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Nutritional status, clinical signals of nutritional deficiencies and social vulnerability among children from the semi-arid region of Paraiba

Estado nutricional, sinais clínicos de carências nutricionais e vulnerabilidade social entre crianças do semiárido paraibano

José Lucas Braga Santos[1]
Poliana de Araújo Palmeira[1]
Vanille Valério Barbosa Pessoa Cardoso[1]
Marília Ferreira Frazão[1]

[1] Universidade Federal de Campina Grande, Núcleo de Pesquisa e Estudos em Nutrição e Saúde Coletiva - Núcleo PENSO. Sítio Olho d´agua da bica, Cuite-PB, Brasil.

Correspondence
José Lucas Braga Santos
E-mail: joselucasbragasantos@hotmail.com

Abstract

Objective: To analyze the anthropometric nutritional status and clinical signs of nutritional deficiencies by social vulnerability status of children aged 0-9 years enrolled in day care centers and municipal public schools in the city of Cuité, Paraíba. *Methods:* A cross-sectional study with the convenience sample composed by 629 children. Family social information was collected and classified according to the poverty line. Anthropometric measurements were performed and nutritional semiology was performed to determine nutritional status. *Results:* The prevalence of overweight children prevailed underweight children between both of income groups analyzed. It was possible to verify the presence of 3 to 5 signals of clinical alterations related with nutritional deficiencies in about 20% of children who live in families above and below the poverty line. However, It was verified that children who show from 3 to 5 deficiency signs and are included in families who live below the poverty line presented higher weight deficit percentage (19,5%) than overweight (15,6%). For children from families who live above the poverty line with the same clinical alterations, the prevalence of overweight (20%) was significantly higher than underweight (8,9%), proving that the presence of signs of nutritional deficiencies are also present in children with opposite weight characteristics. *Conclusion:* Therefore, for different conditions of social vulnerability, it is possible to perceive the presence of a double burden of diseases derived from eating habits: The overweight and the deficiency of specific nutrients, typical characteristics from the contemporary process of the Brazilian nutritional transition.

Keywords: Nutritional Status. Nutritional deficiencies. Child. Poverty.

Resumo

Objetivo: analisar o estado nutricional antropométrico e sinais clínicos de carências nutricionais segundo condições socioeconômicas de crianças com idade entre 0 e 9 anos matriculadas em creches e escolas públicas municipais de Cuité, Paraíba. *Metodologia*: Estudo transversal com amostra por conveniência composta por 629 crianças. Coletou-se informações sociais da família, classificadas segundo linha da pobreza. Foram aferidas medidas antropométricas e realizada semiologia nutricional, para determinação do estado nutricional. *Resultados*: O excesso de peso prevaleceu sobre o baixo peso em ambos os grupos de renda. Verificou-se a presença de 3 a 5 sinais de alterações clínicas relacionadas às carências nutricionais em cerca de 20% das crianças que conviviam com famílias acima e abaixo da linha da pobreza. Entretanto, entre as crianças que apresentaram de 3 a 5 sinais carenciais e estavam inclusas em famílias abaixo da linha da pobreza, observou-se maior percentual de déficit de peso (19,5%) do que de excesso (15,6%). Para as crianças de famílias acima da linha da pobreza com as mesmas alterações clínicas, a prevalência de excesso de peso (20%) revelou-se expressivamente maior que a de baixo peso (8,9%), mostrando a presença de sinais de carências nutricionais em crianças com características de peso opostas. *Conclusão*: Assim, para condições distintas de vulnerabilidade social pôde-se perceber a presença de uma dupla carga de doenças com origem na alimentação: o excesso de peso e carência de nutrientes específicos, o que é típico do processo de transição nutricional.

Palavras-chave: Estado nutricional. Deficiências Nutricionais. Crianças. Pobreza.

Introduction

The 2008-2009 Brazilian government Family Budget Survey (POF, in the Portuguese abbreviation), conducted by the Brazilian government *Instituto Brasileiro de Geografia e Estatística* (Brazilian Institute of Geography and Statistics, IBGE in the Portuguese abbreviation), in a partnership with the Brazilian Ministry of Health, has resulted in a significant increase in the number of overweight children in Brazil, especially in the age group between 5 and 9 years of age. The prevalence of overweight boys has more than tripled between 1989 and 2009, from 8.7% to 30.3%, respectively. Among girls, this variation has been from 7.5% to 26.5% in 2009. As for weight deficit, prevalences have not exceeded, on average, 2.5% in both genders between 1989 and

2009. Regarding height deficit in the age range from 5 to 9 years, prevalence was 6.8%, tending to decrease with age.[1]

Despite malnutrition reduction, studies[2,3] have shown that the prevalence reduction of nutritional deficiencies does not happen with the same speed, that is, linked to increase in overweight and obesity in the Brazilian population there is also great deprivation of micronutrient consumption, which characterizes the development of specific nutritional deficiencies that have long been related to malnutrition in children. These are two situations that aggravate each other simultaneously but are opposed by definition: nutritional deficiency and obesity, some typical condition of food excess.[4]

Recent studies on micronutrient deficiencies, especially in children, are scarce. Findings by Fidelis & Osório[5] stand out in a study with children up to 5 years of age from a 24-hour food recall method, in which it was observed that the prevalence of micronutrient inadequacy was high, mainly for iron and zinc, in those above 12 months of age. Another study, carried out by Pedraza et al.[6] in 2013 in the Brazilian state of Paraíba with children enrolled in public day care centers, based on the observation of serum micronutrient levels, has found that 23.3% of children had vitamin A deficiency, 15.4% were anemic and 13.8% had zinc deficiency. In this sense, it should be emphasized that socioeconomic and environmental conditions such as income, sanitation, housing, access to water and others are responsible for a significant portion of children's health situations.[7]

The present study has aimed to analyze the nutritional status and clinical signs of nutritional deficiencies according to socioeconomic conditions of children aged 0 to 9 enrolled in municipal public day care centers and schools in the urban area of the Brazilian city of Cuité, Paraíba.

It is hoped, therefore, to support with knowledge the distribution and magnitude of nutritional problems in children and thus encourage a proposition of practical health actions in the field of planning and development of educational interventions and assistance on control and prevention of problems nutritional.

Methodology

Population and data collection

This is a cross-sectional study with sampling by convenience, which has included the realization of a Nutritional Call with children regularly enrolled in municipal day care centers and schools in the Brazilian city of Cuité, Paraíba. Nutritional Call is a rapid population estimation strategy often applied to specific populations in vulnerable conditions and for surveillance purposes carried out in a short period of time at a reduced cost.[8]

Researchers were undergraduate students in nutrition from Brazilian Federal University of Campina Grande (*Universidade Federal de Campina Grande* – UFCG) selected from interest and willingness to participate in the research and previously trained, with a workload of 18 hours.

The fieldwork strategy was conceived with support from the schools managers and directors and data collection was carried out in the school context. Dates and times with each of the schools were previously agreed, where the necessary equipment for anthropometric measures was organized.

Data collection was done between May and June 2013. Based on the 2012 school census, there were 2,888 students regularly enrolled in the Cuité municipal school system, of which 1,843 were in schools and kindergartens in the urban area. Based on such survey, it was planned to move the research team to the schools. And those responsible for the students were asked to attend the establishment to contribute with information on families' living conditions.

At the end of the fieldwork, of the total number of students enrolled, 1,562 were surveyed. For this study, it was considered to evaluate only the students classified as children,[11] which includes the age group from 0 to 9 years and 11 months of age, totalizing 782 children. The final sample of this study consisted of 629 children, whose parents attended the school on the day of the research and authorized the participation through signing an Informed Consent Form (ICF). And they also answered a socioeconomic questionnaire.

Environmental and socioeconomic characteristics

A questionnaire containing information about the domicile and the person responding for the family: Area of residence (urban and rural), sanitary sewer (public infrastructure system/ septic tank, rudimentary pit/ditch or open sewer), daily availability of water at home (yes or no), occupation (having or not having jobs) and education of the person responding for the family (low level of education, when the individual reported not having completed high school, and high level of education when they stated having completed at least high school). As for the family's income variable, income values for each family member and the number of residents in the household were collected.

Anthropometry and nutritional semiology

Weight measurement was performed with a digital glass balance ultraSLIM – w903 – WISO. Children were weighed barefoot, with the least amount of clothing possible and without the presence of objects in pockets, having the hands on the head. And also positioned on the scale platform center with the arms along the body. Measurement of the height of children under one

year of age was done by a child wooden stadiometer with the child lying on an appropriate place available in day care centers. For the others, a 0.1 cm precision tape measure was fixed to a wall with no wall skirting board and a smooth surface, with the schoolboy barefoot and without any object on the head, positioned on their back and heels against the wall, as recommended in the Technical Manual from Brazilian government Food and Nutrition Surveillance System *(Sistema de Vigilância Alimentar e Nutricional* – SISVAN).[9]

In order to detect the presence of signs of anemia and deficiency in other specific nutrients, such as zinc, protein, folic acid and vitamin A, physical examination of each child was performed, considering the skin coloration of the palmar area and mucous membranes, mainly the internal mucosa of the eyes. Besides these indicators, the children's oral cavity was observed in nutritional semiology regarding the presence of wounds and trophic changes in the skin, hair and skin appendages (or adnexa), as well as the presence of edema in the lower limbs and abdominal distension.[10]

Data analysis

After the data collection, the questionnaires were digitized using (database management system) Microsoft Access resources on computers installed in the Laboratory of Applied Informatics of the Education and Health Center. After digitization, the database was transferred to (software package) SPSS Statistics for Windows Version 13.0 to accomplish a descriptive statistical analysis of the data on computers in a room at the Center for Research and Studies on Nutrition and Collective Health (*Núcleo de Pesquisas e Estudos em Nutrição e Saúde Coletiva* – PENSO).

The monthly family income per capita was adopted as an independent variable, the child's family being classified with income above or below the poverty line, according to the cutoff point of less than or above BRL 140.00 per month per capita, established for the classification of poverty in the *Programa Bolsa Família* (Family Allowance, a Brazilian government social welfare program).[12]

Dependent variables refer to the child's nutritional status. Nutritional status was evaluated from the two most widely used indicators in scientific fields for evaluation and discussion of a group of children, [(World Health Organization (WHO)] W/A (weight-for-age) and H/A (height-for-age) in view of the highest sensitivity to the classification of nutritional status in the sample age group.[13]

From the analysis of the growth curves from the World Health Organization, 13 children who, by the W/A indicator were at risk of being overweight, obese class I (moderately obese) or obese class II (severely obese) (≥ z-score +1 and > z-score +3) were classified as having excess weight. And those at risk of being underweight, severely underweight or very severely underweight (≥ z-score -2 and < z-score -3) were classified as having low weight. In the same way, for the H/A indicator, when they were found to be at risk or in short stature (≥ z-score -2 and < z-score -2),

children were classified as being of Short stature. And when at risk or in high height (> z-score +2 and ≤ z-score +2), children were classified as being of High stature.

Regarding clinical signs of nutritional deficiencies, nine variables were evaluated: nail aspects (normal or altered), hair (normal, dry, brittle or exhibiting loss) and skin (dry, rough, spotty or rash), palmar pallor and internal mucosa of the eyes, presence of edema in lower limbs, abdominal distension, wound in corner of mouth and Bitot's spots. Each variable was categorized according to the existence or not of any clinical alteration. And subsequently, for each child, the number of clinical alterations observed was added, ranging from 1 to 8.

Considering the frequency distribution of these changes in the sample itself, a maximum of five clinical changes per child was observed. These were grouped according to a criterion of lower or greater physical and clinical characteristics related to nutritional deficiency, adopted by the researchers. In this sense, it was evaluated that children who presented 3 to 5 clinical alterations would meet a greater set of clinical conditions to identify nutritional deficiency.

For all statistical analyses of the data, the test of significance was chi-square, considering the value of $p < 0.05$.

Ethical Aspects

The project was submitted and approved by the Research Ethics Committee (REC) of the Brazilian Alcides Carneiro University Hospital (*Hospital Universitário Alcides Carneiro*) at Brazilian Federal University of Campina Grande (*Universidade Federal de Campina Grande* – UFCG), CAAE: 15713713.0.0000.5182. In order to carry out data collection in schools, the municipal Department of Education signed a Term of Commitment, agreeing with the development of the research.

Student and the person responding for the family were invited by the interviewers to participate in the Nutrition Call, where the research objectives were explained. And in case of acceptance, the person responding for the family signed an Informed Consent Form (ICF).

Results

The schoolchildren studied reside in a small municipality located in the Brazilian northeastern semi-arid region. According to the Human Development Index (HDI), the Cuité municipality is classified as having low development (0.591), which expresses the population's social, health, work and income vulnerabilities in this municipality. With the analysis of the data, this vulnerability is reinforced, since 62.2% of the schoolchildren studied lived among families classified as being below the poverty line.

Table 1 shows the social and demographic characteristics of the families and the children's parents or legal guardians. As for the parents or legal guardians, a higher percentage was found with high education among families classified above the poverty line. Similar percentages of access to sanitary sewer and water were also observed, thus showing that environmental vulnerability reached both the families below and those above the poverty line.

Table 1. Families' social and demographic characteristics according to social vulnerability situation, Cuité, PB, 2012.

Variables	Total		Families above the poverty line		Families below the poverty line		P-value
	N	%	N	%	N	%	
Area							
Urban	583	92.7	220	92.9	361	92.6	*0.884*
Rural	46	7.3	17	7.1	29	7.4	
Sanitary sewer[1]							
Public infrastructure system/septic tank	196	31.8	64	27.5	132	34.4	*0.201*
Rudimentary pit/ditch	392	63.5	157	67.4	235	61.2	
Not available/Open sewer	29	4.7	12	5.2	17	4.4	
Daily water availability							
Yes	490	78.4	190	83.2	292	75.5	*0.022*
No	135	21.6	40	16.8	95	24.5	
Occupation of the person responding for the family							
Has a job	261	41.6	99	41.6	162	41.6	*0.990*
Has no job[2]	366	58.4	139	58.4	227	58.4	
Education of the person responding for the family[3]							
Low level of education	438	70.1	153	64.6	285	73.5	*0.018*
High level of education	187	29.9	84	35.4	103	26.5	

[1]10 cases They do not know/Has not answered; [2] Including retirees and pensioners; [3]02 cases They do not know/Has not answered

Regarding the demographic and anthropometric characteristics of the students studied, comparing the two groups of families analyzed showed homogeneity in the sample, both for gender and age data, as well as for weight and height (Table 2). The age range from 0 to 4 years corresponded to 34.8% of the sample while 65.2% of the children were aged between 5 and 9 years.

Table 2. General characteristics of the sample according to social vulnerability situation, Cuité, PB, 2012.

Variables	TOTAL		Families above the poverty line		Families below the poverty line	
	N	%	N	%	N	%
Gender						
Male	335	53.4	131	55	204	52.4
Female	292	46.6	107	45	185	47.4
Age						
Average age			5.43 (± 2.16)		5.42 (± 2.25)	
Weight						
Average weight			21.76 (± 7.19)		21.08 (± 6.53)	
Height						
Average height			0.99 (± 0.46)		0.97 (± 0.47)	

When analyzing the children's nutritional status, a more significant prevalence of eutrophy was observed in both groups of families (Table 3). When comparing the results of the weight/age indicator according to social condition, it was verified that about 20% of the children studied were classified as overweight in both groups of families whereas for the low weight ones a higher prevalence was found between families below the poverty line.

For the height/age indicator, which can assess nutritional losses in the long term, there was a different result, since risk and low stature percentages were similar for children living in families above and below the poverty line.

Another indicator related to nutritional status adopted in this study is the analysis of nutritional deficiencies clinical signs. In Table 3 it is possible to verify the presence of 3 to 5 signs of clinical alterations related to nutritional deficiencies in children living with families above and below the poverty line, being 20.4% and 22.4%, respectively.

Table 3. Children's nutritional status according to social vulnerability, Cuité, PB, 2012.

Variables	TOTAL		Families above the poverty line		Families below the poverty line		*P-value*
	N	%	N	%	N	%	
Weight/Age indicator							
Low weight	71	12	22	9.6	49	13.5	
Eutrophy	402	68.1	158	69.3	244	67.4	*0.348*
Excess weight	117	19.8	48	21.1	69	19.1	
Children over 4 years of age: Height/Age indicator							
Low stature	71	12	29	12.7	42	11.6	
Eutrophy	456	77.2	173	75.9	283	78.0	*0.841*
High stature	64	10.8	26	11.4	38	10.5	
Clinical signs of nutritional deficiencies							
0-2 clinical signs	452	78.3	179	79.6	273	77.6	*0.570*
3-5 clinical signs	125	21.7	46	20.4	79	22.4	

However, when comparing the risk groups of children with low weight for age and overweight, as shown in Table 4, it was found that children who presented 3 to 5 signs of disability and would be in families below the poverty line showed a greater percentage of weight deficit (19.5%) than overweight (15.6%). The opposite was observed for children in families above the poverty line with the same clinical changes, since the prevalence of overweight (20%) was significantly higher than that of low weight for age (8.9%), showing that the presence of nutritional deficiencies signs was also present in children with opposite weight characteristics.

Table 4. Nutritional status according to the family's social vulnerability situation and presence of nutritional deficiencies clinical signs, Cuité, PB, 2012.

Clinical signs of nutritional deficiencies	Nutritional status						P-value
	Low weight		Eutrophy		Excess weight		
	N	%	N	%	N	%	
Families above the poverty line							
0-2 clinical signs	18	10.2	122	69.3	36	20.5	*0.959*
3-5 clinical signs	4	8.9	32	71.1	9	20.0	
Families below the poverty line							
0-2 clinical signs	34	12.8	178	66.9	54	20.3	*0.272*
3-5 clinical signs	15	19.5	50	64.9	12	15.6	

Discussion

The data presented show that the population of schoolchildren studied is, in the majority, in an adequate nutritional situation, according to the indicators used. However, the presence of overweight and obesity, low weight or risk of low weight and even signs of nutritional deficiencies reaches a significant portion of children, whether they are in families below or above the poverty line.

The profile observed is a common feature in the current process of nutritional transition experienced in Brazil, where overweight, specific nutrient deficiency, malnutrition and other chronic diseases coexist in the same community. According to Batista Filho et al.,[2] the projection of results from studies carried out in the last three decades is indicative of a clearly epidemic behavior of obesity. Thus, an antagonism of temporal tendencies is established between malnutrition and obesity, defining one of the outstanding characteristics of the country's nutritional transition process.

Despite the presence of both nutritional profiles in children, underweight and overweight, the second one prevailed in the income groups studied. For Campos and collaborators,[14] it is noted that the increase in overweight has reached all age groups and socioeconomic levels. Netto-Oliveira et al.,[15] when evaluating overweight and obesity in children 6 to 7 years and 9 months of age regularly enrolled in 24 schools in Brazilian city Maringá, from different economic classes, according to the Brazilian Criteria of Economic Classification (CCEB, in the Portuguese abbreviation) of the

Brazilian Association of Research Companies (*Associação Brasileira de Empresas de Pesquisa* – ABEP),[16] have found that among overweight children the prevalence of overweight was significantly higher, being 28.5%, 20.5% and 16.7% for the high, low and medium economic levels, respectively.

The socioeconomic status of the families studied characterizes the vulnerability in the municipality, contributing to an imbalance in the population's health and well-being, especially regarding access to diversified and quality food. Environmental conditions are responsible for a significant portion of determinants of child health, especially nutritional deficiencies, such as unfavorable situations related to access to drinking water, waste disposal (sanitation) and housing, which contribute to morbidity and significant mortality of children in countries with insufficient and inadequate health structures, such as Brazil.[17]

Among the socioeconomic indicators, the evolution of the families' purchasing power and the progression of education of its members directly affect the secular trend of health conditions in childhood. Of purchasing power depend, for example, the availability of food, the quality of the environment and access to essential services such as sanitation and health care.[18] In a study conducted by Marinho,[19] from SISVAN database in the Brazilian municipalities of the 1st Regional Health Coordination of the state of Rio Grande do Sul in 2006, it is possible to perceive that a population's nutritional state is the result of several social factors, among them education. Once deficient, parents' education may adversely affect the nutritional status of the children population. As shown by Monteiro et al.[20] when analyzing anthropometric surveys conducted at the national level, the frequency of undernourished children has tended to increase with both a decrease in purchasing power and maternal education, as well as lower access to health care and sanitation.

In this context, important social and health policies have been implemented in recent decades with the objective of reducing poverty, food insecurity and improving access to and quality of health services, such as the Brazilian government National School Lunch Program (*Programa Nacional de Alimentação Escolar* – PNAE), Programa Health in School (*Programa Saúde na Escola* – PSE), Food and Nutrition Surveillance System *(Sistema de Vigilância Alimentar e Nutricional* – SISVAN), Zero Hunger (*Fome Zero*, a Brazilian government program with the goal to eradicate hunger and extreme poverty in Brazil) and the *Programa Bolsa Família* (Family Allowance, a Brazilian government social welfare program).[21-24] These policies and programs have reached a wide population coverage in a relatively short period of time, bringing important impacts to children's health and nutrition.[25] An unpublished study carried out in 2,853 Brazilian municipalities shows that the *Bolsa Família* income transfer program had a decisive contribution to the decrease in mortality of children under 5 between 2004 and 2009. The reduction of infant mortality in the cities surveyed reached 17%. The study has also pointed out that the direct action of the *Programa Bolsa Família* in reducing child mortality was even greater when the cause is related to food deprivation. That is, the program was responsible for reducing 65% of deaths caused by malnutrition and 53% of deaths due to diarrhea.[26]

The values found in the present study reveal the higher prevalence of overweight over low weight, regardless of the income group. In the child population, the prevalence of overweight in the last 30 years has increased in all Brazilian regions and in all income strata, as also revealed in POF 2008/2009.[1] The increase in the obesity epidemic has been observed in several countries. Although the prevalence of obesity and overweight is higher in rich countries such as the USA, it is noted that there is a rapid increase in a number of less developed countries among adults and children. In pre-school children (0-5 years of age) in less developed countries, the prevalence of overweight and obesity has been increasing, including in Brazil.[27] Obesity affects populations regardless of the life cycle stage or socioeconomic condition. It is important to emphasize that the more intense and precocious the onset is, the greater the risk of persistence and the more serious the associated comorbidities, such as cardiovascular diseases, arterial hypertension, diabetes and some types of neoplasias.[28]

Regarding nutritional status according to the height/age indicator, used only for children above 4 years of age, there was a high index of children at risk for short stature in the different groups when compared to the prevalences found at national and regional levels. According to POF 2008/2009, the short stature, evaluated from the same indicator among children between 5 and 9 years of age, it was equal to 6.8% in Brazil and 7.9% in the Brazilian northeastern area.[1] The 2006 Brazilian government National Demography and Health Survey (*Pesquisa Nacional de Demografia e Saúde* – PNDS) shows that growth retardation in childhood is concentrated in the less favored social strata. In this case, among children of mothers with one to three years of education (13.6%) or without education (16.6%).[29] Orlonski et al.,[30] when analyzing 335 children between 4 and 10 years of age, according to the height/age indicator, enrolled in the basic education system of the (former Brazilian government education program) Center for Child and Adolescent Care (*Centro de Atenção à Criança e ao Adolescente* – CAIC) in the Brazilian city of Ponta Grossa, Paraná, have found the presence of 6.9% of those in short stature.

In this sense, the strong aspect of the nutritional transition process in the municipality of Cuité is highlighted, where, despite the fact that overweight prevails in relation to low weight according to the weight/age indicator, the children studied still present growth deficits. The height/age index expresses the linear growth of children and corresponds to the data that best represents the cumulative effect of adverse situations on this phase,[13] for which the adequate consumption of macro and micronutrients plays a very important role in promoting physical growth.[31]

Therefore, for Singh,[32] Vitamin A, iron and zinc deficiencies, for example, still present high prevalence in most developing countries, causing several health problems for individuals, since these nutrients are essential for proper functioning of the body and, especially in children, for the growth and development process optimization.

In contemporary society children are one of the population groups most vulnerable to micronutrient deficiency, since they are exposed to high risk situations for nutritional problems during their growth, from inadequate food intake to coexistence with different infectious diseases.[33] For Pedraza et al.,[34] micronutrient deficiency is related to a series of deleterious effects in childhood, with a consequent increase in morbidity and mortality rates, among other health problems, further reinforcing, as this study shows, the nutritional risk of this physiologically vulnerable population. Therefore, this stage of life represents a biological moment that deserves maximum attention regarding the supply of micronutrients, especially iron, vitamin A and zinc, given its importance in low birth weight and height deficit for appropriate growth.

In a study by Pereira et al.,[35] which has evaluated the presence of anemia in school-age children from serum hemoglobin levels, it was found that, of the 267 schoolchildren in the sample, more than half (53.2%) had anemia, which is much higher than what was found for clinical signs of deficiencies (21.6%), which also suggest the presence of anemia. In another study, De Paula et al.[36] have also found, from the serum levels of hemoglobin and retinol in children up to 5 years of age, approximately 16% and 35% of anemia and vitamin A deficiency, respectively.

Taking into account the high cost and difficulty of analyzing blood samples for large studies that assess micronutrient deficits in the population, semiology stands out as a methodological strategy for initial screening. In 2001, the Pan American Health Organization (PAHO) emphasized palmar pallor as an initial screening tool for anemia.[37] In the same year, WHO reinforced the importance of using clinical signs in needy populations with a high prevalence of moderate and severe anemia.[38] Thus, considering the significant prevalence of children who presented signs of nutritional deficiencies, the relevance of the clinical diagnosis carried out in this study is highlighted, evidencing that, possibly, a larger proportion of children may present nutritional deficiencies when evaluated from serum levels, since the presence of clinical signs identified may be related to more advanced deficiencies.

From the results indicated for the presence of signs of nutritional deficiencies, the existence of these is observed in both underweight and overweight children. Thus, it is argued that obesity does not prevent schoolchildren from having specific nutritional deficiencies, showing that the increase in this epidemic rates in the population may actually represent a complex and larger problem.

Ferreira et al.,[39] when assessing hemoglobin dosage in a study with indigenous peoples' communities (or *quilombo* areas) in the Brazilian state of Alagoas, have concluded that the fact that the children are overweight does not exempt them from specific nutritional deficiencies that compromise their growth, development and health. Leão et al.,[3] in a bibliographic review, have also presented studies in which inadequate consumption of zinc and calcium was seen in an obese and hypertensive population with insulin resistance. Anemia, for example, is the most relevant nutritional deficiency in Brazil, affecting approximately 50% of children. Considering

this problem, the Brazilian government has made investments in recent years in enriching wheat and maize meals with iron and folic acid and preventive iron supplementation through the government *Saúde de Ferro* (Iron Constitution) program. And more recently with the NutriSUS Strategy, which established, as of 2015, the enrichment of food with a set of micronutrients for children in public day care centers.[40]

In recent years, studies have indicated the epidemiological implications of micronutrient deficiency, comparing them to macronutrient deficiency. Most of these deficiencies are subclinical, a phenomenon known as "hidden hunger." [32, 41] It is estimated that more than two billion people in the world have some deficiency of essential vitamins and minerals, mainly iron, vitamin A, iodine and zinc, with the majority of them living in low-income countries.[42] Understanding how these inequalities make up the health framework, particularly in childhood, is crucial for formulation, implementation and evaluation of public policies, since for unequal situations, differentiated interventions are required.[43]

Thus, combining the findings from national studies on nutritional deficiencies with those of overweight, it can be stated that Brazil presents a double burden of food-borne diseases.[44] According to Popkin et al.,[45] early nutritional deficits followed by excesses may be particularly important in low- and middle-income countries undergoing rapid social and economic changes. This evidence is highly relevant and constitutes a strong justification for the prevention of obesity in populations that have undergone dramatic changes in the nutritional environment as a consequence of nutritional transition.

Final thoughts

The present research has made possible the collection of data that may contribute to expanding information that characterizes children's nutritional status. Through the information provided by the children's parents or legal guardians it was found that, because it is a small municipality, the majority of the population is characterized as at risk of social vulnerability, which explains a significant number of schoolchildren who are at nutritional risk, whether for low weight or overweight, which is characteristic of the current situation experienced in Brazil.

Thus, in view of the nutritional transition observed, specific nutrient deficiencies and an increase in overweight and obesity may increasingly be seen as relevant problems that require constant and innovative interventions, consistent with the complex epidemiological profile, levels of infant morbidity and mortality and, consequently, improve the individuals' quality of life.

Carrying out research like this one has great relevance for the development of effective public policies, since they support with knowledge about the magnitude of nutritional problems. The

municipality of Cuité needs to devise strategies on how to reach the most distinct social groups possible with local public policies, since, as this study has shown, the most vulnerable groups are no longer the only ones affected by health and nutrition problems.

Regarding the use of nutritional semiology as a method for evaluating children, its importance as a tool for initial screening of specific nutrient deficiency is highlighted, since, under unfavorable conditions or even in large studies, this technique becomes a potential sign of more serious deficits. However, micronutrients serum dosage remains the most effective method for identifying nutritional deficiencies, which is a limitation of the study.

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