CIÊNCIAS DA SAÚDE / HEALTH SCIENCES

Overweight and Associated Factors: A Study in Adults from the Interior of Northeast Brazil

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ABSTRACT. To verify the occurrence of overweight and associated factors in adults of a region in the inland of northeast Brazil. A cross-sectional study of population based with probability sampling, involving adults aged 20 to 59 years. Data collection was based on anthropometric measurements of weight and height,according to the World Health Organization, in addition to the application of a questionnaire comprising questions referring to demographic, socioeconomic, behavioral and presence of chronic diseases. Overweight was determinedfor body mass index (IMC) $\geq 25kg/m^2$. The logistic regression analysis was used to assess the association between overweight and the variables explanations. A number of 345 individuals were evaluated. The prevalence of overweight was 54.4%. In the final model, it was witnessed 105 overweight females (OR = 2.36; IC95%: 1.177-4.758; p = 0.016), age 30 to 39 years old (OR = 2.12; IC95%: 1.016 − 4.435; p = 0.045), and those who hypertension (OR = 3.18; IC95%: 1.337-7.587; p = 0.009). More than half of the population of adults from an inland region of north-eastern Brazil were overweight, corroborating the context of nutritional transition present in several parts of our country and of theworld. In addition, the factors sex, age and hypertension were associated with this profile, conferring a multifactorial characteristic in the etiology of this problem.

Keywords: Adult; nutritionalstatus; epidemiologicalfactors; IMC; obesity.

Introduction

The World Health Organization states that about 70% of the causes of death in the world population are due to chronic non-communicable diseases (NCDs), and in Brazil, this percentage represents approximately 73%. Overweight is considered one of the main risk factors for these diseases (World Health Organization [WHO], 2017).

According to the Surveillance of Risk and Protection Factors for Chronic Diseases by Telephone Survey - VIGITEL, the Brazilian population aged 18 years or older, in 2017, was 54% overweight, and 18.9% had already reached the level of obesity (Malta et al., 2021). Data from the III State Health and Nutrition Survey, carried out in 2006, with a representative sample of a state in northeast Brazil showed that 56.3% female and 43.8% male adults were overweight.

Biological, socioeconomic, and behavioral factors, in addition to genetic predisposition, are associated with overweight and obesity, and their etiology is considered multifactorial (Silva et al., 2022; Geng et al., 2023). In a population-based study carried out with Brazilian adults, it was seen that overweight was more frequent with the increasing of age, of schooling, and family income, as well as in males and in residents of the South, Southeast and Midwest regions of the country (Silva et al., 2012). Other researchers add that overweight was higher in females, from 40 years old, former smokers, individuals with higher income and in women with a first pregnancy under 18 years of age (Pinho et al., 2011).

The verification of the nutritional profile is essential for detecting nutritional risks and provide adequate assistance from the health services, thus avoiding to jeopardize the health condition of individuals and

populations (Mendonça et al., 2022). Studies from representative samples, which focus on the possible determinants of excessive body weight, are still scarce in the northeast region of the country, especially in the interior (Domingos Junior et al., 2020; Victora et al.,2022). In this sense, the present study aimed to verify the prevalence of excessive body weight and associated factors in adults in the interior of northeast Brazil.

Method

A cross-sectional, population-based, analytical study with a quantitative approach was carried out from May to October 2015, involving adults of both genders, aged between 20 and 59 years, from urban and rural areas of northeast region of Brazil. The present study was based on information from the IV Pesquisa Estadual de Saúde e Nutrição (PESN) and was approved by the Research Ethics Committee of the Universidade Federal de Pernambuco (CEP/UFPE), under registration number CAAE: 35167614.9.0000.5208.

Three cities in the interior of northeast Brazil located in the agrestic region of the state of Pernambuco were probabilistically included, being Panelas with an estimated population of 26,005 inhabitants, São Bento do Una with 54,433 inhabitants and Caruaru with 324,095 (Instituto Brasileiro de Geografia e Estatística [IBGE], 2010). Adult individuals of both genders, selected from the state survey of the municipalities of interest for the study, participated in the study, and those who had some physical limitation that made it impossible to measure anthropometric measurements and pregnant women were excluded.

For the operationalization of this research, there was a team that was trained to apply the research questionnaires and collect anthropometric measurements. Anthropometric measurements of weight and height were taken, measured according to the parameters of the World Health Organization [WHO] (2000). Weight was obtained using a digital scale (model/brand MEA-03200/Plenna®), with a capacity of 150kg and a scale of 100g, with the individual barefoot and wearing minimal clothing. Overweight was considered when BMI ≥ 25kg/m², according to the cut-off point recommended by the [WHO] (2000). To obtain height, a portable stadiometer (Alturaexata®, Ltd.) was used, with an amplitude of 200 cm and precision of 1 mm to the fullest extent. To ensure the accuracy of the measurements, two measurements of weight and height were taken, using their average.

The hypothetical causal model constructed to explain overweight considered demographic, socioeconomic, behavioral variables and the presence of chronic diseases. The demographic variables investigated were: gender (male and female), age (categorized in the intervals 20-30 years; 30-40 years; 40-50 years and 50-60 years), skin color (categorized in white, brown/black), municipality of residence (São Bento do Uma, Panelas and Caruaru), geographic area of residence (Urban and Rural).

Regarding socioeconomic issues, it was verified: schooling (none/incomplete elementary, complete elementary, complete high school, complete higher education), social class (established by the questionnaire of the Brazilian Association of Research Companies [ABEP], 2014 - and classified as A1/A2, B1/B2, C1/C2, D/E) type of residence (owned, rented, others), number of people in the household (<4, ≥ 4), water supply (general network, other forms), type of drinking water (treated, other forms), sanitation (general network, cesspool with lid, other forms), garbage disposal (collected, other forms).

Regarding the presence of non-communicable chronic diseases, self-reported diabetes mellitus (yes, no) and self-reported systemic arterial hypertension (yes, no) were investigated. As for the behavioral variables, smoking, alcohol consumption and level of physical activity were analysed. For smoking, the following categories were considered: smoker (individual who reported smoking), non-smoker (individual who reported never having smoked) and ex-smoker (individual who reported smoking at some point in life, but who did not do so at the time of the questionnaire). To determine alcohol consumption, the following categories were considered: yes (for those who have a habit of drinking alcohol), no (for those who are not used to drinking alcohol).

To determine the level of physical activity of the population in this study, the International Physical Activity Questionnaire [IPAQ] (2005) was used in its short version, which considers the four dimensions of physical activity: leisure, domestic activities, occupational activities and activities related to their means of transportation. This instrument measures the frequency and duration of moderate and vigorous physical activities and walking performed in the last week for at least ten continuous minutes, including exercise, sports, occupational and recreational physical activities performed at home, in free time, as a means of transportation, and in the leisure time.

A physical activity score in minutes per week was constructed by adding the minutes spent in walking and moderate-intensity activities with the minutes spent in vigorous-intensity activities multiplied by two, to

consider the different intensities of each activity. A score below 150 minutes per week was the cut-off point used to classify individuals as insufficiently active or sedentary.

Sample calculation and statistical analysis

Based on the sample of 345 individuals interviewed during the state survey, a new calculation was performed to assess whether the initial sample was representative for the new variable of interest and region studied. For that, a prevalence of overweight of 51.1% was considered based on the latest Health and Nutrition Survey (2006), estimated a maximum error of ± 5.5%, a 95% confidence level, power of study of 80%, ratio 1:1, plus approximately 10% of losses, totalling approximately 349 individuals in the EPI INFO program, version 6.04. This calculation was performed later because it was a database. The sample selection process (probabilistic and stratified) was carried out in three stages: (1) drawing of the municipalities of the *"Agreste Pernambucano"* mesoregion; (2) drawing of census sectors (territorial units established by the [IBGE]); (3) random selection of households within each census sector to select families, followed by the incorporation of other families in a counterclockwise order until completing the sample quota provided for each sector (40 ± 5 families). From this random draw, three municipalities were selected (Caruaru, Panelas and São Bento do Una) and two geographic strata (urban area and rural area) were considered.

Data were tabulated in double entry, and the *Validate* module was used to check for possible typing errors, all using Epi-info software, version 6.04 (Centers for Disease Control and Prevention, Atlanta, United States). For statistical analyses, SPSS version 13.00 (SPSS Inc., Chicago, United States) was used.

Statistical analysis was performed in three stages. Initially, a descriptive analysis was carried out to characterize the distribution of the occurrence of events, including the frequency of each variable in the study. In the second stage, a bivariate analysis was performed (using the chi-square test) between the dependent variable (overweight) and the independent variables, with their respective 95% confidence intervals (95%CI). In a third step, a multivariate analysis was performed, using the Stata/SE 14.00 program (Stata Corp. College Station, United States), using the logistic regression method, in which all the variables that were included in the bivariate analysis were included in the multiple models, all the variables that showed association with the event of interest with statistical significance of up to p<0.20. To accept the associations investigated in the final model, the value of p<0.05 was adopted.

Results

From the 345 individuals evaluated, the majority were female (69.6%) young adults, taking into consideration the age group between 20 and 40 years of age (66.4%), brown/black skin color (64.6%), complete elementary school education level (44.3%), belonging to the economic class C1/C2 (50.4%) and urban area (58.5%).

Regarding the assessment of nutritional status, a prevalence of overweight was found in54.4% (IC95%: 49.2 – 59.7), and for obesity the prevalence was 21.4% and underweight was found in 2.9% (IC95%: 1.5 – 5.3) of the population (Figure 1).
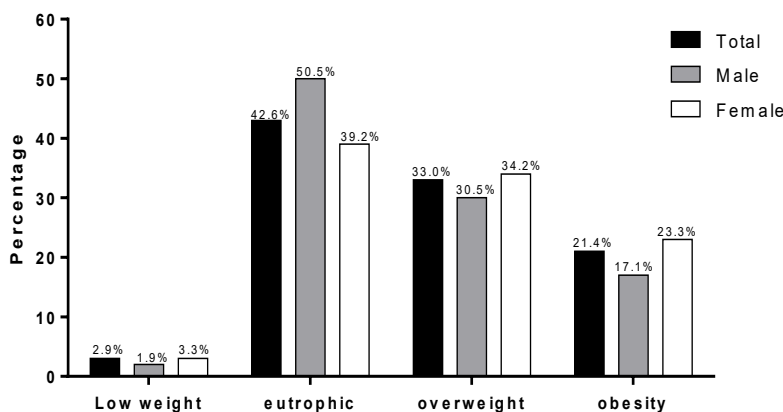

Figure 1. Nutritional status, according to body mass index (BMI) of adults of both sexes, aged 20 to 59 years.

Bivariate analysis found an association between overweight, age, education, smoking, hypertension and diabetes (Table1).

Table 1. Distribution of overweight according to demographic, socioeconomic and behavioral characteristics, and presence of chronic diseases.

Variables	Overweight*				
	N	n	%	IC95%	p-valor
Cities					
São Bento do Una	110	57	51.8	42.6 – 60.9	
Panelas	99	49	49.5	39.8 – 59.2	0.164
Caruaru	136	82	60.3	51.9 – 68.1	
Geographical situation of the domicile					
Urban	202	110	54.5	47.6 – 61.2	1.000
Rural	143	78	54.5	46.4 – 62.5	
Sex					
Male	105	50	47.6	38.3 – 57.1	0.114
Female	249	138	57.5	49.2 – 61.7	
Skin Color					
White	122	74	60.7	51.8 – 68.9	0.112
Black/Brown	223	114	51.1	44.6 – 57.6	
Age (in years)					
20 a 29	122	48	39.3	31.1 – 48.2	
30 a 39	107	64	59.8	50.3 – 68.6	
40 a 49	61	44	72.1	59.8 – 81.9	0.001
50 a 59	55	32	58.2	45.0 – 70.3	
Education (years of study)					
None/Incomplete Fundamentals	118	72	61.0	52.0 – 69.3	
Complete Fundamental	153	83	54.2	46.3 – 61.3	
Complete High School	65	28	43.1	31.7 – 55.2	0.041
Graduated	9	5	55.6	26.6 – 81.2	
Class (ABEP)**					
B1/B2	12	8	66.7	38.8 – 86.4	
C1/C2	174	90	51.7	44.3 – 59.0	0.715
D/E	159	90	56.6	48.8 – 64.1	
Type of Housing					
Own	249	143	57.4	51.2 – 63.4	
Leased	65	32	49.2	37.5 – 61.1	0.143
Others	31	13	41.9	26.4 – 59.3	
Number of people in the household					
<4	189	102	54.0	46.8 – 60.9	0.915
≥4	156	86	55.1	47.3 – 62.7	
Water Supply					
General network	211	113	53.6	46.8 – 60.2	0.743
Other forms	134	75	56.0	47.5 – 64.1	
Water to drink					
Treated	221	124	56.1	49.5 – 62.5	0.447
Other forms	123	63	51.2	42.5 – 59.9	
Sanitation					
General network	159	83	52.2	44.5 – 59.8	
Pit with lid	112	65	58.0	48.8 – 66.8	0.648
Other forms	74	40	54.1	42.8 – 64.9	
Garbage destination					
Collected	291	162	55.7	49.9 – 61.3	0.384
Other forms	54	26	48.1	35.4 – 61.1	
Smoking					
No smoking	179	93	52.0	44.7 – 59.2	
Smoker	33	15	45.5	29.8 – 62.0	0.014
Ex-smoker	28	22	78.6	60.1 – 90.1	
Alcohol consumption					
Yes	65	36	55.4	43.3 – 66.8	0.932
No	175	94	53.7	46.3 – 60.9	
Physical activity level					
Active	171	95	55.6	48.1 – 62.8	0.776
Inactive	174	93	53.4	46.0 – 60.7	
Hypertension					
No	174	82	47.1	39.8 – 54.5	<0.001
Yes	52	42	80.8	67.9 – 89.4	
Diabetes					
No	227	118	52.0	45.5 – 58.4	0.011
Yes	13	12	92.3	64.6 - 99.9	

IC95%: 95% confidence interval. Thu square. Bold p-values signify statistical difference.* Overweight (overweight + obesity).** In the studied sample, there was no participant classified as class A.

Table 2 presents the unadjusted odds ratios and the odds ratios after adjustments, based on Logistic Regression. The final model of the analysis showed that female adults OR = 2.36; IC95%: 1,177-4,758; p = 0.016) aged between 30 and 39 years were more likely to be overweight (OR = 2.12; IC95%: 1.016 – 4.435; p = 0.045) and hypertension (OR = 3.18; IC95%: 1.337-7587; p = 0.009).

Table 2. Logistic regression for overweight in adults according to demographic, socioeconomic, behavioral factors, and presence of chronic diseases in adults.

	Not Adjusted			Adjusted		
	OR	IC95%	p	OR	IC95%	p*
Counties						
São Bento do Una	1		-	1		
Panelas	0.91	0.529 – 1.569	0.737	0.88	0.400-1.948	0.757
Caruaru	1.41	0.850 - 2.346	0.183	1.85	0.531-2.216	0.824
Sex						
Male	1			1		
Female	1.49	0.939 – 2.359	0.114	2.36	1.177-4.758	0.016
Skin color (race)						
White	1			1		
Brown/Black	0.68	0.433-1.062	0.112	0.77	0.404-1.484	0.441
Age						
20 a 29	1			1		
30 a 39	2.29	1.350 – 3.900	0.002	2.12	1.016-4.435	0.045
40 a 49	3.99	2.047 – 7.776	0.000	2.24	0.834-6.025	0.110
50 a 59	2.14	1.123 – 4.098	0.021	1.05	0.362-3.077	0.921
Education						
None/Incomplete Fundamentals	1			1		
Complete Fundamental	0.76	0.465-1.234	0.265	0.88	0.404-1.925	0.752
Complete High School	0.48	0.261-0.894	0.020	0.48	0.191-1.229	0.127
Graduated	0.80	0.204-3.130	0.747	0.29	0.035-2.449	0.256
Type of Housing						
Own	1			1		
Leased	0.719	0.416-1.243	0.237	1.22	0.554-2.708	0.617
Others	0.535	0.251-1.141	0.105	0.37	0.133-1.042	0.060
Smoking						
No smoking	1			1		
Smoker	0.77	0.366-1.624	0.493	0.63	0.237-1.674	0.354
Ex-smoker	3.39	1.312-8.760	0.012	2.42	0.809-7.268	0.114
Hypertension						
No	1	-		1		
Yes	4.71	2.223-9.987	0.000	3.18	1.337-7.587	0.009
Diabetes						
No	1			1		
Yes	11.08	1.418-86.671	0.011	4.131	0.449-37.974	0.210

*Poisson regression. OR = odds ratio p-values in bold mean statistical difference

Discussion

In this study, more than half (54.4%) of the population in rural Northeast Brazil was overweight (overweight + obesity), comprising 33% overweight and 21.4% showed obesity, whereas underweight reached only 2.9 %. Female individuals age between 30-39 years presented factors associated with overweight and self-reported systemic arterial hypertension.

The food pattern around the world has undergone deep changes, influenced by industrial and technological development and the globalization of markets. The increase in the consumption of sugar, fat and refined carbohydrates are typified in the process of nutritional and epidemiological transition that developing countries. Brazil, has been going through an increase in the prevalence of overweight/obesity and a decrease in malnutrition, together with the emergence of chronic non-communicable diseases in the population (Brasil, 2018; Vale et al., 2019; Dinegri et al., 2021). The high prevalence of overweight (EP) and the low prevalence of underweight observed among the individuals confirm the nutritional transition process in the present study.

This percentage of individuals with EP was slightly higher when compared to the data presented by the last Family Budget Research carried out in 2008-2009, which identified an estimated prevalence of EP in 49%

of the Brazilian adult population (Gonçalves et al., 2016). However, the time difference of approximately six years between these two surveys is noteworthy, which possibly explains the inequality of prevalence found in each of them. When comparing with the data from the VIGITEL survey, there are more similar results, where the prevalence of PE in adults in the set of Brazilian capitals and the federal district in 2017 was 54%, and in the capital of Pernambuco, 54.4% (Silva et al., 2019).

Brazilian studies that verified regional and temporal trends showed a progressive increase in obesity in the country over time, corroborating with the advance of the nutritional transition (Alvarez –Castaño et al., 2012; Collaborators et al., 2017; Silva, Theodoro et al., 2019). Victora et. al. (2022) when verifying the evolution of overweight in women aged 10 to 49 years, in the state of Pernambuco, from 1997 and 2006, found a significant increase of 27.1% in the prevalence of overweight. According to Vigitel 2016, overweight grew by 26.3%, comparing data from 2006 (46.2%) and 2016 (53.8%) (Matsudo et al., 2000).

The association between overweight and women, found in the present study, is consistent with findings in other studies (International Physical Activity Questionnaire, 2005; Beagleholeet al., 2010; Bueno et al., 2016; Pereira et al., 2016). This association could be attributed to some factors, such as higher fat composition in the women, hormonal differences, menarche, climacteric, menopause, use of hormonal contraceptives, and pregnancy (Blochet al., 2016; Silva et al., 2016).

Regarding age, it was found that adults aged between 30 and 39 years were more likely to be overweight. Some studies point to a direct relationship between weight gain and the age of the individual, and this relationship is a universal observation (Bueno et al., 2016; Pereira et al., 2016; Collaborators et al., 2017). A possible explanation for this fact could be the influence of the decrease in the basal metabolic rate that physiologically accompanies the aging process, in addition to the natural reduction in the practice of physical activities (Fieldinget al., 2017; Oliveira et al., 2019; Gomes et al., 2022). However, when it is observed, in the present study, that young individuals were more likely to be overweight, and all negative repercussions of morbidity already known in the literature (Maggio et al., 2016), an important warning regarding this population should be emphasized, and specific policies should be adopted in order to give priority to these individuals, as this may be a new phase of the nutritional transition. In addition, the data shown in the present study opens future perspectives regarding a better understanding of the subject, mainly because it is an uncommon finding in the literature (Maggio et al., 2016; Gomes et al., 2022).

Systemic Arterial Hypertension (SAH) is among the most described morbidities related to overweight. Besides being an important public health problem in Brazil and worldwide, it contributes significantly to mortality from cardiovascular diseases (Bloch et al., 2016; Malta et al., 2017). Genetic, environmental factors and behavioral factors interact in the genesis of SAH, and among them overweight plays an important role (Silva et al., 2016; Filho et al., 2021). In the study by Malta et al., (2017) in which the factors associated with self-reported SAH among adults in Brazilian capitals were analysed, it was observed that obese people were up to three times more likely to develop it. Thus, excessive weight and SAH are closely related, and the literature points to weight loss as one of the most effective methods for reducing blood pressure in obese individuals (Gomes et al., 2022).

Even though the current research did not find an association among diabetes, education, smoking and overweight in the final analysis model, it has already been verified in other studies (Fielding et al., 2017; Gomes et al., 2022). Malta et al., (2017) when analysing the factors associated with self-reported diabetes among adults interviewed in the National Health Survey, in 2013, identified a prevalence of diabetes twice as high among those who were overweight and three times higher among those who were obese. With regard to schooling, there is usually an inverse association between this variable and overweight (Fielding et al., 2017; Oliveira et al., 2019). When you have a higher level of schooling, the better your power of discernment, and consequently a lifestyle is assumed healthier (Maggio et al., 2016). In relation to smoking, ex-smokers seem to be more prone to weight gain, as smoking cessation probably leads abstainers to anxiety and the need for psychological compensation, leading to increased food intake, and consequently, body weight gain (Maggio et al., 2016; Fieldinget al., 2017; Oliveira et al., 2019; Gomes et al., 2022).

As it is a cross-sectional study, it is not possible to conclude causal relationships, given that it is not possible to show a relationship of temporality and causality among the involved variables, which is a limitation of this research. Moreover, the population studied showed homogeneity in some aspects, mainly in relation to gender where more than two thirds were female, and to economic class, where most belonged to classes C to E, which may have reduced the possibility of finding other associations. However, the inclusion of variables related to food consumption could help explain the relationship between overweight and diet,

and this study proposes that other surveys incorporate these variables in data collection and analysis models. Even so, it could be seen that the nutritional status of adults in a region in the interior of the northeast Brazil supports the context of nutritional transition present in several parts of the country and the world (Gomes et al., 2022), in view of the fact that more than half of the population was overweight. In addition, this study contributes to a better understanding of the variables that are associated with overweight, and a multifactorial characteristic can be attributed to the aetiology of such problem.

Conclusion

It is concluded that more than half of the population is overweight. In addition, the factors gender, age, and hypertension were associated with this profile, giving a multifactorial characteristic in the aetiology of this problem.

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