Original Article

Relationship between fasting time and evolution of nutritional status in pediatric oncology patients: a longitudinal retrospective study

Relação entre tempo de jejum e evolução do estado nutricional em pacientes oncológicos pediátricos: um estudo longitudinal retrospectivo

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ABSTRACT

Introduction: Cancer and its treatments can have negative effects on children's nutritional status, especially because of fasting. However, this has not yet been clearly investigated. As such, the objective of the study was to analyze the association between fasting time and evolution of the nutritional status of pediatric oncology patients. **Methods:** The retrospective longitudinal study was carried out with 30 pediatric oncology patients admitted into a ward. Data collection was carried out through the electronic medical record, obtaining sociodemographic and clinical information, anthropometric measurements at admission and hospital discharge, gastrointestinal changes and fasting time in hours during hospitalization. To verify the association between the evolution of nutritional status and fasting time during hospitalization, the Kruskal-Wallis test was used, comparing the total fasting period with three groups evaluated using the body mass index/age (BMI/ I): patients who regressed the index during hospitalization, patients who progressed and patients who maintained it. **Results:** Most patients (66.6%) had hematological tumors, did not recur (80%), were fed exclusively orally (70%) and did not present mucositis during hospitalization (53.3%). Though the majority were admitted with adequate weight/eutrophy, 56.6% of them experienced weight loss and 50% with regression of BMI/A scores. The median total hours fasting was 43.5 (10.0-170.0). There was no association between fasting time and the groups evaluated (p=0.675). **Conclusion:** This study highlights the nutritional challenges faced by hospitalized oncology children, reinforcing the need for rigorous nutritional monitoring and interventions to minimize the impacts of prolonged fasting during hospitalization.

RESUMO

Introdução: O câncer e seus tratamentos podem ter efeitos negativos sobre o estado nutricional de crianças, especialmente por causa dos jejuns. Porém, isso ainda não foi bem investigado. Dessa forma, o objetivo do estudo foi analisar a associação entre tempo de permanência em jejum e evolução do estado nutricional de pacientes pediátricos oncológicos. **Método:** Foi realizado um estudo longitudinal de caráter retrospectivo, realizado com 30 pacientes pediátricos oncológicos internados em enfermaria. A coleta de dados foi realizada através do prontuário eletrônico, obtendo informações sociodemográficas, clínicas, medidas antropométricas da admissão e da alta hospitalar, alterações gastrointestinais e tempo de jejum em horas durante a internação. Para verificar a associação entre a evolução do estado nutricional e tempo de jejum durante a internação, utilizou-se o teste de Kruskal-Wallis, comparando o período total em jejum em três grupos avaliados de acordo com indicador índice de massa corporal/idade (IMC/I): pacientes que regrediram o índice durante a internação, pacientes que progrediram e pacientes que mantiveram. **Resultados:** A maioria dos pacientes (66,6%) apresentou tumores hematológicos, não recidivados (80%), alimentavam-se por via de alimentação oral exclusiva (70%) e não apresentaram mucosite durante a internação (53,3%). Apesar de a maioria ter sido admitida em eutrofia, 56,6% apresentou perda de peso, e 50% sofreu regressão dos escores de IMC/I. A mediana de horas totais em jejum foi de 43,5 (10,0-170,0). Não foi observada associação entre o tempo de jejum e os grupos avaliados (p=0,675). **Conclusão:** Este estudo destaca os desafios nutricionais enfrentados por crianças oncológicas hospitalizadas, reforçando a necessidade de monitoramento nutricional rigoroso e intervenções para minimizar os impactos do jejum prolongado durante a hospitalização.

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INTRODUCTION

Cancer is a disease in which there is disorganized growth of cells which can invade other adjacent tissues and organs and/or spread to other regions of the body[1]. In the case of childhood cancer, it is estimated that approximately 430,000 new cases occur every year in children and adolescents aged 0 to 19, with around 70% of these cases affecting populations in countries with a low to medium human development index[2,3].

The main treatments involved in childhood cancer are chemotherapy, radiotherapy, surgery and, in some cases, bone marrow transplantation, particularly in patients with hematological tumors[4,5]. Despite advances in antineoplastic treatments, the adverse effects of these therapies continue to have a significant impact on the mortality and morbidity rates of children with cancer, especially malnutrition[6,7].

The main causes for the development of malnutrition in pediatric cancer patients, in addition to the side effects associated with treatment, are the metabolic changes caused by the disease itself, the increased energy demand resulting from the growth of the tumor and the reduction in food intake[8,9].

Since one of the main causes of malnutrition is related to reduced food intake[10], prolonged periods of fasting during hospitalization can contribute to worsening the nutritional status of these patients. As a consequence, induction of glycogenolysis and lipolysis, accelerated catabolism with loss of muscle mass, reduced immune response, postoperative complications, and increased risk of refeeding syndrome, for example[11,12].

Despite these risks, the relationship between the length of time spent fasting and the evolution of nutritional status in children with cancer is still poorly investigated, especially considering the unique nutritional needs of this group. It is hypothesized that prolonged fasting during hospitalization is associated with a decline in the nutritional status of these patients, which can negatively impact their recovery. In this sense, investigating the relationship between fasting time and the evolution of the nutritional status of pediatric oncology patients is essential, so that early nutritional interventions can be carried out to prevent malnutrition and improve clinical outcomes. The aim of this study was to analyze the association between fasting time and the evolution of the nutritional status of pediatric oncology patients admitted to a ward.

METHODS

A longitudinal study was carried out with retrospective data collection on pediatric oncology patients admitted to the ward of the Hospital das Clínicas of the Federal University of Minas Gerais (HC-UFMG) between August 2022 and July 2023. The sample was non-probabilistic, made up of patients of both sexes, aged between 0 and 18 years and 11 months, diagnosed with oncological diseases, on an oral and/or enteral diet, hospitalized for more than seven days, monitored by the nutrition service, and fasted during hospitalization. Patients on parenteral nutrition, hemodynamically unstable, with no record of fasting during their stay in the unit, and no anthropometric data were not included in the study. For patients with more than one recorded hospitalization, data were collected from the most recent hospitalization that met the inclusion criteria. This project was approved by the UFMG Research Ethics Committee under CAAE 3.742.755.

By consulting electronic medical records, the following information was collected: date of birth, gender, age in years, dates of hospitalization, hospital discharge or unit transfer, total days of hospitalization and nutritional follow-up, occurrence of recurrence of the underlying disease, occurrence of death, weight and length at admission and at hospital discharge or sector transfer. Follow-up ended upon hospital discharge, transfer to another sector, or in the event of in-hospital death.

We also checked total fasting time in days and hours during hospitalization, reason for fasting, route of feeding described in the medical prescription, total days on partial nutritional support, total days on total nutritional support, occurrence of diarrhea, constipation, vomiting and/or mucositis.

For weight and length on admission, the first data recorded in the medical records by the nutritionist was taken into account. Children with edema were excluded from the analysis in order to avoid interfering with the assessment of nutritional status. For weight and length at hospital discharge or transfer, the last data recorded by the professional were taken into account. Regarding the evolution of weight status, the difference between final and initial weight was considered to determine weight gain, maintenance or loss during hospitalization. For the statistical analysis of weight loss during hospitalization, patients were categorized into two groups: those who had a weight loss $\geq$5% in relation to their admission weight and those who had a weight loss of less than 5% in relation to their initial weight[13].

For the nutritional diagnosis, the anthropometric data collected by the nutrition team and recorded in the electronic medical records was entered into Anthro® (for children up to five years old) and AnthroPlus® (for those over five years old) software. For children aged 0 to 5, the indices weight for age (W/A), weight for height (W/H), body mass index for age (BMI/A) and height for age (H/A) were used. For those aged over 5 and under 10, the W/A, BMI/A and H/A indices were used. For those over 10 and up to 18 years and 11 months, the BMI/A and WA/A indices were used. Classification was carried out using the z-score for the W/A, H/A, W/H and BMI/A indicators (on admission and discharge), adopting

the curves proposed by the World Health Organization as the reference standard[14,15]. Eutrophy was considered when the z-score of one of the indicators (W/A, H/A, W/H and BMI/A) was between +1 and -2, underweight when the z score of one of the indicators was in the -2 to -3 range, and very underweight when the z score of one of the indicators was below -3, according to the World Health Organization (WHO) classification[14]. The classification of nutritional status followed the criteria of the WHO[10], considering eutrophy when the z-score of one of the anthropometric indicators (W/A, W/A, W/H and BMI/A) was between -2 and +1. Underweight was defined as scores between -3 and -2, while very low weight corresponded to values below -3. The risk of overweight was characterized by scores between +1 and +2, overweight by values between +2 and +3, and obesity by scores above +3.

Fasting was considered to be the time the patient was on a suspended oral and/or enteral diet. The start of fasting was considered to be when the medical prescription ordered a suspended diet or fasting schedule. The end of fasting was considered to be when the diet was released by the doctor through the prescription or through a verbal medical statement recorded by nursing staff, or from nursing records describing the offer of a meal after the period of suspended diet. The occurrence of mucositis, diarrhea and constipation was considered when recorded in medical or nursing records. Vomiting was considered to have occurred when there was at least one episode during the day. Inaccurate and/or incomplete information was disregarded. When information on the start and end of fasting differed, priority was given to the information recorded by the medical team.

A database was then created in the Microsoft Excel® program and the data was analyzed using the Statistical Jamovi software version 2.3.28, with a significance level of 5% ($p<0.05$). Frequency analysis was used for categorical variables. The normality of continuous data was tested using the Shapiro-Wilk test. Continuous variables with a parametric distribution were presented using the mean and standard deviation, while variables with a non-parametric distribution were presented using the median and minimum and maximum dispersion. The Kruskal-Wallis test was used to verify the association between the evolution of nutritional status and fasting time during hospitalization, and the Mann-Whitney test was used to verify the association between weight loss and fasting time during hospitalization. A non-probabilistic sample was used.

RESULTS

Thirty patients were assessed, with a median age of 9 (1-17) years. Sociodemographic and clinical characteristics are described in Table 1.

Table 1 – Sociodemographic and clinical characteristics of pediatric oncology patients admitted to a ward at Hospital das Clínicas, Belo Horizonte, Brazil, (2023).

Variables	n	%
Sex		
Male	15	50.0%
Female	15	50.0%
Age		
0-5 years	10	33.33%
>5 – 10 years	7	23.33%
>10 years – 18 years	13	43.33%
Type of tumor		
Hematology	20	67.0%
Neurological	3	10.0%
Bone	2	6.66%
Lymphatic system	3	10.0%
Others	2	6.66%
Recurrence		
Yes	6	20.0%
No	24	80.0%
Feeding route		
Oral	21	70.0%
Oral + enteral	9	30.0%
Weight loss during (%)		
≥5%	10	33.33%
<5%	20	66.66%
BMI/A score		
Progression	12	40.0%
Maintenance	3	10.0%
Regression	15	50.0%
Hospital stay		
≥30 dias	18	60.0%
<30 dias	12	40.0%

BMI = body mass index; A = age; n = sample size.

With regard to gastrointestinal alterations, 66.66% of the patients had constipation during their stay, 46.67% mucositis, 46.67% vomiting and 33.34% diarrhea. Only one patient (3.33%) died. Figure 1 shows the procedures that required patients to fast during their hospitalization.

Table 2 shows the sample evolution of the patients' nutritional diagnoses during hospitalization. It can be seen that in the majority of cases, the patients had a diagnosis of adequate weight/eutrophy. However, there were changes in BMI/A scores over the course of the hospital stay, most of which worsened. There was no change in the W/A index.

The median fasting time of patients whose nutritional status improved during hospitalization was 40.5 (12-142)

hours. The median fasting time of patients whose nutritional status worsened was 53 (10-170) hours. The median fasting time of patients who maintained their nutritional status during hospitalization was 39 (11-60) hours (Figure 2). There was no statistically significant difference between the evolution of nutritional status and fasting time during hospitalization in the three groups evaluated (p=0.675).

When the association was made between weight loss and time spent fasting during hospitalization, it was observed that the group with weight loss ≥5% (n=10) had a median of 56 (16-170) hours fasting, while the group with weight loss <5% (n=20) had a median of 38.5 (10-142) hours fasting. However, there was no statistically significant difference between weight loss and fasting time (p=0.118).

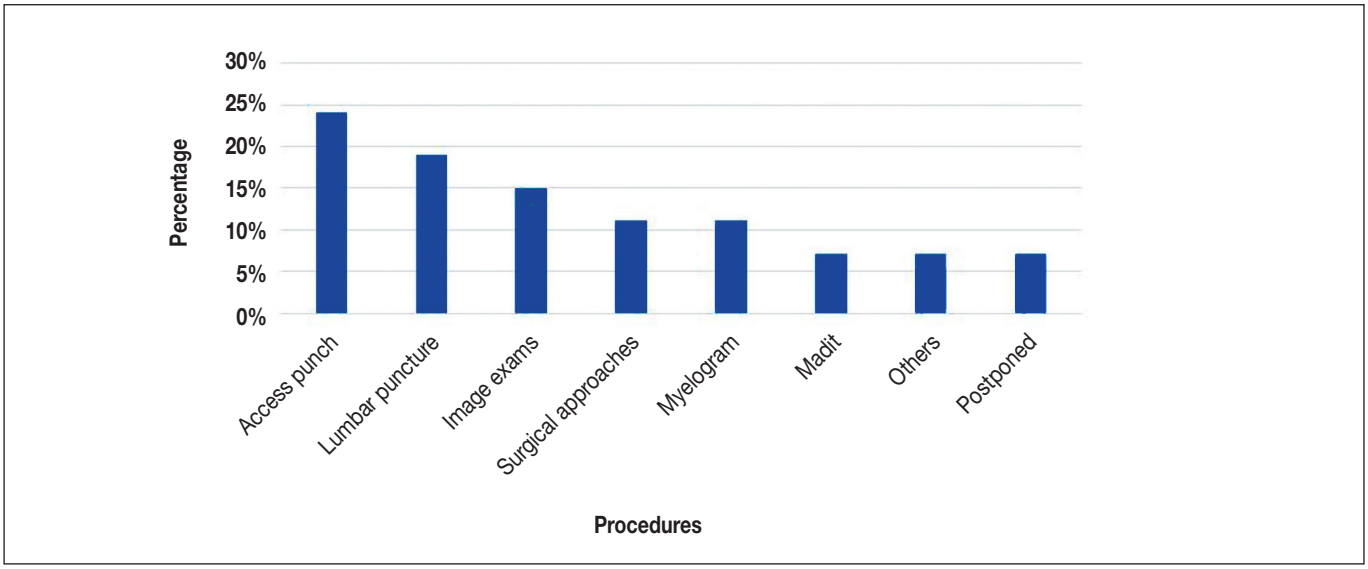

***Figure 1** - Procedures that required fasting by pediatric oncology patients during their stay in the ward at hospital das Clínicas. Belo Horizonte, Brazil (2023) (= 138). MADIT = intrathecal chemotherapy; postponed = procedures postponed due to the patient's clinical condition.*

Table 2 – Sample evolution of nutritional diagnoses of pediatric oncology patients during hospitalization at Hospital das Clínicas, Belo Horizonte, Brazil (2023).

Variable	Sample (n)	Initial n	% initial	Final n	% final	Comparative
W/A (0 – 10 years)						
Very low weight for age		0	–	1	5.88%	>
Low weight for age	17	2	11.76%	1	5.88%	<
Adequate weight for age		13	76.47%	13	76.47%	–
High weight for age		2	11.76%	2	11.76%	–
W/H (<5 years)						
Accentuated thinness		0	–	1	9.0%	>
Thinness		0	–	0	–	–
Eutrophy	11	8	72.72%	7	63.63%	<
Risk of overweight		0	–	0	–	–
Overweight		2	18.18%	2	18.18%	–
Obesity		1	9.0%	1	9.0%	–
BMI/A (<5 years)						
Accentuated thinness		0	–	0	–	–
Thinness	10	0	–	1	10.0%	>
Eutrophy		6	60.0%	5	50.0%	<
Risk of overweight		0	–	1	10.0%	>
Overweight		3	30.0%	2	20.0%	<
Obesity		1	10.0%	1	10.0%	–

Continuation Table 2 – Sample evolution of nutritional diagnoses of pediatric oncology patients during hospitalization at Hospital das Clínicas, Belo Horizonte, Brazil (2023).

Variable	Sample (n)	Initial n	% initial	Final n	% final	Comparative
BMI/A (>5 – 18 years)						
Accentuated thinness		3	15.0%	2	10.0%	<
Thinness		2	10.0%	4	20.0%	>
Eutrophy	20	9	45.0%	9	45.0%	-
Overweight		2	10.0%	1	5.0%	<
Obesity		3	15.0%	3	15.0%	-
Severe obesity		1	5.0%	1	5.0%	-
H/A						
Very low height for age		0	–	0	–	-
Low height for age	30	1	3.33%	1	3.33%	-
Adequate height		29	96.66%	29	96.66%	-

n = sample size; W = weight; A = age; H = height; BMI = body mass index. In the column "Comparative": > = increase in sample size; < = reduction of sample size; - = maintenance of sample size.

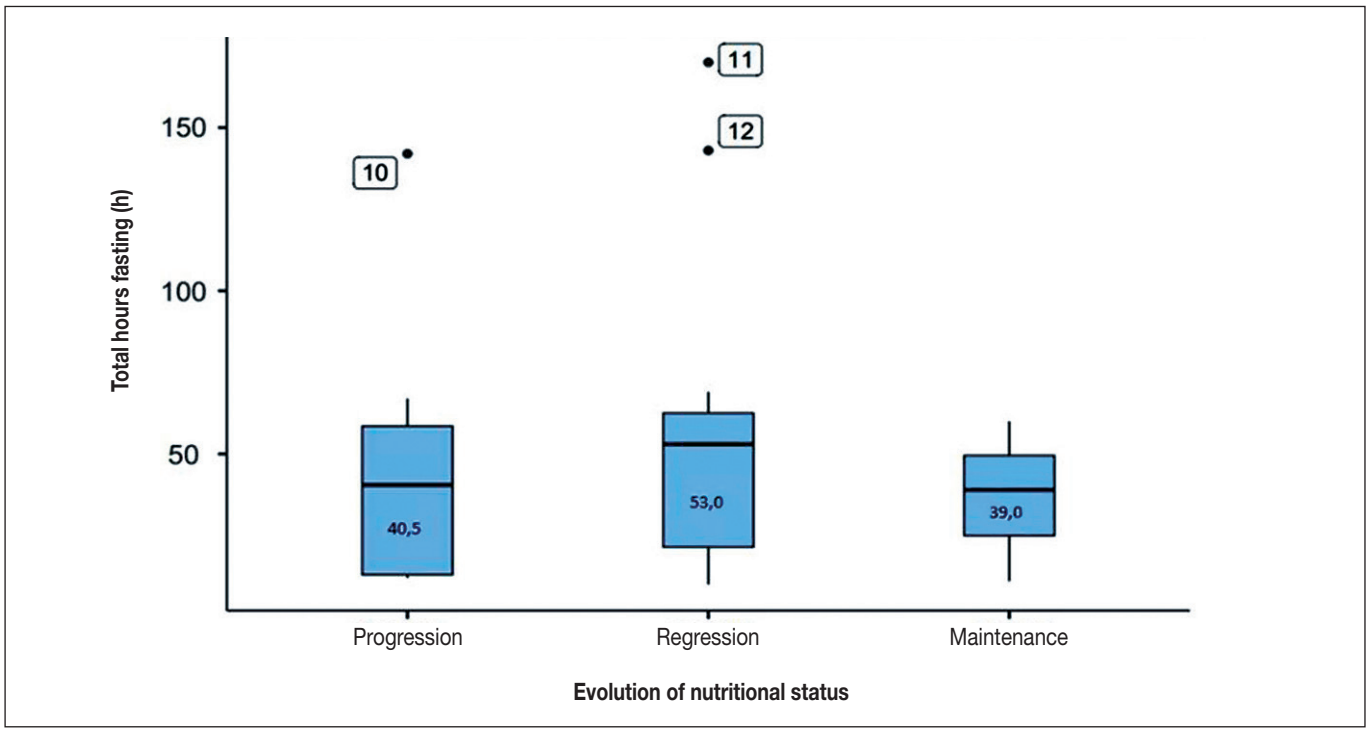

***Figure 2** - Evolution of the nutritional status of pediatric oncology patients, assessed by body mass index and age (BMI/A), in relation to fasting time during hospitalization in the ward of Hospital das Clínicas, Belo Horizonte, Brazil (2023).*

DISCUSSION

This study found no statistically significant association between the evolution of nutritional status and the length of time spent fasting during the hospitalization of pediatric oncology patients. To our knowledge, this is the first study to investigate the association between these variables in hospitalized paediatric oncology patients. However, it is widely described in the literature that hospitalization leads to a worsening of the nutritional status of hospitalized paediatric patients[16,17]. In a study by Bélanger et al.[18] with 307 hospitalized children, the authors observed that nutritional status did not evolve positively when comparing hospital admission and discharge. Similarly, a study of 30 children in a hospital in Campina Grande, PB, Brazil, found that hospitalization was capable of causing malnutrition even in children who were eutrophic on admission[19]. These results were congruent with those found in this study. The majority of patients were admitted with adequate weight/eutrophy, but 56.6% of them lost weight

and 50% had a regression in their anthropometric indices during hospitalization. According to the American Society of Parenteral and Enteral Nutrition (ASPEN), even patients who are eutrophic on admission can develop malnutrition during hospitalization due to the presence of an inflammatory response and limited nutritional intervention[20].

This study identified a median of 43.5 (10.0-170.0) hours of fasting throughout hospitalization, considering all causes, including preoperative fasting, fasting for exams and procedures, as well as periods without food due to clinical symptoms. Guedes et al.[21] observed that pediatric oncology patients undergoing radiotherapy often faced prolonged periods of fasting, with an average of 9 hours, and 78.5% remained fasting for more than 8 hours before the procedures. In addition, these patients showed a progressive worsening of their nutritional status over the course of treatment, highlighting the impact of prolonged fasting. In another study carried out by Lyra et. al[22], which analyzed the nutritional status and preoperative fasting period of adult oncology patients, it was observed that the fasting period exceeded that recommended in the literature with a mean time of 14.2±4.4 hours and 80% of the patients had moderate or severe malnutrition. Although these populations have different characteristics, both studies highlight the need for strategies to minimize the adverse impacts of prolonged fasting on the nutritional evolution of cancer patients.

It is worth noting that the number of hours spent fasting found in this study was higher than that found in other studies. A probable explanation for this difference lies in the fact that this study evaluated the total time spent fasting throughout the hospital stay, while the other studies were restricted to analyzing a single day of preoperative fasting. Despite this, it can be seen that in most of the available studies, fasting took place over long periods[21,22]. With regard to the types of tumors most frequently found, there was a higher prevalence of hematological tumors (66.6%), followed by neurological and lymphatic tumors (10.0%). This finding is in line with what is described in the literature, with leukemia, central nervous system tumors and lymphomas being the most frequent neoplasms in childhood[4,23]. A study carried out at the Santa Casa Hospital in Belo Horizonte, MG, Brazil, with 32 patients admitted to pediatric oncology found similar results to this study. The authors identified that the most prevalent tumors were hematological (leukemias and lymphomas) (62.5%), followed by neurological tumors (central nervous system and sympathetic tumors; 18.8%)[24]. In line with the results found, another study carried out in a pediatric hospital in Brasília, DF, Brazil, with 29 cancer patients found a higher prevalence of diagnoses of acute lymphoid leukemia (45.0%), followed by neuroblastoma (22.0%)[25].

The median length of stay was 35 (7-104) days. Long-stay hospitalization is considered to be when the patient remains in the hospital bed for more than 30 days[25]. A similar result was found by Marques et al.[26] in a study that analyzed the epidemiological profile of pediatric cancer patients in tertiary care, where the average length of stay was 47.07±57.8 days. This prolonged period can be explained by the complexity of the disease, treatment and possible associated complications, which generally lead to prolonged periods of hospitalization[27]. In another study, Magalhães et al.[28] evaluated the association between the length of hospital stay and the evolution of the nutritional status of 200 children up to 10 years of age admitted to a university hospital in Rio de Janeiro, RJ, Brazil, stratified by groups of diseases (respiratory, hematological, digestive, severe infectious and others). The length of stay ranged from 1 to 120 days, and the conditions associated with the longest length of stay were related to diagnoses of hematological diseases, presence of anemia and low weight at admission[28].

With regard to gastrointestinal alterations, in this study the majority of patients had constipation throughout their hospital stay (66.6%). In relation to other symptoms, the prevalence of mucositis was of 46.6%, vomiting of 46.6%, and diarrhea of 33.3%. It is worth noting that the high prevalence of these gastrointestinal alterations can be partially explained by the side effects of cancer treatments, which are common in this population[29]. Similarly, Belsky et al.[30], when analyzing gastrointestinal symptoms documented in the medical records of hospitalized pediatric oncology patients, found that constipation was the most prevalent symptom (64.7%). This result is similar to that of the present study, which found a higher prevalence of constipation than diarrhea. In contrast, a study by Heafliger et al.[31] in a high-complexity hospital to assess the impact of leukemia on 46 pediatric patients aged 0 to 12 found different results in relation to gastrointestinal symptoms, with mucositis and vomiting present in only 8.7% of patients and diarrhea and constipation in only 4.3%. The difference between the results observed may be due to the diagnosis of the patients (only leukemia) and the age group studied.

This study has some limitations that should be pointed out. Due to the specific age range and clinical condition of the participants, a non-probabilistic sample was used and sample calculation was not carried out. Therefore, the sample size may not have been sufficient to verify statistically significant differences between the variables. In addition, the inclusion criteria were restricted to patients monitored by the nutrition service, which excluded some of the patients already admitted to the unit. It is also worth mentioning the probable flaws in the records kept in electronic medical records, limiting the accuracy of the information collected. Finally, the data on gastrointestinal alterations, such as diarrhea, constipation and vomiting, were extracted from the electronic medical records and are informative in nature,

without the adoption of standardized criteria for defining these symptoms.

Despite these limitations, this study offers relevant contributions to the clinical practice of all the staff involved in patient care, raising awareness about the occurrence of long periods of fasting during hospitalization. Furthermore, it is worth highlighting the importance of discussing worsening nutritional status and risk factors such as gastrointestinal alterations. Evidence suggests that these factors, in the context of hospitalization, not only potentiate malnutrition, but also increase length of stay and hospital costs[32,33].

Therefore, more studies are needed to evaluate the association between total fasting time and nutritional status in pediatric oncology patients, and this study can contribute to future research and discussion not only by the nutrition team, but by the entire multi-professional team involved in care.

CONCLUSION

In this study, no statistically significant association was found between the total period of fasting and the evolution of nutritional status during the hospitalization of pediatric oncology patients. Despite this, long periods of fasting and a high prevalence of gastrointestinal alterations associated with treatment were observed. In addition, half of the patients showed a worsening in their anthropometric indices during hospitalization and the majority (60%) had a prolonged hospital stay. Although these findings provide an overview of the clinical reality of these patients, they do not show a statistically significant relationship, highlighting the need for future studies with larger samples to deepen this investigation.

Even so, the results highlight the nutritional challenges faced by hospitalized oncology children, reinforcing the importance of rigorous nutritional monitoring and the implementation of interventions to minimize the impacts of prolonged fasting. This emphasizes the importance of further studies to broaden the understanding of this issue and support more effective nutritional strategies for this population.

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