Factors associated with central obesity in adults from Florianópolis, Santa Catarina: a population based-study

Fatores associados à obesidade central em adultos de Florianópolis, Santa Catarina: estudo de base populacional

Thiago Ferreira de Sousa[I,II]
Markus Vinicius Nahas[I,II]
Diego Augusto Santos Silva[I]
Giovâni Firpo Del Duca[I,II]
Marco Aurélio Peres[III]

[I] Programa de Pós-Graduação em Educação Física da Universidade Federal de Santa Catarina (UFSC); Centro de Desportos (CDS) de Florianópolis, SC.

[II] Núcleo de Pesquisa em Atividade Física e Saúde (NuPAF) da Universidade Federal de Santa Catarina (UFSC); Centro de Desportos de Florianópolis, SC.

[III] Programa de Pós-Graduação em Saúde Pública da Universidade Federal de Santa Catarina (UFSC); Centro de Ciências da Saúde (CCS) de Florianópolis, SC.

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Correspondência: Thiago Ferreira de Sousa. Coordenadoria de Pós-Graduação em Educação Física, Campus Universitário, Bairro Trindade, Florianópolis, SC, CEP 88040-900. E-mail: tfsousa_thiago@yahoo.com.br

Abstract

Objective: To estimate the prevalence of central obesity and its association with socio-demographic factors and health-related behaviors among adults from Florianópolis, State of Santa Catarina, Southern Brazil. **Methods:** A cross-sectional population-based study was carried out in a sample of 1,720 adults between 20 to 59 years of age, residents in the urban area of the city. The outcome was the central obesity which was defined as a waist-height ratio ≥ 0.50. Unadjusted and adjusted models were performed by using Poisson regression allowing estimation of the Prevalence Ratio (PR). All analyses were stratified by sex. **Results:** The prevalence of central obesity was 50.5% (95% CI: 46.6-54.4) among men and 38.9% (95% CI 34.4-43.5) among women. In the adjusted analysis, central higher prevalence of obesity was observed in women aged 50 to 59 years and those who were living with a partner; lower prevalences were observed among women with ≥ 12 years of study (PR: 0.63; 95% CI: 0.47-0.85) and among those with higher income (PR: 0.64; 95% CI: 0.47-0.86). Among men, a higher prevalence of central obesity was associated with ages 50 to 59 years and among those who were living with a partner, while a lower prevalence was identified in those in the highest income group. **Conclusion:** The prevalence of central obesity was high in the population studied. Demographic and socioeconomic factors were strongly associated with central obesity in both sexes. The knowledge of factors associated with central obesity may help the implementation of health interventions in order to prevent this core issue in Public Health.

Keywords: Obesity. Central obesity. Waist-height ratio. Health behavior. Adults. Cross-sectional studies.

Resumo

Objetivo: Estimar a prevalência e os fatores sociodemográficos e comportamentais associados à obesidade central em adultos de Florianópolis, Santa Catarina. **Métodos:** Pesquisa de delineamento transversal de base populacional com amostra de 1.720 adultos de 20 a 59 anos. A obesidade central foi avaliada pela razão entre as medidas da cintura e estatura, sendo considerada como acima do recomendável ≥ 0,50. A Regressão de Poisson foi utilizada para estimar Razões de Prevalência (RP) nas análises brutas e multivariável entre a obesidade central e os indicadores sociodemográficos e comportamentos relacionados à saúde. Todas as análises foram estratificadas por sexo. **Resultados:** A prevalência de obesidade central foi de 50,5% (IC 95%: 46,6-54,4) para os homens e 38,9% (IC 95%: 34,4-43,5) para as mulheres. Após a análise multivariável, maiores prevalências de obesidade central foram observadas para as mulheres com faixa de idade de 50 a 59 anos e aquelas que vivem com companheiro(a) e, com menores prevalências, para as mulheres com escolaridade maior e igual a 12 anos (RP: 0,63; IC 95%: 0,47-0,85) e maior renda (RP: 0,64; IC 95%: 0,47-0,86). Para os homens, maiores prevalências foram evidenciadas com a faixa de idade de 50 a 59 anos, que vivem com companheiro(a) e com menor renda. **Conclusão:** A prevalência de obesidade central foi elevada nesta população e as variáveis demográficas e socioeconômicas foram fortemente discriminantes da prevalência de obesidade central em ambos os sexos. O conhecimento dos fatores associados à obesidade central pode orientar as intervenções dirigidas à prevenção deste importante problema de saúde pública.

Palavras-chave: Obesidade. Obesidade Central. Razão cintura-estatura. Conduta de saúde. Adultos. Estudos transversais.

Introduction

Obesity, defined as the accumulation of body fat above recommended levels, represents a public health problem on a worldwide scale and is strongly linked with diverse non-transmissible chronic diseases[1]. In international studies, prevalence of obesity (body mass index (BMI) above 30 kg/m^2), ranges from 15.7% in Zimbabwe to 32.2% in the United States in adults of all ages[2]. In Brazil, an increase in prevalence of obesity in adults has been observed, with prevalence of 2.8% and 12.4% in men during the period from 1974 and 2009, respectively, and from 8.0% and 16.9% in women during the same period. In 2009, the southern region of the country presented a higher prevalence of obesity when compared to other regions of the country[3].

The estimates of obesity for the detection of health risks are more frequently reported by the BMI. However, it is known that central obesity, defined as the concentration of fat in the abdominal region, presents a greater predictive sensitivity of diseases and health problems[4]. Among the central obesity indicators[5], the waist-to-height ratio (WHtR) has shown itself to be more sensitive in the prediction of health risks than the waist perimeter[6,7,8].

The WHtR presents as advantages a similar cut-off point between the sexes, between different ethnic groups and age ranges[6]. Average WHtR scores in adults from the city of Salvador, (Bahia, Northeast Brazil) were 0.51 and 0.53 for men and women, respectively[8], lower than the average scores observed in adults in the United States of America which were 0.56 in men and 0.57 in women[9]. In studies developed in other countries, averages higher than these rates stand out depending on an increase in age[10,11], among those who do not practice physical exercise, have high blood pressure and high levels of triglycerides and glycemia[10].

The purpose of the current study was to determine the prevalence and the sociodemographic and behavioral factors asso-

ciated with central obesity in adults from Florianópolis, Santa Catarina.

Methods

This study is derived from the population-based *EpiFloripa Adultos 2009*, a research conducted on a representative sample of adults from the urban area of Florianópolis, Santa Catarina. The aim of this study was to investigate self- assessment of health, self-rated morbidities, oral health, utilization of health services and main risk factors for chronic diseases such as demographic and socioeconomic characteristics, alimentary habits, practice of physical activities, blood pressure, anthropometric indicators, problematic use of alcohol and tobacco consumption. The study was realized in Florianópolis, the capital of the state of Santa Catarina. The estimated population in 2009 was 408,161 inhabitants[12]. Data collection occurred between September 2009 and January 2010 and the target population of the study (N = 249.530) comprised adults between 20 and 59 years of age, residents of the urban area of the city. This age range accounted for approximately 60% of the total municipal population in 2009[12].

To estimate the necessary sample size, the *Epi-Info* program was used, version 6.04, publically available[13]. The equation was used to calculate prevalence considering the following parameters: target population of 249.530 individuals, confidence level of 95%, unknown prevalence outcomes of 50%, sample error of 3.5 percentage points, an estimated design effect (*deff*) of 2, percentage (%) of losses estimated at 10% and 15% for control of confounding factors in studies of association. Through application of these parameters, a sample of 2,016 people was obtained.

Considering the study parameters of statistic power as 80%, confidence level of 95% and number of subjects in each category of independent variables, this study can detect prevalence ratios above 1.7 and below 0.6 in men and 1.3 and 0.8 in women, respectively, as factors of risk and protection in the unadjusted analysis.

Sample selection was carried out in two stages: in the first, the 420 urban sector tracts were stratified according to the income deciles of the head of the family (R$ 192,80 a R$ 13.209,50; one US$ worth 1.7 Reais -Brazilian currency)-at the time of data collection) and 60 sectors were selected by drawing lots systematically (fraction of sampling equal to seven), making up six sectors in each decile; in the second stage, the units were the households. For this stage the number of households in each census were updated. Study supervisors (post-graduate staff from department of Public Health, Physical Education and Nutrition from the Federal University of Santa Catarina) counted all the occupied households in the selected tracts (number of occupied households ranged from 61 to 810). The urban sector tract started from the furthest lower right point and ran clockwise.

In order to lower the coefficient of variation between the number of households of the census tracts to allow for a self-weighted sample, the sectors were reorganized through fusion and division of the units. This led to a reduction in the initial variation coefficient of 55% (n=60 sectors) to 32% (n=63 sectors). In this way, of the 16,755 households mapped out in the 63 sectors of the sample, 18 residences were randomly selected systematically (selection interval equal to 13) in each of the sectors, totaling 1,134 selected residences. Losses were recorded when adults were not located at the visited residence in at least four attempts, at different times and on different days during the week and at least once at the weekends and at night. A refusal was given when the resident declined to cooperate.

Data was collected through face to face interviews with all adult residents in the selected households by 35 selected interviewers, all having completed high school, and with full-time availability to carry out field work activities. The interviewers were trained prior to commencement of the research by the team responsible for the study.

This comprised coordinators and supervisors of the study and technicians from the Brazilian Institute of Geography and Statistics. The interviewers were also trained by Physical Education professionals to perform the anthropometric measurements and the intra examiner and inter examiner[14,15] reliability technical errors were calculated by each measurement being done twice consecutively on 10 adults.

Comprehension of the questionnaire was pre-tested by applying it on 30 adults in the same age range in a catchment area of a local health center. After training of the interviewers was complete, a pilot study was carried out on approximately 100 people in a census tract selected for this purpose. Results of this were not incorporated into the overall study.

The interviews were performed using 35 *Personal Digital Assistants* (PDAs) and lasted approximately one hour on average (slightly less for men). Use of this equipment minimized possible typing errors and facilitated checking of possible incoherencies during the data collection period. Quality control of the study was realized through a telephone interview with approximately 15% of the sample (*n*=248), using a shortened version of the questionnaire containing 10 questions. Subsequently, the *Kappa* tests were applied to the categorical variables (nominal and ordinal) and *IntraClass Correlation Coefficient* for the continuous and discrete quantitative variables in order to calculate the reproducibility.

Outcome

The dependent variable of the current study was central obesity, defined by the waist-to-height ratio (WHtR). By dividing the circumference of the waist (cm) by the height (cm), adults were categorized as obese with WHtR scores ≥0.50 with the same cut-off point for both men and women. To assess WHtR, procedures proposed by Lohman *et al*.[16] were adopted. The waist circumference was measured with a non-extendable anthropometric tape by Sanny®, with a 1 mm resolution, considering the smallest circumference, or, when this was unobserved, midway between the uppermost border of the iliac crest and the lower border of the costal margin.

To measure height, a stadiometer with a 1 mm metric tape was built. The participant was placed on a flat base in the orthostatic position and asked to take a deep breath. At this moment, the height measurement was taken from the top of the head. The adults who were unable to remain in the recommended position, pregnant women at the time of the research or who had given birth in the six months prior to the research did not have their anthropometric measurements taken[17]. The maximum relative technical error values observed during training for the waist circumference (intra-examiner 1.18; inter-examiner 1.86) and height (intra examiner 0.24; inter examiner 1.67) were considered satisfactory, according to recommendations by Gore *et al*[15].

Exploratory Variables

For analysis purposes, the variables were categorized in the following way: sex (male and female), age range in completed years (20 to 29 years, 30 to 39 years, 40 to 49 years and 50 to 59 years), marital status (with a partner and without a partner, self-referred skin color, classified as white, brown and black (participants who referred to their skin color as yellow or indigenous were excluded due to the low number, n = 17 e 20 respectively), schooling in successfully completed years of study (0 to 4 years, 5 to 8 years, 9 to 11 years and ≥12 years) and *per capita* family income in reais (1º tertile = up to R$ 566.90; 2º tertile = R$ 567.00 to 1300.00; and 3º tertile = R$ 1300.10 to 33. 333,00).

The variables relative to health-related behaviors were categorized as the following: physical activity, dichotomized as *no* (refers to not having practiced any physical activities during leisure time in the last three months at least once a week, to not have walked or ridden a bicycle part of the way or the whole way, to school or work, refers to

not walking enough or lifting enough weight at work and not being responsible for heavy housework) and *yes* (do physical activities, get around, work outside and in the home)[18]; regular consumption of fruit: *consumption ≥5 days per week and consumption ≤4 days per week*[19]; regular consumption of vegetables (lettuce and tomato salad or any raw vegetable or greens and cooked greens or vegetables like cabbage, carrot, chayote, eggplant, zucchini, except potato, cassava or yam): *consumption ≥5 days per week and consumption ≤4 days per week*[19]; problematic use of alcohol: standardized AUDIT score (*The Alcohol Use Disorders Identification Test*), proposed by the World Health Organization[20], dichotomized as *no* (score 0 to 7) and *yes* (score ≥8).

Data analysis was carried out in Stata 9.0 and descriptive analyses were realized through calculation of prevalence (categorical variables nominal and ordinal) and means, medians and standard deviation (SD) for the continuous and discrete variables of the study. *Poisson* Regression was used to estimate Prevalence (PR) in the adjusted and unadjusted analyses and Confidence Level of 95% (CI95%).

The following hierarchical model[21] was adopted considering the hypothetical temporal relationship between the variables for the multivariable analysis, following the selection of using *backward* variables selection: the demographic variables at the distal level (age range and self-referred skin color), socioeconomic variables (*per capita* income and schooling level) and marital status at intermediary level and, at the proximal level, the variables of health-related behaviors (physical activity, regular consumption of fruit and vegetables and, problematic use of alcohol). All the variables were included in the multivariable analysis, independent of its p value in the unadjusted analysis, following the theoretical hierarchical model. In order to choose selection method of the variables entrance in the multivariable model, we tested both *forward* and *backward*. A similarity was observed in the results between the methods for women although, for men, the income variable presented a differentiated characteristic, maintaining association with the outcome with the use of the *backward* method.

Adjustments were made to the variables of the same level and those which presented a p value ≤0.20 on the *Wald* test remained in the model. All the analyses were carried out taking the design effect (clusters) into account ("*svy*" command in Stata for analysis of complex samples) and stratified by sex. The significance value adopted was 5%. The *EpiFloripa Adultos 2009* project was approved by the Committee of Ethics in Research on Human Beings at the Federal University of Santa Catarina under protocol number 351/08. Informed consent was obtained from all participants and these were informed of the objectives of the study.

Results

The number of participants in the study was 1,720 adults (85.3% response rate) with a mean age of 38.1 years (SD = 11.6) and median of 38 years. The design effect (*deff*) for the outcome of this study (central obesity) was 2.25 and the intra-class correlation coefficient between obesity and the census tracts was 0.05.

A higher proportion of women was observed between 20 and 29 years, white skin color, schooling equal to or greater than 12 years, lower *per capita* income (1º tertile) and living with a partner. In relation to health-related behaviors, it was observed that in women, 11.2% do not practice physical activity, almost 10% present problematic use of alcohol and 40.6% present low consumption of fruit and approximately 37% have a lower consumption of vegetables than five days (Table 1). For men, a higher frequency was observed in the 20 to 29 age range, white skin color, schooling equal to or greater than 12 years and living with a partner. For health-related behaviors, 12.9% did not practice physical activity, a third presented problematic use of alcohol, more than half claimed to consume fruit four days a week or less and 45% claimed their consumption

of vegetables to be equal to or less than four days a week (Table 1).

The mean value observed for central obesity was 0.50 (SD=0.01) and the median was 0.49, being the mean value of 0.50 (SD=0.09) and median of 0.48 for women and mean of 0.51 (SD=0.07) and median of 0.50 for men. The proportion of adults with central obesity was 44.0% (95%CI 40.5 – 47.8), higher for men when compared to women, 50.5% (95%CI 46.6 – 54.4) and 38.9% (95%CI 34.4 – 43.5), respectively (Table 2). Other information on prevalence of central obesity according to socio-demographic and behavioral variables is presented in Table 2.

In relation to women, the following factors were observed in the unadjusted analysis to be associated with the highest prevalence of central obesity: higher age ranges, having a partner and with lower prevalence of central obesity, higher *per capita* income, lower schooling level, fruit consumption lower than five days and problematic use of alcoholic beverages (Table 3). In the multivariable analysis, women of a higher age and those who live with a partner remained associated with the outcome. Higher schooling level and higher *per capita* income presented a lower prevalence when associated with the outcome (Table 3)

For men, in the unadjusted analysis the following were associated with the outcome with higher prevalence: more advanced in age, living with a partner and not practicing physical activity; with lower prevalence were higher schooling levels (Table 4). In the multivariable analysis, advanced age and living with a partner remained associated with the greatest prevalence of the outcome. Men with higher *per capita* income had lower prevalence of central obesity after adjusting for other demographic and economic variables (Table 4).

In relation to prevalence of central obesity measured by the abdominal circumference in adults in Florianópolis, it was observed that the prevalence with a higher circumference (men ≥102 cm and women ≥88 cm) was 16.4% (95%CI: 13.8 – 18.3), being higher in women (19.7%; 95%CI: 16.7 – 23.0) when compared to men (11.6%; 95%CI: 9.3 – 14.3). The same analysis model used for the WHtR was adopted for the abdominal circumference. Higher prevalence was observed in older women, those living with a partner and those with lower *per capita* income. For men, greater prevalence of high waist circumference was observed in older men and those with lower *per capita* income (data not presented).

Discussion

This study presents, as an important methodological characteristic, the use of WHtR for measuring central obesity, as this presents greater predictive sensitivity to cardiovascular risks[7,8], diabetes *mellitus*[22] and high blood pressure[22] than waist circumference. The WHtR is an index that adjusts for waist circumference (discriminator of central obesity) by height and, consequently, minimizes incorrect evaluation of health risks in adults of different height. Studies have shown greater sensitivity of this index in discriminating obesity between the sexes, different age and ethnic groups[6]. In Brazil, population-based studies which used WHtR to estimate central obesity were not found. Studies by Haun *et al.*[8] and Pitanga e Lessa[7] on adults in Salvador, Bahia, stand out which discriminated the predictive strength of WHtR to estimate cardiovascular risks.

The mean values of WHtR observed in the current study were lower (men: 0.51; women: 0.50) than the mean values of studies carried out on adults in the United States (men: 0.57; women: 0.56)[9], Iraq (men: 0.53; women: 0.58)[23], Mexico (men: 0.58; women: 0.66)[24] and Spain (men: 0.57; women: 0.61)[24]. In relation to the mean values of WhtR in Brazilian adults from Salvador, Bahia, it can be seen that women presented a higher score than men, 0.53 and 0.51, respectively[8], which differ from observations made in this study. However, a tendency for a higher index of central obesity for men can be observed when information from other countries is analyzed using the WhtR[9,24]. For the popu-

Table 1 – Socio-demographic characteristics and health-related behaviors overall and by sex in adults from Florianópolis, Santa Catarina, Brazil, 2009.

Tabela 1 *– Descrição das características sociodemográficas e dos comportamentos relacionados à saúde de acordo com o sexo e geral em adultos de Florianópolis, Santa Catarina, 2009.*

	Females		Males		Overall	
Variables	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)
	959	55.8 (53.8-57.6)	761	44.2 (42.3-46.1)		
Age ranges (completed years)						
20 to 29 years	280	29.2 (24.9-33.4)	260	34.2 (29.5-38.8)	540	31.4 (27.4-35.4)
30 to 39 years	220	22.9 (19.8-26.0)	172	22.6 (19.5-25.6)	392	22.8 (20.4-25.2)
40 to 49 years	257	26.8 (23.5-30.1)	181	23.8 (20.6-27.0)	438	25.5 (22.6-28.3)
50 to 59 years	202	21.1 (18.2-23.9)	148	19.4 (16.3-22.6)	350	20.3 (17.9-22.8)
Skin color						
White	802	86.4 (82.9-89.9)	642	85.6 (81.7-89.5)	1.444	86.0 (82.8-89.3)
Brown	73	7.9 (5.6-10.1)	74	9.9 (6.8-12.9)	147	8.8 (6.5-11.0)
Negro or black	53	5.7 (3.3-8.1)	34	4.5 (2.4-6.6)	87	5.2 (3.3-7.1)
Schooling						
0 to 4 years	89	9.3 (6.7-11.8)	69	9.1 (6.4-11.8)	158	9.2 (6.8-11.6)
5 to 8 years	145	15.1 (12.2-18.1)	108	14.2 (11.3-17.2)	253	14.7 (12.1-17.4)
9 to 11 years	305	31.8 (27.9-35.8)	263	34.7 (29.5-39.8)	568	33.1 (29.1-37.1)
≥ 12 years	419	43.8 (37.7-49.7)	318	42.0 (35.4-48.5)	737	43.0 (37.0-48.9)
Marital status						
No partner	375	39.1 (35.4-42.8)	302	39.7 (35.5-43.9)	677	39.4 (36.2-42.5)
With a partner	584	60.9 (57.2-64.6)	459	60.3 (56.1-64.5)	1.043	60.6 (57.5-63.8)
Per capita income in Reais (Brazilian currency)						
1º tertile	335	35.7 (29.2-42.1)	229	30.8 (25.5-36.0)	564	33.5 (27.7-39.2)
2º tertile	304	32.3 (28.7-36.0)	258	34.6 (30.5-38.7)	562	33.3 (29.9-36.8)
3º tertile	301	32.0 (25.4-38.6)	258	34.6 (28.7-40.5)	559	33.2 (27.1-39.3)
Physical activity						
Yes	850	88.8 (85.9-91.7)	657	87.1 (84.3-89.9)	1.507	88.1 (85.7-90.4)
No	107	11.2 (8.3-14.0)	97	12.9 (10.0-15.7)	204	11.9 (9.6-14.3)
Fruit consumption						
≥ 5 days per week	569	59.4 (55.9-62.9)	316	41.5 (37.6-45.4)	885	51.5 (48.6-54.3)
≤ 4 days per week	389	40.6 (37.1-44.1)	445	58.5 (54.6-62.4)	834	48.5 (45.7-51.4)
Vegetable consumption						
≥ 5 days per week	607	63.4 (59.4-67.3)	416	54.7 (50.7-58.6)	1.023	59.5 (56.3-62.7)
≤ 4 days per week	351	36.6 (32.7-40.6)	345	45.3 (41.4-49.3)	696	40.5 (37.3-43.7)
Problematic use of alcohol						
No	870	90.7 (88.3-93.1)	533	70.0 (66.1-73.9)	1.043	81.6 (79.0-84.1)
Yes	89	9.3 (6.8-11.7)	228	30.0 (26.0-33.9)	317	18.4 (15.9-21.0)

% = Prevalence; 95%CI = 95% Confidence interval. / *% = Prevalência; IC95% = Intervalo de confiança de 95%.*

Table 2 – Prevalence of central obesity according to socio-demographic indicators and health-related behaviors overall and by sex in adults from Florianópolis, Santa Catarina, Brazil, 2009.

Tabela 2 *– Prevalência de obesidade central de acordo com os indicadores sociodemográficos e dos comportamentos relacionados à saúde por sexo e geral em adultos de Florianópolis, Santa Catarina, 2009.*

	Females		Males		Overall	
Variables	n	% (I95%IC)	n	% (95% CI)	n	% (95% CI)
	918	38.9 (34.4-43.5)	750	50.5 (46.6-54.4)	1.668	44.0 (40.5-47.8)
Age ranges (completed years)						
20 to 29 years	259	19.3 (13.7-26.5)	257	24.9 (19.3-31.5)	516	22.1 (17.7-27.2)
30 to 39 years	208	31.7 (23.7-41.1)	168	50.6 (42.7-58.5)	376	40.2 (33.6-47.1)
40 to 49 years	254	45.3 (39.3-51.4)	179	66.5 (59.6-72.7)	433	54.0 (49.1-59.0)
50 to 59 years	197	64.0 (56.0-71.2)	146	76.0 (67.1-83.1)	343	69.1 (62.8-74.8)
Skin color						
White	765	38.3 (33.8-43.0)	632	51.4 (47.2-55.6)	1.397	44.2 (40.4-48.1)
Brown	72	37.5 (27.3-48.9)	73	43.8 (35.0-53.1)	145	40.7 (32.8-49.1)
Negro or black	50	46.0 (33.0-59.6)	34	44.1 (30.0-59.3)	84	45.2 (35.4-55.4)
Schooling						
0 to 4 years	88	71.6 (60.5-80.5)	67	67.2 (54.3-77.9)	155	69.7 (61.0-77.2)
5 to 8 years	138	52.9 (44.1-61.6)	108	57.4 (47.9-66.4)	246	54.9 (48.6-61.0)
9 to 11 years	291	39.9 (33.9-46.2)	260	51.9 (44.8-59.0)	551	45.5 (40.5-50.7)
≥ 12 years	401	26.2 (21.3-31.7)	312	43.3 (37.6-49.1)	713	33.7 (29.2-38.5)
Marital status						
No partner	369	31.2 (25.9-37.0)	297	36.0 (30.5-41.9)	666	33.3 (29.2-37.7)
With a partner	549	44.1 (38.6-49.7)	453	60.0 (55.4-64.5)	1.002	51.3 (47.2-55.4)
Per capita income in Reais (Brazilian currency)						
1º tertile	320	47.2 (41.4-53.0)	227	52.0 (45.9-58.0)	547	49.2 (44.7-53.7)
2º tertile	291	41.2 (33.9-49.0)	254	55.9 (49.2-62.4)	545	48.1 (42.8-53.4)
3º tertile	289	26.6 (21.0-33.1)	254	45.7 (38.7-52.8)	543	35.5 (30.4-41.1)
Physical activity						
Yes	820	38.4 (33.7-43.3)	650	48.6 (44.3-52.9)	1.470	42.9 (39.2-46.8)
No	97	42.3 (32.2-53.0)	95	64.2 (54.3-73.0)	192	53.1 (45.3-60.8)
Fruit consumption						
≥ 5 days per week	542	42.1 (36.6-47.7)	311	53.0 (46.7-59.3)	853	46.1 (41.4-50.8)
≤ 4 days per week	376	34.3 (28.7-40.4)	439	48.7 (43.8-53.7)	815	42.1 (38.0-46.3)
Vegetable consumption						
≥ 5 days per week	577	37.3 (32.0-42.8)	410	50.5 (45.5-55.4)	987	42.8 (38.3-47.4)
≤ 4 days per week	341	41.6 (35.5-48.0)	340	50.6 (44.7-56.5)	681	46.1 (41.5-50.8)
Problematic use of alcohol						
No	829	40.7 (36.5-45.2)	528	51.1 (46.5-55.8)	1.375	44.8 (41.4-48.6)
Yes	89	21.3 (13.3-32.4)	222	49.1 (40.9-57.4)	311	41.2 (34.3-48.3)

% = Prevalence; 95%CI = 95% Confidence interval. / *% = Prevalência; IC95% = Intervalo de confiança de 95%.*

Table 3 – *Association between central obesity and socio-demographic factors and health-related behaviors in adult women from Florianópolis, Santa Catarina, Brazil, 2009. Unadjusted and adjusted Prevalence Ratios (PR) estimated by the Poisson regression.*

Tabela 3 *– Associação entre obesidade central e variáveis sociodemográficas e comportamentos relacionados à saúde em mulheres adultas de Florianópolis, Santa Catarina, 2009. Razões de prevalência (RP) brutas e ajustadas estimadas por Regressão de Poisson.*

			Unadjusted Analysis		Adjusted Analysis $	
Leve	Variables	n	PR (95% CI)	p	PR (95% CI)	p
1	Age ranges (completed years)			<0.001*		<0.001*
	20 to 29 years	259	1.00		1.00	
	30 to 39 years	208	1.64 (1.07-2.51)		1.64 (1.06-2.54)	
	40 to 49 years	254	2.34 (1.67-3.28)		2.41 (1.71-3.38)	
	50 to 59 years	197	3.31 (2.36-4.63)		3.46 (2.47-4.84)	
1	Skin color			0.31		0.08
	White	765	1.00		1.00	
	Brown	72	0.98 (0.74-1.29)		1.04 (0.80-1.35)	
	Negro or black	50	1.20 (0.88-1.63)		1.26 (0.97-1.64)	
2	Schooling			<0.001*		0.003*
	0 to 4 years	88	1.00		1.00	
	5 to 8 years	138	0.74 (0.60-0.91)		0.88 (0.71-1.09)	
	9 to 11 years	291	0.56 (0.46-0.67)		0.84 (0.67-1.07)	
	≥ 12 years	401	0.36 (0.28-0.47)		0.63 (0.47-0.85)	
2	Marital Status			<0.001		0.02
	No partner	369	1.00		1.00	
	With a partner	549	1.41 (1.17-1.71)		1.20 (1.02-1.42)	
2	Per capita income in Reais (Brazilian curreny)			<0.001*		0.004*
	1º tertile	320	1.00		1.00	
	2º tertile	291	0.87 (0.71-1.07)		0.92 (0.75-1.13)	
	3º tertile	289	0.56 (0.44-0.73)		0.64 (0.47-0.86)	
3	Physical activity			0.47		0.74
	Yes	820	1.00		1.00	
	No	97	1.10 (0.84-1.43)		1.04 (0.83-1.30)	
3	Fruit consumption			0.03		0.87
	≥ 5 days per week	542	1.00		1.00	
	≤ 4 days per week	376	0.82 (0.68-0.98)		0.98 (0.81-1.20)	
3	Vegetable consumption			0.24		0.41
	≥ 5 days per week	577	1.00		1.00	
	≤ 4 days per week	341	1.11 (0.93-1.35)		1.08 (0.90-1.30)	
3	Problematic use of alcohol			0.003		
	No	829	1.00		1.00	0.16
	Yes	89	0.52 (0.34-0.80)		0.76 (0.52-1.11)	

1 = Distal level; 2 = Intermediate level; 3 = Proximal level. */ 1 = Nível distal; 2 = Nível intermediário; 3 = Nível proximal.*

* Linear trend p value. */ * p valor para tendência linear.*

$ Adjusted for other variables of the same level or higher with a p value ≤0.20. */ $ Ajustada para outras variáveis do mesmo nível ou de nível superior com p valor ≤0,20.*

Table 4 – Association between central obesity and socio-demographic factors and health-related behaviors in adult men from Florianópolis, Santa Catarina, Brazil, 2009. Unadjusted and adjusted Prevalence Ratios (PR) estimated by the Poisson regression.

Tabela 4 *– Associação entre obesidade central e variáveis sociodemográficas e comportamentos relacionados à saúde em homens adultos de Florianópolis, Santa Catarina, 2009. Razões de prevalência (RP) brutas e ajustadas estimadas por Regressão de Poisson.*

			Unadjusted Analysis		Adjusted Analysis $	
Leve	Variables	n	PR (95% CI)	p	PR (95% CI)	p
1	Age ranges (completed years)			<0.001*		<0.001*
	20 to 29 years	257	1.00		1.00	
	30 to 39 years	168	2.03 (1.53-2.69)		2.03 (1.53-2.69)	
	40 to 49 years	179	2.67 (2.01-3.53)		2.67 (2.01-3.53)	
	50 to 59 years	146	3.05 (2.32-4.01)		3.05 (2.32-4.01)	
1	Skin color			0.18		0.87
	White	632	1.00		1.00	
	Brown	73	0.85 (0.69-1.06)		0.92 (0.75-1.12)	
	Negro or black	34	0.86 (0.61-1.21)		1.09 (0.78-1.51)	
2	Schooling			<0.001*		0.22*
	0 to 4 years	67	1.00		1.00	
	5 to 8 years	108	0.85 (0.65-1.12)		0.98 (0.75-1.28)	
	9 to 11 years	260	0.77 (0.62-0.97)		1.03 (0.84-1.27)	
	≥ 12 years	312	0.64 (0.52-0.80)		0.89 (0.71-1.12)	
2	Marital status			<0.001		0.046
	No partner	297	1.00		1.00	
	With a partner	453	1.67 (1.40-1.98)		1.19 (1.01-1.43)	
2	Per capita income in Reais (Brazilian currency)			0.15*		0.03*
	1º tetcile	227	1.00		1.00	
	2º tertile	254	1.08 (0.90-1.29)		1.03 (0.89-1.18)	
	3º tertile	254	0.88 (0.73-1.06)		0.83 (0.71-0.99)	
3	Physical activity			0.004		0.22
	Yes	650	1.00		1.00	
	No	95	1.32 (1.10-1.59)		1.10 (0.94-1.30)	
3	Fruit consumption			0.28		0.31
	≥ 5 days per week	311	1.00		1.00	
	≤ 4 days per week	439	0.92 (0.79-1.07)		1.07 (0.94-1.22)	
3	Vegetable consumption			0.98		0.61
	≥ 5 days per week	410	1.00		1.00	
	≤ 4 days per week	340	1.00 (0.86-1.16)		1.04 (0.89-1.21)	
3	Problematic use of alcohol			0.69		0.20
	No	528	1.00		1.00	
	Yes	222	0.96 (0.79-1.17)		1.12 (0.94-1.35)	

1 = Distal level; 2 = Intermediate level; 3 = Proximal level. / *1 = Nível distal; 2 = Nível intermediário; 3 = Nível proximal.*

* Linear trend p value. / * *p valor para tendência linear.*

$ Adjusted for other variables of the same level or higher with a p value ≤0.20. / *$ Ajustada para outras variáveis do mesmo nível ou de nível superior com p valor ≤0,20.*

lation of Brazil, other studies using this indicator are necessary, due to the economic and cultural differences that exist between the Brazilian regions, which present a strong association with obesity indices in adults[18].

Prevalence of central obesity, measured by waist circumference in studies on Brazilian adults is lower than prevalence of this kind estimated by the WHtR in both sexes in this study. In the study on adults from Salvador,

Bahia[25], the prevalence of central obesity in women was 35.7% and in men 12.9% and in the city of Pelotas, Rio Grande do Sul[26], prevalence of obesity in women and men was 38.7% and 18.5%, respectively. However, prevalence in those studies[25,26] is lower than that found in this study, using high waist circumference. In contrast, the greatest prevalence of central obesity assessed by waist circumference of women in this study corroborates with other Brazilian research[25,26,27]. In addition, prevalence of central obesity in this study exceeds the values observed for obesity, through calculation of BMI in adults from the southern region of Brazil and other regions in the country[3].

In this study, there was a linear trend of an increase in the prevalence of central obesity with the advance of age in both sexes, as was observed in a study on Japanese adults[10,28]. This phenomenon has been observed both when obesity is measured by BMI[29] and when it is measured by central obesity indicators in adults[,26,30]. This accumulation of body fat with ageing is characterized as a common process in old age, inherent to different components such as adoption of sedentary behaviors, insufficient practice of moderate to vigorous physical activity and ingestion of high calorie foods. These are in addition to other physiological aspects such as a slowing-down of the metabolism and hormonal alterations, which can contribute to an increase in levels of body adiposity[1].

No association was observed between health related behaviors and central obesity after multivariable analysis in men and women from Florianópolis. Of the health related behaviors analyzed in women, regular consumption of fruit and problematic use of alcohol lost their association with central obesity after adjusting for socio-demographic indicators, and for men, the practice of physical activity did not remain associated with central obesity. However, the practice of physical activity has been observed as a habit associated with lower central obesity indices [31]. Possibly specific characteristics of the population of Florianópolis, such as the adoption of healthy habits like regular consumption of fruit and vegetables and low consumption of fatty meat and fizzy drinks when compared to other Brazilian capitals[18], may not be discriminators of obesity levels in both sexes. In this study, it was observed that the socio-demographic indicators were strongly associated with central obesity, both when measured by WHtR and by waist circumference.

A study with Brazilian adults from the state of Maranhão identified for both sexes that the socio-demographic factors were discriminators of the central obesity indices (measured by waist circumference) and in a similar way to that observed in this study, the indicators of health-related behaviors lost association with obesity in the multivariate model[27]. Despite the non-association of health-related behaviors, in an intervention study with adults in the United States, regular practice of physical activities and healthy eating were responsible for the reduction in central obesity levels[32]. In a longitudinal study of 21 years on Finnish adults, the practice of physical activity was associated with lower levels of obesity although this relation was only maintained for women after adjusting for confounding variables[33].

In this study an inverse association was observed between schooling and income with central obesity for women and inverse association of income with central obesity in men after adjusting for other socio-demographic and economic variables. This association characteristic, especially for women, was presented by Gonzales *et al.*[34] and Monteiro *et al.*[35] in systematic reviews of studies on obesity and the economic situation of adults. The authors of these reviews observed, among men, a positive association between the socioeconomic indicators and the level of obesity. In a cohort study of live births in Pelotas, Rio Grande do Sul, in 1982 and reassessed in 2006[36] the same characteristic was observed i.e. greater prevalence of central obesity observed in men with a better financial situation and,

contrastively, in women with a worse economic situation[36].

In this study, women with a higher schooling level presented a prevalence of 37% lower of central obesity than those with four or less years of formal education. Other studies with adults corroborate the findings of this study, specifically for women[26,27,30]. Level of schooling was not associated with central obesity in men. However, a lower level of schooling may contribute to an increase in obesity as was observed in European countries[37]. Adults with a partner presented prevalence of central obesity higher than those without a partner, even when controlling for age and economic status. This association was also observed in a population-based study with Brazilian adults, in both men and women[30]. Adults with a partner tend to present lower levels of practicing physical activity, especially during leisure time, possibly due to work activities with a heavy weekly schedule which make regular practice of physical activity impractical and which can contribute to an increase in body adiposity.

Possible limitations of this study include the absence of background information, such as the family economic situation in the past, which presents an association with the current level of obesity, as well as the limitation of assuring a temporal relationship between some exploratory variables and the outcome, above all that of the health-related behaviors which preclude to identify possible causality relationships. On the other hand, the positive points that stand out are the high reproducibility of the interviewers to perform the anthropometric measurements, as well as the high response rate in all income stratums, observed after finalization of the study. Comparisons of composition of age, gender, income and schooling of the sample of this study, with the population of the city of Florianópolis in surveys by the Brazilian Institute of Geography and Statistics, indicate similar characteristics[12].

The information observed in the current study allows us to conclude that central obesity assessed by WHtR was high and associated with demographic and economic indicators in women and men. For women, the highest prevalence of central obesity was observed in advanced ages, lower schooling level, those living with a partner and having lower *per capita* income. On the other hand, in men, highest prevalence of central obesity was observed in older people, in those living with a partner and who reported lower income. These characteristics were similar when only waist circumference was used as an indicator of central obesity. However, the main difference between the obesity indicators, WHtR and waist circumference, was the estimate of obesity prevalence.

Obesity, especially when central, is strongly associated with morbidity and mortality from chronic diseases[4]. For this reason, there is a need to develop strategies to maintain adequate levels of fat in adults. Considering that obesity represents an important public health problem worldwide, the development of interventions with a focus on an ageing population and a decrease in social inequalities through improvements to schooling and income for the population, represents an important alternative in the prevention, control and eradication of this problem[37].

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