Data from the Brazilian Survey of Pediatric Oncology Nutrition: Multicenter, Hospital-Based Study

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Dados do Inquérito Brasileiro de Nutrição Oncológica em Pediatria: Estudo Multicêntrico e de Base Hospitalar

Datos de Encuesta Brasileña de Nutrición en Oncología Pediátrica: Estudio Multicéntrico Hospitalario

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ABSTRACT

Introduction: Malnutrition is found in children with cancer and is associated with negative clinical outcomes. **Objective**: To describe the prevalence of inadequate nutritional status of children and adolescents with malignant neoplasm at hospital admission in childhood cancer reference centers in Brazil. **Method**: Cross-sectional study nested in a multicenter, hospital-based cohort study. The probabilistic sample was carried out in two stages in each stratum by macro-region using the probability method proportional to the size with one year of collection in each institution. Clinical, anthropometric, body composition data and the Pediatric Subjective Global Nutritional Assessment (SGNA) questionnaire were collected from 13 reference institutions within 48 hours of hospital admission, from March 2018 to August 2019. **Results:** The study totaled 723 patients in the 5 regions of Brazil. The prevalence of moderate and severe malnutrition was 25.9% in the age group of 2 to 5 years, 40.1% in 5 to 10 years and 39.7% in 10 to 19 years, pursuant to the SGNA. According to the Body Mass/Age Index (BMI/I), thinness and pronounced thinness totaled 13%, risk of overweight, overweight and obesity showed a prevalence of 26.7% from 2 to 5 years, 24.9% from 5 to 10 years and 25.7% from 10 to 19 years. **Conclusion:** There was a high prevalence of nutritional inadequacy by the SGNA, suggesting that malnutrition can be underdiagnosed when using only the BMI/I, strengthening the need to use complementary methods in the nutritional assessment of children with cancer.

Key words: Nutritional Status; Pediatrics; Neoplasms; Health Surveys.

RESUMO

Introdução: A desnutrição é observada em crianças com câncer e está associada a desfechos clínicos negativos. **Objetivo**: Descrever a prevalência de inadequação do estado nutricional de crianças e adolescentes com neoplasia maligna na admissão hospitalar em Centros de Referência do câncer infantil no Brasil. **Método:** Estudo transversal aninhado em um estudo de coorte, multicêntrico, de base hospitalar. A amostra probabilística foi feita em dois estágios em cada estrato por Macrorregião pelo método de probabilidade proporcional ao tamanho com um ano de coleta em cada instituição. Foram coletados em 13 instituições de referência dados clínicos, antropométricos, de composição corporal e sobre o questionário de Avaliação Nutricional Subjetiva Global Pediátrica (ANSGP), em até 48 horas da admissão hospitalar, entre março de 2018 e agosto de 2019. **Resultados:** O estudo totalizou 723 pacientes nas cinco regiões do Brasil. A prevalência de desnutrição moderada e grave foi de 25,9% na faixa etária de 2 a 5 anos, 40,1% de 5 a 10 anos e 39,7% de 10 a 19 anos, de acordo com ANSGP. Segundo o Índice de Massa Corporal/Idade (IMC/I), magreza e magreza acentuada totalizaram 13%, risco de sobrepeso, sobrepeso e obesidade apresentaram uma prevalência de 26,7% de 2 a 5 anos; 24,9% de 5 a 10 anos; e 25,7% de 10 a 19 anos. **Conclusão:** Evidenciou-se alta prevalência de inadequação nutricional pela ANSGP, sugerindo que a desnutrição pode ser subdiagnosticada quando utilizado somente o IMC/I, fortalecendo a necessidade de utilização de métodos complementares na avaliação nutricional de crianças com câncer.

Palavras-chave: Estado Nutricional; Pediatria; Neoplasias; Inquéritos Epidemiológicos.

RESUMEN

Introducción: La desnutrición se observa en niños con cáncer y se asocia con resultados clínicos negativos. **Objetivo:** Describir la prevalencia del estado nutricional inadecuado de niños y adolescentes con neoplasia maligna al ingreso hospitalario en centros de referencia de cáncer infantil en Brasil. **Método:** Estudio transversal anidado en un estudio de cohorte hospitalario multicéntrico. La muestra probabilística se realizó en dos etapas en cada estrato por macrorregión utilizando el método de probabilidad proporcional al tamaño con un año de recolección en cada institución. Se recopilaron datos clínicos, antropométricos, de composición corporal y el cuestionario Global Pediatric Subjective Nutritional Assessment (ANSGP) de 13 instituciones de referencia dentro de las 48 horas posteriores al ingreso hospitalario, desde marzo de 2018 hasta agosto de 2019. **Resultados**: El estudio totalizó 723 pacientes en las 5 regiones de Brasil. La prevalencia de desnutrición moderada y severa fue de 25,9% en el grupo de edad de 2 a 5 años, 40,1% de 5 a 10 años y 39,7% de 10 a 19 años, según la ANSGP. Según el Índice de Masa Corporal/Edad (IMC/I), la delgadez y la delgadez marcada totalizaron 13%, el riesgo de sobrepeso, sobrepeso y obesidad mostró una prevalencia de 26,7% de 2 a 5 años, 24,9% de 5 a 10 años y 25,7% de 10 a 19 años. **Conclusión**: Hubo una alta prevalencia de insuficiencia nutricional por parte de la ANSGP, lo que sugiere que la desnutrición puede ser infradiagnosticada cuando se utiliza solo el IMC/I, fortaleciendo la necesidad de utilizar métodos complementarios en la evaluación nutricional de los niños con cáncer.

Palabra clave: Estado Nutricional; Pediatría; Neoplasias; Encuestas Epidemiológicas.

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INTRODUCTION

The world estimate of incidence of cancer in children from 0 to 14 years is approximately 400 thousand cases year[1]. Most of the cases diagnosed are in low-and-middle income countries and according to the United Nations – UN, one in each three of these countries present extreme indexes of malnutrition[2,3]. In Brazil, 8,460 new cases of pediatric cancer in the age range from 1 to 19 years were estimated for 2020[4]. Cancer is the leading cause of death by disease for this age range and is a severe problem of public health[4].

Acknowledging the impact of the oncologic disease in the nutritional status[2] is a consensus in the literature. In Brazil, data of healthy children and adolescents show the prevalence of malnutrition and overweight is approximately 6.8% and 25.8% respectively, being overweight more prevalent in adolescents[5,6]. From 1996 to 2007, the improvement of the economic inequality in Brazil changed the scenario of childhood nutrition with significant increase of obesity in the last decades[5,7,8].

The consequences of malnutrition, overweight and obesity on children and adolescent with cancer, at any moment of the treatment are well reported and associated with the increase of morbidity and mortality. In counterpart, the correct nutritional status during the therapy is being associated with better response to the treatment, less toxicity and increase of survival of these patients[9,10].

The prevalence of malnutrition in these patients, either malnutrition or overweight ranges from 8% to 60% according to the type of neoplasm, staging of the disease and modality of treatment[11]. In a recent systematic review, few studies about the nutritional status of children with cancer in Brazil were found. Studies with more consistent data are published in great part of the Southeast region[12] and do not represent the national reality.

The nutritional assessment of the child with cancer is a great obstacle in clinical practice unquestionably since anthropometric methods depending on body weight, typically utilized in healthy children, quite often have limitations for the pediatric patient with cancer, most of all for those with bulky tumor mass, which make these methods inappropriate[13].

Given the absence of multicenter studies on the nutritional status of children with cancer in Brazil and in order to proceed with the investigations of the Brazilian inquest of oncologic nutrition[14,15], with previous data of adult and older patients, the Brazilian Inquest of Pediatric Oncologic Nutrition (IBNOPe)[16] was carried out whose goal in this first publication is to describe the prevalence of the inadequateness of the nutritional status of children and adolescents with malignant neoplasm at hospital admission in Reference Centers to treat childhood cancer in Brazil.

METHOD

Cross-sectional study nested in a hospital-based multicenter, cohort study conducted in partnership with the "*Sociedade Brasileira de Nutrição Oncológica"* (SBNO), the "*Serviço de Nutrição do Hospital do Câncer I* (HCI)" of the National Cancer Institute José Alencar Gomes da Silva (INCA), the "*Instituto de Nutrição Josué de Castro*" of Federal University of Rio de Janeiro and the Reference Centers to treat childhood cancer in different Brazilian regions. Data of children and adolescents at the admission of the Reference Centers were collected from March 2018 to August 2019.

Patients of both sexes in the age-range from 2 to 19 years old diagnosed with confirmed malignant neoplasm and in active treatment were eligible. Patients in end-of-life palliative care admitted at a Reference Center of Pediatric Intensive Care with genetic syndrome, malformation and HIV-infected further to those whose legal guardians or who did not accept to join the study were excluded.

The subjective tool of choice to collect data assesses individuals aged from 2 to 19 years old which determined the selection of the age-range to be investigated[17,18]. The Institutional Review Board of INCA, the proposing institution reviewed and approved the study (CAAE: 72541617.8.1001.5274) and for all the participant sites as well. All the legal guardians signed the Informed Consent Form (ICF) and children older than 12 years signed the Assent Form (AF).

The measures of central tendency and dispersion to describe the data were calculated for quantitative variables and frequency and contingency tables to verify the characteristics of a variable as a function of other variables. Bar charts were prepared for qualitative variables. All the data were processed in SPSS version 26.

The sample was based in the hypothesis that the proportion of the nutritional status of the children diagnosed with cancer can vary according to the geographic region. The calculation of the size considered the extracts per macroregion of the country (regions North, Northeast, Southeast, South and West-Central). The pediatric oncologic hospitals were listed according to the National Information System of Health Units. A two-stage probabilistic sample was eligible for each extract: in the first, the hospitals were selected utilizing the methodology of Probability Proportional to Size (PPS) and in the second, the children at hospital admission.

The power of the sample size is 80% to detect differences of the nutritional status of solid and hematologic tumors within the range of 59% to 79% (differences of at least 20%) among the great geographic regions, except the North region.

Initially, 1,380 children were included in the sample covering 15 hospitals selected for the study, equivalent to 34.9% of all the hospitals with 300 or more admissions in total in 2016. The number of hospitalizations in the sample for each extract followed the proportional assignment with at least 119 children (required for comparisons among regions). The North region failed to reach this figure because of the existing lower number of admissions, but it was considered for the estimate of the nutritional status for Brazil. Data collection occurred from March 2018 to August 2019.

The Nutrition and Dietetics Service of the institutions selected were invited to express their interest after approval of the institution's General Director. Two institutions refused to participate after the selection, (one from the Southeast region and one from the Northeast region) and were replaced automatically in the list of the region respecting the same criteria. After five months into the investigation, two institutions were excluded for non-adherence and in order to avoid delays, in the end, 13 hospitals participated with 723 children.

When collection was completed, a process of calibration and expansion of the sample was initiated considering all the initial calculations reaching the final number of first admissions of 3,600 children who received oncologic consultation in the whole country.

The objective nutritional assessment addressed the anthropometric measures and body composition and the subjective nutritional assessment, the physical exam and application of the questionnaire within 48 hours of hospital admission. Information from hardcopy and electronic charts were collected through a form created exclusively for this investigation. The charts provided clinical and demographic information.

The anthropometric measures of assessment of the nutritional status were: weight, height, body composition measures as arm circumference (AC), tricipital skinfold (TSF), subscapular skinfold (SSF) and muscle arm circumference (MAC). All the measures follow the standards for Nutritional Assessment of Children and Adolescents suggested by the Ministry of Health[19] and by the World Health Organization (WHO)[20]. The nutritional status was classified through the z-score and the weight/age, height/age and BMI/A (Body Mass Index/Age) indexes according to WHO[20] utilizing the software Anthro and AnthroPlus, being Anthro for children until 5 years old and AnthroPlus version 3.2.2[21] for children older than 5 years of age and adolescents. The measures of AC, TSF, SSF and MAC were classified according to the table of percentiles proposed by Frisancho[22] with the following cutoff : for AC, TSF and SSF (P<5 = malnutrition; P≥5 and P≤95 = eutrophy; P>95 = obesity) and MAC (P<5 = malnutrition; P≥5 = eutrophy).

The recommendations of the National Consensus of Oncologic Nutrition of 2016 were followed, based in the equation proposed by Osterkamp[23] to adjust the calculations of nutritional assessment for amputees pediatric patients with cancer.

The subjective nutritional assessment was conducted through the application of the questionnaire of Pediatric Subjective Nutritional Global Assessment – PSNGA for children with cancer and validation of the content by Saraiva et al.[17,18] in the first 48 hours of hospital admission. In the first part of this questionnaire there were questions about the assessment of the clinical history with emphasis in nutrition based in data of height and current weight, unintentional body changes, correct dietetic intake, gastrointestinal symptoms, functioning capacity, metabolic stress and physical exam (loss of subcutaneous fat, muscle loss and edema). The second part addressed feeding anamnesis as frequency of food intake, physical and functioning activities. The nutritional status was classified as normal or well-nourished, moderately malnourished and severely malnourished according to the recommendation of the PSNGA[17,18].

All the participant institutions send a representative, a nutritionist of the local pediatric service, assigned as the study supervisor of the respective institution. These professionals participated of the practical and theoretical training administered by INCA's Nutrition Service of HCI prior to the beginning of the study.

Field supervisors of each unit were multipliers of training and responsible to check whether the study forms were completed, in addition to communication with the coordination team. All of them ensure that the required equipment were in place for the objective nutritional assessment in their hospitals (scale with variation of 0.1 kg, stadiometer with variation of 0.1 cm and caliper Lange®).

RESULTS

13 reference centers for treatment of childhood cancer in Brazil (Chart 1) joined the investigation with a total of 723 children being the Northeast Region the most prevalent and the North Region the less prevalent of the sample. Of these, 59.8% were males and 43.2% adolescents from 10 to 19 years old. In this casuistic, 61.8% had hematologic tumors. Leukemia were the most

Chart 1. List of the Reference Centers to treat children with cancer in the sample of IBNOPe. Brazil

Participant Institutions of IBNOPe per Region
North Regions
Hospital Oncológico Infantil Octávio Lobo - PA
Northeast Region
Hospital Oswaldo Cruz - PE
Hospital da Liga Norte Riograndense contra o Câncer - RN
Hospital Santa Casa de Misericórdia de Maceió - AL
Hospital Universitário Lauro Wanderley - Fundação Napoleão Laureano - PB
West-Central Region
Hospital de Base do Distrito Federal da Secretaria de Saúde do Distrito Federal - DF
Southeast Regions
Instituto Nacional de Câncer José Alencar Gomes da Silva - Hospital do Câncer I - RJ
Hospital Infantil Darcy Vargas da Secretaria de Estado da Saúde de São Paulo - SP
Hospital Infantil Dr. Domingos A. Boldrini. Campinas - SP
Hospital Santa Casa de Misericórdia de Belo Horizonte - MG
South Region
Hospital de Clínicas de Porto Alegre - RS
Hospital Infantil Joana de Gusmão - SC
Hospital da Criança Santo Antônio - Santa Casa de Misericórdia de Porto Alegre - RS

Source: Afonso[16].

prevalent with 47.9% of the hematologic neoplasms, followed by lymphomas and reticuloendothelial neoplasms with 14%. Bone tumors with 10.9% were the most prevalent solid tumors while those of the Central Nervous System had prevalence of 5.0% (Table 1). Chemotherapy alone was the most prevalent oncologic treatment (86.6%) and the mean time of the diagnostic of the disease was 255 days.

According to PSNGA (Table 2), 63.8% were classified as normal or well-nourished. However, an expressive amount of moderate (29.7%) and severe (6.5%) malnutrition was identified according to the method.

Although more than 50% of the patients in all regions were well-nourished, the Northeast (34.6%) and West-Central (40%) regions had more prevalence of patients with moderate malnutrition while the severely malnourished were from the Southeast region (9.4%). Among all, the North region presented the higher percentage of normal or well-nourished patients (83.3%) according to PSGNA for children with cancer.

Table 3 presents objective and subjective data of the nutritional status. According to PSNGA, the prevalence of malnutrition among those classified as moderately malnourished and severely malnourished per age range is 25.9% from 2 to 5 years, 40.1% from 5 to 10 years and 39.7% from 10 to 19 years.

The inadequateness of the nutritional status pursuant to BMI/A is more prevalent for risk of overweight, overweight and obesity than malnutrition for all age ranges. In children from 2 to 5 years, 6.4% present thinness or pronounced thinness and 26.7%, some overweight (risk of overweight, overweight or obesity). For children from 5 to 10 years, 10.8% with thinness or pronounced thinness and 24.9%, overweight. Similar with adolescents, 12.8% present thinness or pronounced thinness and 25.7%, overweight. With BMI/A, overweight is more prevalent in this sample. When results of the subjective assessment are analyzed for this same sample, there is prevalence of more malnutrition in comparison with BMI/A.

More than 90% (n=720) of the study sample in all age ranges presented normal height for age. Very low height was detected in the age range from 2 to 5 years with 4.3%.

According to Table 3 the measures of body composition reveal that by AC, the greater prevalence of malnutrition occurs in the age range from 10 to 19 years old (23.8%). The compromise of muscle tissue can be noticed in the classification by MAC, where 22.7% in the age range from 10 to 19 years old present P<5. The compromise of the adipose tissue by TSF with P<5 was 13.9% found with more prevalence in children aged 2 and 5 years old while SSF with P<5 was more prevalent in adolescents between 10 and 19 years with 7.7%.

Table 1. Sociodemographic characteristics of the sample of IBNOPe. Brazil (n=723)

Variables		n	%
Region			
	North	18	2.5
	Northeast	269	37.2
	West-Central	30	4.1
	Southeast	255	35.3
	South	151	20.9
Sex			
	Female	291	40.2
	Male	432	59.8
Age-range			
	2 to 5 years	189	26.1
	5 to 10 years	222	30.7
	10 to 19 years	312	43.2
Diseases			
	Leukemia	346	47.9
	Lymphomas and reticuloendothelial neoplasms	101	14.0
	CNS neoplasms and mixed intracranial and intraspinal neoplasms	36	5.0
	Tumors of the sympathetic nervous system	39	5.4
	Retinoblastoma	13	1.8
	Renal tumors	39	5.4
	Hepatic tumors	7	1.0
	Malignant bone tumors	79	10.9
	Sarcomas of soft parts	24	3.3
	Neoplasms of germinative, trophoblastic, gonadal cells	13	1.8
	Carcinomas and other malignant epithelial neoplasms	10	1.4
	Other unspecified malignant neoplasms	16	2.2

Source: Afonso[16].
Caption: CNS = Central Nervous System.

Figure 1 presents the results of the classification of the nutritional status according to the measures of body composition per sex and age range.

DISCUSSION

The cross-sectional data are part of a multicenter cohort study, unprecedented in the country and show that the prevalence of malnutrition at any level according to the PSNGA was between 25.9% and 40.1% for children in different age-ranges across all Brazilian Regions. An expressive difference in the prevalence of malnutrition was detected by the nutritional assessment by BMI/A, where 13% of the national sample was diagnosed with malnutrition. On the other hand, 24.9% to 26.7% of the participants were classified with overweight and obesity by BMI/A considering all ages and regions.

The data of the body composition by MAC corroborate the subjective nutritional assessment and indicated a major compromise of the lean mass from 20% to 24% for all ages in comparison with fat mass. This dissimilarity in the prevalence of the inadequacy of the nutritional status shows primarily the great discrepancy among the methods of nutritional assessment and also how it is likely that malnutrition is underdiagnosed in the pediatric population with cancer due to the difficulty of measuring correctly in the clinical routine.

The incidence of malnutrition in the child with cancer varies significantly during the treatment because depends on the type of neoplasms and modality of

Table 2. Pediatric Subjective Nutrition Global Assessment at admission according to characteristics of the sample IBNOPe. Brazil (n=723)

		PSNGA					
		Normal/Well-nourished		Moderately malnourished		Severely malnourished	
		n	%	n	%	n	%
Sex							
	Female	196	67.4	78	26.8	17	5.8
	Male	265	61.3	137	31.7	30	6.9
Age-range							
	2 to 5 years	140	74.1	42	22.2	7	3.7
	5 to 10 years	133	59.9	80	36.0	9	4.1
	10 to 19 years	188	60.3	93	29.8	31	9.9
Region							
	North	15	83.3	2	11.1	1	5.6
	Northeast	161	59.8	93	34.6	15	5.6
	West-Central	16	53.3	12	40.0	2	6.7
	Southeast	156	61.2	75	29.4	24	9.4
	Sul	113	74.8	33	21.9	5	3.3
Brazil		461	63.8	215	29.7	47	6.5

Source: Afonso[16].
Caption: PSNGA = Pediatric Subjective Nutritional Global Assessment.

Table 3. Nutritional status according to the subjective and objective assessment per age-range of the sample of IBNOPe. Brazil (n=723)

	Age-range					
	2 to 5 years		5 to 10 years		10 to 19 years	
	n	%	n	%	n	%
Classification PSNGA (n=723)						
Normal/well-nourished	140	74.1	133	59.9	188	60.3
Moderately malnourished	42	22.2	80	36.0	93	29.8
Severely malnourished	7	3.7	9	4.1	31	9.9
Arm circumference (n=718)						
Malnutrition (P<5)	37	19.7	46	21.0	74	23.8
Eutrophy (P≥5-P≤95)	144	76.6	163	74.4	220	70.7
Obesity (P>95)	7	3.7	10	4.6	17	5.5
Muscle arm circumference (n=714)						
Malnutrition (P<5)	26	13.9	42	19.3	94	22.7
Eutrophy (P≥5)	161	86.1	176	80.7	215	77.3
Tricipital skinfold (n=718)						
Malnutrition (P<5)	26	13.8	25	11.3	21	6.8
Eutrophy (P≥5-P≤95)	159	84.6	181	81.9	272	88.0
Obesity (P>95)	3	1.6	15	6.8	16	5.2

to be continued

Table 3. continuation

	Age-range					
	2 to 5 years		5 to 10 years		10 to 19 years	
	n	%	n	%	n	%
Subscapular skinfold (n=717)						
Malnutrition (P<5)	10	5.3	15	6.8	24	7.7
Eutrophy (P≥5-P≤95)	156	83.0	186	85.0	269	86.8
Obesity (P>95)	22	11.7	18	8.2	17	5.5
Body Mass Index (n=720)						
Pronounced thinness	4	2.1	-	-	-	-
Thinness	8	4.3	-	-	-	-
Eutrophy	126	67.0	-	-	-	-
Risk of overweight	33	17.6	-	-	-	-
Overweight	11	5.9	-	-	-	-
Obesity	6	3.2	-	-	-	-
Pronounced thinness	-	-	12	5.4	20	6.4
Thinness	-	-	12	5.4	20	6.4
Eutrophy	-	-	142	64.3	191	61.4
Risk of overweight	-	-	36	16.3	52	16.7
Overweight	-	-	15	6.8	24	7.7
Severe obesity	-	-	4	1.8	4	1.3
Height-for-age (n=720)						
Very low for age	8	4.3	-	-	4	1.3
Low for age	6	3.2	7	3.2	19	6.1
Correct for age	174	92.6	214	96.8	288	92.6

Source: Afonso[16].
Caption: PSNGA = Pediatric Subjective Nutritional Global Assessment.

intervention, being reported between 0% and 70%[24]. In Brazil, the prevalence of malnutrition for pediatric cancer is from 6% to 25% at the diagnosis[25,26], well above the mean of malnutrition of the Brazilian child population. Overweight and obesity are present for children and adolescents with cancer at the diagnosis with prevalence of nearly 8.6% to 14.8%[9]. National studies report overweight and obesity of 4.1% to 35% at the diagnosis, reaching 7.2% to 57.9% during or after the oncologic treatment[12].

It is clear that children with cancer have high risk of developing nutritional changes and any change is concerning for the health professionals in charge of the care. Elevated risk of treatment-related complications, low tolerance to therapy, difficulty of wound healing, changes of metabolism caused by chemotherapeutics, more odds of infections, unfavorable outcomes with lower survival are among the most reported factors associated with nutritional compromise both at the diagnosis and in the course of the treatment[9,24,27-29].

Nutritional deficit can occur in patients with overweight and these tend to be underestimated in relation to risks of unfavorable nutritional status and many times are overlooked to receive proper nutritional intervention. In addition, nutritional inadequateness in childhood compromises the required physiologic conditions to physical and neurologic development and growth and can favor the appearance or escalation of chronic diseases with negative impact in their quality of life[30].

Although the world data indicate more prevalence of overweight and obesity in children, it is necessary to reflect about which objective measures to assess the nutritional status of children with cancer hospitalized may be ineffectual for not considering all the variables to identify malnutrition[31]. In healthy individuals, the nutritional assessment by anthropometry is well recognized because it follows-up the children's and adolescents' growth and health and early identification of nutritional disorders, malnutrition or obesity and is

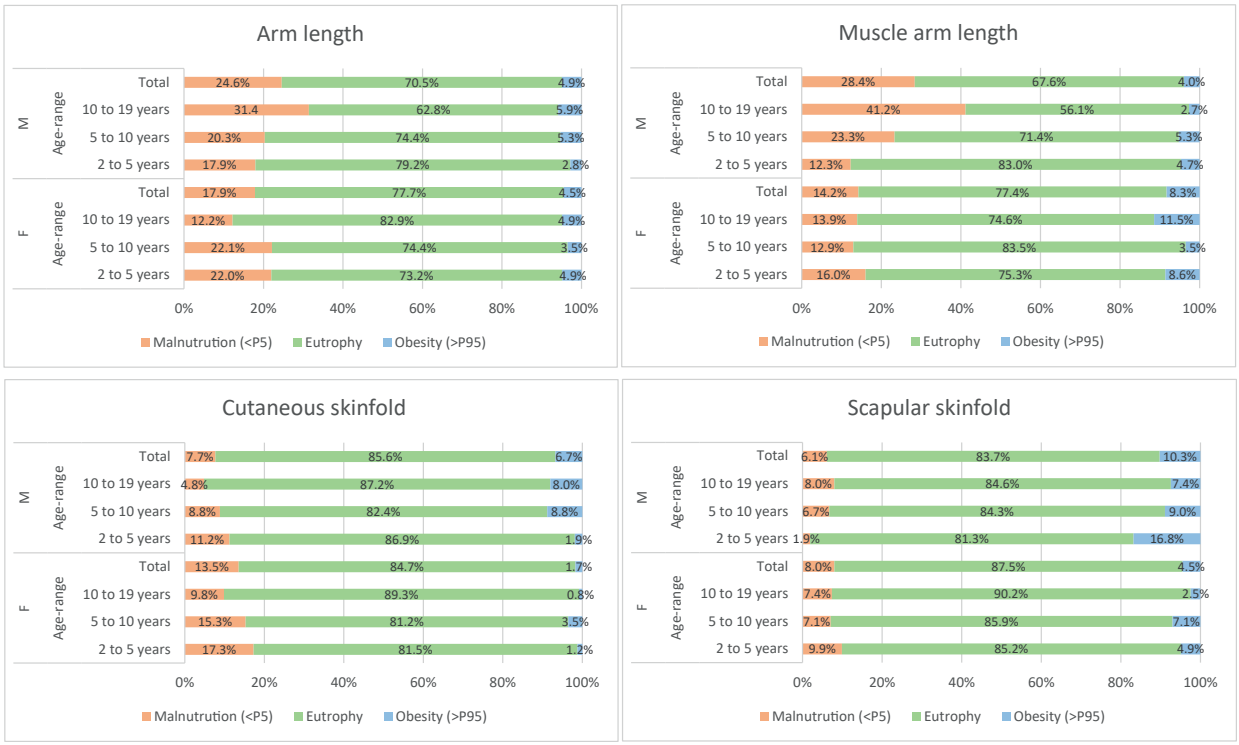

Figure 1. Nutritional status according to the body composition of the cutaneous measures per sex and age-range of IBNOPe. Brazil

Source: Afonso[16].
Captions: M = Male; F = Female.

considered essential to know the health conditions of pediatric patients.

For Sala et al.[13] all the methods for nutritional assessment in pediatric oncology depending on the body weight are problematic to be used in children because in some cases, tumor mass can reach 10% of the body weight and underestimate the severity of malnutrition. Although BMI/A is widely utilized in the nutritional diagnosis of these patients, its use as nutritional assessment method in clinical practice for patients with cancer is quite discouraged because is unable to distinguish fat mass from free fat mass and edema[32]. The oscillations of lean tissue and fat mass can affect the volume of distribution of chemotherapy in the organism and modify the excretion of drugs from the systemic circulation; for this reason, wrong methods of nutritional assessment are worrying[33,34].

The great challenge of the nutritional assessment in children with cancer is their very peculiar characteristics as metabolic alterations, voluminous tumor masses, edema due to high doses of corticosteroids for a prolonged time further to side effects of the antineoplastic therapy, mainly those affecting the gastrointestinal tract as mucositis, hyporexia, nausea, vomits and diarrhea[13,35]. These are clinical conditions inherent to the disease and aggressiveness of the treatment, compromising the nutritional status whose objective assessment may fail.

In this context, the PSNGA is seen as a more appropriate tool because of its capacity of assessing children in different chronic and systemic conditions, clinical complexity and wide variety of comorbidities and subjacent diseases involving the gastrointestinal tract and has shown in an original study better associations with outcomes of hospitalized patients[31,36]. This instrument encompasses domains of weight and height adequacy, dietetic intake, frequency and duration of gastrointestinal symptoms, functioning capacity, metabolic stress and physical exam related to the pediatric age-range which is relevant for nutritional assessment of the pediatric patient with cancer[17,18,31]. Among others, the physical exam focused to nutrition and observation of signs of loss of fat reserves, muscle loss and edema stands out, following a logic and sequential process with a head-to-toe approach, indispensable for the assessment of the child with cancer.

The assessment of the body composition revealed a compromise of the skeletal muscle mass by the anthropometry around 20% to 24% of the sample for all age-ranges. The loss of lean man is a basic element of the phenotype sarcopenic and may result in the syndrome of fragility, hypothesizing premature ageing, susceptibility to clinical complications, lessening of the functioning capacity and alteration of the homeostasis similar to what happens with adults with cancer[37]. The alterations of the body composition can affect the absorption of the

medication, reduce the oxidative metabolism, diminish the rate of glomerular filtration and consequently, increase the serum concentration of drugs and potentially, toxicity[32]. The prediction of malnourishment by the measure of the body composition by anthropometry of the arm is being utilized in children with cancer and suggested as additional method of nutritional evaluation, most of all in low-and-middle income countries because it is a simple, practical, little invasive and cost-effective viable measure[32,35,38,39].

A Brazilian study addressing nutritional status concluded that AC detected more malnourished patients than BMI/A[26]. The authors concluded still that BMI/A was the method that less identified malnutrition compared to others.

Although the authors are aware of the existing income inequalities across several regions of the country, this study did not address data about the socioeconomic conditions of the sample, which is a potential limitation. However, it is believed that because the study was conducted in Reference Centers for childhood cancer in Brazil counting with multiprofessional team and volunteers' network support that provide infrastructure to patients and their families, further to government grants as a right of every individual without income in cancer treatment, this information is not a fragility of the study, it could improve it, instead.

This is the only multicenter and multiregional study which determined the prevalence of nutritional status of the child and adolescent with cancer in the country. It is important as a contribution for national public policies and managers to prioritize the attention to the child with cancer and favor the systematization and administration of nutritional care in pediatric oncology.

The assessment of the nutritional status is paramount not only at the diagnosis as along the treatment and must be continuous to ensure the normal growth and development of the child and optimize the clinical results; if this assessment fails to be done, effective nutritional interventions to modify the nutritional status[29,40] are compromised. However, the nutritional assessment for these patients requires broader criteria of diagnosis to cover the assessment of the body composition in order to identify the differences of the muscle and adipose tissue and allow the diagnosis of sarcopenia in clinical practice.

CONCLUSION

The IBNOPe showed that the prevalence of malnutrition in these patients is great and wide among the regions and the PSNGA appears to best identify malnutrition demonstrating that an additional method, besides anthropometry may be more appropriate for nutritional diagnosis. Apparently, methods with broader diagnostic scope considering the specificities of the child with cancer would be required.

CONTRIBUTIONS

Nivaldo Barroso de Pinho, Wanélia Vieira Afonso, Patricia de Carvalho Padilha, Wilza Arantes Ferreira Peres, Arthur Orlando Corrêa Schilithz, Renata Brum Martucci and Viviane Dias Rodrigues contributed substantially for the study conception and design, collection, analysis and interpretation of the data, wording and critical review. Carolina Fernandes de Macedo Soares and Juliana Silva do Nascimento Braga contributed for the collection and review of the data. All the authors approved the final version to be published.

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There is no conflict of interests to declare.

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REFERENCES

1. Ward ZJ, Yeh JM, Bhakta N, et al. Estimating the total incidence of global childhood cancer: a simulation-based analysis. Lancet Oncol. 2019;20(4):483-93. doi: https://doi.org/10.1016/S1470-2045(18)30909-4
2. Rodriguez-Galindo C, Friedrich P, Alcasabas P, et al. Toward the cure of all children with cancer through collaborative efforts: pediatric oncology as a global challenge. J Clin Oncol. 2015; 33(27):3065-73. doi: https://doi.org/10.1200/JCO.2014.60.6376
3. Centro de Informação das Nações Unidas para o Brasil [Internet]. Rio de Janeiro: UNIC; c2020. OMS: um em cada três países de baixa e média renda enfrenta extremos da má nutrição; 2019 dez 18 [acesso 2020 set 8]. Disponível em: https://nacoesunidas.org/oms-um-em-cada-tres-paises-de-baixa-e-media-renda-enfrenta-extremos-da-ma-nutricao
4. Instituto Nacional de Câncer José Alencar Gomes da Silva [Internet]. Rio de Janeiro: INCA; [data desconhecida]. Tipos de Câncer: câncer infantojuvenil; [modificado 2021 mar 4; acesso 2020 set 8]. Disponível em: https://www.inca.gov.br/tipos-de-cancer/cancer-infantojuvenil
5. Instituto Brasileiro de Geografia e Estatística [Internet]. Rio de janeiro: IBGE; [data desconhecida]. Pesquisa de orçamentos familiares 2008-2009. Análise do consumo alimentar no Brasil; 2009 [acesso 2020 set 7]. Disponível em: https://www.ibge.gov.br/estatisticas/sociais/rendimento-despesa-e-consumo/9050-pesquisa-de-orcamentos-familiares.html?edicao=9058&t=downloads
6. Bloch KV, Klein CH, Szklo M, et al. ERICA: prevalências de hipertensão arterial e obesidade em adolescentes brasileiros. Rev Saúde Pública. 2016;50(Suppl 1):9s. doi: https://doi.org/10.1590/S01518-8787.2016050006685
7. Ministério da Saúde (BR), Secretaria de Atenção à Saúde, Departamento de Atenção Básica. Política Nacional de alimentação e nutrição. Brasília, DF: Ministério da Saúde; 2013.
8. World Health Organization. Reducing stunting in children: equity considerations for achieving the Global Nutrition Targets 2025 [Internet]. Geneva: WHO; 2018 [cited 2020 Sept 10]. Available from: https://www.who.int/publications/i/item/9789241513647
9. Co-Reyes E, Li R, Huh W, et al. Malnutrition and obesity in pediatric oncology patients: causes, consequences, and interventions. Pediatr Blood Cancer. 2012;59(7):1160-7. doi: https://doi.org/10.1002/pbc.24272
10. Brinksma A, Roodbol PF, Sulkers E, et al. Changes in nutritional status in childhood câncer patients: a prospective cohort study. Clin Nutr. 2015;34(1):66-73. doi: https://doi.org/10.1016/j.clnu.2014.01.013
11. Srivastava R, Pushpam D, Dhawan D, et al. Indicators of malnutrition in children with cancer: a study of 690 patients from a tertiary care cancer center. Indian J Cancer. 2015;52(2):199-201. doi: https://doi.org/10.4103/0019-509X.175825
12. Viani K, Albuquerque L, Barr RD, et al. Nutrition of children with cancer in Brazil: a systematic review. JCO Glob Oncol. 2020;6:242-59. doi: https://doi.org/10.1200/JGO.19.00285
13. Sala A, Rossi E, Antillon F, et al. Nutritional status at diagnosis is related to clinical outcomes in children and adolescents with cancer: a perspective from Central America. Eur J Cancer. 2012;48(2):243-52. doi: https://doi.org/10.1016/j.ejca.2011.06.006
14. Instituto Nacional de Câncer José Alencar Gomes da Silva. Inquérito brasileiro de nutrição oncológica [Internet]. Rio de Janeiro: INCA; 2013 [acesso 2020 set 8]. Disponível em: https://www.inca.gov.br/sites/ufu.sti.inca.local/files//media/document//inquerito-brasileiro-nutricao-oncologica.pdf
15. Instituto Nacional de Câncer José Alencar Gomes da Silva. Inquérito luso-brasileiro de nutrição oncológica do idoso: um estudo multicêntrico [Internet]. Rio de Janeiro: INCA; 2015 [acesso 2020 set 8]. Disponível em: https://www.inca.gov.br/sites/ufu.sti.inca.local/files//media/document//inquerito-lusobrasileiro-de-nutricao-oncologica-completo.pdf
16. Afonso WV. Inquérito brasileiro de nutrição oncológica em pediatria: um estudo multicêntrico de base hospitalar [tese na Internet]. Rio de Janeiro, RJ: Instituto de Nutrição Josué de Castro, Universidade Federal do Rio de Janeiro; 2020 [acesso 2020 dez 19]. 178 p. Disponível em: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/viewer.html?pdfurl=http%3A%2F%2Fwww.ppgn.ufrj.br%2Fwp-content%2Fuploads%2F2021%2F04%2FWanelia-Vieira-Afonso-tese.pdf&clen=3161400&chunk=true
17. Saraiva DCA, Afonso WV, Pinho NB, et al. Equivalência semântica do Questionário Pediatric Subjective Global Nutritional Assessment para triagem nutricional em pacientes pediátricos com câncer. Rev Nutr. 2016;29(2):211-27. doi: https://doi.org/10.1590/1678-98652016000200006
18. Saraiva DCA, Afonso WV, Pinho NB, et al. Cross-cultural adaptation and content validation into Portuguese of the Subjective Global Nutritional Assessment for pediatric patients hospitalized with cancer. Rev Nutr. 2017;30(3):307-20. doi: https://doi.org/10.1590/1678-98652017000300004
19. Ministério da Saúde (BR), Secretaria de Atenção à Saúde, Departamento de Atenção Básica. Orientações para a coleta e análise de dados antropométricos em serviços de saúde: norma técnica do Sistema de Vigilância Alimentar e Nutricional - SISVAN. Brasília, DF: Ministério da Saúde; 2011. (Série G. Estatística e Informação em Saúde).
20. World Health Organization. WHO child growth standards: length/height-for-age, weight-for-age, weight-

for-length, weight-for-height and body mass index-for-age: methods and development. Geneva: WHO Press; 2006.

21. WHO Anthro Survey Analyser [Internet]. Version 3.2.2. Geneva: WHO. c2011 - [cited 2018 Mar 13]. Available from: doi: http://www.who.int/childgrowth/software/en
22. Frisancho AR. Anthropometric standards for the assessment of growth and nutritional status. Ann Arbor, MI: University of Michigan Press; 1990.
23. Osterkamp LK. Current perspective on assessment of human body proportions of relevance to amputees. J Am Diet Assoc. 1995;95(2):215-8. doi: https://doi.org/10.1016/S0002-8223(95)00050-X
24. Joffe L, Dwyer S, Bender JLG, et al. Nutritional status and clinical outcomes in pediatric patients with solid tumors: a systematic review of the literature. Semin Oncol. 2019;46(1):48-56. doi: https://doi.org/10.1053/j.seminoncol.2018.11.005
25. Lemos PSM, Oliveira FLC, Caran EMM. Nutritional status of children and adolescents at diagnosis of hematological and solid malignancies. Rev Bras Hematol Hemoter. 2014;36(6):420-3. doi: https://doi.org/10.1016/j.bjhh.2014.06.001
26. Viani K, Barr RD, Odone Filho V, et al. Nutritional status at diagnosis among children with cancer referred to a nutritional service in Brazil. Hematol Transfus Cell Ther. 2020. doi: https://doi.org/10.1016/j.htct.2020.04.008
27. Hingorani P, Seidel K, Krailo M, et al. Body Mass Index (BMI) at diagnosis is associated with surgical wound complications in patients with localized osteosarcoma: a report from the Children's Oncology Group. Pediatr Blood Cancer. 2011;57(6):939-42. doi: https://doi.org/10.1002/pbc.23129
28. Loeffen EAH, Brinksma A, Miedema KGE, et al. Clinical implications of malnutrition in childhood cancer patients -- infections and mortality. Support Care Cancer. 2015;23(1):143-50. doi: https://doi.org/10.1007/s00520-014-2350-9
29. Orgel E, Sposto R, Malvar J, et al. Impact on survival and toxicity by duration of weight extremes during treatment for pediatric acute lymphoblastic leukemia: a report from the Children's Oncology Group. J Clin Oncol. 2014;32(13):1331-7. doi: https://doi.org/10.1200/JCO.2013.52.6962
30. Diller L, Chow EJ, Gurney JG, et al. Chronic disease in the childhood cancer survivor study cohort: a review of published findings. J Clin Oncol. 2009;27(14):2339-55. doi: https://doi.org/10.1200/JCO.2008.21.1953
31. Secker DJ, Jeejeebhoy KN. How to perform subjective global nutritional assessment in children. J Acad Nutr Diet. 2012;112(3):424-31.e6. doi: https://doi.org/10.1016/j.jada.2011.08.039
32. Murphy-Alford AJ, Prasad M, Slone J, et al. Perspective: creating the evidence base for nutritional support in childhood cancer in low- and middle-income countries: priorities for body composition research. Adv Nutr. 2020;11(2):216-23. doi: https://doi.org/10.1093/advances/nmz095
33. Yip C, Dinkel C, Mahajan A, et al. Imaging body composition in cancer patients: visceral obesity, sarcopenia and sarcopenic obesity may impact on clinical outcome. Insights Imaging. 2015;6(4):489-97. doi: https://doi.org/10.1007/s13244-015-0414-0
34. Behan JW, Avramis VI, Yun JP, et al. Diet-induced obesity alters vincristine pharmacokinetics in blood and tissues of mice. Pharmacol Res. 2010;61(5):385-90. doi: https://doi.org/10.1016/j.phrs.2010.01.007
35. Barr R, Collins L, Nayiager T, et al. Nutritional status at diagnosis in children with cancer. 2. An assessment by arm anthropometry. J Pediatr Hematol Oncol. 2011;33(3):e101-4. doi: https://doi.org/10.1097/MPH.0b013e3182002a65
36. Secker DJ, Jeejeebhoy KN. Subjective global nutritional assessment for children. Am J Clin Nutr. 2007;85(4):1083-9. doi: https://doi.org/10.1093/ajcn/85.4.1083
37. Barr RD, Ladas EJ. The role of nutrition in pediatric oncology. Expert Rev Anticancer Ther. 2020;20(2):109-16. doi: https://doi.org/10.1080/14737140.2020.1719834
38. Ladas EJ, Arora B, Howard SC, et al. A framework for adapted nutritional therapy for children with cancer in low- and middle-income countries: a report from the SIOP PODC nutrition working group. Pediatr Blood Cancer. 2016;63(8):1339-48. doi: https://doi.org/10.1002/pbc.26016
39. Bliss J, Lelijveld N, Briend A, et al. Use of mid-upper arm circumference by novel community platforms to detect, diagnose, and treat severe acute malnutrition in children: a systematic review. Glob Health Sci Pract. 2018;6(3):552-64. doi: https://doi.org/10.9745/GHSP-D-18-00105
40. Joffe L, Ladas EJ. Nutrition during childhood cancer treatment: current understanding and a path for future research. Lancet Child Adolesc Health. 2020;4(6):465-75. doi: https://doi.org/10.1016/S2352-4642(19)30407-9

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