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Original / *Obesidad*

Abdominal perimeter is associated with food intake, sociodemographic and behavioral factors among adults in southern Brazil: a population-based study

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Abstract

Objective: **The aim of this study is to investigate the abdominal perimeter determinants in adults who live in the city of Lages, SC.**

Design: **A population-based cross-sectional study in adults from 20 to 59 years-old of the urban area (n=2.022). The dependent variable is the abdominal perimeter, the independent variables are: age, skin color self-reported, marital status, number of children, per capita income, education, physical activity, smoking, nutrition, self-reported diabetes mellitus, high blood pressure, body weight index.**

The differences between the mean perimeters were tested using ANOVA test and multiple linear regression for confounding adjustment.

Results: **The response rate was 98.2%, 52.3% were women. The mean abdominal perimeter for men was 93.66 cm (SD 13.8) and for women 92.80 cm (SD 14.5). There was a positive association of abdominal circumference with age (p<0.001) and negative regarding education. The abdominal perimeter means were higher for those insufficiently active (p<0.001), for former smokers (p<0.001), for those who consumed meat without fat removal (p = 0.001), for those who consumed fruit less than 5 times a week (p<0.001) and for those who were overweight (p<0.001). Remained positively associated with changes in abdominal obesity, insufficient physical activity, smoking, former smoker and consumption of meat without fat removal. All proximal variables remained positively associated with abdominal perimeter.**

Conclusions: **The results have confirmed that diet, lifestyle and sociodemographic conditions determine a different distribution in abdominal fat, it is needed actions to promote a healthy lifestyle.**

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Key words: *Abdominal perimeter. Obesity. Cross-sectional study.*

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PERÍMETRO ABDOMINAL SE ASOCIA A LA INGESTA DE ALIMENTOS, FACTORES SOCIODEMOGRÁFICOS Y DE COMPORTAMIENTO ENTRE LOS ADULTOS EN EL SUR DE BRASIL: UN ESTUDIO BASADO EN LA POBLACIÓN

Resumen

Objetivo: **El objetivo de este estudio fue investigar los determinantes del perímetro abdominal en adultos que viven en la ciudad de Lages, SC.**

Diseño: **Estudio transversal de base poblacional en adultos 20-59 años de edad, de la zona urbana (n= 2022). La variable dependiente fue el perímetro abdominal y las variables independientes fueron: edad, color de la piel auto dicho, estado civil, número de hijos, renta per cápita, nivel educacional, actividad física, tabaquismo, nutrición, diabetes mellitus auto dicho, presión arterial alta e índice de masa corporal.**

Las diferencias entre los promedios de perímetros se probaron a través de la ANOVA y de la regresión lineal múltiple, ajustada para los factores de confusión.

Resultados: **La tasa de respuesta fue de un 98,2%, de los cuales un 52,3% eran mujeres. El perímetro abdominal promedio para los hombres fue 93,66 cm (SD= 13,8 cm) y para las mujeres 92,80 cm (SD= 14,5). Hubo asociación positiva entre la circunferencia abdominal y la edad (p<0,001) y negativa entre la circunferencia abdominal y el nivel educacional. El promedio de perímetro abdominal fue más grande en personas insuficientemente activas (p<0,001), en los ex fumadores (p<0,001), en los que consumen carne sin la eliminación de grasa (p=0,001), en aquellos que consumían frutos menos de 5 veces a la semana (p<0,001) y en los que tenían sobrepeso (p<0,001). Se mantuvo una asociación positiva con los cambios en la obesidad abdominal, la insuficiente actividad física, el tabaquismo, ex fumador y el consumo de carne sin la eliminación de grasa. Todas las variables proximales se mantuvieron asociadas positivamente con el perímetro abdominal.**

Conclusiones: **Los resultados confirman que la dieta, el estilo de vida y las condiciones sociodemográficas determinan una distribución diferente de la grasa abdominal, siendo necesarias acciones para promover un estilo de vida saludable.**

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Palabra clave: *Perímetro abdominal. Obesidad. Estudio transversal.*

Abbreviations

BMI: Body Mass Index (BMI).
SIMTEL: Monitoring System of Risk Factors for Chronic Noncommunicable Diseases for Telephonic Interviews.
UNIPLAC: Universidade do Planalto Catarinense.

Introduction

Obesity is a worldwide phenomenon that affects all age groups, social strata and ethnicities[1,2]. Projections for 2030 indicate that 2.16 billion people will be overweight and 1.12 billion on obesity and associated comorbidities[3]. In Brazil, it is also presenting in all regions, both in rural and in urban areas and in all ages[4].

Obesity is characterized by being a multifactorial disease and presents a positive correlation with body fat storage, associated to health risks, due to its relationship with several metabolic complications[5]. Android obesity is the type that represents higher risk of developing diseases such as heart disease, type II diabetes mellitus, dyslipidemia, and hypertension[6].

In population-based studies, anthropometry has been used as a way to assess obesity, because it is a simple, inexpensive and noninvasive method[7,8]. Among several indicators used to assess obesity, the most cited in the literature are: Body Mass Index (BMI), abdominal perimeter and waist-hip ratio. BMI is the most widely used, despite its limitations for body fat determination. This fact can be attributed to the easy weight and height mass measurement, since these parametrics can be self-reported, and by the fact that the BMI presents cutoff points worldwide renowne[9].

Despite the BMI ease usage, the abdominal perimeter has been indicated as a strong indicator of adiposity, because abdominal obesity is associated with cardiovascular morbidity[10] and also for presenting a strong correlation with more precise methods of evaluation of abdominal fat, such as imaging methods[11].

According to results from epidemiological studies, physical inactivity[12,1,13], sociodemographic factors[14-19], alcohol consumption[20] and excessive dietary energy[21] are determinants related to weight gain. Although it is known the positive association between high dietary energy and abdominal perimeter, there are few population-based studies investigating the food intake characteristics influence on increasing this anthropometric indicator. Therefore, the objective of this study was to investigate sociodemographic, behavioral and dietary determinants of the abdominal perimeter among adults living in Lages, SC, Brazil.

Methods

The study was conducted in the urban area of Lages, a city located in Santa Catarina, 176.5 km from the capital of the state, Florianópolis. The city population, in 2005, was 166.733 inhabitants, 97.4% in the urban area (162.397 inhabitants). The city presented, in 2000, a dependency ratio of 53.8% and a municipal human development index (HDI-M) of 0.813[22].

The study reference population consisted of adults aged between 20 and 59 years-old. This age group comprises approximately 52% of the total population, or 86.998 people [22].

This study is part of a comprehensive health survey with several investigated conclusions. It was adopted a 95% confidence level, prevalence of 50% (unknown prevalence), sampling error of 3.5 percentage points and design study effect equals two. It was added 10% to the sample size to compensate losses and refusals, and 20% to control possible disorder factors in multivariate analysis. The final sample had 2051 adults. For the calculation it was used the program Epi-Info[23].

The sampling process was conducted in two stages by conglomerates. First, census tracts were randomly selected, then a block, and in this block a corner was chosen to be the starting point for the route to the residences, starting clockwise at the chosen corner. There were randomly selected 60 among 186 urban census tracts in Lages by simple random sampling without replacement, using tables of random numbers[24]. All adults who were in the residences were interviewed at the time of data collection. All adults were eligible for the study, totaling, approximately, 34 individuals in 17 residences in each sector. It was considered lost all residents who were visited at least four times, including at least one visiting on weekends and another in the evening, in which the interviewer could not locate the person to be interviewed or had refused to participate.

It was considered as exclusion criteria: pregnant women, amputated individuals, bedridden, suffering from a plaster cast, psychiatric disorders and those who for, some reason, have not been able to stay in the proper position for weight measurement.

The visits included a questionnaire, blood pressure and anthropometric measures. The standardization and pretest of the questionnaire were conducted with 30 adults of the same age in the research area of the Health Unit of the city. The pilot study was conducted in a census tract, obtained by random, and not included in the study sample. The field work was conducted from May to September 2007.

Quality control of data collection was carried out by applying the questionnaire in 10% of the sample by means of a telephone interview conducted by one of the supervisors.

The considered dependent variable was the abdominal perimeter, measured with a tape measure millimeter, inelastic, with a capacity of 2.0 meters. The measurement was performed once at the maximum extension of the abdominal region, following the recommendations proposed by Lohman et al.[25].

The independent variables were grouped into sociodemographic, habits and behaviors related to health and nutrition, self-reported diabetes, high blood pressure and other anthropometric measurements. The first included: age (20 to 29; 30 to 39; 40 to 49 and 50 to 59 years); self-reported skin color (white, afro, mulatto, yellow and indigenous, dichotomized as white or nonwhite); marital status (with partner and unmarried); number of children (none, 1 child, 2 children, 3 or more); per capita income in Real (from 0.026 to 0.500; 0.510 to 0.880; 0.890 to 1.580; 1.590 to 19.740; 1 US Dollar ~ 1.90 Reais during the field work), education (<4, 5 to 8; 9 to 11, > 12 years of schooling).

Habits and behaviors related to health comprehend level of physical activity (sufficient > 150 minutes/week and insufficient <150 minutes/week), as summarized in the Brazilian version of the International Physical Activity Questionnaire (IPAQ)[26]; smoking (non-smoker, former-smoker and smoker at the time of interview)[27] and alcohol consumption (yes or no; using the questionnaire CAGE: Cut down, annoyed, guilty, eye-opener questionnaire), validated in Brazil[28].

The questions relating to food intake were based on a structured questionnaire and tested through telephone interviews, the SIMTEL (Monitoring System of Risk Factors for Chronic Noncommunicable Diseases for Telephonic Interviews)[29,30.] There were considered protective factors for chronic diseases the consumption of fruit, vegetables (cooked), salads (row vegetables) and beans five or more times per week. Soft drink and meat (beef and chicken) with fat intake more than three times a week were considered risk factors.

Self-reported Diabetes Mellitus (yes or no) according to medical diagnosis in the last 12 months was also asked. Blood pressure levels were measured at the beginning and at the end of the interview (for at least 10 minutes) and it was considered the second measurement. The measurements were made with the individual sat, feet on the floor, uncrossed legs, left arm relaxed and resting on the table at heart level with the palm facing up. It was defined as having high blood pressure the individual who had systolic blood pressure > 140 mmHg (SBP > 140 mm Hg) and/or diastolic blood pressure > 90 mmHg (DBP> 90 mmHg), or hypertensive individuals who were using anti -hypertension medication whose blood pressure levels were elevated or not at the time of the interview[31]. It was used Techiline® electronic blood pressure monitors, with digital display, calibrated.

The body weight measurement was performed once with portable digital scales (Tanita®) ranging from 0.1 kg from 150 kg. Height was measured once with an inelastic measuring tape on a vertical surface to 100 cm point distant of the ground. The participants were wearing light clothes, without shoes and hats, standing with heels together, gluteal, shoulders and head touching the vertical surface of the wall, adopting a horizontal line at the moment of breathing. Weight and height were used to calculate body mass index (BMI). The individuals were classified as eutrophic (BMI < 25 kg/m^2), as overweight (25.0 kg/m^2 < BMI <29.9 kg/m^2) or obese (BMI > 30 kg/m^2)[32].

Data were double inserted into Epi Info 6.0[23] by previously trained typists and the comparison was made by the module data compare. After the consistency check, the data were analyzed in the statistical software STATA 10.0[33]. All analyzes were adjusted by the effect of sample design and weighted. The weights were determined by the ratio between the proportions of genders in the population of the city, obtained from IBGE (Brazilian Institute for Geography and Statistics) and in the sample. A descriptive analysis was performed and the variables were compared through analysis of variance *post hoc* of Bonferroni, adopting a significance level of 5%.

It was applied multiple linear regression to verify the adjusted effects of the explanatory variables, as indicator variables (*dummies*). The analyses followed a theoretical determination model, defined in three blocks of variables (Fig. 1). The first block, more distal, was formed by socioeconomic and demographic variables which affect the variables of the block 2, behavioral factors which in turn, influence the biological variables of the block 3 and they influences the conclusion of the study. Variables with $p < 0.20$ in bivariate analysis were selected to take part in the multivariate analysis. It remained, in the final model, those variables that were significantly associated with the outcome in their hierarchical levels ($p \leq 0.05$).

The project was approved by the Ethics Committee in Research of UNIPLAC (Universidade do Planalto Catarinense) protocol nº. 01/2007. There were requested participants' signatures of the informed consent terms of this research. If it were observed any health problems with the individual, the researcher asked him/her toward the nearest Health Unit.

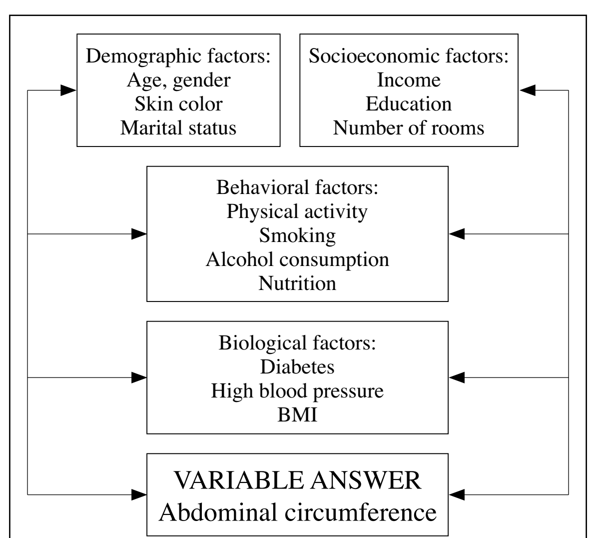

Fig. 1.—Hierarchical model of analysis for predictors factors of abdominal fat.

Results

The response rate was 98.2%, and 52.3% were women. The average age was 31.02 years (SD 11.62) and education was 9.15 years (SD 4.2) and *per capita* income was R$ 333.30 (R$ 10.00 - R$ 7.500,00).The means abdominal perimeter were 93.66 cm (SD 13.8) for men and 92.80 cm (SD 14.5) for women.

The abdominal perimeter was positively associated with age (p<0.001) and negatively associated with education (p<0.001). It was observed a higher average for individuals with partners (p<0.001) (Table I).

The average abdominal perimeter as higher for those insufficiently active individuals (p<0.001), former smokers (p<0.001), those who consumed meat without fat removal (p=0.001), those who consumed fruit less than 5 times per week (p<0.001), those who reported diabetes (p<0.001), those with high blood pressure (p<0.001), and those with overweight and obese (p<0.001) (Table II).

Table III shows the unadjusted and adjusted effects of the independent variables that remained in the final regression model. It was observed that abdominal perimeter increased with age and education, after adjusting for other sociodemographic variables. Among the behavior variables, insufficient physical activity, smoking, former-smoker, consumption of meat without fat removal and consumption of beans less than 5 times a week remained positively associated with abdominal obesity. After adjustment for intermediate and distal variables, all proximal variables remained positively associated with abdominal fat.

Discussion

The main limitations in observational transversal studies are due to the possibility of selection bias of reverse causality and disorder factors. In this study, a representative sample of the population was adopted, evenly distributed in the different age groups. The proportion of women in this study was higher than in the original population. To correct this difference, the analyses were weighted by gender. The use of calibrated instruments, standardization, data quality control, and validated questionnaires contributed to the study internal validity. Moreover, the excellent response rate observed (98.2%) and the selection of the sample also contributed to the validity of the study. Although the number of men is underrepresented in the sample, very common fact in population-based studies[34,35], statistical analysis weighted by gender showed similar results. Although this type of design does not establish a cause-effect relation, it is possible to identify the main

Table I
Average (standard deviation) of abdominal circumference in adults, according to social demographic variables. Lages, Santa Catarina, Brazil, 2007

Variables	*n (%)*	*(SD)*	*P-value*
Age (years) (n=2018)			<0.001
20-29	623 (30.87)	88.28 (14.09)	
30-39	444 (22.00)	92.01 (12.95)	
40-49	528 (26.16)	95.18 (13.67)	
50-59	423 (20.96)	99.03 (13.82)	
Gender (n=2022)			0.221
Women	1217 (61.47)	92.85 (14.48)	
Men	769 (38.53)	93.65 (13.86)	
Color (n=2017)			0.815
White	1237 (61.33)	93.17 (13.67)	
Non white	780 (38.67)	93.05 (14.90)	
Education (years) (n=1995)			<0.001
12 and more	456 (22.86)	91.46 (13.94)	
9-11	611 (30.63)	92.21 (13.55)	
5-8	571 (28.62)	92.75 (14.37)	
0-4	357 (17.89)	97.65(14.92)	
Marital status (n=2017)			<0.001
Without partner	607 (30.09)	90.89 (14.81)	
With partner	1410 (69.91)	94.14 (13.90)	
Income (n=1984) (minimum wage per capita)			0.120
0.026 - 0.59	502 (25.30)	94.38 (15.24)	
0.60 - 0.88	500 (25.20)	93.22 (14.24)	
0.89 - 1.58	515 (25.96)	92.53 (13.09)	
1.59 - 19.74	467 (23.54)	92.43 (14.23)	

Table II
Average (standard deviation) of the abdominal circumference of adult men and women, according to behavioral and nutritional variables. Lages, Santa Catarina, Brazil, 2007

Variables	*n (%)*	*(SD)*	*P-value*
Physical activity (n=1952)			<0.001
Sufficient	1368 (70.08)	92.23 (13.64)	
Insufficient	584 (29.92)	95.36 (15.24)	
Smoking (n=2016)			<0.001
Non-smoker	1090 (54.07)	92.89 (14.83)	
Former smoker	326 (16.17)	95.84 (12.34)	
Smoker	600 (29.76)	92.21 (14.06)	
Alcohol consumption (n=2010)			0.501
No	1369 (68.11)	92.96 (13.94)	
Yes	641 (31.89)	93.42 (14.81)	
Consumption of meat without fat removal (n=1959)			0.001
Yes	695 (35.48)	94.57 (14.96)	
No	1264 (64.52)	92.43 (13.77)	
Consumption of chicken without fat removal (n=1949)			0.187
Yes	638 (32.73)	93.88 (15.28)	
No	1311 (67.27)	92.97 (13.81)	
Bean consumption 5 or more times/week (n=2021)			0.110
Yes	1380 (68.28)	92,82 (14,32)	
No	641 (31.72)	93,92 (14,08)	
Vegetables consumption 5 or more times/week (n=2021)			0.562
Yes	1241 (61.37)	93,20 (13,40)	
No	781 (38.63)	93,11 (15,49)	
Fruit consumption 5 or more times/week (n=2021)			<0.001
Yes	1448 (61.37)	92.06 (13.81)	
No	573 (38.63)	94.38 (14.62)	
Soft drink consumption 3 or more times/week (n = 2021)			0.225
Yes	483 (23.90)	92.48 (14.00)	
No	1538 (76.10)	93.40 (14.32)	
Diabetes (n=2012)			<0.001
Yes	139 (6.91)	101.97 (16.09)	
No	1873 (93.09)	92.51 (13.89)	
High blood pressure (n=2021)			<0.001
Normal	1339 (66.22)	90.54 (13.59)	
High	683 (33.78)	98.29 (14.12)	
BMI (kg/m^2) (n=1969)			<0.001
<25 (eutrophic)	835 (42.41)	82.49 (7.58)	
25|--30 (overweight)	672 (34.13)	94.62 (7.18)	
≥ 30 (obese)	462 (23.46)	108.67 (10.25)	

associations between the dependent and the independent variables, as well as the dose-response effect relationship between them.

The abdominal perimeter was defined according to the recommendations proposed by Lohman et al.[25]. This measure is considered a good predictor for non-communicable chronic diseases due to its strong correlation with the reference standard methods[36,37].

In the present study, we observed that for each change in age strata, there is an increasement about 11cm in abdominal perimeter, corroborating with Castanheira et al.[38] and Linhare*s* et al.[39]. We also described a positive association between abdominal perimeter and education. However, other Brazilian cross-sectional studies showed conflict results regarding this relationship. Carvalhaes et al.[29] observed that approximately 50% of overweight individuals reported having studied 0 to 8 years. On the other hand, Gigante et al.[19] pointed out that lower education was a protective factor against overweight for men, while the opposite occurred for women. Similar results were found in a study developed with 84.000 Iranians adults[14].

In 2006, Teichmann et al.[14], conducted a study in the city of São Leopoldo, RS, with 1.358 women from 20 to

Table III
Linear regression coefficients (unadjusted and adjusted), respective confidence interval, R adjusted, p-value for abdominal circumference in adults, according to the studied factors. Lages, Santa Catarina, Brazil, 2007

Variables	β	*CI 95%*	β*Aj*	*CI 95%*	*RAj*	*P-value[1]*
Age (years)					0.07	<0.001
20-29	0.00	—	—	—		
30-39	3.37	2.04; 5.41	—	—		
40-49	6.89	5.29; 8.50	—	—		
50-59	10.74	9.03; 12.45	—	—		
Education (years)[a]					0.081	0.05
0-4	0.00	—	0.00	—		
5-8	0.75	-0.97; 2.48	0.65	-1.02; 2.33		
9-11	1.29	-0.45; 3.45	-0.13	-1.85; 2.59		
12 and more	6.19	4.22; 8.16	2.65	0.64; 4.66		
Physical activity [b]					0.084	<0.001
Sufficient	0.00	—	0.00	—		
Insufficient	3.13	1.74; 4.51	2.51	1.16; 3.86		
Smoking [b]					0.09	<0.001
Non-smoker	0.00	—	0.00	—		
Former smoker	2.94	1.16; 4.71	-0.02	-1.82; 1.77		
Smoker	-0.68	-2.11; 0.74	-2.30	-3.75; -0.83		
Consumption of meat without fat removal					0.10	0.013
No	0.00	—	0.00	—		
Yes	2.14	3.46; 0.81	2.01	3.32; 0.70		
Consumption of bean 5 or more/week [b]					0.110	0.008
Yes	0.00	—	—	—		
No	1.10	0.24; 2.45	1.79	0.40; 3.17		
Diabeltes [c]					0.119	<0.001
No	0.00	—	0.00	—		
Yes	9.43	6.97; 11.89	6.10	3.54; 8.66		
High blood pressure [c]					0.128	<0.001
No	0.0	—	0.0	—		
Yes	7.74	6.46; 9.02	4.95	3.58; 6.33		
BMI (kg/m^2) [d]					0.642	<0.001
<25 (eutrophic)	0.0	—	0.0	—		
25.1-29.9 (overweight)	12.12	11.28; 12.95	11.46	10.59; 12.32		
≥ 30 (obese)	26.17	25.24; 27.10	25.06	24.05; 26.07		

[1]P-value of multiple linear regression.
[a]Distal variables, adjusted among each other; [b]Intermediate variables, adjusted among them and among the variables variable of block 1; [c]Proximal variables, adjusted among them and among the variables of the blocks 1 and 2; [d]Proximal variable, adjusted for blocks of variables 1 and 2.

60 years and observed a higher prevalence of pre-obesity among married women or in a stable relationship. Secondary data obtained by the system Surveillance of Risk and Protective Factors for Chronic Diseases Telephone Survey[40] (VIGITEL, 2009), showed higher prevalence of obesity and overweight for men and women who reported having stable relationship[19]. Ronsoni et al.[41] and Castanheira et al.[38] observe, as in this study, which individuals in marital status and partner have higher abdominal perimeter, showing that marital stability is a trigger for weight gain. This relationship is probably due to a greater concern for unmarried individuals with body image and more hectic social life, and increased devotion to home and children for those individuals with partners[18,42].

Regarding behavioral variables, there was a relation of abdominal perimeter with physical activity, smoking and diet.

Masson et al.[13] 2005, in a study of 1.800 individuals from Pelotas-RS, between 20 and 69 years-old, also observed relation of abdominal perimeter with physical activity, this was the variable that most affected the reverse causality. Abdominal perimeter increasing was also associated with smoking, with risk for former smokers women.

Martins and Marinho[12], in a study of 1.042 individuals, aged over 20 years in São Paulo, showed significant association of physical inactivity with abdominal, and smoking, alone or associated with alcoholism, showed a protective effect. Alcoholism, as in this study, was not associated with abdominal measurement.

The meat consumption without apparent fat removal presented positive association with the abdominal perimeter. It is known that the restriction of saturated fat, present in meat fat, is effective for reduction of abdominal perimeter and other metabolic syndrome components[43,44]. Meat consumption frequency with excess of apparent fat in 27 Brazilian cities had an average of 39.2%, being lower in São Paulo (26.7%) and highest in Palmas (53.1%)[45].

Fruit inatke <5 times/week was associated with abdominal circumference increasing. Other findings corroborate the present study. Sousa et al.[46], in a population-based study with 1.720 adults from Florianópolis-SC, presented the same methodology and noted, among women, the association between intake of fruits >5 times/week and abdominal perimeter increasing gross variables. Romaguerra[47] found association between lower abdominal circumference with higher consumption of fruits according to the World Health Organization 2010, inadequate intake of fruit and vegetables is an important factor in preventing diseases, because of their low energy density, and are composed of micronutrients and fibers[48,49]. The Brazilian population that consumes fruits and vegetables five or more days a week is still low, reaching 23.9%, which varies from 7.3% in Macapá and 38.6% in Porto Alegre[45].

Beans consumption <5 times per week was associated with increased visceral obesity in the final model of linear regression. In the studies of Silva et al.[50] and Borges et al.[51], with adults of Belém, it was observed that bean consumption less than 5 times per week was related to weight excess for both men and women. These results are even more worrying when it is found that the beans consumption in Brazil is decreasing, where the meal consisting of rice, beans, meat and vegetables is being replaced by fast food and eating out, such as soft drinks, snacks, sandwiches and cookies[52].

Sá and Moura[53], a study conducted by telephone survey with 54.353 adults, observed an association between overweight and poor eating patterns among women, with good food pattern of consumption of fruits >three times a day, beans consumption > 5 days, vegetable consumption > three times a day, lack of soft drinks consumption and meat/chicken with visible fat; regular pattern of two or three of these and poor situations, when there is or not occurrence of any of these situations. In an Australian study, the authors found higher waist circumference increasing associated with inappropriate diet quality index[54]. With respect to biological variables, it is observed association of abdominal circumference increasing with weight excess, diabetes and high blood pressure.

When comparing the data obtained by VIGITEL[40], in 2001 and 2009, it is possible to observe that there was an increase in the prevalence of overweight in the population: 43.4% and 46.6%, respectively. The highest observed variation in the two periods was among women (37.8% and 42.3%) and the number of obese in both genders, ranged from 12.7% to 13.9% in the period[39]. These findings also corroborate national and international studies[47,55].

In conclusion, our results confirm that diet, lifestyle and sociodemographic conditions determine a different distribution in abdominal perimeter. It is suggested that further studies are undertaken to investigate this interaction between lifestyle and body fat distribution. In addition, it is required actions to promote healthy food, such as fruits and vegetables, and the practice of regular physical activity in urban spaces to facilitate this practice, in order to minimize the risk factors and to prevent non-transmissible chronic disease.

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