Nutritional status and hemoglobin values of Aruak and Karibe Indian children – Upper Xingu, Central Brazil, 2001-2002

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Abstract

Objective: To evaluate the nutritional status of indigenous children of the Aruak and Karibe linguistic families from the Upper Xingu, Central Brazil, and study the relationship between hemoglobin levels and children's gender, age and nutritional status. In total, 470 children under age ten were studied in 2001/2002. **Methods:** For children under five years old, the diagnosis of undernutrition was based on the height-for-age and weight-for-age indices, with a cutoff value of two standard deviations below the mean values expected for the age and gender reference - WHO, 2006. A diagnosis of overweight was made when the weight-for-height indice was two standard deviations above the mean expected for the same reference; children between five and ten years old were classified as being underweight, overweight or obese according to their body mass index (BMI) by gender and age, as proposed by Cole et al. The diagnosis of anemia was based on hemoglobin concentrations below 11.0 g/dl for children between 6 and 59 months old or below 11.5 g/dl for children between 60 and 120 months old. **Results/conclusion**: Growth deficit was highly prevalent among the Indian children. Low weight-for-height was a very rare condition and overweight was significant among the younger and the older children. About 70% of the children were anemic, and age seems to be the main factor associated with low hemoglobin concentrations.

Key words: children, Indians, nutritional status, hemoglobin, anemia, Upper Xingu, Central Brazil.

Introduction

Indigenous peoples, like other specific groups who live in precarious socioeconomic conditions in developing countries, have been neglected and highly marginalized by the health sector. These peoples are characterized by substandard living conditions, since they are exposed to factors such as the progressive destruction of the ecosystem, migratory work patterns, alcohol abuse, and indiscriminate land settlement by other groups, which play an important role in the high prevalence of some diseases such as malaria, tuberculosis, and, particularly in children, respiratory infections, parasitoses, diarrhea, and malnutrition.[1]

The prevalence of growth deficit and anemia is one of the most important indicators of improper nutritional conditions of populations. Values above 3% and 5%, respectively, characterize these events as public health problems.[2,3]

The percentage of children under five years old with growth deficit in Brazil has been reduced by 50% over the last decade, ranging from 6% to 15% in different regions of the country.[4] However, this improvement was not observed among the indigenous children. Recent studies on the nutritional status of Indian children in this age group have showed prevalences ranging from 10% to 60%.[5,6,7,8,9,10]

According to estimates, the prevalence of anemia in children under five years old in Latin America is around 40%, thus characterizing anemia as a serious public health problem. Among indigenous children, this value is even higher.[3,5,7,11]

The purpose of this study was to evaluate the nutritional status of indigenous children of the Aruak and Karibe linguistic families from the Upper Xingu, Central Brazil, and study the relationship between hemoglobin levels and children's gender, age and nutritional status.

Material and Methods

Study Population

The Aruak and the Karibe groups inhabit the Upper Xingu, in the Parque Indígena do Xingu, Mato Grosso, and, together with the Tupi (Aweti and Kamaiurá), form the so called Upper Xingu Culture or Uluri (small pubic band used by women) Culture. The Aruak are divided into three tribes (Meinaco, Waurá, and Yawalapiti) and the Karibe are divided into four (Kalapalo, Kuikuro, Matipu, and Nafuquá).

According to data from the Universidade Federal de São Paulo – UNIFESP from September, 2001, the Aruak and the Karibe groups totaled 2,330 individuals, and 29% of them were under 10 years old. This study included 201 Aruak and 269 Karibe children, totaling 470 children (70%).

One of the criteria was to include all children present in the indigenous settlement when the research team arrived there for a visit. The field work teams always had two researchers, which made it possible to standardize procedures. The records used in the field work were created by UNIFESP in 1966 and have been regularly updated, allowing the identification of each child by name and date of birth.

Data Collection

The data collected in this study were: weight, height and hemoglobin levels.

Different techniques were applied to determine the weight of children under and over two years old using a KRATOS-CAS (LINEA model) microelectronic scale with capacity up to 150 kg and accurate to 50 g (manufactured according to the standards issued by the Instituto Nacional de Metrologia – INMETRO/DIMEL). In the first case, we determined the mother's weight and the weight of the mother with the child on her lap, then we subtracted the mother's weight; the older children were weighed in upright position. Mothers and children were weighed barefoot, with no clothes or light clothes.

Length/height measurements were taken using a 100-cm-long horizontal wood anthropometer made in Brazil and accurate to 1 mm for children under 24 months old, and a 200-cm-long vertical Stanley stadiometer accurate to 1 mm for older children. The younger children were measured in supine position (lying on the back), whereas the older ones were measured in upright position and barefoot.

All measurements were taken twice. If the measurements did not match, a third measurement was taken. Afterward, we calculated the average of the measures.

For hemoglobin concentration measurements, we used a hemoglobinometer made in Sweden, the Hemocue system.

Data analysis

Nutritional status of children under 5 years old

The analysis of children's nutritional status was based on the height-for-age and weight-for-age indices expressed in Z-scores in relation to the corresponding WHO reference standard (World Health Organization, 2006[12]). Deficits in children's height and low weight-for-height were defined taking into account the height-for-age and weight-for-height indices and Z-scores, that is, children with height and weight-for-height below two standard deviations from the median values expected for the age and gender and for the gender, respectively; a diagnosis of overweight was made for weight-for-height values above two Z-scores, that is, children with weight above two standard deviations from the weight-for-height median expected for the gender.

Six Aruak and 10 Karibe children were excluded from the nutritional status analysis due to lack of information about their heights or height-for-age ratio below five or more standard deviations from the median (values considered "aberrant").

Nutritional status of children between 5 and 10 years old

To diagnose children's nutritional status, we calculated their body mass index (BMI) by dividing their weight in kilograms by their height in square meters (kg/m^2). The children were classified as being underweight, overweight or obese according to the BMI values by gender and age, as proposed by Cole at al.[13,14] The term "overweight" was adopted to identify overweight or obese children. Children's growth deficit was defined taking into account the height-for-age values and Z-scores, that is, children with height below two standard deviations from the median values expected for the age according to the WHO reference standard (World Health Organization, 2007).[15]

Hemoglobin concentration and anemic status

The prevalence of anemia was determined based on the number of children with hemoglobin concentrations below 11.0 g/dl for children between 6 and 59 months old or below 11.5 g/dl for children between 60 and 120 months old. For hemoglobin depletion values, we considered three stages: mild (10-11 g/dl for children between 6 and 59 months old and 10-11.5 g/dl for children between 60 and 120 months old), moderate (7-9.9 g/dl) and severe anemia (<7.0 g/dl).[16] For this analysis, we excluded the children under six months old (17 from the Karibe group and 16 from the Aruak group) and those without data on hemoglobin (38 Karibe children).

The descriptive analysis was presented according to the children's age range for the Aruak and the Karibe groups. The differences observed between mean hemoglobin values and the prevalence of each outcome (anemia and moderate/severe anemia) were calculated for independent variable categories and tested by the Student's t-test and Chi-square test, respectively. The data were analyzed with the Stata 7.0 software.

Ethical aspects

This study is part of a health program the UNIFESP/EPM is developing in the Parque Indígena do Xingu with the purpose of collecting data for health actions and their evaluation. The objective of this study and the procedures to be adopted for the examination of Aruak and Karibe children were explained to the children's parents to make clear that participation was voluntary. The medical team, in turn, committed itself to make the study results available to the community. This information was initially given to community leaders and Indian Health Agents of the settlements, then presented to the entire community, in indigenous languages. No parents refused to enroll their children in the study, and an agreement was signed by the indigenous leaders. The study design was approved by the UNIFESP/EPM's Institutional Review Board under No. 2182/08 and does not pose any conflict of interest.

Results

Most of the Aruak children were males from the Waurá settlement. Mean hemoglobin levels were below normal values, mainly among the children under 24 months old, expressing a high rate of moderate or severe anemia. In this same age group, growth deficit was highly prevalent, affecting over one third of the children. Low weight for height was practically nonexistent among the children, whereas overweight occurred in about 10% of the children under age two and over age five (Table 1).

Most of the Karibe children were males from the Kalapalo and Kuikuro settlements. Their hemoglobin distribution profiles were very similar to those of the Aruak, except for the severity levels, that is, mild or moderate anemia levels were prevalent among the children under two years old. Growth deficit was high, mainly among the children under age five. The prevalence of low weight for height was insignificant, as it was among the Aruak children, while overweight was frequent, especially among the younger children (Table 2).

Table 3 shows mean hemoglobin values and anemia prevalences, as well the severity levels, according to the demographic variables and nutritional status of the children from both indigenous groups. In the group of children under age five, hemoglobin levels were significantly lower among the children under two years old than among those between two and five years old. However, no differences were observed between girls and boys or regarding their nutritional status.

Mean hemoglobin values did not differ by gender or growth deficit in either group for children over 5 years old. The difference observed in Karibe children's hemoglobin concentrations related to overweight should be viewed with caution due to the small number of anemic children in this condition.

Discussion

The analysis of the indigenous children's anthropometric profiles revealed as major results a high prevalence of growth deficit among children under five years old from both Indian people; among those over five years old, the rate of growth deficit in Aruak children was three times higher than that of the Karibe children. Low weight for height was a practically nonexistent condition, whereas the prevalence of overweight was high among children from both indigenous groups.

The World Health Organization's recent recommendation to adopt as reference for the anthropometric indices the healthy children sample distribution from the multicentric study carried out in six countries[12,15] rather than that of the American sample[17] has enabled the comparison of the nutritional deviation rates observed in this study with the recently published results of the Pesquisa de Demografia e Saúde da Criança e da Mulher, 2006[4] (Research on Children and Women Demographics and Health) for the population under five years old.

The percentage of growth deficit observed among indigenous children under five years old is twice as high as that of non-indigenous children of the same age range in the northern region of the country, where this condition was more frequent (about 15%).[4]

Further comparison shows that overweight rates in children under five years old

Table 1- Demographic and anthropometric characteristics and hemoglobin concentration by range age of Aruak children. Upper Xingu – Central Brazil, 2001-2002.

Variables	Age group (months)							
	<24 (n=52)		24 |– 60 (n =71)		60 |– 120 (n=78)		Total	
	mean (sd)	%	mean (sd)	%	mean (sd)	%	mean (sd)	%
Gender								
Male		63.46		45.07		51.28		52.24
Female		36.54		54.93		48.72		47.76
Etnia								
Meinaco		30.77		25.35		24.36		26.37
Waurá		46.15		47.89		50.00		48.26
Yawalapiti		23.08		26.76		25.64		25.37
Height for age deficit		38.30		28.57		21.79		28.20
Weight for height deficit		-		1.43		-		0.51
Overweight		10.64		2.86		10.26		7.69
Hemoglobin (g/dL)	9.50 (1.46)		10.53 (1.13)		10.89 (1.23)		10.48 (1.34)	
Anemia		83.33		61.97		61.54		65.95
Mild		22.22		30.99		42.31		34.05
Moderate		55.56		30.98		19.23		30.81
Severe		5.55		-		-		1.08

were 8.39% among the Karibe people and 5.98% among the Aruak people. These values are very close to those of non-indigenous children from the five regions of the country, which ranged from 5.2% to 8.8%.[4]

Many studies on indigenous children have used the American reference from the National Center of Health Statistics[17] - NCHS for the children's nutritional status analysis. We decided to include the anthropometric indices results based on that distribution in order to facilitate comparison with previously published studies.

It is important to note that this reference underestimates the rate of growth deficit, especially among children under five years old. In fact, applying the NCHS reference distribution for the height-for-age index would result in the following prevalences of growth retardation: 32.69% among the children under two years old and 21.13% among those between two and five years old for the Aruak group; 18.33% and 14.46% for the Karibe group, respectively.

Even so, the prevalence of growth deficit among these children, essentially among the Aruak group, is higher than that of the Kamaiurá children[6] from the Upper Xingu, who speak the Tupi language.

Even more alarming is the rate of anemia observed among the Aruak and Karibe children: almost 70%. Interestingly, age seems to be closely associated with the severity of anemia, since the number of children with moderate or severe anemia and ages between 6 and 23 months is very high when compared with that of children between 24 and 59 months old, especially among the Aruak people.

In other studies on indigenous children, the highest prevalences of anemia, typically above 80%,[5,6,7] were also observed among children under two years old.

Depending on the age of onset and the degree of hemoglobin deficit, physical and cognitive development, especially the latter,

Table 2 *– Demographic and anthropometric characteristics and hemoglobin concentration of Karibe children, by age. Upper Xingu – Central Brazil, 2001-2002.*

Variáveis	Age group (months)							
	<24 (n=68)		24 |– 60 (n=85)		60|– 120 (n=116)		Total	
	mean (sd)	%	mean (sd)	%	mean (sd)	%	mean (sd)	%
Gender								
Male		45.59		49.41		56.03		51.30
Female		54.41		50.59		43.97		48.70
Etnia								
Kalapalo		45.58		40.0		39.66		41.26
Kuikuro		38.24		41.18		41.38		40.52
Matipu		2.94		4.71		6.90		5.20
Nafuquá		13.24		14.12		12.07		13.01
Height for age deficit		21.67		21.69		6.9		15.06
Weight for height deficit		1.67		-		0.86		0.77
Overweight		15.0		3.61		7.76		8.11
Hemoglobin (g/dL)	9,94 (1,13)		10.43 (1.19)		10.95 (1.36)		10.58 (1.32)	
Anemia		84.62		66.22		67.33		70.09
Mild		33.34		32.43		46.54		39.25
Moderate		51.28		32.44		20.79		30.37
Severe		-		1.35		-		0.46

can be permanently impaired. Children between 6 and 24 months old are at the greatest risk of iron deficiency. The data analysis of inquiries from eleven countries participating in the Demographics and Health Research with a selected sample of children in this age range revealed that, each month, 50% of them were found to be anemic.[16]

During the first year of life, feeding is based mainly on mother's milk, and breast-feeding can last until the child is three years old. Even before the child is six months old, he/she starts receiving cassava porridge sporadically, then fish and some fruit are introduced.[18]

The children's diet characteristics, particularly as of the age of six months, seem to reveal reduced food variety. This, plus the fact that sometimes children start to eat by themselves from the moment they start walking, can result in inadequate food consumption in terms of quantity and risk of parasitic infestation. Recently, non traditional foods have been introduced, such as refined sugar, cookies and snacks.

One limitation of this study was the lack of information on the frequency and type of intestinal parasitoses among the children. These parasitoses, if existing, raise the risk of iron deficiency anemia, independently of the habitual diet of the individuals. Although this descriptive epidemiological study uses data collected during the health care activities that UNIFESP professionals have been providing to these communities for over 40 years, such a limitation does not change the magnitude of the problem found, nor does it allow us to propose, based on the presented data, effective measures to control it. For this purpose, it is essential to carry out planned studies to identify the causes of this problem.

Table 3 - Mean hemoglobin concentration (g/dL) and prevalence (%) of anemia according to age. sex and nutritional status in Aruak and Karibe children. Upper Xingu – Central Brazil. 2001-2002.

Variáveis	Aruak			Karibe		
	Hb (g/dL)	Anemia	Mod/Severe Anemia	Hb (g/dL)	Anemia	Mod/Severe Anemia
	Mean (sd)	%	%	Mean (sd)	%	%
< 60 months						
6 |– 24	9.5 (1.46)	83.33	61.11	9.94 (1.13)	84.62	51.28
24 |– 60	10.53 (1.13)	61.97	30.99	10.43 (1.19)	66.22	33.78
	p= 0.0001	*p= 0.024*	*p= 0.003*	*p= 0.036*	*p= 0.037*	*p= 0.071*
Gender						
Male	10.09 (1.35)	72.22	40.74	10.38 (1.04)	70.0	42.0
Female	10.28 (1.32)	66.04	41.51	10.17 (1.30)	74.6	38.10
	p= 0.455	*p= 0.489*	*p= 0.936*	*p= 0.367*	*p= 0.586*	*p= 0.674*
Height-for-age						
Déficit	10.08 (1.39)	69.44	44.44	10.27 (1.04)	75.0	37.50
No déficit	10.25 (1.31)	68.66	38.81	10.26 (1.24)	71.43	39.29
	p= 0.543	*p= 0.934*	*p= 0.579*	*p= 0.99*	*p= 0.73*	*p= 0.874*
Weigth-for-height (*)						
Normal	10.22 (1.34)	67.35	39.80	10.32 (1.16)	71.57	37.25
Overweight	9.87 (1.37)	100.0	50.0	9.5 (1.51)	80.0	60.0
	p= 0.614	*p= 0.168*	*p= 0.683*	*p= 0.129*	*p= 0.682*	*p= 0.307*
>=60 meses						
Gender						
Male	10.92 (1.39)	55.0	22.50	10.98 (1.54)	64.29	23.21
Female	10.85 (1.06)	68.42	15.79	10.91 (1.13)	71.11	17.78
	p= 0.797	*p= 0.223*	*p= 0.452*	*p= 0.80*	*p= 0.467*	*p= 0.447*
Height-for-age						
Déficit	10.65 (0.76)	76.47	17.65	10.39 (1.41)	87.50	37.5
No déficit	10.95 (1.33)	57.38	19.67	10.99 (1.36)	66.59	19.35
	p= 0.375	*p=0.152*	*p= 0.851*	*p= 0.228*	*p= 0.205*	*p= 0.225*
BMI(*)						
Adequado	10.87 (1.25)	61.48	20.0	10.87 (1.36)	69.15	22.34
Excesso	11.07 (1.14)	62.5	12.50	12.1 (1.11)	33.33	-
	p= 0.657	*p= 0.953*	*p= 0.610*	*p= 0.033*	*p= 0.070*	*p= 0.193*

(*) Underweight children were excluded from the nutritional status analysis

Final considerations

The findings of this study suggest the monitoring of children's growth and hemoglobin status, particularly for those under two years old, in order to reduce health damage or minimize its severity in older ages.

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References

1. Holveck JC, Ehrenberg JP, Ault SK, Rojas R, Vasquez J, Cerqueira, MT, Ippolito-Shepherd J, Genovese MA, Periago MR. Prevention, control, and elimination of neglected diseases in the Americas: pathways to integrated, inter-programmatic, inter-sectoral action for health and development. *BMC Public Health* 2007; 7: 6.

2. World Health Organization. *Physical status: the use and interpretation of anthropometry.* Geneva; 1995 (WHO – Technical Report Series, 854).

3. McLean E, Egli I, Cogswell M, Benoist B, Wojdyla D. *Worldwide prevalence of anemia in preschool age children and pregnant women and non-pregnant women of reproductive age*. In: Kraemer K, Zimmermann MB. Nutritional Anemia. Switzerland: Sight and Life Press: 2007. p.1-12.

4. Ministério da Saúde. PNDS 2006. Relatório da Pesquisa Nacional de Demografia e Saúde da Criança e da Mulher. Brasília/DF, 2008. http://www.saude.gov.br/pnds2006. Acesso: 07/08/2008.

5. Morais MB, Alves GMS, Fagundes-Neto, U. Estado nutricional de crianças índias terenas: evolução do peso e estatura e prevalência atual de anemia. *J Pediatr* 2005; 81(5): 383-9.

6. Mondini L, Canó EN, Fagundes U, Lima EES, Rodrigues D, Baruzzi RG. Condições de nutrição em crianças Kamaiurá – povo indígena do Alto Xingu, Brasil Central. *Rev Bras Epidemiol* 2007; 10 (1): 39-47.

7. Orellana JDY, Coimbra Jr. CEA, Lourenço AEP, Santos RV. Estado nutricional e anemia em crianças Suruí, Amazônia, Brasil. *J Pediatr* 2006; 82 (5): 383-8.

8. Pícoli RP, Carandina L, Ribas, DLB. Saúde materno-infantil e nutrição de crianças Kaiowá e Guarani, Área indígena de Caarapó, Mato Grosso do Sul Brasil. *Cad Saúde Pública* 2006; 22 (1): 223-7.

9. Menegolla IA, Drachler ML, Rodrigues IH, Schwingel LR, Scapinello E, Pedroso MB, Leite JCC. Estado nutricional e fatores associados à estatura de crianças da Terra Indígena Guarita, Sul do Brasil. *Cad Saúde Pública* 2006; 22 (2): 395-406.

10. Leite MS, Santos RV, Coimbra Jr. CEA. Sazonalidade e estado nutricional de populações indígenas: o caso Wari', Rondônia, Brasil. *Cad Saúde Pública* 2007; *23* (11): 2631-42.

11. Baruzzi RG, Barros VL, Rodrigues D, Souza ALM, Pagliaro H. Saúde e doença em índios Panará (Kree-Akarôre) após vinte e cinco anos de contato com o nosso mundo, com ênfase na ocorrência de tuberculose (Brasil Central). *Cad Saúde Pública* 2001; 17(2): 407-12.

12. World Health Organization. *WHO child growth standards:* length/height-for-age, weight-for-length, weight-for-height: methods and development. Geneva: WHO, 2006.

13. Cole TJ, Bellizzi, MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ* 2000; 320: 1-6.

14. Cole TJ, Flegal KM, Nicholls D, Jackson A. Body mass index cut offs to define thinness in children and adolescents: international survey. *BMJ* 2007; 335: 194-201.

15. World Health Organization, 2007. WHO growth reference for school-aged children and adolescents: height-for-age.[site na internet]. http://www.who.int/childgrowth/en/. Acesso: 03/04/2008.

16. Gleason G, Scrimshaw NS. *An overview of the functional significance of iron deficiency*. In: Kraemer K, Zimmermann MB. Nutritional Anemia. Switzerland: Sight and Life Press: 2007. p.45-57.

17. Hamill PV, Drizd TA, Johnson CL, Reed RB, Roche AF, Moore WM. Physical growth: National Center for Health Statistics percentiles. *Am J Clin Nutr.* 1979; 32:607-29.

18. Mattos A, Morais MB, Rodrigues DA, Baruzzi RG. Nutritional status and dietary habits of Indian children from Alto Xingu (Central Brazil) according to age. *Journal of American College of Nutrition* 1999; 18 (1):88-94.