Original Article

Temporal trend of Food and Nutrition Surveillance System coverage among children under 5 in the Northern Region of Brazil, 2008-2017*

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Abstract

Objective: to analyze the temporal trend of Web Food and Nutrition Surveillance System (SISVAN Web) coverage of children under 5 years old in the Northern Region of Brazil between 2008-2017. **Methods:** this was an ecological time series study with data from SISVAN Web; coverage annual percentage change (APC) was estimated using the Prais-Winsten regression model. **Results:** SISVAN Web coverage in the Northern Region in 2008 and 2017 was 12.2% and 37.9%, respectively, with a rising trend (APC=14.2% – 95%CI 10.9;17.6); the states and health regions showed similar trends; Acre was the state with the highest APC (17.3% – 95%CI 13.6;21.1). **Conclusion:** there was a rising trend in SISVAN Web coverage in the Northern Region as a whole, in all its states and in all its health regions.

Keywords: Health Services Coverage; Information Systems; Public Health Surveillance; Nutritional Surveillance; Time Series Studies.

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Introduction

Child malnutrition is a problem still faced by many countries. Although globally the number of children under 5 years old with growth deficits reduced by 10% between 2012 and 2018, 149 million children still had low height-for-age in 2018.[1]

> *Some 30% of indigenous children are estimated to be affected by chronic malnutrition, with variations according to ethnic group.*

In Brazil, prevalence of malnutrition among children under 5 years old has fallen in recent decades, from 36.8% in 1974-1975 to 7.1% in 2006-2007.[2] Nevertheless, it still continues to be a Public Health problem in some regions of the country. In Brazil's Northern Region, 14.8% prevalence in under-five-year-olds was found in 2006, this being higher than the rates in the country's other macro-regions.[3] In 2006, nutrition surveys during vaccination campaigns in the North (Chamada Nutricional Norte),[4] identified 23.1% prevalence in this age group, and it came close to 30.0% in the states of Acre and Amapá. These numbers are even higher among indigenous populations: some 30% of indigenous children are estimated to be affected by chronic malnutrition, with variations according to ethnic group, from 27.8% among the Xavante ethnic group to 83.6% among the Yanomami ethnic group.[5] These data point to slow progress in achieving Target 2.2 of the Sustainable Development Goals (SDG) agreed to by Brazil to end all forms of malnutrition by 2030.[6]

Alencar et al. denounced the debilitated nutritional status to which children living in the rural Amazon setting have historically be submitted, affected above all by chronic malnutrition. The authors also point to the absence of data on health, nutrition and survival conditions of Northern region children.[7] Despite improvements achieved with many economic, education and health indicators, progress is nevertheless timid. Poverty, gender inequality and serious health problems persist, such as malaria, yellow fever and tuberculosis. Also standing out is the disparity between these indicators for urban and rural areas, in particular in relation to indigenous peoples and the challenges they face to ensure their survival.[8] These data corroborate the results of the Intersectoral Food and Nutrition Security Chamber Technical Study, namely that out of the 159 municipalities forming the very high vulnerability group, 41.5% are located in Brazil's Northern Region.[9]

Data from the 2013 National Household Sample Survey,[10] conducted by the Brazilian Institute of Geography and Statistics (IBGE), indicate that 36.1% of the Northern Region's households have some degree of food insecurity. In the case of severe food insecurity, 6.7% of Brazilian households had a member who had experienced hunger. In addition, the Northern Region has undergone nutrition transition in recent decades, leading to the current scenario of a double disease burden, with coexistence of high prevalence of malnutrition and increased overweight and related diseases. As such, it is of fundamental importance to monitor the nutritional status and the health situation of this population.

Among its guidelines, the National Food and Nutrition Policy,[11] defines Food and Nutrition Surveillance and its overriding objective: to improve the food, nutrition and health conditions of the population. It is an indispensable element for organization of nutritional care in the Brazilian National Health System (SUS). Implementing food and nutrition surveillance favors continuous monitoring of the population's health and nutrition status and the determinant factors thereof, this being essential information for planning and articulating interventions aimed at health promotion. Brazil's food and nutrition surveillance strategies are comprised of surveillance carried out in health services, population surveys, nutrition surveys during vaccination campaigns and scientific production.[12,13]

Within this context the Food and Nutrition Surveillance System (SISVAN) was created as a health information system to generate continuous information about nutritional status and food consumption of the population receiving Primary Health Care services. SISVAN was institutionalized by the same Organic Health Law that regulated the SUS and integrated nutritional surveillance as a practice of the health system.[14] In its initial stage, SISVAN was linked to government welfare programs; in 2003 a computerized system known as the SISVAN Municipal Module was implemented in many Brazilian municipalities, but was later replaced by SISVAN Web in 2007. The main advantages of SISVAN Web included the incorporation of World Health Organization (WHO) growth curves established between 2006 and 2007 to assess the nutritional status of children and adolescents, the possibility of recording food consumption markers in different age groups and a more user-friendly interface.[12]

The objective of this study was to analyze the temporal trend of SISVAN Web coverage among under-five-year-olds in the states and health regions of Brazil's Northern Region between 2008 and 2017.

Methods

This was an ecological time series study. The units of analysis corresponded to the municipalities in Brazil's Northern Region, grouped together in states and health regions.

The Northern Region is comprised of seven states. While it is the region with the lowest demographic density, it accounts for 45% of the Brazilian territory. In 2010, all the Northern Region states had Human Development Indices (HDI) lower than the Brazilian average (0.727), according to the Atlas of Human Development in Brazil. Data produced by the Interagency Health Information Network (RIPSA) and by IBGE indicate that in 2011 the average infant mortality rate in Northern Brazil was the highest among the country's five regions.

Secondary data were used which were retrieved from SISVAN Web public domain reports (available at: <http://sisaps.saude.gov.br/sisvan/relatoriopublico/index>), as well as data from the Department of Primary Care/Health Care Secretariat/Ministry of Health and from IBGE (available at: <http://www2.datasus.gov.br/DATASUS/index.php?area=02>). The SISVAN Web platform provides public annual reports containing the results of the most recent assessment carried out in the current year, for all types of monitoring recorded, including (i) individuals monitored by SISVAN Web itself, (ii) those monitored by the Bolsa Família Program Management System and (iii) by e-SUS APS – a strategy of the Ministry's Family Health Department. The first year of the time series was selected based on the year the computerized system was implemented.[12]

The total population of each municipality was obtained from RIPSA and IBGE population estimates available up until 2015. Resident populations in 2016 and 2017 were estimated through projections of the resident population in the previous year which in turn were measured based on average population increase during the period 2008-2015. This rate was calculated by subtracting populations from consecutive years and dividing the result by the previous year's population.

SISVAN Web coverage was calculated. Coverage of a health information system (HIS) is defined as "the extent to which events in the universe (scope) for which the HIS was developed are recorded on the HIS" (Lima et al.[15]). This indicator was calculated by dividing the number of individuals with nutritional status records on SISVAN Web by the total population of the municipality and then multiplying the result by 100.

Variables for system registration and use were also created. Percentage registration refers to the percentage of municipalities that registered individuals on the system and was obtained by dividing the number of municipalities with registration on SISVAN Web by the total number of municipalities and then multiplying the result by 100. Percentage use refers to the percentage of municipalities with at least one monitoring record; this indicator was built in a similar manner to the registration indicator, but the numerator only included municipalities that input records of nutritional status monitoring. The three indicators were obtained from the nutritional status anthropometric index, i.e. what is referred to as 'height-for-age'.

When creating the system coverage indicator, as per the method used in a similar study,[13] we opted to use the total population resident in the municipality and not just the population that used SUS services, as this excludes people who used private health care. This happened because of the large number of municipalities with values inconsistent with the system coverage index (coverage greater than 100%) when only the SUS service user population was tested as the denominator, as this would have resulted in 21.2% of municipalities, including state capitals, being excluded from the analyses. As such, only 6% of the total sample (27 municipalities) had values inconsistent with the coverage index when the total population resident in the municipality was included in the denominator.

First of all the states comprising the Northern Region were characterized according to demographic, socio-economic and health variables. The total population resident in each state was obtained from RIPSA and IBGE estimates for the year 2015 (available at: <http://www2.datasus.gov.br/DATASUS/index.php?area=0206&id=6942>); the human development index (HDI) and per capita gross domestic product (GDP) were retrieved from IBGE statistics for the years 2010 and 2013, respectively; and the infant mortality rate (IMR) was calculated taking the number of deaths of infants under one year old per 1000 live births based on RIPSA statistics (2011). Data on Family Health Strategy coverage and data on the Community Health Agent Program were retrieved from Department of Primary Care public domain reports for December 2017 (available at: <https://egestorab.saude.gov.br/paginas/acessoPublico/relatorios/relHistoricoCobertura.xhtml>). When obtaining these variables, the most recent data available in the time series was used.

The initial sample of Northern Region municipalities with data on the systems (n=450) was divided into seven states and 44 health regions as originally defined by the State Health Departments in order to organize and decentralize their actions. Municipalities that did not have data for all the years analyzed or that had values inconsistent with the system coverage index were excluded from the analyses, as explained above. Three of these municipalities were located in the state of Amazonas, four in Pará, nineteen in Tocantins and one in Acre. None of the state capitals were excluded and the final result of the sample was 423 municipalities.

Prais-Winsten regression was used to analyze the time series, considering serial autocorrelation between the values during the period, i.e. the dependence of one serial measurement in relation to its own values at earlier times.[16] Average annual coverage change and its respective confidence intervals were calculated using the following formula:

$$APC = (-1+[10^{\beta}]) \times 100$$

Where:

APC: average annual percentage change

β: natural base logarithm resulting from Prais-Winsten regression.

A 5% significance level was used. Non-significant p-values ($p \geq 0.05$) indicated a trend of stability; while significant p-values ($p<0.05$) indicated a rising or falling trend, depending on whether annual change was positive or negative, respectively. The coverage rates for each period were also categorized into intervals in an arbitrary manner. They are presented in the form of maps and scales: up to 10.0%; 10.0%-20.0%; 20.0%-30.0%; 30.0%-40.0%; 40.0%-50%, or more.

All statistical analysis was performed using STATA version 13.0 for Windows. The maps were prepared with the aid of QGIS version 3.6.3, generated in a SIRGAS 2000 geographic projection system. The maps are quantitative, determined by class intervals using the quartile method, according to analysis of coverage (%) of nutritional status monitoring – height-for-age – undertaken in 2008, 2012 and 2017 in the Northern Region and in each of its states.

The study project was approved by the University of São Paulo Public Health Faculty Research Ethics Committee (Opinion No. CEP/FSP/USP nº 2.301.602), in compliance with the Ministry of Health Editorial Policy, approved by Ordinance No. 884/2011, which disciplines the provision of data contained on the national databases of health information systems and managed by the Health Care Secretariat.[17]

Results

Table 1 shows the characterization of each Northern Region state according to demographic, socio-economic and health variables. Heterogeneity between the states can be seen regarding the variables studied. The infant mortality rate varied between 15.4 and 24.1 per 1,000 live births; Family Health Strategy coverage ranged between 49.4% and 95.1%; and Community Health Agent Program coverage varied between 50.9% and 99.3%.

Percentage system registration was practically 100% for all municipalities over the period studied. Only two municipalities in the state of Amazonas, two in Pará and one in Tocantins did not have children registered in any of the years assessed. All the municipalities assessed had input at least one nutritional status record on the system.

Table 2 shows coverage of nutritional status monitoring for each state and the total for the Northern Region of Brazil, average annual percentage change (APC) and respective 95% confidence intervals (95%CI). This form of coverage increased from 12.2% in 2008 to 37.9% in 2017, revealing a rising trend in coverage in the Northern Region: 14.2% APC% (95%CI 10.9;17.6). Coverage showed a rising trend in all the region's states in the period studied; the lowest annual change rates were found in Rondônia (8.9% [95%CI 7.4;10.4] and Roraima (8.6% [95%CI 4.9;12.5]), while the highest APC was found in Acre (17.3% [95%CI 13.6;21.1]).

Table 3 shows coverage of nutritional status monitoring in the health regions: only one (Café, RO) out of the 44 health regions analyzed did not show a rising trend in system coverage (2.5% APC [95%CI -0.3;5.4]). The Alto Acre (AC), Juruá e Tarauacá Envira (AC) and Rio Negro e Solimões (AM) health regions stand out for having the highest average annual change rates: 22.5% (95%CI 16.3;29.0), 20.9% (95%CI 14.3;27.9) and 20.9% (95%CI 17.7;24.2), respectively. The states of Rondônia,

Table 1 – Characterization of the Northern Region states by demographic, socio-economic and health variables, Brazil

State	Municipalities (n)	Health regions (n)	Total estimated population	HDI[a]	GDP[b] *per capita*	IMR[c]	ESF[d] coverage (%)	PACS[e] coverage
Acre	22	3	803,503	0.663	14,733.5	18.5	78.4	94.0
Amapá	16	3	766,692	0.708	17,363.8	24.1	49.4	50.9
Amazonas	62	9	3,938,325	0.674	21,873.7	20.0	55.4	61.3
Pará	144	12	8,175,156	0.646	15,176.2	20.6	58.9	81.8
Rondônia	52	7	1,768,162	0.690	17,990.7	17.1	67.9	77.9
Roraima	15	2	505,674	0.707	18,495.8	15.4	68.5	68.7
Tocantins	139	8	1,515,134	0.699	16,086.4	19.3	95.1	99.3
Northern Region	**450**	**44**	**17,472,646**	**0.667**	**17,213.3**	**19.9**	**62.9**	**77.1**

a) HDI: human development index.
b) GDP: gross domestic product.
c) IMR: infant mortality rate.
d) ESF: Family Health Strategy.
e) PACS: Community Health Agent Program.

Table 2 – Coverage of monitoring of the 'height-for-age' index according to the Food and Nutrition Surveillance System, among children under 5 years old, in the Northern Region states, Brazil, 2008-2017

State	Coverage of nutritional status monitoring (%)[a]										Annual change (%) (95%CI)b	p-value	Trend
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017			
Acre	10.9	13.0	17.3	16.1	23.0	28.0	35.6	38.3	40.5	41.7	17.3 (13.6;21.1)	<0.001	Rising
Amapá	6.7	9.5	10.1	8.3	9.9	12.6	17.5	19.2	23.4	27.5	16.4 (11.0;22.0)	<0.001	Rising
Amazonas	11.7	12.5	17.7	16.8	14.9	27.8	31.9	36.9	40.1	41.2	17.0 (12.7;21.4)	<0.001	Rising
Pará	12.5	15.1	21.0	18.8	18.7	29.5	34.6	37.2	37.6	38.3	14.0 (9.9;18.2)	<0.001	Rising
Rondônia	11.6	13.8	15.8	13.5	17.6	18.7	19.2	23.1	25.9	23.9	8.9 (7.4;10.4)	<0.001	Rising
Roraima	13.2	20.7	25.0	21.6	22.0	24.0	25.8	30.7	33.7	34.0	8.6 (4.9;12.5)	<0.001	Rising
Tocantins	16.8	19.9	25.2	24.6	26.9	32.3	34.9	42.1	48.3	46.1	12.3 (10.8;13.9)	<0.001	Rising
Northern Region	**12.2**	**14.5**	**19.5**	**17.8**	**18.2**	**27.3**	**31.6**	**35.3**	**37.4**	**37.9**	**14.2 (10.9;17.6)**	**<0.001**	**Rising**

a) Coverage (%): total number of children registered on the Food and Nutrition Surveillance System (SISVAN Web) for each municipality/total population of all municipalities) x 100.
b) Values obtained using Prais-Winsten regression and calculated according to the following formula: annual = (-1+[10β]) x 100, where β is the natural base logarithm resulting from regression; 95%CI = 95% confidence interval. t

Roraima and Tocantins had the highest annual change rate differences among their respective health regions, varying between 4.1% to 15.8% in Rondônia, 7.7% to 12.2% in Roraima and 8.5% to 14.3% in Tocantins.

As indicated in Figure 1, in 2008 SISVAN Web coverage was up to 20.0% in all states, whereby Amapá had the lowest rate (below 10%). In 2012, Acre, Roraima and Tocantins had reached coverage rates ranging from 20.0% to 30.0% while the other states remained in the same classification categories as in 2008. In 2017, the scenario had changed: all the Northern Region states had minimum coverage of 20.0%, while in Acre, Amazonas and Tocantins it was above 40.0%.

Discussion

This study analyzed SISVAN Web coverage of children under 5 years old, this being an age group particularly sensitive to the determinants of the double disease burden. The results indicate that all the Northern Region states and their respective health regions had a rising trend in SISVAN Web coverage between 2008 and 2017. The state

Table 3 – Coverage of monitoring of the 'height-for-age' index according to the Food and Nutrition Surveillance System, among children under 5 years old, in the Northern Region health regions, Brazil, 2008-2017

State and health regions	Coverage of nutritional status monitoring (%)[a]										Annual change (%) (95%CI)[b]	p-value	Trend
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017			
Acre													
Juruá e Tarauacá Envira	12.0	14.9	22.0	23.1	30.1	43.3	54.0	51.9	54.4	55.2	20.9 (14.3;27.9)	<0.001	Increase
Alto Acre	10.0	14.3	19.0	17.5	21.2	26.6	40.4	55.8	59.6	59.4	22.5 (16.3;29.0)	<0.001	Increase
Baixo Acre e Purus	14.5	13.8	19.5	15.8	27.0	33.8	43.7	44.1	46.6	50.6	13.5 (10.6;16.6)	<0.001	Increase
Amapá													
Norte	7.9	16.1	19.5	15.7	21.4	25.1	34.0	37.1	40.5	41.4	18.9 (12.9;25.3)	<0.001	Increase
Central	9.7	13.1	14.2	10.4	11.5	17.3	30.8	38.0	45.8	45.0	18.6 (8.8;29.3)	<0.001	Increase
Sudoeste	15.2	15.5	18.7	16.5	23.0	23.7	29.0	32.6	41.3	47.4	13.4 (11.4;15.5)	<0.001	Increase
Amazonas													
Alto Solimões	16.3	21.9	27.4	27.2	23.2	37.4	48.6	54.7	54.5	61.9	16.3 (12.3;20.5)	<0.001	Increase
Rio Madeira	17.3	20.1	24.9	23.6	19.9	28.8	36.9	51.0	55.7	57.7	14.4 (9.0;20.1)	<0.001	Increase
Entorno de Manaus e Rio Negro	13.9	16.1	22.0	21.0	16.9	32.5	38.8	44.3	48.4	48.1	19.0 (12.5;26.0)	<0.001	Increase
Purus	24.0	26.1	35.8	32.9	25.9	40.1	48.5	50.6	55.4	59.5	10.9 (7.3;14.6)	<0.001	Increase
Juruá	16.4	15.4	22.4	19.2	15.9	25.5	35.3	35.9	40.9	43.9	14.2 (9.0;19.7)	<0.001	Increase
Triângulo	11.5	14 .0	23.0	20.3	18.8	41.0	43.6	47.5	54.3	58.2	18.5 (14.3;22.8)	<0.001	Increase
Rio Negro e Solimões	11.0	13.6	19.9	23.5	17.2	31.5	39.9	45.6	55.1	62.6	20.9 (17.7;24.2)	<0.001	Increase
Baixo Amazonas	17.3	18.8	29.1	23.8	23.2	35.4	43.4	49.5	56.9	59.5	12.5 (8.5;16.7)	<0.001	Increase
Médio Amazonas	19.8	18.1	27.7	23.2	22.0	37.5	42.5	48.9	60.0	65.2	16.6 (9.3;24.4)	<0.001	Increase
Pará													
Araguaia	15.5	18.2	26.6	24.2	20.5	31.8	37.2	42.8	46.1	45.6	12.1 (8.5;15.8)	<0.001	Increase
Baixo Amazonas	17.1	18.4	27.3	23.3	22.4	41.2	45.0	52.9	58.7	58.3	15.1 (10.0;20.5)	<0.001	Increase
Carajás	16.2	19.9	26.5	24.5	22.7	34.3	38.3	41.8	46.2	47.3	11.5 (8.6;14.4)	<0.001	Increase
Lago do Tucuruí	12.4	17.4	25.6	22.3	21.1	34.5	37.4	36.1	35.3	37.9	11.8 (6.5;17.4)	<0.001	Increase
Marajó	12.7	12.7	20.4	18.0	19.8	34.7	41.7	43.5	46.1	50.9	19.0 (13.9;24.3)	<0.001	Increase
Metropolitana I	7.0	10.6	14.2	12.7	13.6	18.8	23.9	29.6	32.1	31.3	15.3 (8.4;22.7)	<0.001	Increase
Metropolitana II	15.5	16.9	23.4	22.9	25.5	36.1	38.1	46.6	45.6	48.6	16.6 (13.0;20.3)	<0.001	Increase
Metropolitana III	20.0	23.3	29.0	27.4	25.3	42.4	50.3	58.0	60.5	59.7	13.3 (9.4;17.2)	<0.001	Increase
Rio Caetés	22.3	23.8	29.4	23.6	23.9	40.6	47.6	53.6	57.6	54.0	10.5 (6.4;14.8)	<0.001	Increase
Tapajós	16.4	17.0	22.0	19.5	17.3	35.4	33.0	35.9	37.3	39.6	12.6 (9.4;15.9)	<0.001	Increase
Tocantins	14.3	16.4	27.7	24.4	23.9	39.8	43.1	42.5	44.9	52.5	15.4 (10.4;20.5)	<0.001	Increase
Xingu	13.9	19.0	23.9	20.0	17.0	29.8	35.9	38.1	37.8	40.1	12.7 (6.8;19.0)	<0.001	Increase
Rondônia													
Café	23.9	29.9	29.5	22.8	27.6	28.7	25.2	29.0	40.3	33.2	2.5 (-0.3;5.4)	0.071	Stability
Cone Sul	21.9	24.0	21.7	15.7	20.8	24.7	22.4	31.9	31.1	28.6	9.9 (2.8;17.5)	0.011	Increase
Vale do Guaporé	16.1	19.0	26.7	20.4	34.2	36.9	43.2	38.8	45.9	44.1	11.3 (7.7;15.0)	<0.001	Increase
Madeira-Mamoré	8.3	9.4	13.9	12.2	16.2	18.3	19.8	23.5	24.4	24.6	15.8 (10.7;21.2)	<0.001	Increase
Vale do Jamari	12.1	15.3	20.5	17.5	19.6	21.9	23.6	32.9	27.2	25.6	9.2 (5.6;12.9)	<0.001	Increase
Central	19.0	23.7	27.4	25.3	38.0	36.8	32.0	29.7	29.0	29.8	4.1 (0.1;8.3)	<0.046	Increase
Zona da Mata	16.8	18.4	18.5	15.7	28.3	30.1	31.9	36.0	38.4	35.0	10.3 (6.3;14.5)	<0.001	Increase
Roraima													
Centro Norte (Monte Roraima)	17.8	23.6	26.8	23.0	29.4	27.9	27.5	36.3	39.8	42.7	7.7 (3.4;12.3)	<0.001	Increase
Sul (Rio Branco)	21.2	22.1	24.9	29.3	32.5	34.3	50.0	44.7	52.3	52.2	12.2 (10.2;14.3)	<0.001	Increase

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continuation

State and health regions	Coverage of nutritional status monitoring (%)[a]										Annual change (%) (95%CI)[b]	p-value	Trend
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017			
Tocantins													
Capim Dourado	21.9	26.0	32.1	31.8	31.9	43.0	50.2	55.6	56.7	55.0	14.3 (7.6;21.4)	<0.001	Rising
Sudeste	30.3	34.4	38.8	39.1	36.7	48.2	50.8	54.8	61.8	59.9	9.9 (7.7;12.2)	<0.001	Rising
Ilha do Bananal	24.0	30.0	30.7	27.5	28.0	37.6	43.4	44.3	48.7	50.8	8.5 (6.5;10.5)	<0.001	Rising
Cerrado Tocantins Araguaia	18.8	22.2	33.8	35.6	32.4	41.8	43.3	51.3	56.9	56.0	11.2 (7.6;14.9)	<0.001	Rising
Médio Norte Araguaia	15.9	22.7	27.8	27.4	29.5	38.7	40.9	45.6	56.5	57.0	13.0 (9.9;16.1)	<0.001	Rising
Amor Perfeito	26.5	28.7	35.9	29.0	33.0	41.2	44.6	54.4	61.5	60.1	9.8 (6.7;13.1)	<0.001	Rising
Cantão	19.8	22.0	34.0	27.7	29.2	40.7	46.6	47.6	53.1	54.5	9.9 (4.7;15.3)	<0.001	Rising
Bico do Papagaio	18.2	26.2	38.1	35.4	35.2	49.9	53.4	55.5	53.4	59.8	14.0 (9.6;18.6)	<0.001	Rising

a) Coverage (%): total number of children registered on the Food and Nutrition Surveillance System (SISVAN Web) for each municipality/total population of all municipalities) x 100.

b) Values obtained using Prais-Winsten regression and calculated according to the following formula: annual = (-1+[10β]) x 100, where β is the natural base logarithm resulting from regression; 95%CI = 95% confidence interval.

of Acre had the highest annual change rate. Among the 44 health regions assessed, only the Café health region (state of Rondônia) showed a stationary trend, i.e. its annual change rate did not increase significantly over the years studied.

Analysis of percentage evolution of nutritional monitoring coverage over the time series showed that in 2011 there was a slight reduction in the increase seen since 2008 in all states; in 2012, however, the rising trend returned. The coverage increase trend was lowest in Roraima and highest in Acre. With regard to the health regions, a noteworthy increase in coverage trend was found over time. The state of Acre's health regions also had the highest annual percentage change rates: Alto Acre; and Juruá e Tarauacá Envira.

When comparing the expansion of total population nutritional coverage monitored by SISVAN Web in 2014 and 2017, the Overall Situation Report produced by the General Food and Nutrition Coordination Body (CGAN) in 2017 indicated an increase in percentage coverage in the majority of Brazilian states. Out of the seven Northern Region states, three were classified as being among the ten Brazilian states with the best coverage evolution: the state of Tocantins came in first place in the national rating [24.4% [2008] and 29.3% [2017]); Amazonas in was third place (19.0% [2008] and 25.9% [2017]); and Acre was in fifth place (21.5% [2008] and 29.3% [2017]).[18] A similar result was found in our time series of nutritional monitoring of children under five years old in the Northern Region.

Nascimento et al. (2017) analyzed temporal change in coverage of nutritional status monitoring on the national level, according to SISVAN Web, between 2008 and 2013. The results they found provided evidence that the highest frequencies and the biggest total changes in coverage corresponded to the Northeastern and Northern Regions, and that among children under five years old coverage change rose from 17.69% in 2008 to 27.89% in 2012.[13]

Two studies were found regarding SISVAN coverage in the state of Rio Grande do Sul, located in the far south of Brazil. In a study conducted in 2006, Damé et al. identified average coverage of 10.5% among children aged 0 to 10 years, varying between 7.0% and 21.0% among the health regions of that state.[19] Also in Rio Grande do Sul, in 2010 Jung et al. identified 10.5% coverage among children under 5 years old, while coverage for all age ranges was 1.8%, showing greater nutritional surveillance in the first years of life.[20]

A study by the Belo Horizonte Health Region Superintendent's Office relating to the capital city of the state of Minas Gerais, in Southeast Brazil, involving children under 2 years old monitored by SISVAN Web, found coverage change ranging from 4.3% (2008) to 10.7% (2011).[21] Another study conducted by the same group/health region in 2012 in the same catchment area but with children under 5 years old found average coverage of 5.59%.[22] Progress with Food and Nutrition Surveillance contributes to the effective organization of nutrition care by the SUS, as provided for in the National Food and Nutrition Policy (PNAN): by means of nutritional diagnosis of the population, individuals and groups at nutritional risk are identified, thus contributing to updating and planning public food and nutrition policies.[11] As such, the increase in coverage identified in the Northern Region over the years analyzed reflects the

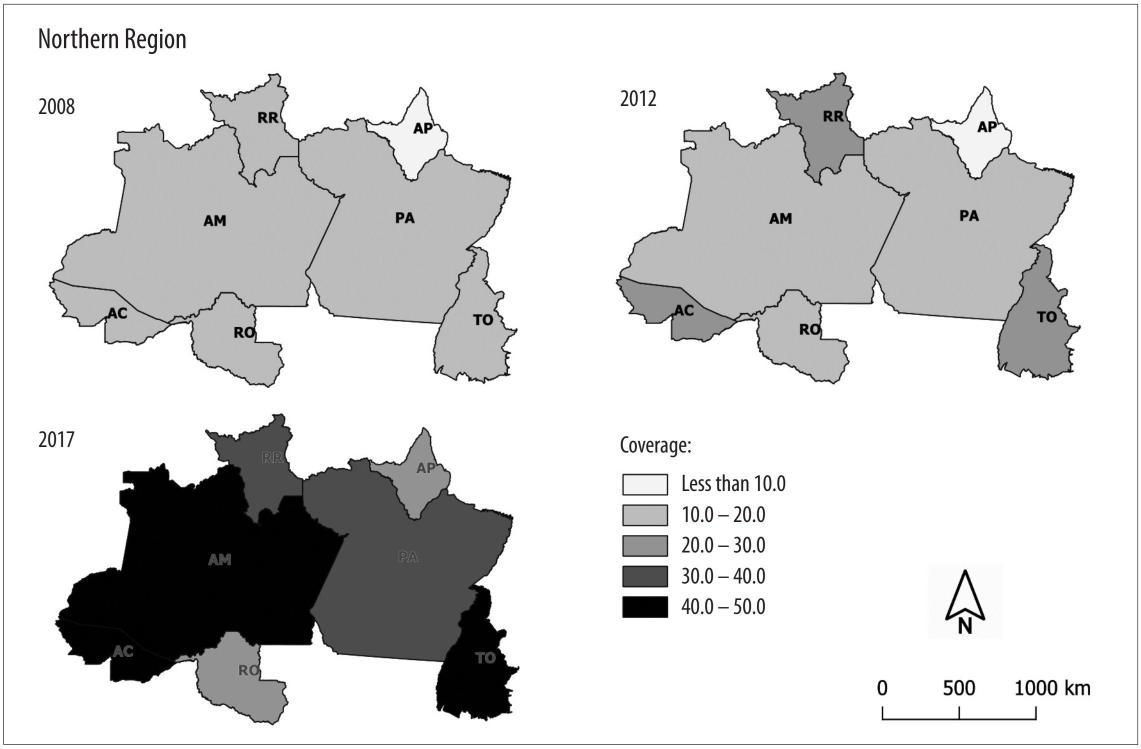

Figure 1 – Coverage of monitoring of the 'height-for-age' index according to the Food and Nutrition Surveillance System, among children under 5 years old, in the Northern Region states, Brazil, 2008, 2012 and 2017

improvement in the indicators of this PNAN guideline regarding nutritional care of children under 5 years old.

The Ministry of Health, via its General Food and Nutrition Coordination Body, has supported state and municipal governments in overcoming the great challenge of Food and Nutrition Surveillance, by promoting training courses and workshops, preparing and disseminating instructional materials, among other initiatives. The 'Food and Nutrition Surveillance Reference Frame for Primary Care' was published in 2015, reiterating the importance of Food and Nutrition Surveillance, its perspectives and SISVAN as an instrument needed to meet the Health sector's commitment to caring for more vulnerable families registered with social programs and receiving Public Health care, thus contributing to increased coverage of nutritional status monitoring, especially pregnant women and children, which has favored the increase in data held on SISVAN.[23]

The increase in SISVAN coverage identified by this study suggests better monitoring of the nutritional status of children under 5 years old in the Northern Region. However, the efforts made so far must remain in force to ensure that municipal and state governments continue to undertake food and nutrition surveillance of this population. Average SISVAN coverage in the Northern Region continued below 40% in 2017, demonstrating the permanent challenge of sustaining positive results and increasing them in this region.

On the national level, the main aspects hindering the system's progress and consolidation and carrying out of food and nutrition surveillance include physical infrastructure problems, lack of equipment and access to the internet in order to enter data on the system, continuous turnover of technical staff, both locally and nationally, among others. A noteworthy point is the reduction in funding of food and nutrition surveillance actions, especially in a context of restrictions to the public budget intended for social and health policies and their direct impact on SUS primary care actions, including food and nutrition actions. Settings of greater vulnerability tend to be the most affected by the austerity policy that is underway.[24]

Moreover, there are cultural and geographic particularities comprising determinant factors for undertaking food and nutrition surveillance in Northern Brazil. The characteristics of the region's territory, most of which is comprised of the Amazon forest, make it harder for the population to get from one place to another. Cultural diversity and the large number of indigenous and riverside communities also pose challenges for dialogue between these populations and health service managers and technical personnel, given the different understandings existing as to the health / illness process and regarding priorities and ways of working in order to take care of one's health.[24]

The information provided by SISVAN should inform SUS planning and care provision in accordance with the public policy cycle[25] and the management and care production cycle,[23] both of these being health service management instruments the initial stage of which provides for identification of nutrition problems to be overcome, not just at the time of decision making, but also when monitoring and evaluating action implementation.

For the SUS, the importance of health information systems lies in their objective of informing nutritional health care planning based on the epidemiological profile, providing indicators enabling diagnosis of the health, surveillance and monitoring of people at nutritional risk, as well as analyzing territorial and temporal distribution of Public Health events.[15] Systematizing data collection on vital events and health events and their notification are crucial tools for health service manager decision-making: defining policies, obtaining public resources, monitoring health conditions, evaluating the impact of prevention and the quality of service provision.[26]

Food and nutrition surveillance has made considerable progress in Brazil in recent decades, enhancing the quality of the data entered on the system, providing increasingly satisfactory results for nutritional issues of greater magnitude in Primary Care.[12]

Nutritional care has been strengthened and extended thanks to the interface between food and nutrition surveillance and other Education and Social Welfare policies, income transfer programs, and with other areas of interest to food and nutrition security, broadening the scope of nutritional care beyond the Health sector. This is essential for promoting and protecting health, as well as for controlling the epidemiological situation of the double disease burden that affects the Brazilian population.[27] In this sense, SISVAN has become a reference instrument for evaluating nutritional profile in Primary Care, notwithstanding its limitations described here.

The maps that portray SISVAN coverage trends over the period studied (2008-2017) provide evidence of progressive growth, in particular in the states of Acre, Amazonas and Tocantins which had the highest percentages. These results may possibly have been influenced by the increase in Family Health Strategy coverage between 2006 and 2016.[28] A study of national coverage of the computerized system found positive correlation between growth in SISVAN coverage and progress made with the Family Health Strategy and the Community Health Agent Program in 2010,[13] corroborating the importance and impact of increased Primary Care food and nutrition surveillance actions.

The results presented here must be interpreted as having limitations, bearing in mind that the study used secondary data, possible inconsistencies in relation to data quantity and quality and underreporting of children monitored by Primary Care. It is also possible that the low coverage rates in the first year of the time series may have been influenced by the switch, in the same year, from the manual system to the computerized system and, consequently, possible shortcomings in data recording at that time.

Given the absence of studies on this theme, especially in the Northern Region, this study presents little explored results about SISVAN coverage in a context marked by double disease burden and high prevalence of malnutrition in specific populations. The data on the states that comprise the Northern Region, despite diverse intra-regional characteristics, provide evidence of the expansion of nutritional status coverage recorded on SISVAN between 2008 and 2017. The joint efforts of the Federative Units are reflected in the increase in Food and Nutrition Surveillance in recent years in Brazil. However, challenges for Food and Nutrition Surveillance persist, both for guaranteeing the quality of the data collected, and for the use of the information it provides when planning nutritional care for children under 5 years old, in the face of the nutrition transition that has been witnessed in recent decades.

Authors' contributions

Mourão E, Nascimento FA and Jaime PC took part in the conception of the study and preparing the study project, data interpretation, writing and critically reviewing the intellectual content of the article. Gallo CO took part in the statistical analysis, data interpretation and writing the article. All the authors have approved the final version and declare themselves to be responsible for the entire contents of the manuscript.

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