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Prevalence of obesity in rural and urban areas in Brazil: National Health Survey, 2013

Prevalências de obesidade em zonas rurais e urbanas no Brasil: Pesquisa Nacional de Saúde, 2013

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ABSTRACT: ***Objective:*** To investigate the role of the domiciliary situation in the prevalence of general and abdominal obesity through the National Health Survey of 2013. ***Methodology:*** General obesity (body mass index ≥ 30 kg/m^2) and abdominal obesity (waist circumference ≥ 102 cm in men and ≥ 88 cm in women) in rural and urban areas were described according to sex and macroregion. Crude and adjusted Poisson regression models were used to test the association between obesity and household situation, with the significance level of 5%. ***Results:*** The study included 59,226 individuals. Out of these, 20.7% presented general obesity and 38% abdominal obesity (higher in women: 24.3 and 52%, respectively). The highest prevalences of general obesity were observed in southern urban areas, for both sexes (20.8% in men and 26.5% in women). In rural areas, the highest prevalences were observed for the central-west region (17.2%) in men and in the south region (27.4%) in women. In males, after adjusting for demographic variables, living in rural areas was associated with lower prevalences of general obesity in the North (prevalence ratios — PR = 0.60; confidence interval of 95% — 95%CI 0.40 – 0.89) and Northeast (PR = 0.47, 95%CI 0,38 – 0.59), and for abdominal obesity in all regions. For women in the Midwest, the rural household situation was associated with lower prevalences of obesity. (PR = 1.11, 95%CI 1.01 – 1.23). ***Conclusions:*** The results evidenced the role of the domiciliary situation among outcomes at the national level, with lower prevalence of general and abdominal obesity in men living in rural areas. However, higher prevalences were found among women, especially for abdominal obesity.

Keywords: Obesity. Abdominal Obesity. Health Surveys. Public health.

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RESUMO: ***Objetivo:*** Investigar o papel da situação de domicílio na prevalência de obesidade geral e abdominal, usando dados da Pesquisa Nacional de Saúde de 2013. ***Metodologia:*** As prevalências de obesidade geral e abdominal, em zonas rural e urbana, foram descritas de acordo com o sexo e a macrorregião do país. A associação entre situação de domicílio e obesidade foi testada por regressão de Poisson bruta e ajustada com nível de significância de 5%. ***Resultados:*** Foram incluídos 59.226 indivíduos. Destes, 20,7% apresentaram obesidade geral e 38% obesidade abdominal (maiores em mulheres: 24,3 e 52%, respectivamente). Em zonas urbanas, as maiores prevalências de obesidade geral foram observadas na Região Sul (20,8 e 26,5% para homens e mulheres, respectivamente). Em zonas rurais, na Região Centro-Oeste (17,2%) em homens e na Região Sul (27,4%) em mulheres. Após ajuste por idade e cor da pele, em homens, viver em zonas rurais foi associado à menor prevalência de obesidade geral nas regiões Norte (razão de prevalência — RP = 0,60; intervalo de confiança de 95% — IC95% 0,40 – 0,89) e Nordeste (RP = 0,47; IC95% 0,38 – 0,59) e para a obesidade abdominal em todas as regiões. Para as mulheres, na Região Centro-Oeste, viver em zona rural foi associado a maiores prevalências de obesidade abdominal (RP = 1,11; IC95% 1,01 – 1,23). ***Conclusão:*** Os resultados evidenciam o papel da situação de domicílio entre os desfechos em nível nacional, com menores prevalências em homens residentes em zonas rurais, no entanto maiores prevalências foram encontradas entre as mulheres, principalmente para obesidade abdominal.

Palavras-chave: Obesidade. Obesidade abdominal. Inquéritos epidemiológicos. Saúde pública.

INTRODUCTION

General obesity is considered a risk factor for individual health, leading to cerebrovascular accident, hypertension, dyslipidemias, diabetes mellitus and certain types of cancer[1]. The assessment of abdominal fat, compared to other anthropometric indicators, is one of the best predictors of visceral fat, which is strongly correlated with most metabolic risk factors[2] and considered an independent risk factor for cardiovascular diseases[3].

Rural populations have low schooling, low income, poor access to health services and more frequent risk factors, such as hypertension and diabetes mellitus[4,5]. Rural areas differ from urban areas in terms of demographic, socioeconomic and cultural characteristics, factors that are known to be important in determining overweight at the population level[6,7]. Although still difficult to measure, urbanization and better access to mechanization have been suggested as important factors in increasing the prevalence of obesity in rural areas around the world[6]. The impact of such factors can be observed through results of changes in eating habits, behaviors and lifestyle[8-11].

Few studies have sought to evaluate the role of household situation in determining these outcomes in Brazil and in the world. Studies have reported differences in the prevalence of obesity according to household situations. Higher values have been reported among urban residents in middle- and low-income countries, while comparable values between both situations are observed in high-income countries[6,7,12-14].

According to the latest census by the Brazilian Institute of Geography and Statistics (IBGE), about 30 million people live in rural areas of Brazil, corresponding to 15.6% of the national population, with the highest proportions in the North and Northeast regions[15]. As in other countries, obesity in Brazil is considered an epidemics[16]. Although there is a worldwide consensus about the importance of studying the prevalence of obesity in rural areas, few studies of national representativity are reported in Brazil.

The present study aims to investigate the role of household situation across Brazilian macroregions in the prevalence of general and abdominal obesity using the largest population survey conducted in the country in 2013.

METHODOLOGY

This is a descriptive, cross-sectional, population-based study conducted in 2013 in the national territory, consisting of the census tracts of the Geographic Operational Base from the Demographic Census 2010[15], excluding areas with special characteristics and reduced population. The National Health Survey ("Pesquisa Nacional de Saúde", PNS)[17] is part of the IBGE's Integrated Household Survey System and functions on the basis of its master sample, with greater geographic coverage and precision gain for specific health estimates.

Conglomerate sampling was used in three stages. Since primary sampling units are considered as census tracts and households are second-stage units, residents aged 18 years or more defined the third-stage units. Therefore, only one individual per household was selected through a simple random process and invited to participate in the research. Weights were applied based on the probability of sample participation, thus guaranteeing accurate representativeness of Brazil, macroregions and household situation. Further details can be found in PNS technical reports[17,18].

We assessed weight, height and waist circumference (WC) of individuals aged 18 years or older, of both genders. Women who reported being or suspected of being pregnant at the time of the interview were excluded from the analyzes. Nutritional status was defined by body mass index (BMI), by dividing weight (in kilograms) by height (in meters) squared, and classified as eutrophic (BMI up to 24.9 kg/m^2), overweight (BMI from 25 to 29.9 kg/m^2) and obesity (BMI ≥ 30 kg/m^2). The cutoff point for obesity was considered to define the outcome in the analysis (yes or no). Regarding abdominal obesity, WC was used, corresponding to the substantially increased risk or level II (WCII) (WCII ≥ 102 cm for men and ≥ 88 cm for women)[19]. This information was assessed and classified according to the recommendations of the World Health Organization (WHO)[19].

To gather anthropometric variables, PNS had two measurements of height, WC and weight, and considered the average when values were equal or differed, at most

in 1 cm for height and WC or 0.5 kg for weight, at most[18]. In cases where only one of the measures was informed, this value was adopted as final value of the analysis variable. For weight and/or height, total data imputation was 12.7% for men and 12.5% for women. For WC, the imputation percentage was around 8% (8.01 and 8.07% for men and women, respectively)[18].

Outcomes were described and stratified by gender. The analyzes aiming at testing the association between household situation and the outcomes were stratified by gender and macroregions.

Data was processed in the Stata 14.0 software (StataCorp, College Station, Texas, USA), and the cluster sampling effect was considered in all analyzes by the "survey" command. Prevalences in each region were compared by the χ^2 test for heterogeneity. The difference in prevalence of general and abdominal obesity between genders in each household situation was calculated based on a decrease in the prevalence of general and abdominal obesity in women compared to respective values in men living in urban and rural areas, according to macroregions. To compare household situations, we performed crude and adjusted Poisson regression, with two adjustment models.

The first model included the variables age (18 to 24, 25 to 34, 35 to 44, 45 to 54, 55 to 64, and 65 years or more) and skin color (white, black, yellow, brown or indigenous) The second model included the variables age, skin color, marital status (measured by the question "Do you live with a spouse or partner?" and answers "no" or "yes"), schooling (no education or incomplete elementary; complete primary or incomplete high school; complete high school or incomplete higher education; complete higher education), and index of assets (in quintiles).

Because they were considered potential mediators of the association with household situation, the outcomes for schooling, income and marital status were added to the second model. The value of p=0.05 defined factors associated with the outcome.

The study was approved by the Research Ethics Committee of the Medical School of *Universidade Federal de Pelotas* [Federal University of Pelotas], under opinion number 2,423,849.

RESULTS

The sample of interest in our study was of 59,226 individuals. Of these, 52.9% were females, 21.7% were between 25 and 34 years old, 47.4% had white skin color, 38.2% had complete high school or incomplete higher education, 61.5% were married, and 23.6% belonged to the richest income quintile. As for macroregion, 44.0% lived in the Southeast. Of the total sample, 86.2% were urban dwellers. The prevalence of overweight was 36.1% (38.7% for men and 33.7% for women,

p<0.001). The prevalence of general obesity was 20.8% (16.8% in males and 24.3% in females, p<0.001) and abdominal obesity was 38% (22.3% in males and 52.0% in females, p<0.001) (Table 1).

A clear heterogeneity of the outcomes evaluated between macroregions is seen (Table 2). Considering general obesity in the urban area, prevalence was 17.8% in males and 24.7% in females, with the highest prevalences in the Southern Region for both genders (20.8% in males and 26.5% in females) (Table 2). In rural areas, prevalences were 11.0% in males and 21.8% in females. The highest prevalences were found in the Midwest among males (17.2%) and in the Southern among women (27.4%) (Figure 1). As for abdominal obesity in urban areas, prevalences were 23.7% in men and 52.1% in women. Higher prevalences in the urban area were found in the South among males (29.1%) and in the Southeast among females (57.4%). In rural areas, prevalences were 14.8% for males and 51.5% for females. Higher prevalences were found in the South for men (22.3%) and in the Southeast for women (57.4%) (Figure 2).

Comparing prevalences according to gender, higher rates of obesity were found among women, with differences between men and women in rural areas, both for general obesity (10.8 percentage points - pp) and for abdominal obesity (36.7 pp). Values of difference reached 14.6 pp of prevalence of general obesity in rural regions in the Southeast and 40.1 pp of prevalence of abdominal obesity in rural areas in the Northeast (Table 2).

In order to test the effect of household situation on the prevalence of obesity in the national territory and in each macroregion, the Poisson regression was used. In the crude analysis, lower prevalences of general obesity were observed in rural areas for the North and Northeast regions among men. Considering abdominal obesity, lower prevalences were found in rural areas of all regions, except in the South. When adjusted for age and skin color, associations with general obesity in the North and Northeast regions remained significant (prevalence ratio – PR = 0.60, 95% confidence interval – 95%CI 0.40 – 0.89 and PR = 0.47, 95%CI 0.38 – 0.59, respectively). For abdominal obesity, all regions had a statistically significant association, even in the South (PR = 0.75, 95%CI 0.61 – 0.93). After inclusion of the variables schooling, marital status and income, the associations in the Northeast Region taking into account general obesity (PR = 0.64, 95%CI 0.50 – 0.81) and abdominal obesity (PR = 0.64, 95%CI 0.51 – 0.74) were maintained (Table 3).

As for women, prevalences of general and abdominal obesity in rural and urban areas were similar, except in the Midwest Region, the rural area being associated with a higher prevalence of abdominal obesity after adjusting for age and skin color (PR = 1.11, 95%CI 1.01–1.23). After including the variables schooling, marital status and income, association with abdominal obesity was observed only in the Northeast Region (PR = 0.88, 95%CI 0.81–0.96) (Table 3).

Table 1. Characterization of the studied population according to demographic variables, based on the National Health Survey (PNS) of 2013 (n = 59,226).

Variable	Male (n = 25,920) n (%)	Female (n = 33,306) n (%)	Total (n = 59,226) n (%)
Age (years)	p < 0.001*		
18–24	3,467 (16.6)	4,020 (15.2)	7,487 (16.0)
25–34	5,877 (22.5)	7,571 (21.0)	13,448 (21.7)
35–44	5,545 (18.9)	7,118 (19.5)	12,663 (19.2)
45–54	4,633 (17.5)	5,602 (17.5)	10,235 (17.5)
55–64	3,276 (13.1)	4,405 (13.8)	7,681 (13.4)
65 or more	3,122 (11.4)	4,590 (13.0)	7,712 (12.2)
Skin color	p = 0.056*		
White	10,226 (46.8)	13,545 (48.1)	23,771 (47.4)
Black	2,525 (9.1)	3,032 (9.2)	5,557 (9.2)
Yellow	203 (1.0)	320 (1.0)	523 (1.0)
Brown	12,796 (42.8)	16,165 (41.2)	28,961 (41.9)
Indigenous	169 (0.3)	242 (0.5)	411 (0.5)
Schooling	p < 0.001*		
No education or incomplete primary school	5,867 (21.1)	7,537 (22.4)	13,404 (21.8)
Complete primary or incomplete high school	7,526 (29.6)	8,642 (25.3)	16,168 (27.3)
Complete high school or incomplete higher education	9,419 (37.9)	12,595 (38.4)	22,014 (38.2)
Complete higher education	3,108 (11.4)	4,532 (13.9)	7,640 (12.7)
Marital status	p < 0.001*		
No	10,022 (35.9)	15,435 (41.9)	25,457 (39.0)
Yes	15,898 (64.1)	17,871 (58.1)	33,769 (61.0)
Index of resources (quintiles)	p = 0.057*		
1º (poor)	6,908 (19.1)	7,835 (17.6)	14,743 (18.3)
2º	5,088 (18.2)	6,998 (18.2)	12,086 (18.2)
3º	4,721 (18.8)	6,542 (19.7)	11,263 (19.3)
4º	4,526 (20.3)	6,068 (20.9)	10,594 (20.6)
5º (rich)	4,677 (23.6)	5,863 (23.5)	10,540 (23.6)

Continue...

Table 1. Continuation.

Variable	Male (n = 25,920) n (%)	Female (n = 33,306) n (%)	Total (n = 59,226) n (%)
Household situation	p < 0.001*		
Urban	20,480 (84.9)	27,972 (87.3)	48,452 (86.2)
Rural	5,440 (15.0)	5,334 (12.6)	10,774 (13.7)
Regions	p < 0.001*		
North	5,544 (7.6)	6,700 (7.2)	12,244 (7.4)
Northeast	7,760 (26.5)	10,264 (26.7)	18,024 (26.6)
Southeast	6,036 (43.4)	8,081 (44.3)	14,117 (44.0)
South	3,294 (15.0)	4,149 (14.6)	7,443 (14.7)
Midwest	3,286 (7.5)	4,112 (7.2)	7,398 (7.3)
Nutritional status**	p < 0.001*		
Eutrophic	11,450 (44.5)	13,889 (42.0)	25,339 (43.2)
Overweight	10,097 (38.7)	11,458 (33.7)	21,555 (36.1)
Obesity	4,373 (16.8)	7,959 (24.3)	12,332 (20.7)
Abdominal obesity***	p < 0.001*		
No	20,355 (77.6)	16,064 (47.9)	36,419 (61.9)
Yes	5,565 (22.3)	17,242 (52.0)	22,807 (38.0)

*P-value refers to χ^2 test; **according to body mass index (kg/m^2) – eutrophic: up to 24;9; overweight: 25 to 29;9; and obesity: ≥ 30[19] –; ***graded by waist circumference (cm) – men: ≥ 102 and women ≥ 88[19].

DISCUSSION

In this study, the severity of the general and abdominal obesity epidemics in rural and urban areas of Brazil is disclosed by the values originating from data of national representativity. We identified an important effect of household situation on outcomes at the national level, with a notable difference between genders.

The national prevalence of general obesity found in this study was higher than observed in the Household Budget Survey[20] in 2008–2009. In this survey, prevalences in urban areas reached 13.2% for men and 17.0% for women, while prevalences in rural areas reached 8.8% and 16.5%, respectively, for men and women. Moreover, the prevalence of general obesity described in this study for the rural area is in agreement with the few studies carried out in rural areas of Brazil (varying from 5.5% in Minas

Table 2. Prevalence of general and abdominal obesity in Brazilian adults according to the National Health Survey of 2013 (n = 59; 226).

Regions	Male		Female		Δ Urban	Δ Rural
	Urban (n = 20,480)	Rural (n = 5,440)	Urban (n = 27,972)	Rural (n = 5,334)		
	% (95%CI)	% (95%CI)	% (95%CI)	% (95%CI)		
Obesity						
Southeast	17.6 (16.0 – 19.4)	12.1 (9.3 – 15.7)	26.2 (24.6 – 27.8)	26.7 (23.3 – 30.4)	8.6	14.6
North	15.5 (13.6 – 17.7)	11.9 (9.0 – 15.5)	20.1 (18.2 – 22.1)	16.1 (12.1 – 21.2)	4.6	4.2
Northeast	15.8 (14.1 – 17.6)	7.8 (6.5 – 9.3)	21.3 (19.8 – 23.0)	20.5 (18.0 – 23.1)	5.5	12.7
South	20.8 (18.5 – 23.2)	16.5 (13.0 – 20.6)	26.5 (24.1 – 29.0)	27.4 (22.3 – 33.3)	5.7	10.9
Midwest	19.0 (17.2 – 20.9)	17.2 (14.1 – 20.8)	24.6 (22.9 –26.4)	23.2 (19.6 – 27.3)	5.6	6
Total	**17.8 (16.9 – 18.8)**	**11.0 (9.5 – 12.6)**	**24.7 (23.8 – 25.6)**	**21.8 (19.9 – 23.8)**	6.9	10.8
	p = 0.003*	p < 0.001*	p < 0.001*	p = 0.002*		
Abdominal obesity						
Southeast	24.3 (22.6 – 26.2)	18.9 (15.2 – 23.3)	54.7 (52.9 – 56.4)	57.4 (53.9 – 60.9)	30.4	38.5
North	19.0 (16.3 – 22.0)	13.6 (10.3 – 17.8)	42.5 (40.1 – 45.1)	44.4 (39.4 – 49.6)	23.5	30.8
Northeast	20.0 (17.6 – 22.7)	9.7 (8.2 – 11.6)	51.2 (49.2 – 53.2)	49.8 (46.8 – 52.8)	31.2	40.1
South	29.1 (26.4 – 32.0)	22.3 (18.5 – 26.6)	51.1 (48.2 – 54.0)	53.6 (47.6 – 59.6)	22	31.3
Midwest	24.3 (22.4 – 26.4)	17.4 (13.2 – 22.7)	48.9 (46.9 – 50.9)	52.1 (46.7 – 57.5)	24.6	34.7
Total	**23.7 (22.6 – 24.8)**	**14.8 (13.1 – 16.6)**	**52.1 (51.1 – 53.2)**	**51.5 (49.0 – 54.0)**	28.4	36.7
	p < 0.001*	p < 0.001*	p < 0.001*	p = 0.001*		

95% CI: 95% confidence interval; Δurban / rural: difference in prevalence between women and men in urban and rural areas; * referring to the comparison between the prevalence and the different Brazilian regions. Tested by χ^2.

Gerais[21] to 29.5% in Rio Grande do Sul[22]), in the United States (39.6 to 45.7%)[23,24], Turkey (30.3%)[25], South-Eastern Limestone Coast region in Australia (30.0%)[26], and South Africa (27.2%)[27].

When stratified by region, the results resemble those of the Household Budget Survey in 2008-2009[20], which reported higher prevalences of general obesity in the urban area of the South Region in men (16.4%) and women (19.3%). In the same survey, the rural area of the South Region was also reported as holding the highest prevalence of obesity in men (13.8%) and women (21.2%). Using data from PNS 2012–2013, the South also appeared as the region with the highest prevalence among women living in rural areas and showed one of the highest values among men, however higher than those reported by the first survey. The differences found between both studies may be due to factors such as time elapsed between surveys, differences in sampling methods and anthropometric data collection.

Regarding abdominal obesity, the lack of large surveys in rural areas restricts the possibility of comparisons. However, the findings of this study are in agreement with the high prevalences reported in specific studies for Brazilian rural areas, varying from 11.6% in the Southeast Region (Minas Gerais)[28] to 37.8% in the South Region (Pelotas)[22]. A study conducted with women in the South Region of the country (Catuípe)[5] showed an even

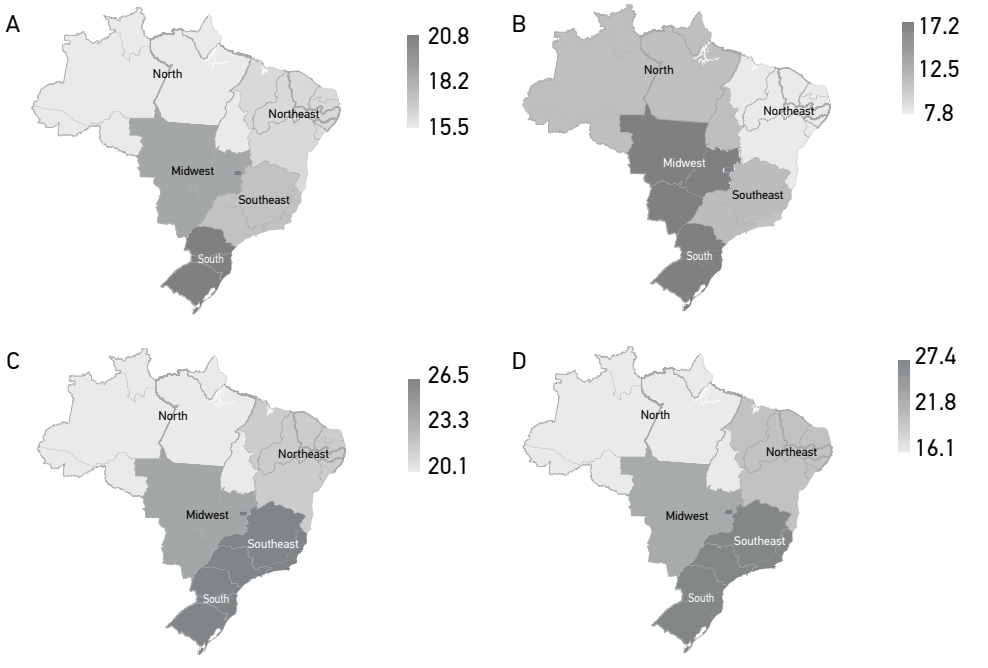

Figure 1. Prevalence of general obesity in men and women according to household situation: (A) general obesity in men in urban areas; (B) general obesity in men in rural areas; (C) general obesity in women in urban areas; (D) general obesity in women in rural areas.

higher prevalence of abdominal obesity, 54.6%. In comparison with other countries, few studies are found in literature. The values observed in Brazil are the highest reported when compared to rural areas of Nigeria (38.5%)[29] and Liaoning Province (15.1%)[30].

Household situation was shown to play a determining role in the distribution of outcomes, with differences between genders. In general, higher prevalences of general obesity in urban areas were observed for low- and middle-income countries, such as South Africa (28.0% urban vs. 17.3% rural)[31] and China (10.6% urban vs. 7.6% rural)[32]. In Turkey, however, a strong similarity between the prevalence of obesity between household situations[25] (approximately 30% in both cases) was found in adults, but a higher prevalence of obesity in rural areas (39.6% rural vs. 33.4% urban) was reported in the United States[24]. In Brazil, in one of the few studies that evaluated household situations in relation to abdominal obesity, a higher prevalence was found in the rural countryside (71.2%) compared to the urban countryside (67.6%) and the metropolitan region (69.5%) of Pernambuco[3].

The increase in prevalence of obesity in rural areas has been attributed to the modernization of societies, which, among other factors, has led to the improvement of working instruments, mechanization and automation of rural work[11,33], also in Brazil[4]. A positive association between urbanization and abdominal obesity in adults has been reported in China[34].

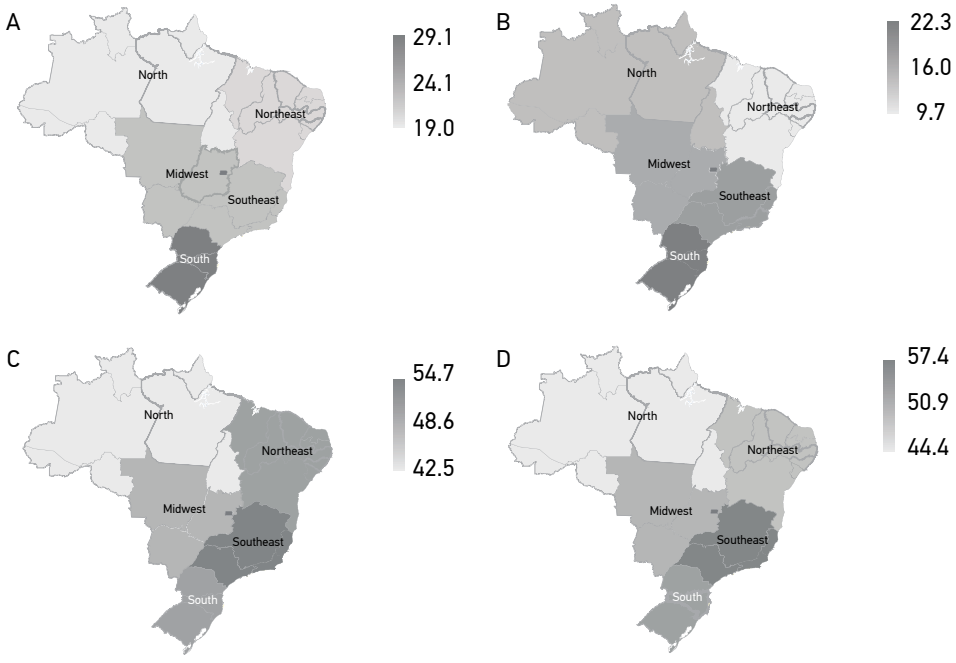

Figure 2. Prevalence of abdominal obesity in men and women according to household situation: (A) abdominal obesity in men in urban areas; (B) abdominal obesity in men in rural areas; (C) abdominal obesity in women in urban areas; (D) abdominal obesity in women in rural areas.

Table 3. Prevalence ratio for general and abdominal obesity considering domiciliary situation as exposure. Analyzes stratified by macroregion and by gender. According to the National Health Survey (PNS) of 2013 (n = 59,226).

	Male			Female		
	PR_{crude} (95%CI)	$PR_{adjusted}$ * (95%CI)	$PR_{adjusted}$ ** (95%CI)	PR_{crude} (95%CI)	$PR_{adjusted}$ * (95%CI)	$PR_{adjusted}$ ** (95%CI)
General obesity						
Southeast	0.67 (0.44 – 1.01)	0.68 (0.45 – 1.02)	0.90 (0.58 – 1.39)	0.86 (0.72 –1.04)	0.87 (0.73 – 1.05)	0.84 (0.69 – 1.02)
North	0.59 (0.39 – 0.89)	0.60 (0.40 – 0.89)	0.78 (0.51 –1.19)	0.90 (0.74 – 1.10)	0.90 (0.74 – 1.09)	0.85 (0.69 – 1.05)
Northeast	0.48 (0.38 – 0.60)	0.47 (0.38 – 0.59)	0.64 (0.50 – 0.81)	0.89 (0.75 – 1.05)	0.88 (0.74 – 1.04)	0.86 (0.73 – 1.03)
South	0.82 (0.62 – 1.08)	0.77 (0.58 – 1.02)	0.91 (0.67 – 1.24)	1.05 (0.82 – 1.34)	1.02 (0.81 – 1.29)	0.81 (0.63 – 1.05)
Midwest	0.98 (0.77 – 1.24)	0.94 (0.74 – 1.19)	1.06 (0.82 – 1.38)	1.08 (0.91 – 1.29)	1.07 (0.90 – 1.27)	0.92 (0.76 – 1.11)
Abdominal obesity						
Southeast	0.71 (0.52 – 0.97)	0.71 (0.52 – 0.97)	0.93 (0.68 – 1.28)	0.96 (0.87 – 1.07)	0.97 (0.88 – 1.08)	0.91 (0.82 – 1.00)
North	0.67 (0.46 – 0.96)	0.64 (0.45 – 0.91)	0.91 (0.63 – 1.32)	1.09 (0.97 – 1.23)	1.07 (0.96 – 1.20)	1.00 (0.89 – 1.14)
Northeast	0.51 (0.40 – 0.63)	0.48 (0.38 – 0.59)	0.64 (0.51 – 0.79)	0.97 (0.89 – 1.06)	0.95 (0.88 – 1.03)	0.88 (0.81 – 0.96)
South	0.84 (0.67 – 1.04)	0.75 (0.61 – 0.93)	0.89 (0.71 – 1.10)	1.08 (0.93 – 1.26)	1.05 (0.93 – 1.19)	0.92 (0.80 – 1.05)
Midwest	0.73 (0.56 – 0.94)	0.68 (0.53 – 0.86)	0.82 (0.63 – 1.06)	1.14 (1.03 – 1.26)	1.11 (1.01 – 1.23)	1.02 (0.92 – 1.14)

Note: the urban area was considered as a reference category; PR: prevalence ratio; 95% CI: 95% confidence interval; *adjusted for age and skin color; **adjusted for age; skin color; schooling; marital status and index of goods.

Concomitantly, the so-called nutritional transition has led to a greater caloric intake, with an increase in the consumption of fats, sugar and refined cereals, thus modifying the profile of morbidity and mortality in societies[33]. However, trends in urbanization and modernization have different effects between populations in each country, making it impossible to generalize these effects on health at the national or global levels[6].

With data from the PNS 2013, the relationship between household situation and the outcomes analyzed differs between genders, and these relations behave differently in each macroregion, with lower prevalences of general obesity among men living in rural areas in the North and Northeast regions, and, for abdominal obesity, lower prevalences in rural areas in all regions. Among women, similar prevalences between household situations were observed across the country. The prevalence of obesity in women was still higher than in men for both rural and urban areas, with an alarming discrepancy in the values for women, mainly for abdominal obesity. Age and parity, as biological conditions, may explain these findings, since they are directly related to weight gain. Socioeconomic and occupational aspects related to the specificities of men and women in rural areas could explain these findings.

The difference in occupations between genders in these regions can also be related to the results, considering that functions that require less physical effort, coinciding with the technological advances, increased mechanized work and less leisure physical activities are known to lead to weight gain[16]. A study carried out with a cohort of rural workers in Canada[35] reported a consistent association between increased participation in mechanized tasks in agricultural work, overweight and obesity[36]. In Brazil, a study carried out in a rural area of Minas Gerais showed a higher concentration of physical activities in men[37], and reports of life habits of these places, when compared to the urban area, include higher consumption of family farming products, higher energy expenditure with physical displacement at work, and intense manual labor, especially during harvest[38,39]. However, in women, the same study reported lower concentration of physical activity at work, while the domestic domain was the most prevalent[37]. Thus, it is possible that our findings are in agreement with the hypothesis that, although technologies currently developed and urbanization induce changes in living standards and food/eating behavior of populations, manual labor in some rural regions may be considered a protective factor for obesity, especially among men.

The socioeconomic determinants, with emphasis on income and schooling, may be related to weight gain in younger age groups and to schooling among women, a fact already consolidated in literature[40-43]. In the Brazilian rural area, characterized by low educational level, low income and poor access to health services and research, the population often has health problems neglected[4]. Unschooled or incomplete elementary school students represent 44.2% of urban inhabitants and 79.6% in rural areas, according to the latest census[44]. Also, the relation between occupation and schooling reported in the same census[44] is highlighted, as the group of lower educational level

78.3% of individuals self-declared as "skilled in agricultural, forestry, hunting and fishing"[44], occupations typical of rural areas. The same has already been demonstrated by a study with agricultural workers in Brazil, which concluded that these activities are performed mostly by men at younger age, non-white skinned, with lower level of schooling and income, and living in regions with the worst social and health indicators of the country[45], factors that are also associated with obesity. Thus, disparities between rural and urban areas can be justified by the relationship between educational and socioeconomic levels in each macroregion.

The literature has already shown that mean BMI in less developed countries is generally higher in urban areas than in rural areas[6], but the extent of the association between urban area and BMI is substantially reduced after adjusting for socioeconomic status, suggesting the importance of these factors to understand this association[6]. After the inclusion of the variables marital status, schooling and income, the latter considered a proxy for socioeconomic level, the results showed an association between residing in rural areas and abdominal obesity only for the Northeast Region among both men and women. Regarding general obesity, there was a change in the measure of effect, but not in statistical significance, suggesting that the economic disparity is an important element when it comes to differences in prevalence related to household situation, especially with regard to the Northeast Region. Further research exploring the linkage of socioeconomic variables and specificities of economic factors in rural areas may provide important information to explain the associations observed here.

The limitations of this study include the lack of data on the current degree of mechanization and urbanization in rural areas of Brazil, which may influence the process of epidemiological transition characterized by changes in nutrition and consumption pattern that accompany changes in the economic, social, demographic and health profile of the population[46]. This variable could further support the explanation of lower prevalence of obesity among men living in rural regions with physical labor. However, the present study was the largest one ever carried out in the country, with a representative sample, and one of the few that aimed to explore the relationship with household situation. In addition, the advantage of anthropometric measurements has been verified.

CONCLUSION

Finally, the present study shows a clear heterogeneity in the prevalence of general and abdominal obesity between the regions studied. In general, lower values were found among men living in rural areas in all regions. On the other hand, it is suggested that living in rural areas may have a negative impact on the health of women with regard to general and abdominal obesity, especially highlighting the greater difference in abdominal obesity found in this household situation compared to men, which places this group at higher risk for cardiovascular diseases and other health problems.

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