

Living conditions, nutrition, and maternal and child health in the Baniwa Indigenous people, Northwest Amazon, Brazil

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THEMATIC ARTICLE

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Abstract *Epidemiological surveys by ethnic groups are scarce in Brazil. The health and nutrition conditions of indigenous peoples who face situations of social inequities and inequalities, negatively influence their health indicators. This study is the widest investigation on the subject ever carried out on the Baniwa ethnic group, one of the most numerous in the country. The survey aimed to analyze the living conditions and nutritional profile of children aged under 60 months and women aged 14 to 49 years of the Baniwa ethnic group, residing in the northwest region of the state of Amazonas, in the Indigenous Land of Alto Rio Negro, an area that serves as a border connecting Brazil, Colombia, and Venezuela. The results show a high prevalence of chronic malnutrition in 52.5% (95%CI 48.9-56.1) and anemia in 68.3% (95%CI 64.5-71.8) of children under 60 months, in addition to overweight in 26.3% (95%CI 18.4-27.0) and anemia in 52.3% (95%CI 43.6-53.6) of the women. The situations of food insecurity observed in this study are linked to poor income and sanitation conditions. The magnitude of these injuries expresses the low effectiveness of primary care actions offered by the health system, with a significant percentage of hospitalizations resulting from injuries sensitive to basic care at the primary care level.*

Key words *Health of Indigenous peoples, Nutritional status, Maternal health, Child health, Amazon*

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Introduction

Surveys aimed at characterizing health and nutritional conditions carried out in the Brazilian population in recent decades have demonstrated a decline in nutritional issues, such as a decrease in malnutrition and anemia, in parallel with an accelerated increase in chronic Noncommunicable Diseases (NCDs), with an emphasis on obesity, cardiovascular diseases (CVDs), and diabetes mellitus¹⁻³.

Compared to what is observed for the Brazilian population in general, the health and nutritional conditions of Indigenous peoples who face social and health inequities and inequalities are less known, which negatively influence their health indicators^{1,4,5}. Studies conducted with Indigenous peoples in Brazil have pointed to the persistence of a high prevalence of chronic malnutrition and anemia in children⁶, concurrent with the rapid nutritional transition that is reflected in the high prevalence of excess weight, diabetes mellitus, and high blood pressure in adults⁷⁻¹⁰. At the same time, infectious and parasitic diseases persist in the epidemiological scenario, with diarrhea and acute respiratory infections standing out as the main causes of illness and death in children under five years of age^{11,12}.

The 1st National Health and Nutrition Survey of Indigenous Peoples in Brazil, the only nationwide survey that focused on the Indigenous population in the country, evidenced the marked inequality that separates them from the non-Indigenous contingent of the population⁵. Without denying the relevance of producing nationwide data on the health and nutritional conditions of Indigenous peoples in the country, investigations focusing on local contexts can also potentially deliver information that enables the identification of intra-regional inequalities and ethnic singularities. Furthermore, there are not enough epidemiological studies representative of ethnic groups as a whole. This investigation aimed to analyze the living conditions and nutritional profile of children under 60 months and women aged 14 to 49 years in the Baniwa ethnic group, from the Northwest region of the state of Amazonas. This is the most extensive investigation on the subject ever conducted regarding this specific ethnic group, one of the most numerous in the country.

Population and methods

The Baniwa people live in villages distributed along the Içana River, a tributary of the Rio Negro in the Alto Rio Negro Indigenous Lands (I.L.), municipality of São Gabriel da Cachoeira, state of Amazonas, in a border area connecting Brazil, Colombia, and Venezuela^{13,14} (Figure 1).

The Baniwa population receives medical care from the Indigenous Health Subsystem through the Alto Rio Negro Special Indigenous Health District (DSEI-ARN), which has five operational units, the base hubs (Camarão, Tunuí, Tucumã, São Joaquim, and Canadá), on the land occupied by the Baniwa. Each base hub provides care to the main village and a group of smaller villages attached to it, forming five health microregions equivalent to the traditional territorial distribution of Baniwa kinship groups.¹³ The reference care system is located in the municipal headquarters of São Gabriel da Cachoeira. It also provides banking and other public institution services, in addition to commercial establishments used by Indigenous people.

The study population was selected based on a list produced by the Indigenous Health Care Information System of the Rio Negro Special Indigenous Health District which, in January 2009, totaled 5,980 individuals. The Camarão microregion, closest to the municipal headquarters, had 21 villages and 1,622 Indigenous residents; Tunuí had 14 villages, and 1,576 residents; Tucumã had 17 villages, and 1,088 Indigenous people; Canadá had 18 villages and 1,694 Indigenous people; and São Joaquim had 19 villages and 1,186 Indigenous people. Women of childbearing age (14-49 years) made up 22.8% of the population (n = 1,366) and children < 60 months represented 15.5% (n = 930)¹⁵.

A stratified probabilistic sample was calculated for the set of Baniwa villages and by microregion, estimated based on the size of the target population in each microregion with a prevalence of 50% for all endpoints, a relative precision of 5%, and a 95% confidence level (95% CI). The estimated sample size was increased by 20% to reduce the impact of potential losses.

Villages with less than 2 families (n = 4) and those that did not have children < 60 months or women aged 14 to 49 years (n = 6) were excluded from the sample calculation. The five host villages of the base hubs were left out of the draw and were included in the study population *a priori*. At the end of this phase, 78 villages remained on the list for sample calculation purposes. The

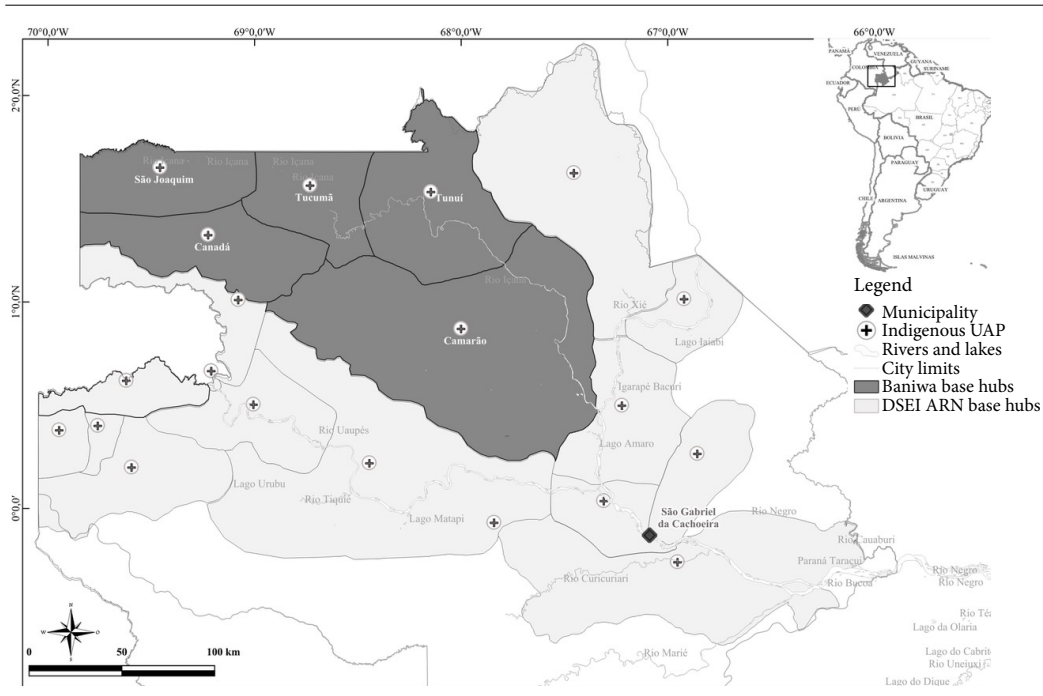


Figure 1. Map of the São Gabriel da Cachoeira municipality, Alto Rio Negro DSEI base hubs in the Içana River, Baniwa ethnic group, Amazon Northwest, Brazil.

Source: Adapdet from IBGE - 2022 and DSEI - ARN - 2020. Forecast SIRGAS - 2000.

selection followed sequential Poisson sampling criteria. For the selection of women and children, our study estimated the need to include in the sample at least 602 Baniwa women and 450 children, residents of the sampled villages, based on data from the DSEI -RNA Indigenous Health Care Information System (*Sistema de Informação da atenção à Saúde Indígena* - SIASI).

Data collection was carried out between 2011 and 2013, guided by the procedures used in the 1st National Survey of Health and Nutrition of Indigenous Peoples in Brazil⁵, seeking to achieve data comparability. The questionnaires contained variables for village, household, women, and children. Living conditions and socioeconomic profiles were investigated, using household sociodemographic variables, such as the total number of residents in the household, sources of income and food consumed, asset rate, and sanitation conditions. The asset rate calculation was also based on the methodology of the 1st Survey (Coimbra *et al.*⁵), whose measurement of durable goods available in each household formed a correlation matrix between the numbers of items found. The sum and relative contribution of each durable good supported the formulation of scores

that guided the classification of households into tertiles (1st tertile – lowest sum of goods; 2nd tertile – intermediate sum; and 3rd tertile – highest sum of goods), by microregion.

The nutritional profile was obtained through anthropometric measurements taken by two trained evaluators (Lohman *et al.*¹⁶). Height was measured using a portable anthropometer AlturaExata (Belo Horizonte, Brazil), with an accuracy of 0.1 cm. The same anthropometer was used to measure the length of children < 24 months of age. Weight was measured with a portable digital scale (Seca 872, Hamburg, Germany), with a capacity of 150 kg and precision of 100 g. The mother/child function of the same scale was used for children < 2 years of age.

Hemoglobin concentration in children (ages ≥ 6 months and < 5 years of age) and women (aged 14-49 years) was measured by drawing a drop of capillary blood with finger sticks, using disposable lancets and an Accu-Chek Softclix lancing device (Roche, Mannheim, Germany) and portable hemoglobinometers (HemoCue Hb 201+, Ängelholm, Sweden). Children with hemoglobin levels < 11.0 g/dL were considered anemic and levels < 9.5 g/dL were considered in-

dicative of moderate/severe anemia; women were considered to have anemia with hemoglobin levels < 12.0 g/dL for those over 14.0 years of age and < 11.0 g/dL for pregnant women¹⁷.

The Anthro software was used to calculate anthropometric indicators, using data on children's height, weight, and age to estimate height-for-age (H/A), weight-for-age (W/A), and body mass index-for-age (BMI/A), according to the cutoff points proposed by the World Health Organization (WHO) for diagnosing malnutrition¹⁸. Women's BMI was calculated and the WHO¹⁹ cutoff points were used for diagnosing underweight, overweight, and obesity.

The population characteristics were described by absolute and relative frequencies, with statistical weighting. Their respective 95% CIs were estimated considering the effect of the stratified probabilistic sample study design. Calculations were performed in IBM SPSS Statistics 22.0 (IBM Corp, Armonk, NY, USA).

The research was approved by the Research Ethics Committee of the Federal University of Amazonas and by the National Research Ethics Committee (CAAE-0337.0.115.115-10). All legal procedures for obtaining consent were followed.

Results

The final sample of the study consisted of 26 villages: 6 in the Camarão microregion, 4 in Tunuí, 5 in Canadá, 4 in Tucumã, and 7 in São Joaquim. Among the sample of households, 361 participated (86.8% of what was planned), and none refused. The inclusion of 602 women, aged 14

to 49 years, and 450 children, aged < 60 months, was planned, with data being obtained for 577 (95.8%) and 376 (83.6%), respectively. The stratified calculations for women and children, according to the planned and actual sample microregions, are shown in Table 1.

The highest percentage of losses occurred in São Joaquim (24.8% losses for the child population), due to the impossibility of geographic access to one of the selected villages. Camarão had 23.6% losses, due to the absence of residents during the collection period.

The median number of residents per household was 6 people. The Canadá microregion had the highest density of people per household (median = 8 and mean = 7.71). For the set of women, the median was one woman per household, with a maximum number of five women per household, except in the Canadá microregion (median = 2). As for the children, in all microregions, the median was one per household, with a maximum of four children per household in Camarão.

The socioeconomic profile of the households (Table 2) showed that the majority had dirt floors (75.3%), with slightly lower percentages being recorded in the two microregions closest to the municipal headquarters (namely, Camarão – 62.2% and Tunuí – 67.2%). The majority of houses had wattle and daub/adobe walls (64.7%) and thatched roofs (61.4%), with lower percentages in Canadá (32.0% of wattle and daub/adobe walls) and Tunuí (47.5% of thatched roofs).

In the distribution of the household goods rate, 36.3% of households were found in the 1st tertile of the sum of goods. The proportion of households with social security beneficiaries

Table 1. Villages, households, and study population by microregion. Baniwa ethnic group, Amazon Northwest, Brazil 2011 to 2013.

Microregion	Heas and attached villages		Household			Women (14-49 years old)				Children (< 60 months old)			
	N	n	N	final n	%	N	n	final n	%	N	n	final n	%
Camarão	19	6	101	101	100	302	144	140	97	223	123	94	76
Tunuí	14	4	92	75	82	311	114	117	103	215	92	85	92
Canadá	16	5	72	58	81	221	97	116	120	171	76	66	87
Tucumã	17	4	59	51	86	249	88	84	95	146	58	55	95
São Joaquim	17	7	92	76	83	283	159	120	75	175	101	76	75
Total	83*	26	416	361	87	1.366	602	577	96	930	450	376	84

Key: N = eligible locations and populations; n = planned sample (in absolute numbers); final n = sample achieved (in absolute numbers); % = percentage of the sample achieved; * total number of eligible villages (78 from the draw for sample calculation and 5 base hub headquarters).

Source: Authors.

was 20.5% for all microregions. This percentage was lower in Tunuí (9.5% of retirees) and higher in Canadá (27.0%) (Table 2). In approximately half of the sampled households (55.8%), their

residents were enrolled in a government social benefit program. In two of the five microregions in the study, this percentage exceeded 65.0% (Camarão with 66.1% and Canadá with 65.7%).

Table 2. Demographic and housing characteristics, and socioeconomic indicators by microregion. Baniwa ethnic group. Amazon Northwest. Brazil 2011 to 2013.

Characteristics	All	Microregions				
		Camarão	Tunuí	Canadá	Tucumã	São Joaquim
Residents						
Mean (SD)	6.23 (2.55)	6.10 (2.58)	5.94 (2.04)	7.71 (3.14)	5.74 (2.31)	5.96(1.97)
Var (min-max)	6.4 (2-17)	6.65 (2-15)	4.17 (2-11)	9.83(3-17)	5.31 (2-13)	3.88(2-13)
Median	6	6	6	8	6	6
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
	IC (95%)	IC (95%)	IC (95%)	IC (95%)	IC (95%)	IC (95%)
Type of floor						
Dirt	858 (75.3)	242 (62.2)	119 (67.2)	155 (87.1)	190 (86.8)	152 (86.4)
	72.7-77.9	57.8-66.7	60.3-73.7	82.3-92.0	81.9-91.1	80.9-91.0
Wooden	08 (0.7)	---	---	08 (4.5)	---	---
	0.2-1.2	---	---	1.8-8.0	---	---
Ceramic	16 (1.4)	16 (4.1)	---	---	---	---
	0.7-2.2	2.2-6.0	---	---	---	---
Cement	251 (22.0)	131 (33.7)	58 (32.8)	15 (8.4)	23 (10.5)	24 (13.6)
	19.6-24.6	29.1-38.0	26.3-39.7	4.5-12.6	6.7-14.7	9.0-19.1
Other	06 (0.5)	---	---	---	6 (2.7)	---
	0.2-1.0	---	---	---	0.9-5.0	---
Type of wall						
Straw	02 (0.2)	---	---	02 (1.1)	---	---
	0.0-0.4	---	---	0.0-3.0	---	---
Wooden	387 (34.0)	201 (51.7)	62 (35.0)	119 (66.9)	05 (2.3)	---
	31.3-36.7	46.7-56.7	27.9-42.4	59.8-73.6	0.5-4.5	---
Brick	02 (0.2)	---	---	---	03 (0.9)	---
	0.0-0.4	---	---	---	0.0-2.3	---
Wattle and daub/adobe	737 (64.7)	180 (46.3)	115 (65.0)	57 (32.0)	212 (96.8)	173 (98.3)
	62.0-67.4	41.5-51.4	57.6-72.1	25.4-39.2	94.4-99.0	96.2-100.0
Tarp/plastic	---	---	---	---	---	---
	---	---	---	---	---	---
Other	11 (1.0)	08 (2.1)	---	---	---	03 (1.7)
	0.4-1.6	0.7-3.6	---	---	---	0.0-3.8
Type of roof						
Straw	697 (61.4)	181 (47.0)	84 (47.5)	87 (48.9)	196 (89.5)	149 (84.7)
	58.7-64.1	42.2-51.9	39.9-54.4	41.8-56.4	85.1-93.3	79.2-89.6
Wooden	02 (0.2)	---	---	02 (1.1)	---	---
	0.0-0.4	---	---	0.0-2.9	---	---
Slab	---	---	---	---	---	---
	---	---	---	---	---	---
Tarp/plastic	---	---	---	---	---	---
	---	---	---	---	---	---
Tile (mud)	---	---	---	---	---	---
	---	---	---	---	---	---
Tile (zinc or asbestos)	436 (38.4)	204 (53.0)	93 (52.5)	89 (50.0)	23 (10.5)	27 (15.3)
	35.8-41.1	48.1-57.8	45.6-60.1	42.5-57.2	6.7-14.9	10.4-20.8

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Table 2. Demographic and housing characteristics, and socioeconomic indicators by microregion. Baniwa ethnic group, Amazon Northwest, Brazil 2011 to 2013.

Characteristics	All	Microregions				
		Camarão	Tunuí	Canadá	Tucumã	São Joaquim
Asset rates						
1st tertile	414 (36.3)	64 (16.5)	76 (42.9)	79 (44.4)	105 (47.9)	90 (51.1)
	0.14-0.16	0.10-0.14	0.14-0.19	0.15-0.19	0.15-0.18	0.10-0.15
2nd tertile	38 (33.6)	140 (36.0)	58 (32.8)	62 (34.8)	84 (38.4)	39 (2.2)
	0.63-0.67	0.66-0.72	0.57-0.65	0.61-0.70	0.52-0.60	0.63-0.79
3rd tertile	342 (30.0)	185 (47.6)	43 (24.3)	37 (20.8)	30 (13.7)	47 (26.7)
	1.75-1.86	1.75-1.90	1.63-1.92	1.81-2.17	1.45-1.76	1.63-1.82
Retirement benefit						
Yes	234 (20.5)	95 (24.4)	17 (9.5)	48 (27.0)	37 (16.9)	37 (21.0)
	18.2-22.9	20.2-28.5	5.1-14.3	20.4-34.0	12.2-22.0	15.0-27.1
No	905 (79.5)	294 (75.6)	160 (90.4)	130 (73.0)	182 (83.1)	139 (79.0)
	77.1-81.8	71.5-79.8	85.7-94.9	66.0-79.6	78.0-87.8	72.9-85.0
Government benefits						
Yes	636 (55.8)	257 (66.1)	76 (42.9)	117 (65.7)	101 (46.1)	85 (48.3)
	52.9-58.6	61.3-70.9	35.2-50.3	58.3-72.6	39.3-52.8	41.0-56.3
No	503 (44.2)	132 (33.9)	101 (57.1)	61 (34.3)	118 (53.9)	91 (51.7)
	41.4-47.1	29.1-38.7	49.7-64.8	27.4-41.7	47.2-60.7	43.7-59.0

Key: n = sample with statistical weighting (in absolute numbers); % = percentage in relation to the column; SD = standard deviation; Var = variance; CI = confidence interval.

Source: Authors.

For this variable, geographic distance was irrelevant, since the percentage reached by residents in São Joaquim, the furthest microregion from the municipal headquarters, was slightly higher (48.3%) than that achieved in other microregions comparatively closer to the city, such as Tunuí (42.6%) and Tucumã (46.1%).

Respondents pointed out the production of food resources in the territory itself as significant: 98.2% of households cultivate or raise animals and in around 97% hunting, fishing, and food collection activities are carried out (data not tabulated). The number of households (95.2%) reporting the consumption of processed foods was high, while the proportion of respondents (7.0%) who reported receiving donated food was low.

As for sanitary conditions (Table 3), water from the river was referred to as the main source for domestic consumption (76.7%), and, in the microregions furthest from the municipal headquarters, this reached 100%. Almost all of the interviewees (97.6%) declared that they defecate in the open. Electricity is discontinuous in most households (59.3%), and 40.7% did not have electricity. In the Tucumã microregion, this per-

centage rose to 73.1% of the participants without electricity in their homes. Charcoal or firewood burned outside the home (58.4%) were the main fuels used in cooking food among the Baniwa.

Table 4 highlights the main nutritional problems found among Baniwa women and children. Overweight and obesity were identified in 26.3% and 4.6% of women, respectively. Canadá and Camarão stood out for the highest overweight frequencies (36.0% and 32.1%). The microregions closest to the municipal headquarters, Camarão and Tunuí, had higher obesity rates, 7.5% and 7%, respectively. The proportion of women with anemia was 52.3% and varied little between microregions, except for Canadá (71.5%).

More than half of the children < 60 months (52.5%) had low height-for-age, with reduced variation between microregions, and 11.2% had low weight-for-age. No cases of overweight or obesity were found in children (data not tabulated). The frequency of anemia in children was 68.3%, with emphasis on Tunuí, where 75.3% of children were anemic. The main self-reported causes of hospitalization among hospitalized children were diarrhea (45.1%) and acute respiratory infections (35.0%).

Table 3. Socio-sanitary characteristics by microregion. Baniwa ethnic group, Amazon Northwest, Brazil 2011 to 2013.

Characteristics	Microregions					
	All	Camarão	Tunuí	Canadá	Tucumã	São Joaquim
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
	95% CI	95% CI	95% CI	95% CI	95% CI	95% CI
Source of water for consumption						
Tap indoors	04 (0.4) 0.1-0.7	04 (1.0) 0.2-2.1	---	---	---	---
Tap outdoors used by the household	41 (3.6) 2.5-4.7	---	41 (23.2) 17.0-29.9	---	---	---
Tap outdoors for collective use	08 (0.7) 0.3-1.2	08 (2.1) 0.8-3.5	---	---	---	---
Well	101 (8.9) 7.2-10.6	68 (17.5) 13.6-21.2	---	---	---	33 (18.8) 12.6-24.9
River, creek, lake, reservoir	874 (76.7) 74.2-79.1	232 (59.6) 54.9-64.7	120 (67.8) 60.5-74.7	174 (97.8) 95.1-99.5	210 (100.0) ---	129 (73.3) 65.8-79.8
Other	111 (9.7) 8.0-11.5	77 (19.8) 15.7-23.8	16 (9.0) 5.0-13.4	04 (2.2) 0.5-4.9	---	14 (8.0) 4.0-11.9
Electric light in the household						
Yes, but discontinuous	675 (59.3) 56.5-61.9	285 (73.3) 68.7-77.6	133 (75.1) 68.7-81.6	131 (73.6) 66.9-79.8	59 (26.9) 20.9-32.7	67 (38.1) 31.2-45.6
No	464 (40.7) 38.1-43.5	104 (26.7) 22.5-31.3	44 (24.9) 18.4-31.3	47 (26.4) 20.2-33.1	170 (73.1) 67.3-79.1	109 (61.9) 54.4-68.8
Place where residents usually defecate						
Indoors (latrine/toilet)	04 (0.4) 0.1-0.7	04 (1.0) 0.2-2.1	---	---	---	---
Outdoors (latrine/toilet used only by the household)	20 (1.8) 1.0-2.6	20 (5.1) 3.1-7.5	---	---	---	---
Outdoors (collective latrine/toilet)	03 (0.3) 0.0-0.6	---	---	---	---	03 (1.7) 0.0-3.9
In the woods	1112 (97.6) 96.6-98.5	365 (93.8) 91.2-96.2	177 (100.0) ---	178 (100.0) ---	219 (100.0) ---	173 (98.3) 96.1-100.0
For cooking, what is predominantly used						
Natural Gas	155 (13.6) 11.5-15.5	142 (36.5) 31.5-41.4	07 (4.0) 1.3-7.1	---	06 (2.7) 0.9-4.9	---
Coal or firewood, indoors, with exhaust to the outside	08 (0.7) 0.3-1.2	08 (2.1) 0.8-3.6	---	---	---	---
Coal or firewood, indoors, with no exhaust	111 (9.7) 8.1-11.6	36 (9.3) 6.4-12.4	42 (23.7) 17.6-30.1	28 (15.7) 10.1-21.3	05 (2.3) 0.45-4.4	---
Coal or firewood, outdoors	665 (58.4) 55.5-61.2	199 (51.2) 46.0-56.2	78 (44.1) 36.3-51.4	115 (64.6) 57.9-71.8	157 (71.1) 65.9-77.6	116 (65.9) 59.1-73.4
Combination of natural gas, coal, or firewood	200 (17.6) 15.3-19.8	04 (1.0) 0.3-2.1	50 (28.2) 21.8-35.3	35 (19.7) 13.9-25.6	51 (23.3) 17.8-29.0	60 (34.1) 26.6-40.9

Key: n = sample with statistical weighting (in absolute numbers); % = percentage in relation to the column; SD = standard deviation; Var = variance; CI = confidence interval.

Source: Authors.

Discussion

In addition to providing a detailed overview of the living and health conditions of the Baniwa, based on a statistically representative sample, the

findings provided comparisons with previous research that focused on Indigenous peoples on a national scale, as occurred in the 1st National Health and Nutrition Survey of Indigenous Peoples.

Table 4. Demographic, nutritional, and selected health problems profile in women and children by microregion. Baniwa ethnic group, Amazon Northwest, Brazil 2011 to 2013.

Characteristics	All	Microregions				
		Camarão	Tunuí	Canadá	Tucumã	São Joaquim
Women (aged 14-49 years)						
Mean (SD)	1.57 (0.86)	1.41(0.69)	1.50 (0.79)	1.88(0.98)	1.64(0.99)	1.57 (0.90)
Var (min-max)	0.75(1-6)	0.47 (1-4)	0.63(1-4)	0.97(1-5)	0.97(1-5)	0.82(1-6)
Median	1	1	1	2	1	1
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
	IC (95%)	IC (95%)	IC (95%)	IC (95%)	IC (95%)	IC (95%)
Low weight	13 (1.0)	04 (1.7)	01 (0.4)	06 (2.5)	---	02 (1.2)
	0.0-0.8	0.0-4.1	0.0-1.3	0.0-5.4	---	0.0-3.2
Overweight	329 (26.3)	77 (32.1)	48 (19.8)	86 (36.0)	74 (22.6)	31 (18.9)
	18.4-27.0	24.8-40.9	15.2-24.6	27.0-46.4	19.7-39.1	10.7-25.7
Obesity	58 (4.6)	18 (7.5)	17 (7.0)	13 (5.4)	01 (0.3)	09 (5.5)
	2.7-7.2	3.3-12.2	4.0-10.4	1.0-9.4	0.0-3.9	1.1-9.6
Anemia	684 (52.3)	104 (39.2)	128 (49.4)	176 (71.5)	179 (50.0)	97 (54.2)
	43.6-53.6	30.5-47.4	43.4-55.6	64.7-81.4	34.4-55.4	64.7-81.4
Children (aged <60 months)						
Mean (SD)	1.00(0.83)	0.96(0.89)	1.07(0.80)	1.12(0.89)	0.91(0.78)	0.98(0.72)
Var (min-max)	0.70(0-4)	0.80(0-4)	0.64(0-3)	0.79(0-3)	0.61(0-3)	0.53(0-3)
Median	1	1	1	1	1	1
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
	IC (95%)	IC (95%)	IC (95%)	IC (95%)	IC (95%)	IC (95%)
Low H/A	390 (52.5)	93 (50.3)	101 (53.4)	80 (53.0)	53 (57.6)	63 (50.0)
	48.9-56.1	43.1-57.9	45.8-60.3	45.2-61.0	46.2-68.0	41.3-59.4
	83 (11.2)	26 (14.1)	17 (9.0)	20 (13.2)	09 (9.8)	11 (8.7)
Low W/A	9.0-13.6	9.5-19.3	5.2-13.2	7.5-19.1	4.5-17.2	4.2-13.8
	459 (68.3)	107 (62.6)	125 (75.3)	98 (72.1)	54 (63.5)	75 (65.8)
Anemia	64-5-71.8	55.6-69.8	68.5-81.8	64.4-79.4	52.9-74.7	57.0-74.6
At least one hospitalization in the last 12 months	71 (9.5)	22 (11.9)	20 (10.5)	07 (4.5)	08 (8.7)	14 (11.1)
	7.5-11.7	7.6-17.0	6.3-14.7	1.9-8.4	3.4-15.2	5.9-16.9
The cause of hospitalization, among children hospitalized in the last 12 months, was diarrhea	32 (45.1)	06 (27.3)	13 (65.0)	01 (14.3)	03 (37.5)	09 (64.3)
	35.0-57.4	9.5-47.8	42.9-85.7	0.0-50.0	0.0-77.8	36.4-90.0
The cause of hospitalization, among children hospitalized in the last 12 months, was respiratory infection	25 (35.2)	06 (27.3)	08 (40.0)	03 (42.9)	01 (12.5)	07 (50.0)
	24.6-47.1	9.1-47.4	18.2-62.5	0.0-80.0	0.0-42.9	22.2-77.8
The cause of hospitalization, among children hospitalized in the last 12 months, was malaria	04 (5.6)	0 (0.0)	0 (0.0)	0 (0.0)	02 (25.0)	02 (14.3)
		---	---	---	0.0-60.0	0.0-37.5

Key: n = sample with statistical weighting (in absolute numbers); % = percentage in relation to the column; SD = standard deviation; Var = variance; CI = confidence interval.

Source: Authors.

The Alto do Rio Negro region has been the focus of important investigations over the last few decades¹⁴, both from an anthropological and an ecological-human point of view. Studies indicate that the forest is well preserved, but the soils are described as acidic and lacking in mi-

cronutrients essential for agriculture, conditions that also result in limited availability of game and fish²⁰⁻²². The traditional Baniwa settlement pattern is characterized by low population density and spacing of villages, characteristics that contribute to reducing the depletion of land and

food sources around homes¹³. However, changes in settlement patterns, demographic growth in villages, and recent changes in families' economic activities have had a negative impact on production and access to traditional foods. These changes promote the consumption of processed foods and the consequent impoverishment of the diet²³. In this context of change, the results of the present study need to be contextualized and interpreted.

This study's results showed that the Baniwa face unfavorable income conditions, with 36.3% of households falling into the lowest tertile of the asset rate. One can question the use of consumer goods to classify the socioeconomic profile of Indigenous families. However, maintaining the same methodology used in the 1st Survey provided a comparison of the Baniwa findings with the group of Indigenous population living in the national territory, of which 33.4% of households fall into the same tertile. This problem is exacerbated in other Indigenous populations living in the Amazon, since, according to the 1st Survey, 50.8% of Indigenous households in the North region fall into the lower tertile⁵, putting the Baniwa in a slightly more favorable situation than their counterparts in the North.

The physical conditions of the dwellings exhibit significant differences when comparing the Baniwa with the global profile of the Indigenous population investigated by the 1st Survey, in which 30.9% of the houses had dirt floors and 25.4% had thatched or wooden roofs⁵. The frequencies for these two characteristics were more than double in Baniwa households (75.3% and 61.4%, respectively). However, in the case of Amazonian Indigenous peoples, this characterization needs to be relativized, as the scenario found indicates that members of the group continue to use natural resources available in their territory to build homes. This condition guarantees autonomy in the management of livelihoods and allows families to channel financial resources towards other subsistence needs²³.

This reasoning does not extend to the lack of sanitation that favors the transmission of infectious and parasitic diseases associated with open defecation and consuming water of dubious drinkability. The preponderance (97.6%) of those who declared that they defecate in the open contrasts with the 30.0% of respondents to the 1st Survey who answered affirmatively to the same question⁵. A similar proportion was obtained for the origin of water consumed in households, with 76.7% of respondents reporting that they obtain it

from rivers and other watercourses, as compared to 11.6% of Indigenous households interviewed in the 1st Survey. In this regard, 97.8% of respondents from Canadá stated that they consume water from rivers and streams; from São Joaquim, 73.3%, and from Tunuí, 67.8%, showing that exposure to waterborne diseases worsens in certain locations. In at least two of these microregions, São Joaquim and Tunuí, diarrhea was the most frequent cause of child hospitalizations (64.3% and 65.0%, respectively).

Although there are no representative studies on the frequency of intestinal parasitism in the Baniwa population as a whole, the investigation of 270 people in two Baniwa villages showed that 100% of them were infected with protozoa or helminths, with a predominance of *Giardia intestinalis* and *Entamoeba spp.* in children aged 0-12 years, confirming the need to ensure adequate sanitation²⁴.

The geographic barriers faced by Indigenous populations in the Amazon have been identified as factors limiting access to health care, as they restrict the provision of care infrastructure and allocation of healthcare professionals, limiting the quality and effectiveness necessary for health care²⁵. In Baniwa lands, the large geographic extension and 14 large waterfalls make travel more expensive, making it difficult to internalize public policies and provide regular assistance. These conditions also affected data collection for this research, due to difficulties in accessing more distant villages. Such conditions contribute to an increase in hospitalizations for conditions sensitive to primary care, such as diarrhea, having a negative impact on the nutritional status of children.

The percentage of overweight (26.3%) and obesity (4.6%) among Baniwa women was lower than the levels usually reported in the national literature for Indigenous populations in this age bracket²⁶⁻³⁰. However, the percentage values for overweight and obesity are similar to the numbers found in the 1st Survey for Indigenous women in the North region of Brazil⁵.

Conversely, anemia affected more than half of Baniwa women (52.3%), confirming the findings of high prevalence of this condition among Indigenous women in the North region of Brazil.³¹ The values found in the present study are almost double the prevalence of anemia in non-Indigenous women in the country³².

In Brazil, there are few investigations into the concomitant occurrence of maternal and child anemia, making it impossible to outline a general scenario on the topic. However, the long-term

consequences of anemia for maternal and child health are well established.³³ The few available data point to the importance of this association, as occurs among Suruí women with more than one anemic child, aged 6 to 35 months, who are three times more likely to be anemic than those without anemic children³⁴. A nationwide study, derived from the 1st Survey, also found concomitant anemia in 29.4% of women of childbearing age and their children³¹. In Acre³⁵, a higher prevalence of anemia was found among children whose mothers were anemic. There is also no information on a national scale among non-Indigenous families, but a study carried out in Pernambuco indicated the coexistence of 16.4% of anemic mothers and a prevalence of anemia of 34.4% among their children, with a positive association also being observed with low-income conditions, a large number of residents, and precarious conditions in the households studied³⁶.

Among the Baniwa, the distribution of anemia in women, according to microregions, was highest in Canadá, where mothers and children have anemia percentages of 71.5% and 72.1%, respectively. This microregion has the highest number of residents (median of 8) per household and almost half of the households analyzed (44.4%) fall into the worst tertile of the asset rate. The socio-sanitary indicators of the Canadá microregion appear to be more compromised overall when compared to the others. The variables selected for the study did not allow for more detailed reasons to explain such findings.

For Baniwa children < 60 months, the weight-for-age deficit, with a prevalence of 11.2%, is double the percentage of 5.9% found in the 1st Survey for the entire Indigenous child population of the country⁵. However, it is a value close to that reported for Indigenous children in the North region (11.4%).³⁷ On the other hand, Baniwa children have a prevalence of underweight up to 4-fold higher than non-Indigenous children¹. This percentage value among the Baniwa exceeds the findings among Indigenous children in the Midwest, South, and Northeast regions³⁸⁻⁴⁰; among Kaingang children in the South region (with 9.2%)³⁹; and among Suruí children (8.5%) in Rondônia¹⁰. The weight deficit of Baniwa children is almost four times greater than that found in the Brazilian child population (2.9%) and the non-Indigenous child population of the North region, considering an equivalent age (2.6%), according to the national ENANI-2019 survey¹.

The height-for-age deficit (52.5%) among Baniwa children is twice as high as the value re-

ported for Indigenous children in Brazil (25.7%), in addition to exceeding the frequency reported for the sample from the North region, according to the 1st Survey (40.8%)³⁷. The prevalence of chronic malnutrition in Baniwa children exceeds the percentage values in Indigenous communities in the North and Midwest regions, such as the Suruí (38.6%)¹⁰, the Xavante (29.9%)³⁸, and the Wari' (45.8%)⁸. In non-Indigenous children in Brazil, the prevalence of short height-for-age is 7.0%¹.

The high prevalence of anemia does not differ from that indicated by other studies with Indigenous children^{7,10,41}. These are children who live in a region with high population mobility and suffer the environmental impacts of predatory mining, disorderly occupation of space, insufficient access to health services, and limited economic conditions^{5,10,12,42}.

One of the latest national surveys that assessed the nutritional status of non-Indigenous children in Brazil indicated a frequency of 10.1% of anemia among children < 60 months in Brazil and 17.0% in the North region, for the same age group². These results suggest an overall improvement in this health indicator in the country, despite the findings among poorer communities in the Amazon³⁵, indicating a high prevalence of anemia, suggesting the persistence of intra-regional and inter-ethnic inequalities, since the data available for the Indigenous population show an even higher prevalence of this condition.

In the Baniwa Indigenous lands, more than half of children, aged < 60 months, have anemia (68.3%). In the distribution by micro-regions, it is clear that in two of them (Tunuí and Canadá) the percentage of affected children exceeds 70%. These values are much higher than the 51.2% of anemic children found in the Indigenous child population as a whole in Brazil and are close to the prevalence of anemia in the Indigenous population of the North region (66.4%)⁴¹. The Baniwa findings are similar to the results of other research in specific Indigenous communities, with prevalence rates exceeding 60% of children in the same age group in the North macro-region, as in the case of the Suruí peoples¹⁰. They also match findings among Indigenous people from the Midwest (Kamaiurá⁴³ and Terena⁴⁴) and Northeast^{7,45}. These rates are much higher than the 40% that, according to international criteria adopted by the WHO¹⁹, allow such findings to be classified as a serious public health problem.

Hospitalizations due to respiratory infections are also considered indicative of low effectiveness

of primary care actions¹¹. Among Indigenous children in the North, the proportion of hospitalizations due to this condition was 54.4%, while 47.6% of hospitalizations of Indigenous children in Brazil as a whole had the same cause¹¹. These values exceed the percentage of Baniwa children hospitalized due to respiratory infections (35.2%), and it is not possible to distinguish whether this difference is due to a lower frequency of these illnesses in Baniwa children or to less access to hospitalization in this Indigenous territory.

Hospitalization of children due to diarrhea was around 45.1%. Diarrhea is recognized as being associated with poor sanitation conditions⁴⁶ and is considered a condition that is susceptible to primary care interventions^{5,12,47}. This is a higher percentage than hospitalizations for the same cause found for all Indigenous children in the national territory (37.1%) and slightly lower than the percentage found among Indigenous people in the North region (48.4%), according to the 1st Survey^{5,10,11}.

Final considerations

The present study shows analyses that are representative of an ethnic group as a whole, highlighting situations of economic, food, and health vulnerability that express a compromise in Indigenous living conditions in the Amazon context and point to the lack of internalization of public policies, limited opportunities, and profound in-

equality when compared to the non-Indigenous population.

The high prevalence of chronic malnutrition and anemia in children under 60 months of age, associated with food insecurity, lack of sanitation, insufficient income, and ineffective primary care, is evidenced by the significant percentage of hospitalizations resulting from conditions sensitive to primary care.

Deficiency diseases such as anemia and malnutrition should not be viewed solely from a biological point of view, as they express social and health inequalities that have a profound impact on the Baniwa population, although they are not limited to them. On the contrary, these are widespread events among Indigenous and non-Indigenous Amazonian populations.

This study's results point to an alarming situation that demands the recognition of nutritional disorders as a health problem to be prioritized by families and the Indigenous healthcare subsystem. Overcoming this challenge requires the development of actions at different levels, not restricted to health services, as environmental sustainability, food security, and access to income are intersectoral elements.

Additionally, it should be remembered that this study was conducted before the influence of global climate change on river flooding and, consequently, on food supply was acutely perceived. Recent events related to droughts in the Amazon require the intensification of actions to mitigate the vulnerabilities described here.

Collaborations

HG Santos Jr and L Garnelo participated in the conception and development of the project, collection, analysis and interpretation of data, writing of the article and final approval of the version to be published. MC Souza participated in the conception, design of the sampling plan, data analysis, writing and review of the final version to be published. AA Ferreira participated in the analysis and interpretation of data, writing of the article and final approval of the version to be published.

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