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Associated Factors with the Nutritional Status of Children Undergoing Pediatric Oncology Treatment at the Departmental Teaching Hospital Ouémé-Plateau, Porto-Novo (CHUD-OP)

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Abstract

Background: Malnutrition is a frequent complication of pediatric oncology. This study aims to assess the nutritional status of children undergoing cancer treatment and hospitalized in the Pediatric Unit of the CHUD-OP in Porto-Novo. **Methods:** It was a prospective descriptive and analytic study held in five months from 2nd January to May 31st 2023. The population study was made up of children undergoing cancer treatment in the Pediatric Oncology Unit during the study period. The assessment of the nutritional status was made with the anthropometrics measurements (weight-for-age, height-for-age, mid-upper arm circumference, body-mass-index for age). Data analysis was made with the R software (4.1.2 version) and the Nutriservey 2007 software had been used to calculate the concentration of nutrients consumed in the 24-hour recalls. The p-value is significant when lower than 5%. **Results:** In all, 47 children were included of which 26 boys (55.3%) giving a sex ratio of 1.23. The average age was 7.72 years, with extremes of 7 months and 18 years. Over three-quarters (n = 36; 76.6%) of the parents had a low level of education. Acute lymphoblastic leukemia (n = 6; 12.8%), retinoblastoma (n = 6; 12.8%), Burkitt's lymphoma (n = 5; 10.6%) and nephroblastoma (n = 5; 10.6%) were the most frequently diagnosed cancers. Most of the children (n = 40; 85.1%) had insufficient energy intake. The prevalence of wasting was 57.4%, with 17.0% suffering from severe acute malnutrition and 40.4% from moderate

acute malnutrition. The prevalence of stunting was 38.3%. Factors significantly favoring the onset of undernutrition in these children were female gender ($p = 0.03$), parental education level ($p = 0.02$) and the nature of the cancer pathology ($p = 0.02$). **Conclusion:** Nutritional care of children with cancer is essential, and should be part of the supportive care offered in the same way as cancer treatment. It must be appropriate and adapted to each type of child in order to reduce morbidity and mortality rate.

Keywords

Wasting, Stunting, Pediatric Oncology

1. Background

Malnutrition is a major issue in pediatric oncology especially in limited resource's countries [1]. It is a silent urgency widely ignored. The prevalence of undernutrition among children with cancer is estimated between 10% and 37.5% according to the criteria and the assessment of undernutrition [1]. In sub Sahran Africa, infectious or chronic diseases accentuate undernutrition among children and make those with cancer more vulnerable [2]. A given number of pathophysiological mechanisms contribute to the development of malnutrition and stunting in cancer, including complex interactions between energy and substrate metabolism, hormonal and inflammatory components, and altered metabolic compartments. These lead to accelerated mobilization, oxidation of energy substrates and loss of body proteins [3]. The specificity of pediatrics lies in the fact that this aggression occurs in an organism whose growth generates high and/or specific macro- and micronutrient requirements [4]. The impact of malnutrition in pediatric oncology is under estimated while it can increase the infectious risk, lower autonomy and alter the quality of life of the patient [5]. Thus, poor nutritional status contributes to reduced immune function, delayed wound healing and impaired drug metabolism [6]. According to the European Organization for the Research and Treatment of Cancer - EORTC - QLQ-30), adequate nutrition plays a decisive role in the response to cancer treatment, improving quality of life and reducing the cost of care [7]. As a result, malnutrition is directly responsible for patient death in 5 to 25% of cases [8]. An improvement in malnutrition could therefore be conducive to a better response to cancer treatment. In Benin, according to the 2018 Demographic and Health Survey, 37% of children under 5 years old had malnutrition, including 32% chronic malnutrition and 5% severe malnutrition. Among children overall, the existence of malnutrition is noted, induced or associated with chronic diseases, including cancer. In view of the increasing frequency of childhood cancers in the CHUDOP Pediatric Oncology Unit, it seemed appropriate to assess the factors associated with malnutrition in these children, in order to improve their nutritional care.

2. Methods

This was a prospective descriptive and analytical study conducted over five months from January 2nd to May 31st, 2023.

It concerned all children, regardless of their sex and age, treated for cancer in the Pediatric Oncology Unit during the study period and who had received at least two 24-hour dietary recalls. The sampling was therefore exhaustive. The dietary recall is the estimate in quantity and energy of the daily ration. The assessment of the nutritional status was made with the anthropometrics measurements (weight-for-age, height-for-age, mid-upper arm circumference, body-mass-index for age) according to WHO 2015 curves; the interpretation of anthropometric parameters is summarized in Table 1. The weight of children under 24 months of age was measured using an electronic baby scale, calibrated before each weight measurement on a totally undressed child. For children over 24 months of age, weights were measured on patients who were either undressed or in light clothes, barefoot, using a mechanical scale calibrated before each weight measurement. Children who were unable to stand were weighed using an electronic weight wheelchair. Height was measured using a millimeter gauge with a maximum capacity of 2100 mm, placed vertically on a flat surface for children over 24 months, and horizontally for children under 24 months. Brachial Perimeter (BP) was measured in children aged 6 months and over using a strip (Shakir strip: colored for children) or a MUAC (UNICEF) and is expressed in mm or cm. The variables studied were sociodemographic and economic characteristics (age, sex, parent's occupation, parents' level of education, monthly household income, residence), comorbidities (anemia, tuberculosis, HIV infection, parasitic infections, hepatitis B and C), type of cancer (hematological malignancies and solid tumors), type of antineoplastic treatment (chemotherapy, surgery, radiotherapy), disease and treatment side effects (taste alteration, nausea, anorexia, vomiting, diarrhea), dietary intake (number of meals per day, foods consumed, quantity), enteral or parenteral nutritional support and health system factors (content of nutritional management, composition of care team, modality of nutritional management). Data were collected using a questionnaire. The analysis was carried out using R (version 4.1.2) and epi info software. Dr Juergen Erhardt's Nutriservey 2007 (nutrition calculations and surveys) software, developed in 2007 at the University of Indonesia, was used to calculate the concentration of nutrients consumed in the 24-hour recalls collected from patients. The p-value is significant when it is less than 5%.

3. Results

Forty-seven children treated for cancer were included in the study. The most represented age group was 5 to 12 years (n = 21; 44.7%). The mean age was 7.72 ± 4.23 years, with extremes of 7 months and 18 years. There was a predominance of males, with a sex ratio of 1.23. More than 3/4 (n = 36; 76.6%) of the parents had a low level of education (maximum level of schooling at primary level). The

main cancers found were acute lymphoblastic leukemia (n = 6; 12.8%), retinoblastoma (n = 6; 12.8%), Burkitt's lymphoma (n = 5; 10.6%), nephroblastoma (n = 5; 10.6%), Hodgkin's lymphoma (n = 4; 8.5%), rhabdomyosarcoma (n = 4; 8.5%) and osteosarcoma (n = 2; 4.3%). The majority of children (n = 40; 85.1%) were receiving curative or palliative chemotherapy. At nutritional assessment, the prevalence of wasting was 57.4% (n = 27) with 17.0% (n = 8) severe acute malnutrition (SAM) and 40.4% (n = 19) moderate acute malnutrition (MAM). The prevalence of stunting was 38.3% (n = 18), with 10.6% (n = 5) of severe chronic undernutrition (SCU) and 27.7% (n = 13) of moderate chronic undernutrition (MCU). The distribution of children's nutritional status according to age is shown in Table 2. The majority of children (n = 41; 87.2%) presented with digestive symptoms (nausea, vomiting, diarrhea, anorexia, taste alterations) and more than a third with abdominal mass (n = 16; 34%) that did not facilitate feeding. Biologically, the children were anemic (n = 39; 83%) and none had hepatic cytolysis or a kidney failure. All the children were on oral diet, and only almost a third (n = 15; 31.9%) had nutritional support. Nutritional treatment consisted of plumpy-nut (n = 12; 25.5%), enriched porridge (n = 7; 14.9%) and therapeutic milk (n = 2; 4.3%). The majority of children surveyed had inadequate intakes of energy, protein, lipids and vitamins B12 and B9. However, iron and vitamin C intakes were adequate. Dietary intakes of energy, macronutrients and micronutrients are shown in Table 3. The factors significantly favoring the onset of acute undernutrition in these children were female gender (p = 0.03), parent's low level of education (p = 0.02) and the nature of the cancer pathology, notably osteosarcoma and rhabdomyosarcoma (p = 0.02). Chemotherapy (p = 0.69) did not favour the onset of undernutrition. No factors favouring the onset of chronic undernutrition were found.

Table 1. Interpretation of children's anthropometric parameters.

Z score value	Height-for-age prone - standing	Weight-for-age	Weight-for-height prone - standing	BMI for age
Above 3	Gigantism		Obesity	Obesity
Above 2	*Normal Zone*	Macrosomia/Obesity	Overweight	Overweight
Above 1			Possible risk of overweight	
Mean		*Normal zone*		
Below 1				
Below 2	Moderate stunting	Moderate underweight	Moderate wasting	Moderate wasting
Below 3	Severe stunting	Severe underweight	Severe wasting	Severe wasting
	Chronic undernutrition	General undernutrition	Acute undernutrition	

Table 2. Distribution of children's nutritional status by age.

	[6 - 30 months] n (%)	[30 months - 5 years] n (%)	[5 - 12 years] n (%)	[12 years -18 years] n (%)
Emaciation				
Good	2 (4.2)	3 (6.4)	11 (23.4)	4 (8.5)
SAU	2 (4.6)	3 (6.4)	3 (6.4)	0
MAU	3 (6.4)	3 (6.4)	7 (14.9)	6 (12.8)
Stunting				
Good	4 (8.5)	3 (6.4)	14 (29.8)	8 (17.0)
CMU	2 (4.2)	4 (8.5)	5 (10.6)	2 (4.2)
SCU	1 (2.1)	2 (4.2)	2 (4.2)	0

Table 3. Distribution of children according to assessment of dietary energy, macronutrient and micronutrient intakes.

	Insufficient n (%)	Sufficient n (%)
Energy (kcal)	41 (87.2)	6 (12.8)
Carbohydrates (g)	22 (46.8)	25 (53.2)
Proteins (g)	27 (57.5)	20 (42.5)
Lipids (g)	39 (83)	8 (17)
Vit C (mg)	17 (36.2)	30 (63.8)
Iron (mg)	4 (8.5)	43 (91.5)
Vit B9 (mg)	47 (100)	0 (0)
Vit B12 (mg)	44 (93.6)	3 (6.4)

4. Discussion

The mean age of the children was 7.72 ± 4.23 years, with extremes ranging from 7 months to 18 years, and the most represented age group was 5 - 12 years (44.7%). These data are comparable to those of other authors, who have found a mean age ranging from 6.16 to 7.5 years, with a higher proportion of 5 - 10 year-olds [5] [9] [10]. The male predominance found, with a sex ratio of 1.23, is comparable to those of other authors, who found a sex ratio of 1.4 and 1.7 [9] [10]. The male predominance observed in the various studies seems to show that boys are at greater risk of being affected by pediatric cancer. In sub-Saharan Africa, most parents came from a low socio-economic background (80%) and had a low level of education, especially mothers (75%) [5] [11]. The pediatric cancers most frequently diagnosed in our study population were acute lymphoblastic leukemia (12.8%), retinoblastoma (12.8%), Burkitt's lymphoma (10.6%) and nephroblastoma (10.6%). Our results were comparable to those of other Sub-Saharan African

countries, but with varying predominance of non-Hodgkin's lymphoma (33.5%), especially Burkitt's lymphoma, ranging from 18.8% to 26.1% [9] [12]. The low prevalence of Burkitt's lymphoma in our study could be explained by the fact that some cases are managed in ENT departments and not in pediatric oncology units. However, other non-Hodgkin's lymphomas are seen in the pediatric oncology unit. In pediatric oncology, the use of weight as an indicator of undernutrition can lead to misclassification, as tumor masses can sometimes reach 10% of body weight, and edema may be present [5]. Mid-upper arm circumference is therefore recommended in these situations to prevent deterioration in the nutritional status of cancer patients. In our study, the prevalence of wasting was 57.4%, with 17.0% of severe acute undernutrition and 40.4% of moderate acute undernutrition. The prevalence of stunting was 38.3%, with 10.6% of severe chronic undernutrition and 27.7% of moderate chronic undernutrition. In Nicaragua in 2017, similar results were found with 19.1% moderate acute malnutrition and 47.9% severe acute malnutrition [10]. This similarity can be explained by the fact that Nicaragua is a country with almost the same level of economic development as Benin. However, it has the highest malnutrition rate in the Americas. Furthermore, variable prevalences were obtained in Morocco in 2008, with 37% moderate underweight, 33% severe acute malnutrition and 20% moderate chronic malnutrition, and in Mali in 2010, 47.4% moderate acute malnutrition, 56.8% moderate underweight and 52.6% moderate chronic malnutrition [5] [13]. These high rates in our study and in others could also be the consequence of tumor pathology, which leads to significant metabolic changes affecting proteins, lipids and carbohydrates: high energy expenditure, reduced intake and malabsorption. As a result, current therapeutic modalities affect the nutritional status of the child through severe adverse effects: pain, altered taste perception, anorexia, nausea, vomiting, mucositis, enteritis and constipation, profoundly influencing the child's food intake [5] [14]. The majority of our children had inadequate energy and macronutrient intakes. This is the case in most sub-Saharan countries, where nutritional intakes are inadequate [11] [15] [16]. Also, in the UK, a developed country, a study showed that 40% of hospital food served to patients was left on plates and returned, with the result that patients ate less than 80% of their individual energy and protein requirements [17]. In our study, the factors significantly favoring the onset of acute undernutrition were female gender ($p = 0.03$), parent's low level of education ($p = 0.02$) and the nature of the cancer pathology, notably osteosarcoma and rhabdomyosarcoma ($p = 0.02$). Chemotherapy ($p = 0.69$) did not favour the onset of undernutrition. No factors favouring the onset of chronic undernutrition were found. Numerous studies have noted that tumor type may be a risk factor for undernutrition in children with cancer (Ewing's sarcoma, stage IV neuroblastoma, osteosarcoma) [16]. In our study, the majority of parents had low socio-economic status; this may not only alter the child's nutritional intake, but also delay early diagnosis and management, creating hypermetabolic energy consumption. In many rural sub-Saharan countries, priority is given to preventive and curative care

for boys. This could be at the root of inadequate nutritional intake or delayed diagnosis and treatment in girls. All these factors, combined with socio-economic precariousness, may explain the favourable factors identified in our study.

5. Conclusion

This study identified associated factors with the nutritional status of children treated for cancer at the pediatric oncology unit in Porto-Novo, Benin. Early diagnosis and appropriate care, including nutritional support, will improve their prognosis.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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