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NUTRITION AND ITS RELATIONSHIP TO PHYSICAL APPEARANCE IN CHILDREN WITH CANCER

Happy Indri Hapsari[1]*, Rita Benya Adriani[2], Dwi Sulistyowati[2]
[1]Universitas Kusuma Husada Surakarta, Jl. Jaya Wijaya No. 11 Kadipiro, Banjarsari, Surakarta, Central Java 57136, Indonesia
[2]Poltekkes Kemenkes Surakarta, Jl. Letjend Sutoyo, Mojosongo, Surakarta, Central Java 57127, Indonesia
*hapsari.happy@gmail.com

ABSTRACT
Cancer treatment experienced by children and adolescents has a wide range of impacts, including nutritional status. Nutritional status changes the shape of children and adolescents with cancer. The purpose of this study was to analyze the relationship between malnutrition and the physical appearance of children with cancer. The design of this study was cross-sectional, the sampling technique used was purposive sampling, with cancer children undergoing active treatment who were school-aged and adolescents. There are 47 respondents. Multiple regression is a statistical analysis in this study. Data were collected directly at the hospital after obtaining ethical approval and permission from the hospital and the patient's parents/guardians, using physical measurements (LLA) and questionnaires (SPPC), as well as demographic data. Predicted factors of physical appearance ($R2 = 0.36$, $p = 0.00$) were sex ($\beta = -0.17$, $p = 0.27$), age ($\beta = 0.02$, $p = 0.48$), cancer type ($\beta = 0.24$, $p = 0.51$), and nutritional status ($\beta = 0.12$, $p = 0.00$). Being female, older, having solid mass cancer, and having a higher body mass index will affect the physical appearance of a child with cancer. Children with cancer are particularly susceptible to nutritional problems, both undernourished and overnourished, which directly affect their physical appearance. These changes, such as hair loss, weight changes, and skin color, create significant psychological distress on children and adolescents, especially due to concerns about social acceptance. Studies show that good nutritional status is positively correlated with better physical appearance, underscoring the importance of comprehensive nutritional interventions as an essential part of childhood cancer care. Nutritional status is the most significant predictor of the physical appearance of children with cancer, where better nutrition is directly correlated with better physical appearance. Cancer is more common in boys and blood cancer is most common, physical changes due to treatment greatly affect psychological well-being, especially in adolescent girls who feel greater pressure related to body image.

Keywords: cancer; children; malnutrition; physical appearance

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INTRODUCTION

Children with cancer diagnosed with leukemia, lymphoma and other solid tumors show malnutrition, either malnutrition or overnutrition. Malnutrition in children with cancer is a predictor of overall survival (OS) and event-free survival (EFS) (Karalexi et al., 2022). Meta-analysis studies showed that children with acute lymphoblastic leukemia (ALL) with a higher body mass index (BMI) had worse EFS. A high BMI is also significantly associated with an increased mortality rate, and an increase in the risk of recurrence. Children diagnosed with acute myeloid leukemia (AML) who had a higher BMI were also significantly associated with worse EFS and OS when compared to those with lower BMIs. (Iijima et al., 2022).

Malnutrition in children is defined as an imbalance between nutritional needs and intake that can lead to disorders including growth, neurocognition and bodily functions. Malnutrition usually occurs in children with chronic diseases. In children with cancer, particularly those undergoing chemotherapy, face a dual nutritional challenge they have increased energy and metabolic

requirements to fight disease and support recovery, but at the same time, they experience a drastic decrease in micro and macronutrient intake due to the side effects of treatment (Fabozzi et al., 2022). Energy deficiency and systemic inflammation are the main triggers of fat mass loss and lean free mass in children with cancer, which significantly worsens their prognosis (Shorter et al., 2024). However, other studies have shown that there is a difference in body composition at 3 months after diagnosis and 6, 9, and 12 months after diagnosis. During the first 3 months when a child is diagnosed with cancer, there is a significant decrease in body composition. In the range of 3-12 months after diagnosis, body composition tends to improve statistically. In children and adolescents with acute lymphoblastic leukemia (ALL) and also some types of solid cancer, they tend to experience significant weight gain and increased fat mass during the intensive treatment phase, especially those involving the use of high-dose steroids (Gil et al., 2023).

In the first three months after cancer diagnosis, children experience weight changes. Weight loss occurs in blood cancers and solid tumors; While most patients with brain tumors experience weight gain. In this period, older children have a statistically significantly lower BMI than younger children, and children with solid tumors have a much lower BMI than brain cancer. In addition, statistical differences were seen in changes in standard deviations in BMI (stable, up, down, or recoverable) months after being diagnosed with cancer (Kandemir, 2023). A review of previous studies also showed that cases of children with brain tumors showed a sevenfold increase in weight change (from 6% to 43%), this evidenced the presence of disease-specific and treatment-specific effects on nutritional status (Wadhwa et al., 2023). The prevalence of malnutrition was much higher in children with cancer in Low-Middle-Income Countries (LMICs) compared to High-Income Countries (HICs). This is often a combination of pre-existing malnutrition (prior to cancer diagnosis), exacerbated by limited access to nutritious food, adequate health facilities, and nutritional support during treatment (Makamo et al., 2025).

Weight gain during cancer treatment is still uncertain. Glucocorticoids as a treatment for all stimulate the deposition of central fats and directly dull the sensitivity of adipocyte insulin. Children with cancer also experience higher energy levels and reduced physical activity during treatment. An imbalance between physical activity and total daily expenditure may be one of the factors that affect being overweight in children with cancer (van der Hoek et al., 2025). The symptoms of cancer itself and the side effects of treatment associated with nutritional disorders include poor appetite, nausea, vomiting, diarrhea, problems chewing and swallowing, and changes in taste and smell (Molassiotis et al., 2018). In addition, parents say that limited food intake and difficulty eating are quite serious challenges that cause frustration and distress. Dealing with changes in taste, difficulty communicating with children, and receiving weight loss in children with cancer are problems when children are undergoing cancer treatment (Clarke et al., 2023).

Research conducted in Indonesia shows that the prevalence of underweight children with cancer is 24.4%, overweight is 9.8%. and obesity 6.1% based on BMI for age. Most cancer children show nutritional deficiencies based on upper arm circumference, and about 4% are in the overweight category. Stunting reaches 20.8% of cancer patients. Most of them are energy deficient. The percentage of cancer children meeting the national micronutrient needs is low, ranging from 3.8% to 56.1%, with the highest average adherence to vitamin A consumption and the lowest with vitamin E consumption (Ermamilia et al., 2023). During childhood, nutrition is important for growth, development, puberty, balancing body composition, and maintaining health (Tripod) et al., 2023).

Receiving a cancer diagnosis in adolescence adds even more stress to an already difficult and changing world. Adolescents are a vulnerable group because it can also jeopardize their ability to reach important milestones in life (Wei et al., 2025). Previous research has shown that cancer treatments, especially chemotherapy, alter their physical appearance, such as their moon face, hair

loss, and plump cheeks. Girls are more concerned with changes in physical appearance than boys. However, girls and boys are equally concerned about how their friends and significant others will respond to the physical changes they are experiencing. Until now, there has been no research that examines the nutritional status of children and their role in shaping the physical appearance of children with cancer. Changes in body shape due to malnutrition cause cancer children to be reluctant to evaluate their physical appearance. This study aims to analyze the relationship between malnutrition and the physical appearance of children with cancer undergoing treatment.

METHOD

The design of this study was cross-sectional, linking nutritional status and physical appearance. The population used is children with cancer who are undergoing treatment, with inclusion criteria being school-age children and adolescents, and able to read. Meanwhile, the exception criteria in this study were cognitive impairment and were in an unstable condition. This research was conducted at Dr. Moehwardi Hospital Surakarta, Indonesia. The sampling technique is purposive sampling, with a sample size of 47 respondents. The research instrument used to measure nutritional status is the circumference of the upper arm. Physical appearance variables were measured using the Self-Perception Profile for Children (SPPC) for the physical appearance domain, which consisted of 6 statement items. SPPC has been tested for validity and reliability in Indonesia with an alpha Cronbach value of 0.929, and a construction validity between 0.276 and 0.790, with all items statistically significant ($p < 0.05$).

The demographic data measured in respondents were age, gender, type of cancer, and type of treatment. This research has gone through an ethical exception with the number 1758/UKH. L.02/EC/I/2024. Dr. Moewardi Surakarta Hospital has granted permission to conduct research with the number 893/2.594/2024. The consent form is given to the patient's parent or guardian. After obtaining approval, the researchers measured the patient's upper arm circumference and gave the patient a physical appearance questionnaire. The questionnaire cannot be filled out at home. Statistical analysis used Spearman Rho correlation to test the relationship between nutritional status and demographic data and physical appearance. Multiple regression is used to analyze predictors of physical appearance in children with cancer.

RESULT

Table 1.
Demographic Data, Middle Upper Arm Circumference, Physical Appearance in Child Cancer

	Child Cancer (n = 47 responden)	
	Frequency	Percentage
Gender		
Gadis	20	42.6%
Son	27	57.4%
Types of cancer		
Blood cancer	44	93.6%
Dense cancer	3	6.4%
Types of treatment		
Active care	47	100%
No treatment	0	0%
	Minimum-Maximum	Average (+1 SD)
Age	8 – 18	10.57 (2.65)
Middle Upper Arm Circumference (MUAC)	15 – 22	18.63 (2.03)
Physical appearance	1.00 – 3.17	2.44 (0.60)

Table 1 shows that the average age and class distribution show almost the same data. Boys have a higher percentage than girls. Most cancer respondents were diagnosed with blood cancer and were undergoing active treatment.

Table 2.
Correlation of Demographic, Nutrition and Physical Appearance Data in Children with Cancer

	1	2	3	4	5
1. Gender					
2. Age	-0.17				
3. Types of cancer	0.13	-0.51**			
4. Nutritional status	0.07	0.13	0.17		
5. Physical appearance	-0.11	0.15	0.12	0.58**	

* *P* value < 0.05; ** p value < 0.01; *** p value < 0.001

Table 2 shows that nutritional status is significantly positively correlated with physical appearance in children with cancer (r=0.58, p<0.01). Regarding demographic data in children with cancer, there is no demographic data that correlates with the physical appearance of children with cancer.

Table 3.
Factors That Predict Physical Appearance in Children with Cancer

	B	*t*	*p*
Konstan	-1.01	-1.27	0.21
Gender	-0.17	-1.13	0.27
Age	0.02	0.71	0.48
Types of cancer	0.24	0.66	0.51
Nutritional status	0.17	4.28	0.00
R2		0.36	
F		5.99	
p		0.00	

Table 3 shows that a regression model that includes sex, age, cancer type, and nutritional status simultaneously has a significant effect on physical appearance, with $p = 0.00$. Partial nutritional status had a significant effect on physical appearance ($p = 0.00$). Variations in sex, age, cancer type, and nutritional status as independent variables affected changes in physical appearance by 36%. While the rest were influenced by other variables outside the study.

DISCUSSION

The tendency of cancer prevalence in children to be higher in males is often reported in various studies. Recent global cohort studies continue to show a slight dominance of cancer incidence in boys compared to females, although these differences may vary depending on the specific type of cancer and the population studied (Wu et al., 2022) . The majority of respondents (93.6%) were diagnosed with blood cancer. This is consistent with the epidemiology of childhood cancer in general, where leukemia (blood cancer) is the most common type of cancer in children (Sung et al., 2021).

Low MUAC values are often associated with the risk of acute malnutrition, which is a common problem in children with cancer (Viani et al., 2020). Malnutrition in children with cancer can be caused by a variety of factors, including medication side effects (nausea, vomiting, anorexia), increased metabolic needs due to illness, and difficulty eating. Studies have shown that malnutrition in children with cancer can worsen the prognosis, increase the risk of infection, and prolong hospitalization (Karalexi et al., 2022). Children with cancer often experience significant physical appearance changes due to illness and treatment, such as hair loss (alopecia), weight changes, paleness, and skin side effects (Antony & Professor, 2022).

Findings of a significant positive correlation between nutritional status and physical appearance (r=0.58,p<0.01). This means that the better the nutritional status of a child with cancer, the better his physical appearance tends to be, and vice versa. Previous research has shown that children with cancer who undergo treatment tend to be malnourished, both obesity and malnutrition, when compared to healthy children. Common complications in children with different types of cancer, are not limited to just one category. Factors that trigger malnutrition, such as chemotherapy side effects

(nausea, vomiting, anorexia), difficulty swallowing due to mucositis, increased metabolic needs due to disease, and frequent hospitalizations, apply across types of cancer (Raybin, 2022).

Cancer treatment in children often causes a series of visible physical changes, such as hair loss (alopecia), paleness, skin discoloration, and weight fluctuations (gain or decrease). When these changes are exacerbated by poor nutrition, the impact on physical appearance can be even more significant. Malnutrition can lead to a sunken face, thin body, or a distended belly, and in chronic cases, it can affect linear growth leading to short stature (Seal et al., 2024) . These physical changes, especially in children and adolescents who are in the development stages of self-identity and body image, can cause great psychological distress. The study highlights that negative perceptions of body image and physical appearance are common problems among children with cancer (Antony & Professor, 2022).

Good nutritional status is the foundation of a child's health and growth, and in cancer patients, adequate nutrition to support response to therapy, recovery, and prevention of complications. Malnutrition is a common problem in children with cancer, often caused by anorexia, nausea, vomiting, metabolic changes, and medication side effects (Seal et al., 2024) . Malnutrition can lead to weight loss, loss of muscle mass, weakness, and skin changes, all of which directly affect physical appearance. While there may be differences in psychological responses to changes in appearance based on gender, the direct physical impact on appearance tends to be similar. The child's physical appearance does not directly deteriorate or improve with age in this group of cancer children. However, the side effects of cancer treatment.

During cancer treatment, children eat fewer fruits, vegetables, and dairy products, accompanied by increased consumption of high-sugar foods and unhealthy snacks. Children show a higher preference for foods that are high in salt, high in carbohydrates, and foods with strong flavors (Babi & Lompatan, 2024). This is because during cancer treatment, cancer patients experience several side effects related to nutrition. Some of the things they experience are changes in the taste of food and pain when eating (Milliron et al., 2022). There was a significant negative correlation between age and cancer type ($r=-0.51, p<0.01$). This suggests that younger children tend to be diagnosed with blood cancer more often, while older children may be diagnosed with solid cancer more often. These findings are consistent with the epidemiology of childhood cancer globally, where leukemia is the most common cancer in early childhood, while the incidence of some specific solid tumors tends to increase in adolescence (Karalexi et al., 2022).

From the results of this study, being a girl, being older, having dense mass cancer, and overnutrition are predictive factors for the physical appearance of children with cancer. Physical changes due to the side effects of cancer treatment change the way adolescents view body image. The level of concern about body image in adolescents changes over time, especially during treatment and as cancer survivors (Moore et al., 2021). These results are supported by previous research that states that adolescent girls feel more pressure due to physical changes due to treatment than boys. This is due to the concerns and expectations of society that associate women with beauty. (Belle et al., 2022). Teens show greater concern about body image than younger children. Ages 5-14 show concern about physical changes due to cancer treatment. However, adolescents with cancer who are older than 16 years of age show better body image (Li et al., 2022). As teenagers age, they increasingly have a sense of autonomy over themselves and care less about the judgments of others (van der Hoek et al., 2025).

Body image changes also occur due to weight loss or weight gain during cancer treatment. This is because there is a change in the sense of taste that feels the change in the taste of food, so that eating becomes difficult for children and adolescents with cancer. Significant changes in weight

cause others to respond negatively, leading to changes in adolescent self-concept, especially related to physical appearance (Moore et al., 2021).

CONCLUSION

This study shows that nutritional status has a statistically significant correlation with a child's physical appearance with cancer. Furthermore, gender, age, type of cancer and nutritional status simultaneously affect the physical appearance of cancer adolescents. More specifically, being a girl, getting older, having dense mass cancer, and nutrition has a greater impact on the physical appearance of cancer teens. Childhood cancers are more common in males and this type of blood cancer is the most common, especially at a young age, in line with global patterns. Malnutrition is a common problem in childhood cancers of all types, triggered by side effects of treatment and increased metabolic needs. Malnutrition not only worsens the clinical condition but also significantly affects physical appearance. It was found that better nutritional status is directly related to better physical appearance. Physical changes due to cancer treatment have a major impact on psychological well-being, especially in adolescent girls, triggering a decline in self-esteem and anxiety due to social pressures related to appearance. Although demographic factors such as gender, age, and cancer type are not strong predictors of individual physical appearance, nutritional status is the most significant predictor. Therefore, proactive and comprehensive nutritional interventions are essential in the treatment of childhood cancer to improve clinical outcomes and quality of life through improvements in physical appearance.

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