

**VARIABLES ASSOCIATED WITH THE OCCURRENCE OF DIABETES *MELLITUS*  
AND/OR ARTERIAL HYPERTENSION IN THE TAPEBA/CAUCAIA-CE  
INDIGENOUS PEOPLE**

Maria Lourdes dos Santos<sup>1</sup>, Maria Iara Socorro Martins<sup>2</sup>, Artur Paiva dos Santos<sup>3</sup>  
Leidy Dayane Paiva de Abreu<sup>4</sup>, André Ribeiro de Castro Júnior<sup>5</sup>, Jéssica Araújo de Carvalho<sup>6</sup>  
Fabíola Monteiro de Castro<sup>7</sup>, Francisco Jadson Franco Moreira<sup>8</sup>

**Highlights:**

1. The only variable associated with SAH/DM: dietary guidance prescribed by the healthcare team.
2. Focus on enhancing educational interventions carried out by the healthcare team.
3. Strategies for the promotion, prevention, diagnosis and control of SAH/DM are needed.

PRE-PROOF

(as accepted)

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<sup>1</sup> Paulo Marcelo Martins Rodrigues School of Public Health. Fortaleza/CE, Brazil. <https://orcid.org/0000-0002-94133802>

<sup>2</sup> Paulo Marcelo Martins Rodrigues School of Public Health. Fortaleza/CE, Brazil. <https://orcid.org/0000-0001-9366-8621>

<sup>3</sup> Paulo Marcelo Martins Rodrigues School of Public Health. Fortaleza/CE, Brazil. <https://orcid.org/0000-0002-9261-8718>

<sup>4</sup> Paulo Marcelo Martins Rodrigues School of Public Health. Fortaleza/CE, Brazil. <https://orcid.org/0000-0001-8895-1481>

<sup>5</sup> Paulo Marcelo Martins Rodrigues School of Public Health. Fortaleza/CE, Brazil. <https://orcid.org/0000-0002-3681-3607>

<sup>6</sup> Paulo Marcelo Martins Rodrigues School of Public Health. Fortaleza/CE, Brazil. <https://orcid.org/0000-0002-6898-9973>

<sup>7</sup> Paulo Marcelo Martins Rodrigues School of Public Health. Fortaleza/CE, Brazil. <https://orcid.org/0000-0003-0639-3629>

<sup>8</sup> Paulo Marcelo Martins Rodrigues School of Public Health. Fortaleza/CE, Brazil. <https://orcid.org/0000-0003-3141-4700>

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**ABSTRACT:** The objective was to analyze the variables associated with the occurrence of Systemic Arterial Hypertension (SAH) and/or Diabetes Mellitus (DM) in the Tapeba Population residing in Caucaia-CE. Epidemiological, cross-sectional, analytical study, carried out with SAH and/or DM data from 2010 to 2021, of the Tapeba indigenous population. Data collection was carried out between July 2021 and October 2022, using the registration forms of this population assisted by the health teams and made available by the Special Indigenous Sanitary District. Descriptive, bivariate and multivariate statistics were used for analysis using the Statistical Package for Social Science version 23.0. 663 registration forms were reviewed, obtaining a higher occurrence of cases of SAH and/or DM in 2019, in the population residing in Jandaiguaba and among women. The mean age was  $51.9 \pm 15.2$  years. Among all the variables tested in the multivariate regression model, following dietary advice from the health team was the only one associated with the occurrence of SAH and/or DM. This study demonstrates the need to enhance and value educational interventions carried out by health professionals through the creation of strategies for health promotion, prevention, diagnosis and control of SAH and DM.

**Keywords:** Health of Indigenous Peoples; Indigenous Population; Hypertension; Diabetes Mellitus.

## INTRODUCTION

The Tapeba indigenous population is the result of a process of ethnic individuation of several native indigenous organizations gathered in the village of Nossa Senhora dos Prazeres de Caucaia, which gave rise to the name of the municipality, Caucaia, metropolitan region of Fortaleza in Ceará. Tapeba or "stilt" is also the toponym of a pond and stream, it is a word of Tupi origin meaning "flat/flat/polished stone". Data from the Indigenous Health Care Information System (SIASI) and the Special Secretariat for Indigenous Health (SESAI) estimate, in 2014, the existence of 6,651 Tapebanos living in settlements, working in agriculture, artisanal fishing, street vendors, and salaried work <sup>1</sup>. It is noteworthy that SESAI is the area of the Ministry of Health responsible for coordinating the National Policy for Health Care for Indigenous Peoples <sup>2</sup>.

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According to Sousa <sup>3</sup>, there is no way to talk about health and not talk about the concept of land for the indigenous population, which in a broad and complex definition crosses several fields of significance, not only as a space for struggles, resumptions, but also referring to the care of the community by naming it as housing, food, education, family relations, religion (in the production of knowledge for prayers and healings) and health, in its connection with the body and perception of space as life. And it was only with the National Policy for Health Care for Indigenous Peoples (PNASPI) that the indigenous population had greater ease and access to health actions, as well as greater participation in actions and social control.

The Brazilian Northeast is one of the regions with the highest geographic density of indigenous population living outside indigenous lands, after the Southeast region. Many of these indigenous people live in urban areas and are affected by the consequences of risk behaviors, such as the use of illicit substances and a greater predisposition to Chronic Non-Communicable Diseases (NCDs) <sup>4</sup>.

NCDs act as the main health problem in the world and are related to the large number of premature deaths and loss of quality of life, in addition to the high prevalence of disability experiences, with economic impact on families, communities and society <sup>5</sup>. It is noteworthy that the relationship of indigenous people with non-indigenous society directly impacts their life habits, as well as sociocultural and economic aspects. These are intense changes in relation to land and work, as well as the decrease in physical activities and, mainly, the difficulty of access to health services, resulting in an increase in the indicators of NCDs <sup>6</sup>.

NCDs affect people from all socioeconomic strata and, more intensely, those belonging to vulnerable groups, such as the elderly and those with low education and income. According to the Ministry of Health, in the period between 2015 and 2017, Brazil registered approximately 9 million cases of Systemic Arterial Hypertension (SAH) and Diabetes *Mellitus* (DM), affecting 24.7% of the population. In the same period, the Indigenous Health Care Subsystem (SasiSUS) also notified, in indigenous peoples, 42,583 cases of NCDs, including cardiovascular diseases, acute respiratory diseases, DM and neoplasms. There were also 2,371 deaths due to cardiovascular diseases and DM<sup>7</sup>. In this sense, it is important to emphasize the growing number of cases of DM and SAH that are related to cultural changes, eating habits, and lifestyle<sup>8</sup>.

Knowing the incipience of studies related to indigenous health and the absence of exploratory studies of NCDs in the Tapeba indigenous population in Ceará, this research aimed

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to analyze the sociodemographic and health context variables associated with the occurrence of DM and/or SAH in Tapeba indigenous people cared for by the health teams of the Caucaia-CE hub, according to the case registration form from 2010 to 2021.

### METHODS

This is an epidemiological, cross-sectional, analytical, quantitative study, carried out in the municipality of Caucaia in the state of Ceará, with data from registration forms of cases of SAH and DM in the Tapeba indigenous population, in the period between 2010 and 2021.

Data collection took place between July 2021 and October 2022, using the information present in 663 registration forms of this population, made available by the DSEI in printed but de-identified forms, containing information from 14 indigenous communities: Capoeira, Capuan, Cipó, Coité, Jandaiguaba, Jardim do Amor, Lagoa (here we have the sum of the communities Lagoa das Bestas, Lagoa Tapeba I and Lagoa Tapeba II), Lameirão, Ponte, Sobradinho, Trilho and Vila Nova, accompanied by the health team of the Polo de Caucaia-CE.

The data were tabulated in a *Microsoft-Excel®* spreadsheet by double entry to avoid tabulation errors, as described in the study on data management<sup>9</sup>, then analyzed using the *Statistical Package for the Social Sciences (SPSS)®* version 23.0. For the qualitative variables, absolute and relative frequencies were calculated. Quantitative variables were summarized using mean and standard deviation statistics. The normality of the distribution of the data of quantitative variables was studied using the histogram graph and the *Kolmogorov-Smirnov* test, and the distribution was considered approximately normal if the histogram presented aspects of a distribution with visualization of the *Gaus* curve and in the statistical test the p-value was  $> 0.05$ .

The bivariate analysis for acceptance or rejection of the hypothesis that there are no statistical relationships between quantitative variables and qualitative variables with two response categories was conducted using the *independent sample t-test*. For these analyses, the p-value was obtained with statistical significance when  $< 0.05$  and a 95% confidence interval (95%CI). The analysis of the association between the qualitative variables, regardless of the number of response categories, was conducted using *Pearson's chi-square test*, considering the association statistically significant when p-value  $< 0.05$ .

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To explore the association between the independent variables and the dependent variables shown in Chart 1 (supplementary file 1), *Binary Logistic Forward* Regression was used. This model was selected because of the nature of the dependent variables as dichotomous qualitative and the independent variables as metric, dichotomous and qualitative variables with two response categories.

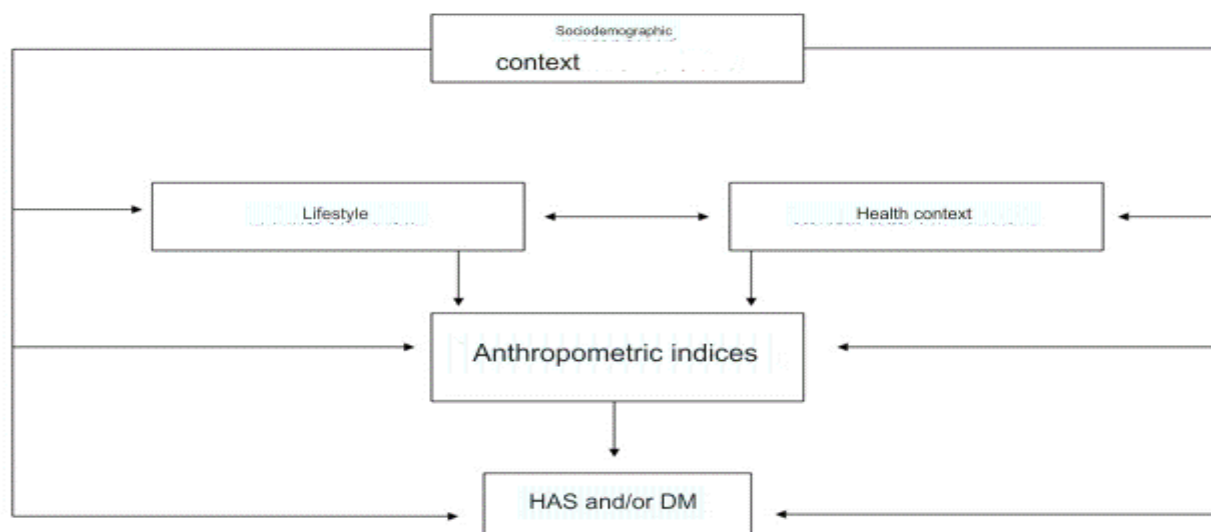
Arbitrarily, the year of registration variable was transformed into a two-category ordinal variable (2010 to 2016 = 0; 2017 to 2021 = 1). The indigenous communities variable was transformed into a nominal variable of two categories (Jandaiguaba and Trilho = 1; Other communities = 0). Jandaiguaba and Trilho were grouped into a single category because they are communities with the highest occurrence of cases. The waist circumference variable was transformed into a qualitative variable in two categories (Above 94 cm for men and 80 cm for women = 1; Below 94 cm for men and 80 cm for women = 0). These cut-off points for the waist variable were selected based on the recommendations for cardiovascular risk of the World Health Organization (WHO)<sup>10</sup>.

The age variable was transformed into an ordinal variable of two categories (Below 60 years = 1; Greater than or equal to 60 years = 0). The cut-off point for age is in accordance with the Statute of the Elderly, which characterizes an elderly person over 60 years of age<sup>11</sup>. The variable body mass was arbitrarily transformed into an ordinal variable of two categories (Below or equal to 80 kg = 1; Above 80 kg = 0). The Body Mass Index (BMI) variable was transformed into an ordinal variable of two categories (Below or equal to 25 kg/m<sup>2</sup> = 0; Above 25 kg/m<sup>2</sup> = 1). The cut-off point for BMI is in accordance with the WHO recommendation for values above 25 kg/m<sup>2</sup> to constitute overweight or obesity<sup>12</sup>.

The multivariate analysis was based on a statistical determination model, considering two levels. At the first level, the unadjusted analysis was performed between all characteristics and primary outcomes using the bivariate analysis previously described. At the second level, an adjusted analysis was performed, including the variables of the first level, with  $p < 0.20$ . To enter the variables at the second level of the analysis, a hierarchical conceptual model adapted from Sturmer *et al.* was used.<sup>13</sup> (Figure 1).

**Figure 1.** Explanatory hierarchical conceptual model, adapted from Sturmer *et al.*<sup>13</sup>.

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Source: Sturmer *et al.*, 2006<sup>13</sup>.

The reference response categories of the independent variables were chosen according to the highest prevalence of the cases, and the dependent variables (SAH and/or DM) were selected according to the outcome of interest ("yes" for the conditions under study). In the hierarchical approach, the variables of more distal levels are tested in the model for adjustment of those more proximal to the outcome, controlling their effect. The first model was conducted with the presence of variables related to anthropometric measurements, the second by health and lifestyle context variables, and the third by sociodemographic variables.

The *Odds Ratio* (OR) and its respective 95% CI were used to estimate the magnitude of the association between the variables, adjusting for a series of variables that could act as potentially confounding variables<sup>14</sup>. The diagnosis of the selected model was performed by means of the *Hosmer-Lemeshow* test, and the model with a p-value > 0.05 and a value of the R<sup>2</sup> *Nagelkerke* was relevant, making it possible to identify the percentage of explanation<sup>15</sup> of the model under analysis. The results are presented in tables.

This study contemplates some of the objectives of the research project called "Occurrence of Diabetes *Mellitus* and Chronic Arterial Hypertension in the Health of the Tapeba Indigenous Population in Caucaia-Ce from 2010 to 2020: an epidemiological analysis", referring to call 02/2020 of the Research Program for SUS: Shared Management in Health - PPSUS-CE-FUNCAP-SESA-DECIT/SCTIE/MS-CNPq, which is in accordance with the determinations of the National Ethics Commission in Research (Conep), as well as the attributions defined by the National Health Council (CNS) through Resolution 466 of 2012,

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approved by the Research Ethics Committee (CEP) of the School of Public Health of Ceará Paulo Marcelo Martins Rodrigues and, followed, by Conep, with opinion No. 4,713,724.

## RESULTS

A total of 663 records of SAH and/or DM cases in the Tapeba population were analyzed. Of the 663 records, about 599 were from people with SAH with loss of 2 records, 148 had DM with loss of 15 records, and 208 contemplated both health conditions with loss of 14 records.

The mean age, regardless of health condition, was  $51.9 \pm 15.2$  years. The mean age of individuals without SAH was  $45.4 \pm 11.4$  years and with SAH it was  $52.6 \pm 15.4$  years ( $p < 0.001$ ; 95%CI = -10.40 to -4.07); without DM it was  $51.7 \pm 15.5$  years and with DM it was  $52.5 \pm 14.5$  years ( $p = 0.54$ ; 95%CI = -3.30 to 1.75); without SAH and DM was  $50.9 \pm 15.2$  years and among individuals with simultaneous occurrence of these was  $55.6 \pm 14.5$  years ( $p = 0.001$ ; 95%CI = -7.49 to -1.90).

Table 1 shows the results regarding the sociodemographic characterization of the study population and the occurrence of hypertension and/or DM. There was a significant association only between gender, age and diagnosis of SAH ( $p < 0.05$ ). None of the variables were statistically associated with the occurrence of DM ( $p > 0.05$ ). It is noteworthy that only age was statistically significantly associated with the diagnosis of hypertension and DM ( $p < 0.05$ ).

**Table 1.** Sociodemographic characterization of the Tapeba indigenous population diagnosed with Systemic Arterial Hypertension and/or Diabetes Mellitus according to registration forms from 2010 to 2021 of the Special Indigenous Health District of Ceará.

SAH, n(%)	DM, n(%)	SAH and DM, n(%)
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	Yes	Total	p	Yes	Total	P	Yes	Total	p
<b>Year of registration</b>									
2010	1(0,2)	1(0,2)		0(0)	1(0,2)		0(0)	1(0,2)	
2011	2(0,3)	2(0,3)		1(0,5)	2(0,3)		1(0,5)	2(0,3)	
2012	4(0,7)	5(0,8)		3(1,5)	5(0,8)		2(1,4)	5(0,8)	
2013	18(3,0)	20(3,1)		4(2,0)	19(3,0)		2(1,4)	19(3,0)	
2014	22(3,7)	23(3,5)		4(2,0)	19(3,0)		3(2,1)	19(3,0)	
2015	68(11,4)	75(11,5)	0,40	24(11,5)	71(11,0)	0,31	16(11,0)	70(10,9)	0,39
2016	41(6,9)	44(6,7)		7(3,4)	43(6,5)		4(2,7)	43(6,7)	
2017	110(18,5)	113(17,3)		35(17,1)	112(17,4)		32(21,9)	112(17,4)	
2018	106(17,8)	122(18,6)		40(19,5)	120(18,7)		26(17,8)	121(18,8)	
2019	140(23,6)	156(23,8)		49(23,9)	156(24,3)		35(24,0)	156(24,3)	
2020	76(12,8)	87(13,2)		35(17,1)	88(13,7)		23(15,8)	87(13,6)	
2021	6(1,1)	7(1,0)		3(1,5)	7(1,1)		2(1,4)	7(1,0)	
<b>Year of registration in two categories</b>									
2010 to 2016	156(26,3)	170(26,0)	0,57	43(21,0)	160(24,9)	0,11	28(19,2)	159(24,8)	0,07
2017 to 2021	438(73,7)	485(74,0)		162(79,0)	483(75,1)		118(80,8)	483(75,2)	
<b>Indigenous Communities</b>									
Jandaiguaba	145(24,2)	162(24,5)		58(27,9)	160(24,7)		41(27,7)	161(24,8)	
Coité	12(2,0)	15(2,3)		3(1,4)	15(2,3)		0(0)	15(2,3)	
Capoeira	36(6,0)	41(6,2)	0,05	14(6,7)	35(5,4)	0,51	9(6,1)	35(5,4)	0,50
Vila Nova	4(0,5)	4(0,5)		1(0,5)	3(0,5)		1(0,7)	3(0,5)	
Rail	144(24,1)	152(23,0)		46(22,1)	153(23,6)		38(25,7)	152(23,5)	
Sobradinho	4(0,7)	4(0,6)		0(0)	4(0,6)		0(0)	4(0,6)	



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Capuan	85(14,2)	89(13,5)	22(10,6)	89(13,7)	18(12,2)	89(13,7)	
Bridge	12(2,0)	16(2,4)	4(1,9)	15(2,3)	2(1,2)	15(2,3)	
Lameirão	6(1,0)	6(0,9)	1(0,5)	6(0,9)	1(0,7)	6(0,9)	
Pond	93(15,6)	109(16,5)	37(17,8)	106(16,3)	21(14,2)	105(16,2)	
Garden of Love	58(9,7)	63(9,6)	22(10,6)	63(9,7)	17(11,5)	63(9,8)	
<b>Indigenous Communities in two categories</b>							
Jandaiguaba and Trail	289(48,2)	314(47,5)	104(50,0)	313(48,2)	79(53,4)	313(48,3)	
			0,23		0,53		0,15
Other communities	310(51,8)	347(52,5)	104(50,0)	336(51,8)	69(46,6)	335(51,7)	
<b>Gender</b>							
Man	227(38,8)	259(40,1)	82(40,2)	254(40,0)	51(35,2)	254(40,1)	
			0,03		0,94		0,17
Woman	358(61,2)	387(59,9)	122(59,8)	381(60,0)	94(64,8)	380(59,9)	
<b>Age in two categories</b>							
Under 60 years old	399(67,2)	455(69,5)	142(69,3)	447(69,5)	87(59,6)	446(69,5)	
			<0.001		0,92		0,003
Above or equal to 60 years	195(32,8)	200(30,5)	63(30,7)	196(30,5)	59(40,4)	196(30,5)	
<b>Level of education</b>							
No literacy	46(16,7)	48(15,8)	17(17,5)	48(15,8)	15(21,7)	48(15,8)	
Elementary school (complete or incomplete)	157(57,3)	173(57,2)	55(56,7)	173(57,2)	39(56,5)	173(57,1)	
			0,38		0,92		0,38
High school (complete or incomplete)	64(23,4)	74(24,4)	23(23,7)	74(24,4)	14(20,3)	74(24,4)	

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Higher education							
(complete or incomplete)	7(2,6)	8(2,6)	2(2,1)	8(2,6)	1(1,5)	8(2,7)	

SAH – Systemic Arterial Hypertension; DM – Diabetes Mellitus; n – absolute value; % - relative value; p – significance value when  $< 0.05$

Inferential statistics using *Pearson's chi-square test*

**Source:** Prepared by the authors (2023).

Table 2 shows a statistical association between cardiovascular risk, sedentary lifestyle, family history of NCDs and dietary follow-up by the health team with the occurrence of hypertension ( $p < 0.05$ ). Regarding the occurrence of DM, there was a relationship with the variable of dietary follow-up by the health team ( $p < 0.05$ ). On the other hand, SAH and DM were associated with cardiovascular risk, sedentary lifestyle, dietary follow-up by the team, and BMI ( $p < 0.05$ ).

The mean waist circumference of individuals without SAH was  $97.2 \pm 12.6$  cm and of those diagnosed with SAH was  $100.6 \pm 11.5$  cm ( $p = 0.03$ ; 95%CI = -6.48 to -0.30). Individuals without SAH had a mean body mass of  $73.1 \pm 15.4$  kg on the registration forms, and those diagnosed with SAH had a mean of  $74.3 \pm 15.6$  kg ( $p = 0.56$ ; 95%CI = -5.29 to 2.88). Regarding BMI, the mean BMI was  $29.1 \pm 5.5$  kg/m<sup>2</sup> among those who did not have a diagnosis of hypertension, and among those with a diagnosis it was  $30.1 \pm 5.4$  kg/m<sup>2</sup> ( $p = 0.18$ ; 95%CI = -2.42 to 0.47).

The mean waist circumference of individuals without DM was  $99.8 \pm 11.6$  cm and of those diagnosed with DM was  $101.2 \pm 11.8$  cm ( $p = 0.15$ ; 95%CI = -3.36 to 0.55). Individuals without DM had a mean body mass of  $73.7 \pm 15.3$  kg on the registration forms, and those diagnosed with DM had a mean of  $75.1 \pm 16.3$  kg ( $p = 0.29$ ; 95%CI = -3.98 to 1.20). Regarding BMI, the mean BMI among those who did not have a diagnosis of DM was  $29.8 \pm 5.5$  kg/m<sup>2</sup> and among those diagnosed with DM it was  $30.3 \pm 5.2$  kg/m<sup>2</sup> ( $p = 0.28$ ; 95%CI = -1.39 to 0.41).

Among individuals without simultaneous diagnosis of SAH and DM, the mean waist circumference was  $99.4 \pm 11.8$  cm, and among those diagnosed with SAH and DM, it was  $103.1 \pm 10.8$  cm ( $p = 0.001$ ; 95%CI = -5.85 to -1.55). Individuals without SAH and DM had a mean body mass of  $73.6 \pm 15.3$  kg on the registration forms, and those diagnosed with SAH and DM had a mean of  $76.0 \pm 16.5$  kg ( $p = 0.09$ ; 95%CI = -5.30 to 0.45). Regarding BMI, the mean BMI among those who did not have a diagnosis of SAH and DM was  $29.7 \pm 5.5$  kg/m<sup>2</sup> and among

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those diagnosed with SAH and DM it was  $30.8 \pm 5.1 \text{ kg/m}^2$ , a statistically significant difference ( $p = 0.02$ ; 95% CI = -2.13 to -0.12).

**Table 2.** Association between health context variables and the occurrence of Systemic Arterial Hypertension and/or Diabetes Mellitus in the Tapeba indigenous population according to registration forms from 2010 to 2021 of the Special Indigenous Health District of Ceará.

	SAH, n(%)			DM, n(%)			SAH and DM, n(%)		
	Yes	Total	p	Yes	Total	p	Yes	Total	p
<b>Cardiovascular risk</b>									
Yes	401(69,7)	435(68,5)	<b>0,03</b>	142(71,4)	427(68,4)	0,28	112(78,9)	428(68,6)	<b>0,003</b>
No	174(30,3)	200(31,5)		57(28,6)	197(31,6)		30(21,1)	196(31,4)	
<b>Obesity</b>									
Yes	347(63,1)	379(62,7)	0,57	125(66,1)	376(62,6)	0,22	93(67,9)	376(62,7)	0,15
No	203(36,9)	225(37,3)		64(33,9)	225(37,4)		44(32,1)	224(37,3)	
<b>Smoking</b>									
Yes	102(18,1)	111(17,9)	0,75	28(14,5)	111(18,0)	0,12	19(13,5)	111(18,0)	0,10
No	462(81,9)	508(82,1)		165(85,5)	504(82,0)		122(86,5)	504(82,0)	
<b>Alcoholism</b>									
Yes	15(7,1)	17(7,7)	0,22	3(4,9)	17(7,8)	0,32	1(2,1)	17(7,8)	0,09
No	195(92,9)	205(92,3)		58(95,1)	202(92,2)		47(97,9)	201(92,2)	
<b>Sedentary lifestyle</b>									
Yes	392(68,1)	425(66,8)	<b>0,04</b>	142(70,6)	419(66,6)	0,14	110(76,9)	419(66,7)	<b>0,003</b>
No	184(31,9)	211(33,2)		59(29,4)	210(33,4)		33(23,1)	209(33,3)	
<b>Family history of NCDs</b>									
Yes	273(53,8)	287(51,5)	<b>&lt;0.001</b>	79(46,7)	284(51,4)	0,14	65(53,3)	285(51,5)	0,66
No	234(46,2)	270(48,5)		90(53,3)	268(48,6)		57(46,7)	268(48,5)	
<b>History of Heart Disease</b>									

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Yes	5(2,4)	5(2,3)		1(1,7)	5(2,4)		1(2,1)	5(2,4)	
No	200(97,6)	210(97,7)	0,61	57(98,3)	207(97,6)	0,70	46(97,9)	206(97,6)	0,90
<b>History of Coronary Artery Diseases</b>									
Yes	5(0,9)	6(0,9)		3(1,5)	6(1,0)		2(1,4)	6(1,0)	
No	572(99,1)	630(99,1)	0,53	197(98,5)	623(99,0)	0,33	141(98,6)	622(99,0)	0,53
<b>History of Acute Myocardial Infarction</b>									
Yes	6(1,0)	7(1,1)		3(1,5)	7(1,1)		2(1,4)	7(1,1)	
No	572(99,0)	630(98,9)	0,64	198(98,5)	623(98,9)	0,53	142(98,6)	622(98,9)	0,71
<b>History of Stroke</b>									
Yes	6(1,0)	7(1,1)		2(1,0)	7(1,1)		1(0,7)	7(1,1)	
No	572(99,0)	630(98,9)	0,64	199(99,0)	623(98,9)	0,84	143(99,3)	622(98,9)	0,58
<b>Occurrence of Chronic Kidney Disease</b>									
Yes	0(0)	1(0,2)		1(0,5)	1(0,2)		0(0)	1(0,2)	
No	572(100)	626(99,8)	0,08	194(99,5)	619(99,8)	0,31	142(100)	618(99,8)	1,00
<b>Occurrence of diabetic foot</b>									
Yes	-	-		1(0,5)	1(0,5)		0(0)	1(0,5)	
No	-	-	-	198(99,5)	199(99,5)	1,00	144(100)	197(99,5)	0,27
<b>Occurrence of amputation due to complications of diabetes</b>									
Yes	-	-		3(1,5)	3(1,5)		2(1,4)	3(1,5)	
No	-	-	-	195(98,5)	196(98,5)	1,00	142(98,6)	194(98,5)	1,00

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**Occurrence of blindness due to complications of diabetes**

Yes	-	-	-	1(1,6)	1(1,6)	1,00	0(0)	1(1,6)	0,23
No	-	-	-	62(98,4)	63(98,4)		48(100)	62(98,4)	

**Dietary guidance prescribed by the health team**

Yes	49(22,9)	58(25,4)	0,001	29(46,0)	57(25,9)	<0,001	19(39,6)	56(25,6)	0,01
No	165(77,1)	170(74,6)		34(54,0)	163(74,1)		29(60,4)	163(74,4)	

**Drug treatment for NCDs**

Yes	599(100)	661(100)	-	208(100)	649(100)	-	148(100)	648(100)	-
No	-	-	-	-	-	-	-	-	-

**Use of traditional indigenous medicine**

Yes	6(3,0)	8(3,7)	0,07	2(3,8)	8(3,9)	1,00	0(0)	8(4,0)	0,35
No	195(97,0)	206(96,3)		51(96,2)	195(96,1)		39(100)	194(96,0)	

**Waist in two categories**

Below 94 cm for men and 80 cm for women	16(2,7)	20(3,1)	0,09	8(3,9)	21(3,3)	0,53	3(2,1)	20(3,1)	0,40
Above or equal to 94 cm for men and 80 cm for women	573(97,3)	630(96,9)		195(96,1)	617(96,7)		142(97,9)	618(96,9)	

**Body mass in two categories**

Below or equal to 80 kg	413(69,3)	456(69,3)	0,99	138(66,7)	447(69,2)	0,33	96(65,3)	447(69,3)	0,23
Over 80 kg	183(30,7)	202(30,7)		69(33,3)	199(30,8)		51(34,7)	198(30,7)	

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**BMI in two categories**

Below or equal to 25 kg/m <sup>2</sup>	135(22,8)	150(22,9)	41(20,0)	150(23,3)	25(17,1)	149(23,2)	0,74	0,17	0,04
Above 25 kg/m <sup>2</sup>	458(77,2)	504(77,1)	164(80,0)	493(76,7)	121(82,9)	493(76,8)			

SAH – Systemic Arterial Hypertension; DM – Diabetes Mellitus; n – absolute value; % - relative value; NCDs – Chronic Non-Communicable Disease; BMI – Body Mass Index; p – significance value when < 0.05

Inferential statistics using *Pearson's chi-square test*

Source: Prepared by the authors (2023).

Table 3 shows the results of the final model of the Binary Logistic Regression analysis. For the SAH model, the decision was made to remove the variable of occurrence of Chronic Kidney Disease (0%) and use of traditional indigenous medicine (3.0%), given the low prevalence of the event of interest ("yes" to SAH). The second model was chosen ( $p = 0.02$ ;  $R^2 = 24.5\%$ ; *Hosmer and Lemeshow test* with  $p = 0.74$ ), explaining 94.9% of the cases. Among the models for DM (Table 3), the second one was chosen ( $p = 0.001$ ;  $R^2 = 19.3\%$ ; *Hosmer and Lemeshow test* ( $p = 0.67$ ), explaining 78.7% of the cases; while the third model was chosen for SAH and DM ( $p = 0.004$ ;  $R^2 = 27.2\%$ ; *Hosmer and Lemeshow test* with  $p = 0.96$ ), explaining 83.6% of the cases.

It is evident that only the variable of dietary follow-up guided by the health team is associated with the occurrence of SAH and/or DM, i.e., people who follow dietary guidance guided by the health team are 0.09 times less likely to belong to the group of people with SAH, and those who do not follow it are 7.64 times and 4.13 times more likely to belong to the group of people with DM and SAH and DM. respectively (Table 3).

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**Table 3.** Final model of the multivariate analysis on the variables associated with the occurrence of Systemic Arterial Hypertension and/or Diabetes Mellitus in the Tapeba indigenous population, according to registration forms from 2010 to 2021 of the Special Indigenous Health District of Ceará.

HAS			
	B	p	adjusted OR; CI95%
Waist circumference (ref. Above or equal to 94 cm for men and 80 cm for women)	-2,51	0,24	0,08; 0.001 to 5.36
Waist circumference (centimeters)	0,04	0,45	1,04; 0.92 to 1.18
Body Mass Index (kg/m <sup>2</sup> )	-0,13	0,27	0,87; 0.68 to 1.11
Cardiovascular risk (ref. Yes)	-0,12	0,89	0,88; 0.13 to 5.77
Family history of NCDs (ref. Yes)	0,14	0,90	1,15; 0.11 to 12.11
Sedentary lifestyle (ref. Yes)	-0,33	0,65	0,71; 0.16 to 3.16
<b>Follows dietary guidelines (ref. No)</b>	<b>-2,36</b>	<b>0,004</b>	<b>0,09; 0.01 to 0.46</b>
DM			
Body Mass Index (ref. Above 25 kg/m <sup>2</sup> )	-0,49	0,40	0,60; 0.18 to 1.96
Waist circumference (centimeters)	0,01	0,57	1,01; 0.97 to 1.04
Year of registration (ref. 2017 to 2021)	0,06	0,87	1,06; 0.49 to 2.29
Smoking (ref. No)	-0,37	0,36	0,69; 0.30 to 1.54
Family history of NCDs (ref. Yes)	0,03	0,94	1,03; 0.33 to 3.19
Sedentary lifestyle (ref. Yes)	-0,83	0,07	0,43; 0.17 to 1.10
<b>Follows dietary guidelines (ref. No)</b>	<b>2,03</b>	<b>&lt; 0.001</b>	<b>7,64; 3.15 to 18.55</b>
HAS and DM			
Body Mass Index (ref. Above 25 kg/m <sup>2</sup> )	-0,82	0,29	0,43; 0.09 to 2.06
Waist circumference (centimeters)	0,02	0,64	1,02; 0.92 to 1.13
Body mass (kg)	0,04	0,31	1,04; 0.96 to 1.12
Body Mass Index (kg/m <sup>2</sup> )	-0,14	0,18	0,86; 0.70 to 1.06
Year of registration (ref. 2017 to 2021)	-0,66	0,17	0,51; 0.19 to 1.35
Cardiovascular risk (ref. Yes)	0,58	0,48	1,78; 0.35 to 9.07
Obesity (ref. Yes)	-0,46	0,43	0,62; 0.19 to 2.03
Smoking (ref. No)	-0,45	0,39	0,63; 0.22 to 1.79
Sedentary lifestyle (ref. Yes)	-0,91	0,12	0,40; 0.12 to 1.28
Alcoholism (ref. No)	-0,92	0,41	0,39; 0.04 to 3.65
<b>Follows dietary guidelines (ref. No)</b>	<b>1,41</b>	<b>0,007</b>	<b>4,13; 1.48 to 11.52</b>

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Community (ref. Jandaiguaba and Trail)	-1,36	0,08	0,25; 0.05 to 1.19
Gender (ref. Woman)	-0,71	0,33	0,49; 0.11 to 2.05
Age (ref. Under 60 years old)	0,43	0,60	1,53; 0.30 to 7.81
Age (years)	0,03	0,25	1,03; 0.97 to 1.09

B – Coefficient of the binary logistic regression model; p – Statistical significance value when  $< 0.05$ ; OR – *Odds Ratio*; CI – Confidence Interval; ref. – Reference value in the independent variable; SAH – Systemic Arterial Hypertension; DM – Diabetes Mellitus; NCDs – Chronic Non-Communicable Disease; BMI – Body Mass Index. Multivariate Analysis by Binary Logistic Regression  
**Source:** Prepared by the authors (2023).

## DISCUSSION

This study shows that among all the variables tested in the multivariate regression model, the variable following dietary guidance by the health team was the only one associated with the occurrence of SAH and/or DM in the sample of case registration forms of the Tapeba population living in Caucaia-CE. It is worth noting that this research is a pioneer in Ceará and to date no scientific studies have been reported in Brazil that evaluate the occurrence of SAH and/or DM in this population.

Although they are not part of the territory delimited in 2017 by the National Indian Foundation, Jandaiguaba (part of the community) together with Capuan, have the largest number of Tapebanos, which could explain the higher frequency of DM and SAH in this indigenous community<sup>16</sup>. The occurrence of DM and SAH in the Tapeba population followed a flow also observed among the 27 capitals surveyed in 2019 by the VIGITEL 17 survey, through which a frequency of 24.5% in SAH and 7.4% in DM can be observed, with a higher incidence among women, increasing with advancing age and decreasing schooling.

It is known that the influence of gender on the prevalence of health problems is known, studies indicate that the higher frequency in females may occur due to the presence of specific biological characteristics (such as a decrease in the production of steroid hormones, weight gain in the menopausal phase, others), better self-perception of the health condition and periodic exams that, Most of them allow an early diagnosis of the disease<sup>18</sup>.

Even though in the multivariate analysis this difference did not remain statistically significant, when analyzing the occurrence according to gender, the two morbidities suggest a higher prevalence among women, which may be attributable to the fact that they seek primary



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health care services more, similar to the pattern of the Brazilian female population, creating opportunities for diagnosis<sup>19-20</sup>. Study by McDermott et al<sup>21</sup> conducted in Australian indigenous communities and the epidemiological study conducted in Pará, Brazil by Corrêa PKV *et al.*<sup>22</sup>, likewise, identified a higher prevalence of DM and SAH in women.

The present study revealed that age greater than 50 (fifty) years is associated with the onset of hypertension and DM, in line with the study by Gritti *et al.*<sup>23</sup>, which found that 29% of deaths associated with NCDs in developing countries occur in people under 60 (sixty) years of age and, specifically in Brazil, these deaths exceed 66%.

Regarding the BMI and SAH/DM ratio, a Brazilian study showed that 93% of the hypertensive population and 96.77% of the diabetic population have risk factors, among which the highlight is related to obesity and high BMI<sup>24</sup>. Another study found that the BMI assessment of patients in the female population with SAH and DM showed that 40% were overweight; 38% mildly obese; 2% medium obesity; 2% morbidly obese. Among the male population, 28.57% were overweight; 42.86% were mildly obese and 11.43% were moderately obese. The study did not observe morbid obesity in the male group, but the findings point to high cardiovascular risk related to the occurrence of hypertension or hypertension and DM<sup>25</sup>.

Chronic diseases such as hypertension and DM are associated with some modifiable risk factors such as a sedentary lifestyle, irregular eating behavior, as well as a family history of NCDs, expressed in the present study and in a study that associated NCDs and personal/family history in rehospitalized patients<sup>23</sup>. The authors also express the need to strengthen health promotion measures as a source of NCD prevention. Guidance on how to maintain a healthy diet was a protective factor in all study groups - SAH, DM and SAH and DM - which corroborates this statement.

According to Moreira *et al.*<sup>25</sup> Healthy eating is directly associated with lower exposure to risk factors for the development of NCDs, assuming the role of a protective and health promotion factor, which, at the same time as representing a behavioral habit, is influenced by socioeconomic factors, resulting in the quantitative and qualitative impairment of food, that is, in the food security of individuals<sup>26</sup>.

It is observed that the early detection, treatment and control of SAH and DM need and should be aligned with preventive actions related to lifestyle and ensuring access to quality multidisciplinary care. Nevertheless, it is necessary to review and comply with the current SAH

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and DM care protocols, instituted by the SUS as specific policies for the care of indigenous people in the dynamics of the communities in the light of the National Policy for Health Care of Indigenous Peoples<sup>18</sup>.

According to Alves *et al.*<sup>27</sup> The relationship between basic health information and adherence to self-care in health is closely linked to knowledge about food. In the same position, Estrela *et al.*<sup>28</sup> clarifies that the relationship between knowledge and real knowledge still remains fragile, given that knowledge alone does not determine change, but becomes a basic instrument for the construction of healthy behavior.

The main limitations of this research are information and selection biases. It is worth mentioning that, as this is a documentary study, it was not possible to control, under methodologically standardized processes, the obtaining of information and measurements of the variables for analysis, exposing the results to the bias of incorrect classification and measurement. Based on the literature<sup>29,30</sup>, it is understood that smoking and alcoholism are factors related to the occurrence of NCDs, however, in this sample the prevalence of these habits was considered low, and it is understood that there may have been Hawthorne's bias in obtaining data for these variables. In addition, it is known that there is a relationship between lower schooling and higher prevalence of NCDs<sup>30</sup>, and in the present study a low occurrence of NCDs was obtained in individuals with a higher level of education, however, without a statistically significant association. It is worth mentioning that this schooling variable was only present in registration forms from 2018 onwards (period of incorporation of the updated form), in this analysis there is information bias.

The data were obtained from physical files (registration form) under the domain of DSEI-Ceará and it is possible that some forms have not yet been sent to the District within the data collection period and this situation exposes the results to selection bias. Another limitation to be highlighted is the survivor bias, as it was not possible to verify death records and cross-reference them with the case records in an attempt to identify if there were cases that died due to hypertension and/or DM, but that did not have the record form among the rescued files.

Even in the face of these limitations, the results of the present study can be considered in groups with characteristics similar to those described in this study. In addition, this is the first study and the only study to date of this publication conducted in the Tapeba population in Caucaia-CE.

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## CONCLUSIONS

Of the variables analyzed, following dietary guidance prescribed by the health team was the only one with a significant association with the occurrence of hypertension and/or DM in the sample of the Tapeba indigenous population of Caucaia-CE. Highlighting the importance of healthy eating practices in the prevention of SAH and/or DM, a challenge to indigenous health authorities in establishing strategies and care that should be taken for the prevention of NCDs, as bad eating habits are added to the difficulties to control westernization in the new indigenous generations, as well as territorial battles and struggles for demarcation.

Knowing the epidemiological profile of the Tapeba indigenous population related to the occurrence of SAH and DM is of paramount importance for health professionals, considering that public policies, as well as strategies for addressing the ethnic group, should be offered mainly at the primary level of care in order to provide guidance on the consequences of unhealthy eating habits and behaviors. for the development of severe and, for the most part, irreversible comorbidities. It is necessary to plan better health education strategies and strengthen control programs within the community, particularly to strengthen ethnoeducation, interculturality in health and the recovery of cultural identity.

It is also important to highlight the relevance of the present research for future longitudinal investigations to better elucidate the relationship between dietary orientation and diagnosis of SAH and/or DM and that the conclusion reported here is susceptible to information and selection bias.

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**Authors' contributions:**

Maria Lourdes dos Santos: Conceptualization; Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Project administration; Resources; Supervision; Visualization; Writing – original draft; Writing – review & editing.

Maria Iara Socorro Martins: Conceptualization; Data curation; Formal analysis; Funding acquisition; Resources.

Artur Paiva dos Santos: Conceptualization; Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Resources.

Leidy Dayane Paiva de Abreu: Conceptualization; Data curation; Formal analysis; Funding acquisition; Methodology; Resources.

André Ribeiro de Castro Júnior: Conceptualization.

Jéssica Araújo de Carvalho: Conceptualization; Funding acquisition; Methodology.

Fabíola Monteiro de Castro: Conceptualization; Funding acquisition; Methodology.

Francisco Jadson Franco Moreira: Conceptualization; Funding acquisition; Methodology.

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**Corresponding author:**

Maria Iara Socorro Martins

Paulo Marcelo Martins Rodrigues School of Public Health

Av. Antônio Justa, 3161, Meireles - Fortaleza/CE, Brazil. Cep: 60165-090

E-mail: [lourdes58santos@gmail.com](mailto:lourdes58santos@gmail.com)

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ATTACHMENT

**Supplement 1.** Table 1. Dependent and independent variables of the study.

Dependent variables	Nature of the variable
Systemic Arterial Hypertension	Dichotomous (0 – no; 1 – yes)
Diabetes Mellitus	Dichotomous (0 – no; 1 – yes)
Systemic Arterial Hypertension and Diabetes Mellitus	Dichotomous (0 – no; 1 – yes)
Independent variables	Nature of the variable
Year of registration	Ordinal (2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021)
Year of registration in two categories	Ordinal (0 - 2010 to 2016; 1 - 2017 to 2021)
Indigenous community	Nominal (Jandaiguaba; Coité; Capoeira; New Village; Rail; Sobradinho; Capuan; Bridge; Lameirão; Pond; Garden of Love; Vine)
Indigenous community in two categories	Nominal (1 - Jandaiguaba and Rail; 0 - other communities)
Gender	Nominal (0 - male; 1 - female)
Waist circumference (centimeter)	Continuous
Waist circumference (categorical)	Ordinal (0 - below or equal to 80 centimeters; 1 - above 80 centimeters)
Cardiovascular risk	Dichotomous (0 – no; 1 – yes)
Age (year)	Discreet
Age (categorical)	Ordinal (1 - under 60 years; 0 - above or equal to 60 years)
Schooling	Nominal (no literacy; elementary school; high school; higher education)
Body mass (kg)	Continuous
Body mass (categorical)	Ordinal (1 - below or equal to 80 kg; 0 - above 80 kg)
Body Mass Index (kg/m <sup>2</sup> )	Continuous
Body Mass Index (categorical)	Ordinal (0 - below or equal to 25 kg/m <sup>2</sup> ; 1 - above 25 kg/m <sup>2</sup> )
Obesity	Dichotomous (0 – no; 1 – yes)
Smoking	Dichotomous (0 – yes; 1 – no)
Family history of Chronic Non-Communicable Disease	Dichotomous (0 – no; 1 – yes)
Sedentary lifestyle	Dichotomous (0 – no; 1 – yes)
Alcoholism	Dichotomous (0 – yes; 1 – no)
History of Heart Disease	Dichotomous (0 – yes; 1 – no)

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History of Coronary Artery Diseases	Dichotomous (0 – yes; 1 – no)
History of Acute Myocardial Infarction	Dichotomous (0 – yes; 1 – no)
History of Stroke	Dichotomous (0 – yes; 1 – no)
Occurrence of Chronic Kidney Disease	Dichotomous (0 – yes; 1 – no)
Occurrence of diabetic foot	Dichotomous (0 – yes; 1 – no)
Amputation due to complications of diabetes	Dichotomous (0 – yes; 1 – no)
Blindness due to complications of diabetes	Dichotomous (0 – yes; 1 – no)
Feeding under the guidance of the health team	Dichotomous (0 – yes; 1 – no)
Drug treatment for Systemic Arterial Hypertension and/or Diabetes Mellitus	Dichotomous (0 – no; 1 – yes)
Use of traditional indigenous medicine	Dichotomous (0 – yes; 1 – no)

**Source:** Prepared by the authors (2023).