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Factors associated with abdominal obesity and lipid alterations in low-income adults

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ABSTRACT. To evaluate the prevalence of abdominal obesity, hypercholesterolemia and hypertriglyceridemia and its associated factors in adults in a low income region. Cross-sectional, population-based study with probabilistic sample representative of a region of the Brazilian Northeast. Abdominal obesity was determined by waist circumference ⩾ 80cm for women and ⩾ 94cm for men. The classification considered for hypercholesterolemia was cholesterol ⩾ 240mgdL^{-1} and for hypertriglyceridemia, triglycerides ⩾ 200mgdL^{-1}. The Poisson regression analysis evaluated the association between abdominal obesity, serum lipid changes and explanatory variables. A number of 260 adults, of the economic level C and D/E (≅96%) were evaluated. The prevalence of abdominal obesity, hypercholesterolemia and hypertriglyceridemia were 71.5, 21.2 and 26.9%, respectively. There was an association between abdominal obesity and female gender, age 50-59 years, overweight, and brown/black race was related as a protection factor. Hypercholesterolemia, was associated with subjects aged 50-59 years and ⩾ 60 years, and hypertriglyceridemia was associated with overweight, aged ⩾ 40years and smoker individuals. High prevalence of abdominal obesity, hypercholesterolemia and hypertriglyceridemia were found. From the age of 40 the subjects already had a risk factor for hypertriglyceridemia and 50 years for hypercholesterolemia and abdominal obesity. Abdominal obesity was also associated with overweight female individuals, and the brown/black race was connected to a protective factor. Smoking and overweight were associated with hypertriglyceridemia.

Keywords: Abdominal obesity; waist circumference; dyslipidemia; non-communicable diseases; adults.

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Introduction

Chronic non-communicable diseases (NCDs) are one of the biggest public health problems and have generated a high number of deaths. In 2016, around 41 million deaths occurred due to these diseases, representing 71% of the total (Brazil, 2012; World Health Organization, 2018). Among NCDs, cardiovascular ones are responsible for the highest mortality, representing 44% of the total (World Health Organization, 2018). In this context, it is worth mentioningas an explanatory model for this group of diseases, dyslipidemia and abdominal obesity (Malta, & Merhy, 2010; Santos, Schneider, Valença, Peter, & Muniz, 2021).

In Brazil, there are still few investigations related to health and nutrition conditions, especially in urban/rural interiors in less favored areas (Fenget al., 2022). This circumstance makes it difficult to plan and implement public policies aimed at expanding and/or adapting specific health prevention programs to the needs of the population, taking into account demographic, socioeconomic and behavioral differences.

Knowledge of the epidemiological profile of abdominal obesity and lipid alterations, as well as their associated factors, can help to develop strategies to face the problem, in addition to enabling information to be monitored and trends to be traced (Halpern et al., 2010).

In this context, the population-level assessment of the lipid profile, abdominal obesity and its associated factors may represent a health diagnosis of the population studied, in addition to identifying possible risk factors related to such diseases. This study aims to evaluate the prevalence of abdominal obesity, hypercholesterolemia and hypertriglyceridemia and their associated factors in the adult population in a low-income region.

Method

An analytical cross-sectional population-based study was carried out, referring to the region of interest (cities of Panelas, São Bento do Una and Caruaru, Pernambuco, Brazil) contained in the database of the IV State Research on Health and Nutrition. The study was approved by the Research Ethics Committee of the Universidade Federal de Pernambuco (CAAE:35167614.9.0000.5208).

The cities studied are located in the rural region of Pernambuco of a low and Human Development Index (HDI), with the city of Panelas with an estimated population of 26,005 inhabitants (HDI=0.569), São Bento do Una 54,433 inhabitants (HDI= 0.593) and Caruaru 324,095 (HDI=0.677) (UNDPBrazil, 2019). The study comprised adult individuals of both genders, over 20 years of age, residing in the chosen cities, excluding pregnant women.

The main dependent variables were abdominal obesity, hypercholesterolemia and hypertriglyceridemia. The independent variables were demographic, socioeconomic, behavioral, morbidities and biochemical parameters.

Abdominal obesity was assessed from waist circumference (WC), measured in duplicate at the midpoint between the last rib and the iliac crest at the time of expiration, with an inextensible 200 cm tape measure and a variation of 0.1cm, according to the protocol established by the WHO (World Health Organization, 2000) considering the following cutoff points: WC ⩾ 80cm for women and ⩾ 94 cm for men. WC was measured by the same evaluator and repeated when the measurement error between the two measurements was greater than 1 cm, using the average between the two closest values.

For anthropometric evaluation, weight and height were measured. The weight of the adults was obtained using a digital scale. Model MEA-03200/Plenna®, both with a maximum capacity of 150 kg and precision of 100 g, with the individual barefoot and minimal clothing. Height was determined with a portable stadiometer (Alturaexata®, Ltda), with an amplitude of 200 cm and precision of 1mm.

The body mass index (BMI) was used, according to WHO recommendations (World Health Organization**,** 2000) considering the following cutoff points for adults: ⩾ 25.0 Kg/m (World Health Organization [WHO], 2018)=overweight and for the elderly: ⩾ 27=overweight (Lipschitz, 1944).

For the biochemical evaluation, blood samples were collected after a 10-hour fast for determination of blood glucose, cholesterolemia and triglyceridemia using the biochemical analyzer (ACCUTREND.GCT), after venipuncture. The classification was based on the following criteria (Malachias et al., 2016; Brazilian guideline on dyslipidemia and prevention of atherosclerosis, 2017). Diabetes mellitus ⩾ 126 $mgdL^{-1}$; Cholesterolemia: Increased ⩾ 240 $mgdL^{-1}$ and Triglyceridemia: Increased ⩾ 200 $mgdL^{-1}$.

The laboratory team, using a mercury column tensiometer (Model table-Glicomed-CE-0483), performed the blood pressure measurement. The classification used was from the Brazilian Society of Cardiology (Malachias et al., 2016): Normal: < 140 mmHg-systolic and < 90 mmHg-diastolic and Arterial hypertension: ⩾ 140 mmHg-systolic or ⩾ 90 mmHg-diastolic.

Exploratory variables were represented categorically, including: sex (male and female), age (20-29.30-39.40-49.50-59 and ⩾ 60 years), race (white, yellow, brown and black), geographic area of residence (urban and rural), education, in complete years of schooling (0-4.5-8 and ⩾ 9 years), family income (classes: A, B, C, D/E), smoking(smoker and non- smoker), alcohol consumption (yes or no), physical activity (active or sedentary), systemic arterial hypertension, diabetes and overweight (yes or no).

From the data of the IV State Survey, a region of interest was selected. The sample selection was by conglomerate, with three municipalities being drawn, four census sectors per municipality, approximately, with urban/rural distribution according to 2010 census data, 20 households per census sector and one adult per household. The list of random numbers from the EPITABLE subprogram, from the EPI-INFO program (version, 6.04) was used to draw the municipalities and census sectors.

To ensure the representativeness of the sample calculated in the state survey (n=260) a new calculation was performed considering the three variables of interest in the current study. For that, we took into account a prevalence of 51.9% for abdominal obesity (maximum error=±6.1%), 17.9% (maximum error=±4.7%) for hypercholesterolemia and 25.8% (maximum error=±5.4%) for hypertriglyceridemia, (significance=95%, power=80% and ratio=1:1), plus 10% of losses, totaling approximately 258, 257 and 252 individuals, respectively.

For the analyses, the *Statistical Package for the Social Sciences* (SPSS-version-20.0) was used. A descriptive analysis was carried out to characterize the distribution of the occurrence of events, including the frequency of each variable in the study. Then, a bivariate analysis was performed using the chi-square test between the dependent variables (abdominal obesity, hypertriglyceridemia and hypercholesterolemia) and the independent variables.

Prevalence ratios (PR) had calculated for each exposure variable by Poisson regression. Variables with $p < 0.20$ in the bivariate analyses were selected to compose the model. The results were expressed as prevalence ratios (PR) adjusted with respective 95% confidence intervals (95% CI) and were considered statistically significant ($p < 0.05$).

Results

A total of 260 individuals (68.5% women) were evaluated, with a mean age of 40.9±15.4 years. More than half of the sample was brown/black (63.4%) and 43.5% had studied for less than five years. Around 96% had C and D/E economic levels. Regarding behavioral characteristics, 13.5% were smokers, 5.0% were diabetics, 28.8% were hypertensive, 35.8% were physically inactive, 56.5% were overweight and 13.8% reported drinking alcohol. The prevalence of abdominal obesity, changes in cholesterol and hypertriglyceridemia are shown in Table 1.

Table 1. Prevalence of abdominal obesity, hypercholesterolemia and hypertriglyceridemia.

	Total		Men		Women	
	n(%)	95%CI	n(%)	95%CI	n(%)	95%CI
Abdominal obesity	186(71.5)	65.7–76.7	34(41.5)	31.4–52.3	152(85.4)	79.4–89.9
Hypercholesterolemia	55(21.2)	16.6–26.5	15(18.3)	11.3–28.1	40(22.5)	16.9–29.2
Hypertriglyceridemia	70(26.9)	21.9–32.6	28(34.1)	24.8–44.9	42(23.6)	17.9–30.4

CI95%- Confidence Interval 95%

Bivariate analyses showed an association between abdominal obesity and female sex and excess weight, hypercholesterolemia with age, schooling and physical activity, and hypercholesterolemia with age, schooling, diabetes, arterial hypertension and overweight (Table 2).

Table 2. Analysis of factors associated with abdominal obesity, hypercholesterolemia and hypertriglyceridemia.

	Abdominal obesity					Hypercholesterolemia					Hypertriglyceridemia				
	No	no	%	95%CI	P	No	no	%	95%CI	P	No	no	%	95%CI	P
Sex															
Male	82	34	41.4	31.4-52.3	<0.001	82	15	18.3	11.3-28.1	0.546	82	28	34.1	24.8-44.9	0.103
Feminine	178	152	85.5	79.4-89.9		178	40	22.5	16.9-29.2		178	42	23.6	17.9-30.4	
Age years)															
20–29	69	43	62.3	50.5-72.8		69	7	10.1	4.7-19.8		69	6	8.7	3.7-18.0	
30–39	80	58	72.5	61.8-81.1		80	12	15.0	8.6-24.6		80	18	22.5	14.6-32.9	
40-49	37	29	78.4	62.6-88.9	0.143	37	9	24.3	13.2-40.3	<0.001	37	15	40.5	26.3-56.5	<0.001
50–59	36	29	80.6	64.7-90.5		36	16	44.4	29.5-60.4		36	14	38.9	24.7-55.2	
⩾ 60	38	27	71.0	55.1-83.1		38	11	28.9	16.8-44.9		38	17	44.7	30.1-60.3	
Breed															
White	95	73	76.8	67.4-84.2	0.195	95	20	21.1	13.9-30.4	1,000	95	28	29.5	21.2-39.3	0.577
Brown/Black	165	113	80.0	57.8-92.5		165	35	21.2	15.6-28.1		165	42	25.4	19.4-32.6	
Area															
Urban	147	106	72.1	64.3-78.7	0.925	147	33	22.4	16.4-29.9	0.667	147	44	29.9	23.1-37.8	0.268
Rural	113	80	70.8	61.8-78.4		113	22	19.5	13.2-27.8		113	26	23.0	16.1-31.6	
Education															
0–4	113	82	72.6	63.7-79.9		113	32	28.3	20.8-37.3		113	41	36.3	27.9-45.5	
5-8	58	41	70.7	57.9-80.9	0.774	58	8	13.8	6.9-25.2	0.039	58	15	25.9	16.2-38.5	0.001
⩾ 9	89	63	70.8	60.6-79.2		89	15	16.9	10.4-26.1		89	14	15.7	9.5-24.8	
Economic class															
A/B	8	4	50.0	21.5-78.5		8	two	25.0	6.3-59.9		8	1	12.5	0.1-49.2	
C	124	93	75.0	66.7-81.8	0.246	124	26	20.9	14.7-29.0	0.873	124	35	28.2	21.0-36.7	0.694
IN	128	89	69.5	61.0-76.9		128	27	21.1	14.9-29.0		128	34	26.6	19.6-34.8	
Smoking															
No	217	156	71.9	65.6-77.5	0.585	217	43	19.8	15.0-25.6	0.089	217	55	25.3	20.0-31.5	0.052
Yes	35	23	65.7	49.1-79.2		35	12	34.3	20.8-50.9		35	15	42.9	27.9-59.2	
Diabetes															
No	247	174	70.4	64.5-75.8	0.165	247	49	19.8	15.3-25.3	0.550	247	61	24.7	19.7-30.4	0.001
Yes	13	12	92.3	64.6-99.9		13	6	46.2	23.2-70.9		13	9	69.2	42.0-87.6	
HAS															
No	184	127	69.0	62.0-75.3	0.234	184	35	19.0	13.9-25.3	0.231	184	38	20.7	15.4-27.1	0.001
Yes	75	58	77.3	66.6-85.4		75	20	26.7	17.9-37.7		75	32	42.7	32.1-53.9	

Physical activity															
Active	167	116	69.5	62.1-75.9	0.395	167	43	25.7	19.7-32.9	0.023	167	47	28.1	21.9-35.4	0.654
Inactive	93	70	75.3	65.6-82.9		93	12	12.9	7.4-21.4		93	23	24.7	17.0-34.4	
Overweight															
No	113	50	44.2	35.4-53.4	<0.001	113	20	17.7	11.7-25.8	0.297	113	18	15.9	10.2-23.9	0.001
Yes	147	136	92.5	86.9-95.9		147	35	23.8	17.6-31.3		147	52	35.4	28.1-43.4	
Alcohol consumption															
No	204	143	70.1	63.5-75.9	0.460	204	40	19.6	14.7-25.6	0.373	204	54	26.5	20.8-32.9	1,000
Yes	36	28	77.8	61.7-88.5		36	10	27.8	15.7-44.1		36	9	25.0	13.6-41.3	

Chi-square test. SAH-Systemic Arterial Hypertension.

After adjustment, the female gender, the age group 50–59 years and overweight remained in the explanatory model of abdominal obesity. The brown/black race was a protective factor. A risk factor for hypercholesterolemia was the age group 50–59 years and for hypertriglyceridemia the age groups over 40 years, smoking and overweight (Table 3).

Table 3. Poisson regression of factors associated with abdominal obesity, hypertriglyceridemia and hypercholesterolemia.

	Abdominal obesity			Hypertriglyceridemia			Hypercholesterolemia		
	PR	95%CI	P	PR	95%CI	P	PR	95%CI	P
Age									
20–29	1			1			1		
30–39	1.10	0.93-1.32	0.264	1.95	0.81-4.65	0.130	1.49	0.63-3.55	0.363
40-49	1.09	0.89-1.34	0.388	2.58	1.04-6.41	0.040	2.28	0.94-5.55	0.068
50–59	1.24	1.01-1.54	0.037	2.64	1.07-6.55	0.036	3.98	1.77-8.93	0.001
⩾ 60	1.21	0.96-1.53	0.108	2.78	1.06-7.29	0.038	2.52	1.36-6.12	0.042
Overweight									
No	1			1					
Yes	1.88	1.56-2.28	<0.001	1.86	1.13-3.07	0.014			
Breed									
White	1								
Brown/Black	0.81	0.72-0.92	0.001						
Sex									
Male	1								
Feminine	1.98	1.58-2.48	<0.001						
smoking									
No				1					
Yes				1.59	1.03-2.47	0.038			

PR-prevalence ratio

Discussion

This research shows an alert for the risk of CNCDs, given the high rates found for abdominal obesity, hypercholesterolemia and hypertriglyceridemia in a low-income region. Added to this problem, the young age (40 years) in which the subjects are exposed to at least one analyzed risk factor, it is a concern. Excess weight was associated with at least two variables analyzed (abdominal obesity and hypertriglyceridemia), female gender, smoking and mixed race with only one variable (abdominal obesity, hypertriglyceridemia and abdominal obesity, respectively), the last being considered was a factor of protection.

Individuals who live in less favorable socioeconomic conditions may be at greater risk for obesity (Guimarães Filho, Silva, & Silva, 2022). Despite the region studied having an HDI considered low and medium (Brazil, 2019), almost 97% of this population consisting of classes C and D/E, this may have been the cause of the surprising prevalence of abdominal obesity and the high of cholesterolconcentrations found. These data are reinforced when compared to the findings of the III State Survey for abdominal obesity (Omar, Taha, Hassan, Al-Wutayd, & Adam, 2020) (71.5% *vs* 51.9%) and the National Health Survey (Instituto Brasileiro de Geografia e Estatística [IBGE], 2014)forhypercholesterolemia (21.5% *versus* 12.5 %) who had more heterogeneous data regarding socioeconomic aspects.

The decline in energy expenditure in individuals, associated with changes in working conditions, decreased physical activity, sedentary behavior and inadequate nutrition (Costa & Thuler, 2012). These factors are linked to the nutritional transition process, installed in Brazil in recent decades and can be added to the understanding of the results of this research.

Cardiovascular risk factors are increasingly present in the population (Xavier et al., 2013; Queiroz et al., 2021). It is noteworthy that from the age of 40, the subjects already had a risk factor for cardiovascular diseases and that it increased with advancing age. From the third decade of life onwards, vascular endothelium lesions become more evident and their clinical consequences appear around the age of 40 (Sözmen, 2016). The association of abdominal obesity with age is quite consistent in the literature, and it was observed in several Brazilian cities and worldwide (Ahmed, Waslien, Al-Sumaie, & Prakash 2012; Brazil, 2019; Cunha, 2022). Martins-Silva, Mola, Vaz, and Tovo-Rodrigues (2018), found that abdominal obesity showed a tendency to increase with age, being more evident after the fourth decade of life.

Females would be more predisposed to the development of abdominal obesity. This relationship could be attributed to the higher concentration of body fat present in women due to pregnancies, hormonal differences and climacteric (Guimarães Filho, Silva, & Silva, 2022; Dias et al. 2022).The association between abdominal obesity and race does not seem to be consensual evidence (Ahmed et al., 2012). Worldwide studies (Lear, Humphries, Frohlich, & Birmingham, 2007; Huxley et al., 2008; Martins-Silva et al., 2018) and the International Diabetes Federation Criteria (International Diabetes Federation, 2006) suggest the use of specific cutoff points for ethnic groups. Compared with European populations, African women have less visceral adipose tissue or percentage of body fat, indicating that intervening factors associated with cardiovascular risk should not be treated universally for all races (World Health Organization, 2008). This is due to the great influence exerted by socioeconomic determinants and their implications for lifestyle and eating habits. In addition, the different classifications used to define race/ethnicity constitute a limiting factor for this type of investigation (Moretto, Fontaine, Garcia, Neri, & Guariento, 2016).

The industrialization and urbanization processes observed in modern societies have brought about an increase in calorie intake and a decrease in physical activity, establishing an energy imbalance that may be related to overweight and abdominal obesity (Cunha, 2022; Diaset al., 2022). According to Souza et al., 2019, the condition of being overweight is related to dyslipidemia, a result also found in the present study. It can be explained by the accumulation of adipose tissue and the release of free fatty acids, which are easily directed to the liver for greater production of VLDL.

Another risk factor associated with hypertriglyceridemia was smoking, which has already been shown (Précoma et al., 2019; Gomes et al., 2021) by increasing triglycerides, VLDL and LDL-c values, as well as decreasing HDL-c levels. Gouveiaet al., 2020 observed a slight increase in total cholesterol, LDL cholesterol, VLDL cholesterol and triglycerides among smokers.

The cross-sectional design of this work constitutes a possible limitation, as it does not allow the identification of causality between the outcomes and possible correlated factors. In addition, there was a slight predominance of females in the sample, which can be explained by the greater difficulty in finding men at home, since they represented, in a greater percentage, the economically active population. Nevertheless, this study contributes to a better understanding of the variables that are associated with abdominal obesity and lipid alterations, and the multifactorial nature of the etiology of these problems can be identified.

Conclusion

The present study found more than 70% of abdominal obesity, almost 20% of hypercholesterolemia and 27% of hypertriglyceridemia. This expressive prevalence revealed in a low-income population shows the epidemic levels that these problems have assumed in the country. Age was associated with all outcomes. The female gender and being overweight were risk factors for abdominal obesity, and the brown/black race was a protective factor. Smoking and being overweight were also associated with hypertriglyceridemia.

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