ORIGINAL ARTICLE

ANALYSIS OF THE NUTRITIONAL STATUS OF ADULTS WITH HYPERTENSION IN THE CAPITAL CITIES OF NORTHEAST BRAZIL, 2013 TO 2023: ECOLOGICAL STUDY

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Highlights: (1) Identifies a high tendency for weight gain in hypertensive patients. (2) It highlights the importance of nutrition in the prevention and control of hypertension, emphasizing excess weight as a risk factor for the development and association of Non-Communicable Chronic Diseases. (3) It serves as a guide for health managers in formulating more effective policies for hypertension control, considering sociodemographic factors

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ABSTRACT

Systemic arterial hypertension, known as high blood pressure, could affect 60% of the world's population by 2025, with approximately 7.1 million deaths annually. The national prevalence of excess weight has increased over the years and acts as a risk factor for complications of the disease. Monitoring the nutritional status of hypertensive patients helps to set goals and promote actions to improve health and prevent diseases. The objective of this study was to analyze the nutritional status of hypertensive adults in the capitals of the Northeast from 2013 to 2023. This is an ecological study using secondary data from Vigitel in the capitals of the Northeast from 2013 to 2023, including adults with hypertension aged 18 to 59 years. Sociodemographic characteristics and nutritional status were assessed using BMI. The findings of this study showed a decrease in hypertensive adults in 2014 and 2023, as well as a high prevalence of overweight, mainly in males, with higher education/postgraduate education, aged 40 to 49 years, and in the capital Natal. It was concluded that there was a high prevalence of overweight in hypertensive adults, which affects health costs and may hinder primary care in prevention policies, as well as socioeconomic disparities in the Northeast region, enabling the targeting of resources in these more vulnerable areas.

Keywords: nutritional status, systemic arterial hypertension, overweight.

INTRODUCTION

Systemic arterial hypertension (SAH) or high blood pressure is one of the leading causes of cardiovascular disease (CVD)[1]. It is characterized by high blood pressure levels in the arterial vessels and is one of the major risk factors for coronary artery disease, stroke, and renal failure[2].

It is estimated that by 2025, there will be a 60% increase in cases of SAH worldwide, with approximately 7.1 million deaths per year from the disease[3]. Brazil has more than 38 million Brazilians aged 18 or older diagnosed with the disease[4] . In the Northeast, 162,152 deaths associated with SAH and other hypertensive diseases were recorded in the Mortality Information System (SIM) of the Unified Health System (SUS) between 2012 and 2021.

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The nutritional status of adults, assessed by Body Mass Index (BMI), allows us to estimate the characteristics of a population regarding excess weight in different age groups in relation to the risk of cardiovascular disease[6]. Sociodemographic characterization plays a crucial role in the prognosis of SAH, which not only influences prevalence patterns but also hinders the control of the disease[7].

In the Brazilian population, overweight and obesity, characterized as the accumulation of body fat, have shown a rapid and progressive increase in recent decades, especially in the adult population[8]. The national prevalence of overweight increased from 42.6% in 2006 to 55.4% in 2019 (2.05%/year) and acts as a risk factor for complications of SAH.

SAH leads to increased healthcare costs. In 2018, CVDs cost the SUS more than R$ 2.9 billion, the highest amount among the groups of diseases that led to hospital admissions[10] , in addition to spending on medications, mainly due to complications such as cerebrovascular disease, heart failure, chronic renal failure, and peripheral vascular disease [11] .

The use of tools to monitor the nutritional status of patients with SAH is important for producing evidence, setting goals, and evaluating actions to promote health and prevent diseases [12]. The analysis of the prevalence of hypertensive adults and its relationship with nutritional status is fundamental, constituting a major public health problem. Furthermore, understanding the social determinants of health allows for the identification of inequalities and the targeting of more effective public policies, with optimized resource allocation and improvements in the control of SAH.

The objective of this study was to analyze the nutritional status of hypertensive adults in the capitals of the Northeast region of Brazil between 2013 and 2023.

METHODOLOGY

Design

This is an ecological study using annual secondary data from the Surveillance System for Risk and Protective Factors for Chronic Diseases by Telephone Survey (Vigitel) in the capitals of Northeast Brazil for the period from 2013 to 2023.

Context

Vigitel annually assesses the population aged 18 years or older residing in households in the capitals of the 26 Brazilian states and the Federal District (DF) through telephone interviews. The first stage of Vigitel sampling consists of a systematic and stratified random selection by postal code (CEP) of at least 5,000 telephone lines per city, using residential landlines from telephone companies. The second stage consists of randomly selecting one adult (≥ 18 years of age) residing in the selected household. All estimates are weighted to be representative of the entire adult population of each capital city. The telephone interviews are conducted by a specialized company, which undergoes prior training and supervision by the Ministry of Health, through the Secretariat of Health Surveillance, and research centers at partner universities. The questionnaire allows questions to be read directly on a video monitor screen and answers to be recorded immediately on the computer, with direct and continuous input into the system database[12].

The Northeast stands out as a region with a population that has low levels of income and education, making it the most vulnerable to chronic noncommunicable diseases (CNCDs), such as SAH. In addition, it has lower coverage by the Family Health Strategy (ESF), which contributes to higher prevalence of the disease [10].

Participants

In this study, only hypertensive adults aged 18 to 59 years residing in Northeastern capitals were included in the sample. Individuals who were underweight, aged 60 years or older, and those who met the exclusion criteria established by VIGITEL were excluded.

Variables

BMI was used to assess nutritional status, with variables related to weight and height, following the World Health Organization classification [13] : underweight (<18.5), normal weight (18.5 to 24.9), overweight (25 to 29.9), obesity grade I (30 to 34.9), and morbid obesity (≥ 35). The outcome variable was dichotomized into overweight (overweight, obesity grade I, and morbid obesity) and eutrophic (eutrophic). The following were considered explanatory variables: gender (male and female), age (18 to 29; 30 to 39; 40 to 49 and 50 to 59 years), education (Never studied/Does not know; Elementary School I; Elementary School II; High School; Higher education/Postgraduate), year (2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023) and capital city (Aracaju, Fortaleza, João Pessoa, Maceió, Natal, Recife, Salvador, São Luís, Teresina).

Inclusion and Exclusion Criteria

Self-reported hypertensive adults aged 18 to 59 years residing in northeastern state capitals were included, along with their respective variables of sex, age, education, and BMI. Participants with incomplete information, individuals over 60 years of age, and other VIGITEL variables were excluded from the sample.

Study size

The study is temporal in nature, including data from 2013 to 2023 from all northeastern state capitals. The final sample consists of 20,284 hypertensive adults analyzed.

Statistical methods

Absolute frequency and percentage of hypertensive adults were used for the analysis. To verify possible associations between the outcome and sociodemographic variables, Pearson's chi-square test was used in the unadjusted model, in addition to calculating the prevalence ratio (PR) with the respective confidence interval (95% CI) and p-value. In the unadjusted model, variables with $p < 0.20$ were analyzed. To determine

the adjusted model, Poisson regression with a robust estimator was used, whose significance was verified by Wald statistics. The Omnibus test was used to test the significance of the final adjusted model. *Statistical Package for the Social Sciences* (SPSS) version 24.0 and *LibreOffice Community 7.1.0* were used for graphs and writing. A p-value <0.05 was considered significant.

The Annual Percentage Change (APC) analysis was calculated by:

$$APC=[-1+10\ b_1]*100\%$$

$$95\%\ CI=[-1+10\ b_1\ min.]*100\%;\ [-1+10\ b_1\ max.]*100\%,\ where$$

b_1: obtained by generalized linear regression analysis using the Prais-Winsten method.

RESULTS

In the sample of 20,284 hypertensive adults, most were overweight (14,796; 72.9%), aged 50 to 59 years (11,046; 54.5%), and female (12,913; 63.7%). Regarding the other characteristics, the predominance was overweight BMI (8,017; 39.5%), in 2013 (2,660; 13.1) and 2015 (2,664; 13.1), in the capital of Salvador (2,528; 12.5), and with a high school education (8,495; 42.2%) (Tables 1).

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Table 1. Number and percentage of hypertensive adults by outcome and characteristics surveyed in the northeastern capitals of Brazil – 2013 to 2023

VARIABLE	N	%
Outcome		
Overweight	14,796	72.9
Eutrophic	5,488	27.1
BMI		
Thin	259	1.3
Eutrophy	5,229	25.8
Overweight	8,017	39.5
Grade I obesity	4,640	22.9
Morbid obesity	2,139	10.5
Year		
2013	2,660	13.1
2014	2,132	10.5
2015	2,664	13.1
2016	2,566	2.7
2017	2,448	12.1
2018	2,306	11.4
2019	2,364	11.7
2020	1,022	5.0
2021	760	3.7
2022	250	1.2
2023	1,112	5.5
Capital		
Aracaju	2,351	11.6
Fortaleza	2,020	10
Joao Pessoa	2,145	10.6
Maceió	2,494	12.3
Natal	2,231	11
Recife	2,433	12.0
Salvador	2,528	12.5
São Luís	1,915	9.4
Teresina	2,167	10.7
Age		
18 to 29	1,130	5.6
30 to 39	2,569	12.7
40 to 49 years old	5,539	27.3
50 to 59 years old	11,046	54.5
Gender		
Male	7,371	36.3
Female	12,913	63.7
Education		
Did not study/Do not know	327	1.6
Elementary	1,432	7.1
Elementary II	3,978	19.8
High school	8,495	42.2
Higher education/Postgraduate	5,883	29.2

Source: The authors (2025).

When performing the temporal evolution, statistical significance and the respective APC values with a 95% confidence interval were found for the variables: age group 30 to 39 (p=0.012; APC=0.65 and 95% CI 0.56; 2.46) and 40 to 49 (p=0.003; APC=0.33 and 95% CI=0.40; 1.13) years; female gender (p=0.001; APC=0.39 and 95% CI=0.52; 1.27); education level of those who did not study/do not know how to report (p=0.005; APC=1.42 and 95% CI=1.55; 5.06), elementary school I (p=0.033; APC=0.42 and 95% CI=0.21; 1.75), elementary school II (p=0.002; APC=0.33 and 95% CI=0.42; 1.13) and higher education/postgraduate studies (p=0.022; APC=0.22 and 95% CI=0.15; 0.88); and the state capitals Salvador (p=0.025; APC=0.63 and 95% CI=0.39; 2.53) and São Luís (p=0.018; APC=0.62 and 95% CI=0.46; 2.41) (Table 2).

Table 2. Evolution of the prevalence (%) of hypertensive adults by sociodemographic variables and by year – 2013 to 2023

	YEARS													
VARIABLE	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**APC**	**95% CI**	**p-value**
Age group														
18 to 29	63.37	61.36	68.15	62.76	68.28	60.91	58.68	62.50	74.36	44.44	72.97	-0.43	(-2.12; 0.18)	0.130
30 to 39	69.43	72.67	72.11	80.13	71.92	78.93	74.64	76.38	69.89	93.75	81.41	0.65	(0.56; 2.46)	**0.012**
40 to 49	71.20	73.80	75.27	79.17	74.03	77.51	76.35	78.49	79.10	76.00	80.83	0.33	(0.40; 1.13)	**0.003**
50 to 59	68.65	73.66	71.45	72.61	71.75	71.19	73.41	73.02	71.90	68.66	74.71	0.02	(-0.29; 0.36)	0.829
Gender														
Female	64.81	69.49	69.35	71.99	69.42	69.93	71.68	70.99	71.76	72.39	75.49	0.39	(0.52; 1.27)	**0.001**
Male	76.24	78.08	77.79	79.45	76.95	78.72	77.26	80.21	77.97	74.71	81.22	0.01	(-0.22; 0.29)	0.795
Education														
Did not study/Does not know	53.66	63.16	70.21	63.33	72.22	67.39	65.00	64.29	86.67	83.33	78.57	1.42	(1.55; 5.06)	**0.005**
Elementary I	72.02	72.66	70.85	70.90	69.84	80.43	72.25	72.00	77.19	85.71	69.23	0.42	(0.21; 1.75)	**0.033**
Elementary II	69.88	75.16	70.27	76.05	71.23	74.68	73.46	72.87	75.97	79.07	77.43	0.33	(0.42; 1.13)	**0.002**
High school	68.68	71.46	73.85	76.08	72.45	71.67	73.00	74.88	72.45	69.30	78.15	0.14	(-0.29; 0.96)	0.323
Higher/ Postgraduate	69.54	74.14	73.46	74.52	73.40	73.22	75.30	75.43	72.62	74.68	78.14	0.22	(0.15; 0.88)	**0.022**
Capital														
Aracaju	71.99	70.35	72.26	79.80	71.38	76.92	73.59	75.24	79.59	60.00	75.91	-0.12	(-1.32; 0.77)	0.611
Fortaleza	71.76	70.54	72.55	76.47	75.22	79.50	71.23	72.90	69.33	68.18	79.55	0.04	(-0.94 ; 1.16)	0.851
Joao Pessoa	70.97	76.08	76.63	74.90	71.43	67.89	74.60	77.78	82.43	80.43	70.27	0.15	(-1.04; 1.76)	0.635
Maceió	74.26	70.77	73.52	75.40	74.11	75.00	69.69	74.58	68.67	77.27	83.05	0.24	(-0.37; 1.49)	0.271
Natal	72.08	76.13	70.50	73.60	74.64	75.11	74.47	77.24	78.87	85.29	82.64	0.23	(0.07; 0.99)	0.051
Recife	66.76	78.03	74.20	78.00	70.38	71.53	80.46	80.00	69.05	59.26	74.14	-0.26	(-2.27 ; 1.12)	0.516
Salvador	63.93	71.80	72.89	75.08	72.21	73.90	74.04	69.11	72.97	83.33	79.29	0.63	(0.39; 2.53)	**0.025**
São Luís	58.43	67.54	71.92	67.38	67.39	67.16	68.20	68.42	70.59	72.73	74.04	0.62	(0.46; 2.41)	**0.018**
Teresina	70.68	72.32	66.91	70.18	72.27	70.08	73.85	74.07	72.15	70.00	76.36	0.23	(0.07; 0.99)	0.051

Source: The authors (2025).

During the period analyzed, the years 2014 and 2023 showed the highest prevalence of overweight in hypertensive adults, with rates of 5.29 and 5.9, respectively (Table 3).

Table 3. Prevalence ratio (PR) of overweight based on the year 2013 and annual increase/decrease rate of PR in hypertensive adults in the northeastern capitals of Brazil – 2013 to 2023

YEAR	PR	RATE (%)
2013	1.000	--
2014	1.053	5.29
2015	1,048	-0.48
2016	1.081	3.17
2017	1.043	-3.49
2018	1.058	1.41
2019	1.064	0.55
2020	1.076	1.09
2021	1.066	-0.91
2022	1.059	-0.66
2023	1.121	5.9

Source: The authors (2025).

Regarding nutritional status and explanatory variables, it was found that the majority were overweight, especially in the 40-49 age group (4,205; 75.9%), the year 2023 (862; 77.5%), the capital city of Natal (1,668; 74.8%), male gender (5,753; 78.0%), and higher education/postgraduate education (4,338; 73.7%). In the unadjusted model, the verification of association between sociodemographic variables and nutritional status found that the following variables were significant: age ($p<0.001$), year ($p<0.001$), city ($p<0.001$), and gender ($p<0.001$) (Table 4).

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Table 4. Unadjusted model with number and percentage of patients, by explanatory variables and nutritional status, with respective Prevalence Ratios of overweight in hypertensive adults in the northeastern capitals of Brazil – 2013 to 2023

	NUTRITIONAL STATUS							
	Overweight		Eutrophic					
VARIABLE	**N**	**%**	**N**	**%**	**RP**	**95% CI**		**p**
Age								**<0.001a**
50 to 59 years	7945	71.9	3101	28.1	1.1	1.07	1.17	
40 to 49 years	4,205	75.9	1334	24.1	1.2	1.1	1.24	
30 to 39 years	1919	74.7	650	25.3	1.2	1.1	1.22	
18 to 29 years	727	64.3	403	35.7	1.0			
Year								**<0.001a**
2023	862	77.5	250	22.5	1.1	1.1	1.2	
2022	183	73.2	67	26.8	1.1	0.98	1.15	
2021	560	73.7	200	26.3	1.07	1.01	1.12	
2020	760	74.4	262	25.6	1.08	1.03	1.12	
2019	1739	73.6	625	26.4	1.1	1.03	1.10	
2018	1687	73.2	619	26.8	1.1	1.02	1.10	
2017	1766	72.1	682	27.9	1.04	1.01	1.08	
2016	1918	74.7	648	25.3	1.08	1.05	1.12	
2015	1930	72.4	734	27.6	1.05	1.01	1.08	
2014	1552	72.8	580	27.2	1.05	1.02	1.09	
2013	1839	69.1	821	309	1.0			
Capital								**<0.001a**
Aracaju	1743	74.1	608	25.9	1.04	1.00	1.08	
Fortaleza	1495	74.0	525	26.0	1.04	1.00	1.08	
Joao Pessoa	1582	73.8	563	26.2	1.03	1.00	1.07	
Maceió	1839	73.7	655	26.3	1.03	1.00	1.07	
Natal	1668	74.8	563	25.2	1.05	1.01	1.09	
Recife	1801	74.0	632	26	1.04	1.00	1.08	
Salvador	1829	72.3	699	27.7	1.01	0.98	1.05	
São Luís	1293	67.5	622	32.5	0.9	0.91	0.99	
Teresina	1546	71.3	621	28.7	1.0			
Gender								**<0.001a**
Male	5753	78.0	1618	22.0	1.1	1.09	1.13	
Female	9043	70.0	3870	30.0	1.0			
Education								**0.099a**
Did not study/Does not know	219	67	108	33	0.9	0.84	0.98	
Elementary School	1042	72.8	390	27.2	0.99	0.95	1.02	
Elementary II	2912	73.2	1066	26.8	0.99	0.97	1.02	
High school	6190	72.9	2305	27.1	0.99	0.97	1.01	
Higher Education/Postgraduate	4338	73.7	1545	26.3	1.0			

Source: The authors (2025).

The final adjusted model consisted of the following significant variables: age ($p<0.001$), city ($p<0.001$), and gender ($p<0.001$), all of which were risk factors for overweight. The results showed that the OR was higher in the 40-49 age group

(OR=1.13), in the capital city of Natal (OR=1.04), and in males (OR=1.09), all of which are risk factors for overweight in hypertensive individuals. The Omnibus test indicated that the adjusted model was significant (p<0.001) (Table 5).

Table 5: Results of the adjusted model

VARIABLE	PR	95% CI		p
Age				<0.001
50 to 59 years	1.1	1.06	1.12	<0.001
40 to 49 years	1.13	1.10	1.2	<0.001
30 to 39 years	1.1	1.08	1.2	<0.001
18 to 29 years	1.0			
City				<0.001
Aracaju	1.03	1.00	1.1	0.014
Fortaleza	1.03	1.0	1.1	0.022
Joao Pessoa	1.03	1.0	1.1	0.032
Maceió	1.03	1.0	1.1	0.025
Natal	1.04	1.01	1.1	0.003
Recife	1.03	1.01	1.1	0.015
Salvador	1.02	0.99	1.0	0.181
São Luís	0.97	0.94	1.0	0.027
Teresina	1.0			
Gender				<0.001
Male	1.09	1.07	1.1	<0.001
Female	1			

Source: The authors (2025).

DISCUSSION

The number of hypertensive adults evaluated decreased during the years studied. In 2021, the frequency of adults (aged 18 years or older) in Brazilian state capitals who reported a medical diagnosis of hypertension was 26.3%[12]. The Northeast was the region with the highest proportion of hospitalizations for complications of SAH in 2013[22], and between 2015 and 2019, it had the highest number of deaths from hypertensive diseases nationwide[23]. This shows that the Northeast presents relevant data on the need for action to combat SAH, and its complications imply high costs for the specialized health system, making it difficult to direct financial resources to primary care and, consequently, weakening public prevention policies.

The capitals Salvador and São Luís stood out with high rates of overweight adults with hypertension. Few studies focus on the influence of macroeconomic determinants on the development and complications of hypertension[18], which presents a challenge to be addressed by public health[19]. The Northeast was the second region with the highest obesity mortality rates between 2008 and 2018[20]. The surveys conducted were unable to indicate a correlation between genetic factors and the occurrence of high obesity rates, with evidence that excessive accumulation of body fat is also triggered by socio-environmental factors[21]. Social inequality may have contributed to the increase in risk factors and their implications for the severity of the disease. In addition, low public investment in health, difficult access to the SUS (Unified Health System) for the population, and insufficient physical structures may justify this vulnerability.

Women had higher rates of SAH, and men had a higher prevalence of overweight. This relationship between BMI, sex, and SAH has not been widely researched and requires further investigation[14]. Self-care is different between the sexes, with women attending health care services more frequently [15], indicating the need for strategies that cover both sexes for the effective treatment of SAH and its comorbidities.

The results found among hypertensive and overweight adults with educational attainment were at odds with the literature, which shows an association between higher chances of developing SAH in populations with low educational attainment [16,10,30]and that the more years of schooling, the greater the knowledge in adopting health-protective behaviors [17,18]. These divergent findings highlight the lack of health knowledge and monitoring at all levels of education, with a need to develop strategies on risk factors for SAH, regardless of context.

In this study, the analysis of the temporal evolution of the prevalence of hypertensive adults was significant in the 30-49 age group, with emphasis on the significance of excess weight in the 40-49 age group. Weight gain at any age is correlated with an increase in blood pressure, and the increasing rise in BMI, especially in adults, is associated with an increased risk of developing and/or complications of SAH [6,24]. The data found showed that there is an increase in the prevalence of overweight in hypertensive adults, which can impair their prognosis and worsen their quality of life.

Cohort studies conducted in China have found that weight gain in individuals with SAH can increase blood pressure values and the relationship between high BMI and other cardiovascular complications [25,26] . Obesity is directly related to several metabolic and cardiovascular diseases, especially SAH, which can impose an economic and health burden[27]. The combination of SAH with high BMI values brings risk factors for the development of other associated NCDs in the same individual, which becomes a public health problem, with increased morbidity and mortality rates.

The increase in the number of people diagnosed with SAH influences the social and economic organization of the country, since it is a CNCD and requires continuous care[17]. Although public policies have been implemented to monitor and control hypertensive individuals, there is still the challenge of controlling the high prevalence of overweight individuals in this population[7]. It is necessary to highlight the importance of studies that focus on location-specific risk factors, especially in developing regions, as there are strong social and economic disparities between and within countries[28].

This research has the limitation of using secondary data and self-reported data from participants, but it is possible to perform a panoramic analysis of public health. The VIGITEL sample is restricted to individuals with a telephone line, but to minimize bias, post-stratification weights were assigned to the individuals studied.

This study contributed to the understanding of the relationship between overweight and hypertension in adults in the capitals of the Northeast region during the years analyzed. It should be noted that sociodemographic conditions may have been risk factors for the development of SAH, and further research is needed to describe the influence of social, environmental, economic, and cultural factors across different regions of Brazil.

CONCLUSION

This study concluded that there was a prevalence of overweight in hypertensive adults, with nutritional status and sociodemographic factors influencing morbidity and mortality from SAH, which directly affects economic and social values at the national

level. In addition to detecting regional inequalities and the need for new regional policies that consider socioeconomic disparities in Brazilian regions, which can help direct resources and strategies to the most vulnerable areas.

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ANALYSIS OF THE NUTRITIONAL STATUS OF ADULTS WITH HYPERTENSION IN THE CAPITAL CITIES OF NORTHEAST BRAZIL, 2013 TO 2023: AN ECOLOGICAL STUDY

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