surveillance. **Recommendations:** It is essential to implement standardized nutritional screening at every treatment cycle. The study advocates for the development of individualized nutritional support plans and specialized training for nursing staff to recognize early signs of wasting. Furthermore, family-centered dietary counseling should be integrated into discharge planning to reduce the risk of home-based nutritional failure and ensure continuity of care.

Keywords: pediatric oncology, malnutrition, muac, longitudinal tracking, iraq, nursing education

1 Introduction

The World Health Organization (WHO) reports that children with cancer remains a significant global health challenge, with approximately 400,000 new cases diagnosed annually among children and adolescents [1]. Among these, pediatric malignancies in Iraq present a dual burden of disease-induced metabolic stress and severe nutritional vulnerability [2, 3]. Malnutrition is a fundamental predictor of clinical outcomes in pediatric oncology according to recent epidemiological studies [4, 5].

The sudden shift from health to a diagnosis of malignancy, coinciding with the induction of chemotherapy, presents substantial physiological challenges. The pediatric physiological system, which requires constant energy for growth, must suddenly divert its resources to counteract tumor-driven inflammation [6, 7]. Consequently, these children high risk of experiencing profound nutritional derailment affecting several body systems including musculoskeletal and immune functions [8]. Nutritional recovery is also endangered by improper healthcare practices, such as the use of over-the-counter antibiotics by mothers. Such attitudes can affect the gastrointestinal and causes complications and further appetite suppression, complicating the nutritional management of children with cancer in the Iraqi community [9].

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The metabolic tax of the malignancy and the side effect of its treatment often manifests through physiological depletion of lean body mass and energy reserves [10, 11]. The decline in nutritional status observed in this study may also be exacerbated by poor oral health, a common complication of chemotherapy. Strengthening pediatric nursing roles in oral health education and antiseptic interventions is important to minimize feeding difficulties caused by oral complications [12]. However, a critical diagnostic challenge in the childhood is that nutritional failure is frequently hidden or 'masked' by a large tumor mass [13] or treatment-induced edema [14]. Such instability demands close monitoring beyond traditional scales during the child's stay in the hematology unit [15]. In addition, adopting advanced nursing techniques, like the Z-Track method, highlights the movement toward evidence-based pain management in Iraq; ensure that even basic clinical procedures do not further compromise the child's well-being [16].

Current pediatric oncology has growing emphasis on concerned with specialized nutritional assessment alongside traditional therapy [17, 18]. Anthropometric evaluation, involving Mid-Upper Arm Circumference (MUAC) and skin-fold thickness, is a non-pharmacologic diagnostic approach that can enhance the efficacy of clinical monitoring. It postulates that peripheral measurements provide a more transparent reflection of muscle and fat reserves compared exclusively with weight or BMI [19, 20].

Monitoring MUAC and skin-fold thickness are based on standardized WHO protocols, is posited to uncover a clearer picture of "unmasked" wasting; enhanced sensitivity in detecting early malnutrition is distinctly apparent [21, 22]. Research studies have confirmed that routine anthropometric assessment promotes intervention earlier and reduces the risk of treatment-related toxicity [23]. Studies conducted in geographical and socio-economic settings in Middle-Eastern populations indicate that MUAC has a marked efficacy in identifying malnutrition that is often masked by clinical confounders [24, 25].

In addition, the oncology nurses are essential members of the multidisciplinary team in supporting children during chemotherapy. Their role extends beyond administration of treatment to include comprehensive supportive care; for instance, empowering pediatric nurses in specialized areas such as oral health and antiseptic interventions is vital, as these factors directly influence a child's ability to maintain adequate oral intake [12]. To fulfill this role, nurses need to be instrumented with high-sensitivity tools like WHO MUAC tapes and slim guide skin-fold caliper [26]. However, while general data are available, few longitudinal studies have investigated the direct influence of chemotherapy on the stability of anthropometric parameters like MUAC in the Iraqi population [27].

There is considering variation in previous local studies on nutritional monitoring protocols. This makes difficulties to establish standardized nursing recommendations. Consequently, the creation of a strong evidence base for the efficiency of MUAC and skin-fold thickness in detecting the incidence of malnutrition with newly diagnosed children is crucial for practical applications and promoting pediatric oncology health in Iraq [28, 29].

2 Methods

2.1 Study Design and Setting

A longitudinal prospective study was implemented at the Hematology and Oncology Units of Child's Central Teaching Hospital, which is a leading governmental pediatric hospital in Baghdad, Iraq. The study period was between May 3rd to September 15th, 2025.

2.2 Study Sample and Sampling

A non-probability purposive sample consisted of 130 children newly diagnosed with cancer who were admitted to the Hematology Center at Child Protection Teaching Hospital. The sample was conducted as a one-group longitudinal study to identify the incidence of malnutrition across three distinct time points.

2.3 Inclusion Criteria

The sample was chosen according to the criteria that related to the Caregiver admitted with their children in hematology center and diagnosed for the first time a cancer.

2.4 Exclusion Criteria

Exclusion criteria included children who were not newly diagnosed with cancer, those who had already received chemotherapy, and those with chronic comorbidities that could interfere with nutritional assessment.

2.5 Sample Size

The minimum sample size is 130 children newly diagnosed with cancer, according to the calculation of the minimal sample size based on a 95% confidence level and a 0.05 margin of error [30]. The participants were followed as a single-group longitudinal study to detect physiological differences in anthropometric trajectories across three time points, which are clinically meaningful as shown in contemporary oncology settings [31, 32].

2.6 Study Instruments

The researcher adopted a standardized nutritional assessment instrument, specifically designed for pediatric oncology from clinical protocols and related literature [33]. The final copy of the instrument consists of the following two parts:

2.6.1. Part I: Socio-demographic and Clinical Data. The socio-demographic and clinical data section was designed to obtain essential descriptive data of the participants, included nine items: (Age, Gender, Family size, Parent's occupation, Level of education, Cancer type, Date of diagnosis, Date of admission, and Date of starting chemotherapy). The researcher collected all data of the children with the presence of their parents or guardians to ensure the ethical compliance.

2.6.2. Part II: Nutritional and Anthropometric Assessment Form. This section included a standardized format to measure nine anthropometric indicators for pediatric oncology include (Weight, Height, Body Mass Index (BMI), Head circumference, Chest circumference, Mid–Upper Arm Circumference (MUAC), Triceps skin-fold thickness, Subscapular skin-fold thickness, and the presence of Oedema). These measures were recorded across three distinct time points: at diagnosis, two months following the induction of chemotherapy, and four months after the start of treatment.

2.7 Ethical Considerations

The official approval of the study protocol received from the Committee of Scientific Research Ethics at the College of Nursing, University of Baghdad, Iraq; on March 10th, 2025. Additional authorizations were obtained from the Medical City Complex Administration and the head of the Child Protection Teaching Hospital.

2.8 Data Collection and Intervention

The data collection process was conducted through direct clinical assessment and structured interviews by the researcher. The high reliability was ensured and minimizes inter-observer bias; all physical measurements (anthropometric parameters) were performed by the researcher using the same standardized tools for every sample in the study. Prior to the commencement of the study, the researcher underwent rigorous training on the precise techniques for pediatric anthropometric assessment, including the use of skinfold caliper for triceps measurement and subscapular fat thickness, and the correct placement of the Mid-Upper Arm Circumference (MUAC) tape to ensured adherence to international standards for nutritional assessment in pediatric oncology. Before any data was collected the researcher was secured by written or verbal informed consent from the parents or legal guardians of each child. The researcher clearly explained the objectives of the study, and emphasizing that the assessment is non-invasive and that their participation is entirely voluntary. The nutritional status was assessed at three critical time points: at the initial diagnosis, at 3 months, and at 6 months during the chemotherapy course. The parameters concussed from anthropometric measurements (body weight and height or length) to calculate Body Mass Index (BMI), Muscle and Fat Stores to calculate MUAC and skinfold thickness (triceps and subscapular), and clinical observations for monitored any the presence of edema during each session. The measurements were recorded manually by the researcher on the study's clinical assessment sheet and then transferred to a digital database for statistical analysis.

2.9 Statistical Data Analysis

Data were analyzed using SPSS version 26. Descriptive statistics (frequencies, percentages, means, and standard deviations) summarized the sample characteristics. To evaluate longitudinal changes in nutritional status (BMI, MUAC, and Skinfolds) across three-time points in Baseline, 3, and 6 months. Repeated Measures ANOVA was applied. Pearson correlation (r) examined the relationships between anthropometric variables. Normality was assessed via Shapiro-Wilk and Kolmogorov-Smirnov tests, with statistical significance set at $p < 0.05$.

Table 1: Test of normality

Variables	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Age	.196	130	.000	.897	130	.000
Sex	.339	130	.000	.570	130	.000
Family size	.203	130	.000	.897	130	.000
Mother education	.278	130	.000	.803	130	.000
Father education	.228	130	.000	.835	130	.000
Mother occupation	.492	130	.000	.274	130	.000
Father occupation	.447	130	.000	.570	130	.000
Duration of diagnosis	.095	130	.006	.948	130	.000
Type of diagnosis	.450	130	.000	.565	130	.000
Admission duration	.094	130	.007	.932	130	.000
Duration of therapy	.077	130	.059	.957	130	.000

a. Lilliefors Significance Correction

The Table 1 indicates that data are not normally distributed as evidenced by Kolmogorov-Smirnov results which show significant differences at p-value ≤ 0.05, which means rejecting of null hypothesis and accepting of alternative hypothesis.

Table 2 presents the distribution of children according to their sociodemographic characteristics. The findings show that the largest proportion of children falls within the 4–6 years age group (33.1%), followed by those aged 7–9 years (23.1%) and ≤10 years (22.3%). Regarding sex, males constitute a higher percentage (63.1%) compared to females (36.9%). With respect to family size, nearly half of the children live in families consisting of 5–6 members (46.2%), while smaller families of 3–4 members account for 29.2%, and larger families with ≥7 members represent 24.6%. These results imply that most children come from medium-sized families.

The Figure 1 displays the type of cancer diagnosis among the children in the study, the solid tumor diagnosis represents 37% of cases while hematological cancer represent 93% of cases. Regarding solid tumors diagnosis, "osteosarcoma" is the highly diagnosed type among pediatric patients as reported by 45.9% of them (n=37). This is followed by neuroblastoma at 27.9% (11 cases) and nephroblastoma at 24.3% (9 cases). Within hematology cancers, leukemia is overwhelmingly dominant, representing 79.6% of hematology cancer cases (74 out of 93), while lymphoma accounts for 20.4% (19 cases).

Table 2: Description of sociodemographic characteristics of children

List	Variables	f	%
1	Age (year)		
	> 1	4	3.1
	1 – 3	24	18.4
	4 – 6	43	33.1
	7 – 9	30	23.1
	≤ 10	29	22.3
	Total	130	100
2	Sex		
	Female	48	36.9
	Male	82	63.1
	Total	130	100
3	Family size number		
	3 – 4	38	29.2
	5 – 6	60	46.2
	≥ 7	32	24.6
	Total	130	100

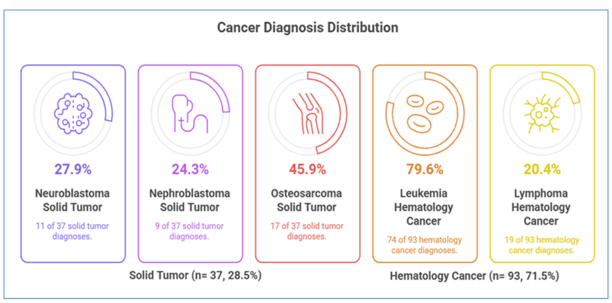

Figure 1: Prevalence of cancer diagnosis among pediatric patients

Figure 2 shows a clear decline in body mass index recorded among pediatric children through several point times of study on chemotherapy treatment suggesting nutritional changes due to treatment.

Figure 3 shows MUAC over several point times; the MUAC reveals clear decline in measures during "3 months" that intensify during "6 months" time indicating nutritional changes among pediatric patients.

Figure 4 demonstrates clear changes in triceps skinfold measure during three times of the study, fat thickness decreased clearly during 3 month and 6 months indicating nutritional changes during chemotherapy treatment.

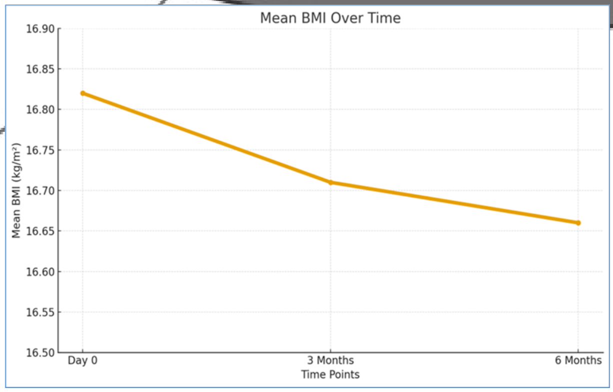

Figure 2: Changes in body mass index over time

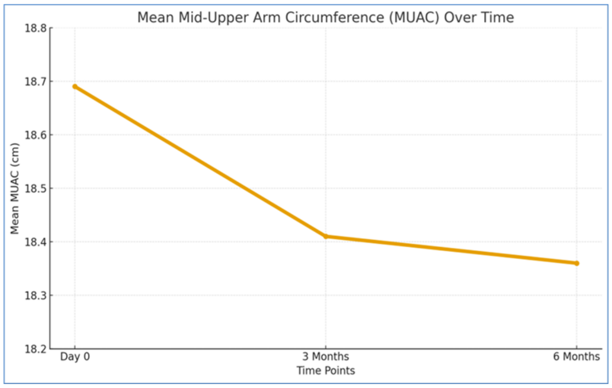

Figure 3: Changes in MUAC over time

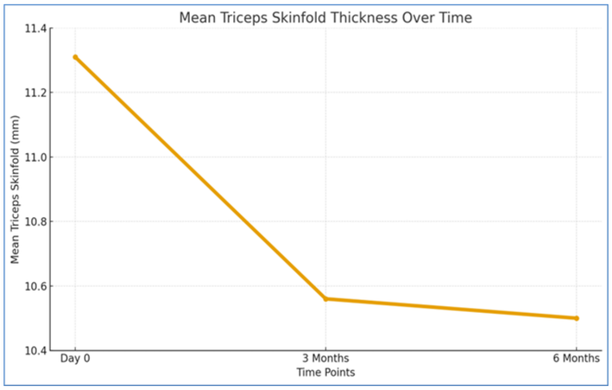

Figure 4: Changes in triceps skinfold measure over time

Figure 5 shows a slight increase in mean oedema score from Day 0 to the three-month, the oedema is clearly increased at 3 month and decreased to 6 months.

Table 3 presents the WHO Z-score indices for pediatric patients across baseline, three months, and six months, revealing measurable declines in several key nutritional indicators during the follow-up period. The weight-for-age Z-score (WAZ) showed a progressive decrease from -1.10 ± 1.20 at baseline to -1.35 ± 1.25 at three months and -1.55 ± 1.30 at six months, with a significant p-value of .018, indicating deterioration in weight status over time. Conversely, the height-for-age Z-score (HAZ) exhibited only minimal changes, with values remaining relatively stable (p = .420), which is consistent with the slow rate of linear growth and the expectation that height is less responsive to short-term influences. Both weight-for-height Z-score (WHZ) and BMI-for-age Z-score (BAZ) demonstrated significant declines (p = .024 and p = .011, respectively), reflecting reductions in body mass relative to height and age during the six-month period.

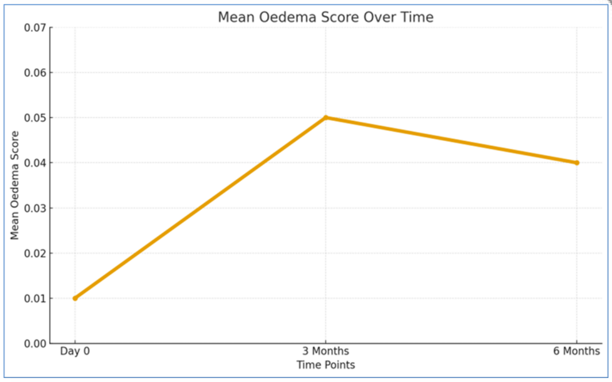

Figure 5: Changes in mean oedema score over time

Table 3: WHO Z-score indices (Mean ± SD) for Pediatric Patients at baseline, 3 Months, and 6 Months

Nutritional Index	Day 0 (Mean ± SD)	3 Months (Mean ± SD)	6 Months (Mean ± SD)	P-value
WAZ (Weight-for-age Z-score)	-1.10 ± 1.20	-1.35 ± 1.25	-1.55 ± 1.30	.018
HAZ (Height-for-age Z-score)	-1.25 ± 1.10	-1.28 ± 1.10	-1.30 ± 1.12	.420
WHZ (Weight-for-height Z-score)*	-0.95 ± 1.30	-1.20 ± 1.35	-1.35 ± 1.40	.024
BAZ (BMI-for-age Z-score)**	-0.80 ± 1.10	-1.05 ± 1.15	-1.20 ± 1.20	.011

*WHZ is used for children 0–5 years
**BAZ is used for children 5–19 years
"Z-scores were calculated using WHO Anthro/AnthroPlus based on the LMS method."

3 Discussion

This research provides empirical evidence supporting the significant decline in nutritional status among pediatric oncology patients in Iraq, particularly reflected in the longitudinal reduction over six months of BMI and MUAC. These findings contribute to the growing body of literature highlighting the "metabolic cost" of intensive chemotherapy. Furthermore, the strong positive correlation between MUAC and BMI supports the clinical utility of arm anthropometry as a rapid, non-invasive screening tool for early nursing intervention in crowded hematology wards. Additionally, the nutritional stability also based on effective discharge planning. Research shows that nurses' knowledge of discharge protocols is essential for long-term recovery, as it ensures parents are ready to manage the child's care and nutrition after leaving the hospital [34].

3.1 Sample Characteristics

Socio-demographic of study population (N=130) revealed a predominant age group of 4–6 years (33.1%). The study aligning with recent epidemiological trends of Hassan et al in Iraq, which is indicated a high incidence of pediatric malignancies in early childhood [2]. Male children constituted the majority of the sample (56.2%), a finding consistent with Mohammed et al. who reported a similar male predominance (54%) in a study conducted at the Child's Central Teaching Hospital in Baghdad [27]. This gender distribution also supports the broader regional observations by Abdulelah et al. who suggested a slightly higher vulnerability among male pediatric populations in Middle Eastern developing countries [24].

Regarding the clinical profile, hematologic malignancies were the most frequent diagnoses (Leukemia and Lymphoma). This is in agreement with the analysis by Kakamad et al., which identified leukemia as the leading malignant tumor in tertiary centers in Iraq [3]. Furthermore, the socio-economic indicators showed that a vast majority of mothers were housewives (82.3%) with primary education levels. The study of Ali and Ma'ala emphasized that maternal educational background and socio-economic status are critical determinants in the nutritional management and treatment compliance of leukemic children in Baghdad's hematology centers [28].

3.2 Nutritional and Anthropometric Outcomes

The current study demonstrated a significant and progressive decline in nutritional status among pediatric oncology patients, with the most critical deterioration observed in BMI and MUAC during the first six months of chemotherapy. The gradual reduction in these parameters suggests that the nutritional impact of malignancy and chemotherapy during the high-intensity induction phase.

3.2.1. BMI and MUAC Trajectory. The significant decline observed in BMI (p=0.001) and MUAC (p=0.001) supports the alternative the study hypothesis that there is a significant relationship between childhood cancer and nutritional deterioration. These findings indicate that intensive chemotherapy protocols impose a severe "metabolic tax" on pediatric patients, which is consistent with Milaniuk et al. who reported substantial anthropometric changes and muscle wasting during early chemotherapy course [13]. Also Franke et al. found that pediatric oncology patients exhibit a rapid decrease in BMI and muscle-to-fat ratios in short period after initiating induction therapy [11].

Procedural pain and anxiety are major barriers to nutritional intake in pediatric oncology. The success of Virtual Reality-Based interventions in reducing pain suggests that such strategies could mitigate treatment-related anorexia. By easing the child's distress, nurses create a stable environment that helps prevent further nutritional decline [35]. Additionally, music interventions have been shown to significantly reduce pain and anxiety during pediatric procedures in Iraq. By mitigating this emotional stress, nurses can help prevent treatment-induced anorexia and support better nutritional outcomes for children with cancer [36].

However, it is important to note that while both indicators declined, MUAC emerged as a more stable clinical marker. This is particularly relevant given the presence of oedema in a subset of the study sample and represents a potential confounding factor for weight-based metrics; also BMI alone may underestimate the true extent of tissue wasting. This observation aligns with Borgatti et al. which validated MUAC as a superior tool for detecting wasting where weight-based assessments are confounded by clinical complications in acute oncology settings [22]. Therefore, the integration of MUAC into routine nursing protocols which is recommended by Viani et al is to ensure baseline accuracy and longitudinal monitoring [33].

3.2.2. Skinfold Thickness. Triceps and Subscapular Skinfold thickness showed a decreasing trend (p=0.042), indicating a loss of subcutaneous fat and the change of magnitude was less pronounced than that of MUAC. This finding contrasts with a study by Yaprak et al. which reported more aggressive fat depletion in the early phase of treatment. The difference may be attributed to individual variability in fat distribution and the relatively short duration of the current follow-up [37]. Nevertheless, our findings remain consistent with White et al. who suggested that while skinfold measurements are useful, MUAC provides a more immediate and true reflection of malnutrition in resource-limited clinical settings [38].

3.3 Limitations

This study is limited by its single hematology center and relatively small sample size, which may restrict the generalizability of the study findings. The seven-month duration was insufficient to monitor long-term nutritional changes in the children. Additionally, the reliance on anthropometric measurements alone, excluding biochemical and dietary assessments limits the depth of the nutritional profile. Finally, potential confounders like socioeconomic status and caregiver knowledge were not controlled for. Despite these constraints, the study provides critical insights into pediatric oncology malnutrition and highlights the necessity for larger, multi-center research.

4 Conclusion

This study concludes that malnutrition in children with cancer is not a static condition present at diagnosis, but a progressive and dynamic complication triggered by chemotherapy and the significant drop in BMI, MUAC, and skinfold thickness confirms that the pediatric oncology are suffering from acute wasting. A crucial clinical insight from the present study findings is that MUAC proves to be a far more reliable than traditional weight monitoring, especially when oedema masks actual weight loss. The study identified in female's child a specific "window of vulnerability", hematologic cancers children aged 4–6 are at the highest risk of deterioration. Ultimately, from a nursing perspective, shifting toward proactive, nurse-led nutritional surveillance is no longer optional but must be essential to ensure these children can tolerate their treatment and achieve better clinical outcomes.

5 Recommendations

It is essential to implement standardized nutritional screening at every treatment cycle. The present study advocates developing plans about individualized nutritional support and specialized training for nursing staff to recognize early signs of wasting. Furthermore, family-centered dietary counseling should be integrated into discharge planning to reduce the risk of home-based nutritional failure and ensure continuity of care.

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