

Abdominal obesity and healthcare costs related to hypertension and diabetes in older adults

Obesidade abdominal e custos com saúde relacionados à hipertensão e diabetes em idosos

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ABSTRACT

Objective

To analyze the association between excess abdominal fat and healthcare costs related to hypertension and diabetes *Mellitus* in older adults.

Methods

These cross-sectional analyses are part of the Health, Wellbeing and Aging Study conducted in *São Paulo*, Brazil, with 806 older adults with self-reported hypertension and diabetes *Mellitus*. The study included the annual costs with medicines, hospital admissions, and outpatient services for hypertension and diabetes *Mellitus* control. Excess abdominal fat was diagnosed based on waist circumference. Level of physical activity, age, and gender were considered covariates. The sample was divided into two groups according to waist circumference. Multiple logistic regression analyzed the associations between annual costs and waist circumference.

Results

The cost of services and hospitalizations (R\$551.05; 95%CI=418.27–683.83) and total costs (R\$817.77; 95%CI=669.21–966.33) were higher in the excess abdominal fat group. Older adults with high waist

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circumference had higher odds of increasing annual costs due to medicines (OR=2.6; 95%CI=1.13–3.77), regardless of gender, age, and level of physical activity.

Conclusion

Healthcare costs for treating hypertension and diabetes *Mellitus* in older adults are higher in the presence of excess abdominal fat.

Keywords: Aging. Health care costs. Obesity abdominal. Public health.

RESUMO

Objetivo

Analisar a associação entre excesso de gordura abdominal e custos com saúde relacionados à hipertensão arterial sistêmica e ao diabetes *Mellitus* em idosos.

Métodos

Estudo transversal que faz parte do Estudo Saúde, Bem-estar e Envelhecimento realizado em São Paulo, São Paulo, incluindo 806 idosos com autorreferência à hipertensão arterial sistêmica e ao diabetes *Mellitus*. Os custos anuais com medicamentos, internações e serviços ambulatoriais para o controle dessas patologias foram considerados. O excesso de gordura abdominal foi diagnosticado segundo os valores de circunferência da cintura. Nível de atividade física, sexo e idade foram considerados como covariáveis. Os idosos foram divididos em dois grupos segundo a circunferência da cintura, sendo que a análise de regressão logística múltipla verificou associações entre essa medida e custos anuais.

Resultados

Os custos com serviços e hospitalizações (R\$551,05; IC95%=418,27–683,83) e custos totais (R\$817,77; IC95%=669,21–966,33) foram maiores no grupo de idosos com excesso de gordura abdominal. Os idosos com maior circunferência da cintura apresentaram maior risco para custos anuais superiores devido ao uso de medicamentos (OR=2.06; IC95%=1.13–3.77), independentemente do sexo, idade ou nível de atividade física.

Conclusão

Os custos com saúde para hipertensão arterial sistêmica e diabetes *Mellitus* em idosos são superiores quando existe excesso de gordura abdominal.

Palavras-chave: Envelhecimento. Custos de cuidados de saúde. Obesidade abdominal. Saúde pública.

INTRODUCTION

In 2013 the proportion of older adults in the Brazilian population reached 11%, placing the country among the 10 largest populations of adults aged 80 years or more, and the projection for 2050 is that it will be the fifth largest population of this age group in the world [1]. As a consequence, there will be great demand for health services given the high prevalences of chronic diseases especially because of the increasing prevalences of hypertension and Diabetes *Mellitus* (DM) in the last decades [2,3].

Adipose tissue, especially visceral, is one of the variables associated with hypertension in older adults [4] possibly due to the production of

large quantities of pro-inflammatory cytokines by this tissue [5,6]. Moreover, insulin resistance seems to be more related to obesity than to aging-related physiological changes [7]. Concern with the prevalences and control of hypertension and DM stems from the risk of cardiovascular complications [8], higher risk of mortality [9,10], and high treatment cost. Thus, older adults diagnosed with excess abdominal fat are at higher risk of developing hypertension and DM, and consequently, increase healthcare costs.

Indeed, there are indications that monthly healthcare cost is higher in individuals with uncontrolled hypertension or blood pressure $\geq 140/90$ mmHg [11]. A study using Brazilian data published in 2010 found that the cost of treating

hypertension reached U\$398.9 million in that year, consuming 1.43% of the Unified Healthcare System resources [12].

Nonetheless, population-based studies with older Brazilians that analyzed the association between excess abdominal fat and healthcare costs do not exist. Such information would provide a base to ground public health strategies for disease control and reduce spending as financial resources are scarce and inadequate, by controlling abdominal adiposity. Thus, the objective of the present study was to analyze whether the annual costs of health procedures related to hypertension and DM were associated with excess abdominal fat in older adults from the municipality of *São Paulo* who participated in the *Saúde, Bem-Estar e Envelhecimento* (Sabe, Health, Wellbeing, and Aging) study.

METHODS

The Health, Wellbeing, and Aging study is an international multicenter study that began in 2000. It was conducted in Latin America, coordinated by the Pan American Health Organization (PAHO) to investigate the inherent health characteristics of people aged 60 years or more. In Brazil the study was conducted in the urban area of the capital of the state of *São Paulo*, coordinated by researchers from the Department of Epidemiology of the School of Public Health of the *Universidade de São Paulo* (USP). The sampling process of the participants has been published elsewhere [13].

In order to meet the objective of investigating the association between the costs related to hypertension and DM control, only the older adults who reported having these conditions in 2010 were included in the study. Other inclusion criteria were having body weight, height, and waist circumference data. Hence, the study is characterized as household-based, epidemiological, and cross-sectional.

The Health, Wellbeing, and Aging study Protocol was approved by the National Research

Ethics Committee and by the Research Ethics Committee of USP. The project of the present study was also approved by the Research Ethics Committee under Protocol nº 475.455.

Analysis of this study regard the expenses of the *Sistema Único de Saúde* (SUS, Unified Healthcare System) with continuous use of medicines, outpatient procedures, and hospitalizations to treat older adults with hypertension and DM in the city of *São Paulo*.

The older adults were asked to show all medicines they were taking so that the analyses could include both the prescribed and self-medicated medicines. Phytotherapeutic medicines were not included because they are not provided by SUS, and compounded medicines, because of the unviability of investigating their prices.

The need of using outpatient health services to control the study diseases was self-reported and considered a SUS outpatient procedure. The costs were estimated based on the mean cost of a clinical appointment according to Datasus.

The study considered the mean cost of spending the night at a hospital to treat hypertension or DM multiplied by the self-reported annual frequency.

All 2010 costs were adjusted for inflation in 2015 using the *Índice de Preços ao Consumidor* (IPCA, Consumer Price Index) of *Instituto Brasileiro de Geografia e Estatística* (IBGE, Brazilian Institute of Geography and Statistics). The costs with health procedures refer to the amount spent annually by SUS in *reais* (R\$).

Excess abdominal fat was diagnosed according to waist circumference, measured by a trained interviewer using an inelastic tape measure placed at the midpoint between the lowest rib and the iliac crest, or at the "natural waist" of the older adult if the midpoint could not be found. Waist circumference was measured three times, and the average was used in the analyses. Abdominal obesity was defined as waist circumference ≥ 94 cm in men and ≥ 80 cm in women [14,15].

The level of physical activity was determined by the International Physical Activity Questionnaire (IPAQ) – Short Version. The level of physical activity was classified according to the global physical activity recommendation provided by the World Health Organization (WHO) [16] as follows: (a) Active: ≥ 150 minutes a week of moderate physical activity or ≥ 60 minutes a week of intense physical activity [17]; (b) Insufficiently active: < 150 minutes a week of moderate physical activity or < 60 minutes a week of intense physical activity.

The analyses of association between cost and abdominal obesity were done considering gender (reference: male) and age groups: (a) 60 to 64 years as reference and (b) 65 to 69 years and (c) ≥ 70 years as covariates.

The study used statistical analyses and tests for survey (svy)-type studies with weighing as this is a population-based study with analyses resulting from complex samples.

The total annual cost in *reais* (R\$) was given by adding the costs of the components, namely medicines, hospitalization, and outpatient services: Total Cost = (R\$ medicines) + (R\$ hospitalizations) + (R\$ outpatient services).

The mean costs in *reais* were presented as means and their respective 95% Confidence Intervals (95% CI), and medians and their respective 25th percentiles (P_{25}) and 75th percentiles (P_{75}). The results of categorical variable analyses are presented as absolute (n) and relative (%) values.

In the analyses to verify the association between costs and abdominal obesity (adjusted for gender, age, and level of physical activity), the sample was classified into quartiles according to the variable 'cost', and then considered as dependent variables in separate multiple logistic regression models.

The bottom annual cost quartile was considered a risk category (annual R\$ $\geq P_{75}$). The top three quartiles (with lower annual costs) were grouped and represented the reference category (annual R\$ $< P_{75}$).

This procedure was done separately for the cost variables (medicines, services, and hospitalizations) and for the total cost variable, which is characterized by the sum of the former three.

The significance level was set at 5%, and all analyses were performed by the Statistical Package Stata (StataCorp LLC, College Station, Texas, United States of America) version 13.0.

RESULTS

Of all the individuals interviewed by the SABE Study in 2010, 806 older adults with a mean age of 70.7 (95% CI=70.2–71.3) years participated in the present study; 60.9% were female, 48.6% were aged more than 70 years, 72.0% were insufficiently physically active, and 81.9% had excess abdominal fat based on their waist circumference (Table 1).

The mean annual costs with medicines, services and hospitalizations, and all three were, respectively, R\$244.74 (95% CI=197.16–292.33), R\$487.79 (95% CI=376.49–599.09), and R\$732.54 (95% CI=607.57–857.50). The costs with services and hospitalizations (R\$551.05; 95% CI=418.27–683.83) and total costs (R\$817.77; 95% CI=669.21–966.33) were higher in the group with excess abdominal fat (Table 1).

Older adults with abdominal obesity were more likely to be in the group of higher annual costs with antihypertensive and blood glucose-lowering drugs (OR=2.06; 95% CI=1.13–3.77) or in the group with higher mean total annual cost (OR=2.61; 95% CI=1.47–4.61), regardless of gender, age, and level of physical activity (Table 2).

DISCUSSION

The results of the present study show that the annual costs of treating hypertension and DM are higher for older adults with excess abdominal fat. Older adults with high waist circumference

Table 1. Distribution of explanatory variables in the study sample and costs (R\$) by abdominal fat status.

Explanatory variables	Sample		Excess abdominal fat				p
			No		Yes		
	n	%	n	%	n	%	
Sample	806	100.0	152	18.1	654	81.9	
<i>Gender</i>							0.000
Men	280	39.1	93	29.8	187	70.2	
Women	526	60.9	59	10.6	467	89.3	
<i>Age</i>							0.002
60 to 64 years	186	28.3	23	12.2	163	87.8	
65 to 70 years	151	23.1	21	13.6	130	86.4	
>70 years	469	48.6	108	23.7	361	76.3	
<i>Level of Physical Activity</i>							0.462
Insufficient	575	72.0	116	18.8	459	81.2	
Active	231	28.0	36	16.4	195	83.6	
<i>Annual costs (R\$)</i>							
<i>Medicines (R\$)</i>							
Mean (95%CI)	244.74	(197.16–292.33)	145.46	(77.72–213.21)	266.72	(210.70–322.75)	
Median [P ₂₅ -P ₇₅]	59.88	[13.80–152.04]	94.44	[46.08–170.40]	133.68	[82.92–458.76]	
<i>Services + hosp. (R\$)</i>							
Mean (95%CI)	487.79	(376.49–599.09)	202.04	(81.12–322.97)	551.05	(418.27–683.83)	
Median [P ₂₅ -P ₇₅]	64.40	[0.00–154.70]	64.96	[51.40–308.40]	128.50	[51.40–308.40]	
<i>Total costs (R\$)</i>							
Mean (95%CI)	732.54	(607.57–857.50)	347.51	(205.36–489.65)	817.77	(669.21–966.33)	
Median [P ₂₅ -P ₇₅]	163.94	[68.96–474.48]	224.47	[101.40–423.60]	321.94	[171.16–1200.40]	

Note: Hosp.: Hospitalizations.

Table 2. Association between abdominal obesity and higher annual costs (≥P₇₅) related to hypertension and diabetes Mellitus.

Abdominal obesity	Annual costs ≥P ₇₅		
	Medicines	Services + hospitalization	Total costs
<i>OR (95%CI)</i>			
No	1.00	1.00	1.00
Yes	1.84 (1.04–3.26)	1.42 (0.92–2.17)	2.69 (1.55–4.65)
<i>Adjusted OR (95%CI)*</i>			
No	1.00	1.00	1.00
Yes	2.06 (1.13–3.77)	1.36 (0.88–2.12)	2.61 (1.47–4.61)

Note: *Multiple logistic regression model adjusted for gender, age, and level of physical activity.

OR: Odds Ratio; 95%CI: 95% Confidence Interval.

are more likely to be in the group with higher annuals costs with antihypertensive and blood glucose-lowering drugs, and in the group with higher total annual costs, which also include costs with outpatient services and hospitalizations.

Studies of the impact of excess abdominal fat on healthcare costs do not exist. However, studies have investigated the direct relationship

of Body Mass Index (BMI)-based excess weight with the use of medicines and the need of hospitalization [18,19], and such studies found that BMI affects healthcare costs [20,21]. Recently, an extensive review of 32 original articles published between 1990 and 2009 [22] found that the direct healthcare costs of obese individuals (BMI ≥30kg/m²) are approximately

30.0% higher. In fact Yu *et al.* [23] found that a 1.0% reduction in body weight was directly associated with a 3.6% reduction in the costs of treating diabetics. Our results show that higher waist circumference is associated with higher costs, regardless of BMI. In this sense, studies have found that cardiovascular risk is better determined by waist circumference than by BMI [24]. Cardiovascular risk may require more healthcare, increasing healthcare costs.

A healthcare cost analysis of individuals with hypertension and DM treated at a reference public healthcare unit in *Recife, Pernambuco*, found that most expenditures were with medicines (36.3%), followed by outsourced services (20.5%), and staff (20.1%). The remaining costs stemmed from basic services, supplies, and building costs [25]. These are not the only costs associated with the treatment of chronic diseases given that most individuals have medical leave of absence, many retire on disability, and those who die leave a pension to their dependents [26].

Another important point is the twofold higher cost related to the use of services and hospitalizations by older adults with excess abdominal fat. These results are also corroborated by the literature, especially the association between abdominal fat and adverse health outcomes [27]. In older women Rocha *et al.* [28] found a positive correlation between waist circumference and triglycerides, and an inverse correlation between waist circumference and high density lipoprotein, and these two variables are directly associated with cardiovascular diseases, which have high costs in public healthcare [29]. Wong *et al.* [30] found that waist circumference predicted hospitalization for heart failure in individuals with impaired glucose tolerance. Moreover, there is evidence of the greater risk of older adults with high waist circumference developing the diseases discussed herein. According to Oliveira *et al.* [31], older women in the highest waist circumference tertile were more likely to be hypertensive. Gouveia *et al.* [32] found that each extra centimeter of waist circumference

increased the odds of women and men developing DM by 8% and 17%, respectively. Nevertheless, food intake contributes to changes in nutritional status, and together with physical activity, it can more effectively control abdominal obesity and/or excess weight in older adults [33].

The present study found higher costs related to hypertension and DM in older adults using global cutoffs published in the literature to identify cardiovascular risk in adults, namely, waist circumference ≥ 94 cm for men and ≥ 80 cm for women [14,15]. If the study had considered the higher waist circumferences that have been proposed by some authors to detect the risk of developing cardiovascular and metabolic diseases in older adults [32,34], the difference between the treatment costs would be even greater. Therefore, the study result can be considered an indication that the relationship between abdominal fat and the costs of treating chronic diseases also occurs in adults, and the age at onset for this group of illnesses is decreasing.

Regular physical activity, such as walking, is an efficient strategy to control abdominal obesity [35]. Bueno *et al.* [36] found that 66% of individuals with waist circumference-based excess abdominal fat had low level of commuting physical activity against only 25% of individuals with proper waist circumference ($p < 0.04$). In the context of public health, this information is important because physical activity, such as walking, is preferred by older adults [37,38] and can be more easily encouraged than sports. Also, the cost of implementing these strategies may be lower as walking does not require special equipment or site.

The combination of physical activity and proper food intake is recommended by the Brazilian Society of Cardiology to maintain adults' nutritional status and prevent cardiovascular diseases [30]. According to the 2002/2003 and 2008/2009 *Pesquisa de Orçamentos Familiares* (POF, Family Budget Survey), older adults who reported food intake as "always enough" were 30% more likely to be overweight and 44% more

likely to be obese than normal-weight adults, and older women who reported food intake as "always enough" were 15% more likely to be overweight or obese [33].

A study of individuals who frequented a reference center for older adults in the municipality of *São Paulo* found that 15% were overweight (BMI between 28 and 30kg/m²) and 33% were obese (BMI ≥30kg/m²). Although these older adults had some positive dietary aspects, such as the preservation of healthy habits like regular intake of rice, beans, and dark green vegetables, they also had a high intake of refined carbohydrates in detriment of whole foods, and a monotonous diet [39].

Older adults from *Ouro Preto, Minas Gerais*, had even higher prevalences of excess weight (53.6%) and high waist circumference (67.9%). These individuals also presented changes in the blood glucose profile (56.5%) and high blood pressure (82.0%). Food intake analysis found that 93.0% and 89.0% of older adults had high intakes of ultra-processed foods and high glycemic index foods, respectively [40]. Intake of these foods, which contain numerous ingredients and generally high contents of saturated fat, cholesterol, sugar, and sodium, is related to the development of obesity and chronic noncommunicable diseases [41].

Like every study that uses self-reported data, the memory bias associated with answering questions during an interview may impact the study results. The estimated hospitalization and outpatient service costs was based on the self-reported number of times the older adult required those items. Therefore, the costs may have been affected by the older adults' memory. General costs were collected from governmental databases available online for anyone to access. These databases are influenced directly by the organization in place for entering the data. In this respect the Brazilian literature does not provide a standard for analyzing financial information. The absolute values in *reais* may not reflect accurately the values practiced by the government in

outpatient care, hospitalization, and purchase of medicines provided by SUS. Therefore, this is the information available for population studies in Brazil, so it must be used despite the difficulties and limitations discussed herein as a study using nationwide healthcare data has already demonstrated that the cost of hospitalizing older adults is higher than the cost of hospitalizing adults, making it critical to identify the factors related to this increase [42].

Another important point is the cross-sectional character of the study, which limits the interpretations about cause and effect between the variables. Nonetheless, this study has strengths, such as the use of a representative sample of the older adults from the municipality of *São Paulo*. As mentioned earlier, this is the first study of this type conducted in the city of *São Paulo*. Moreover, population-based studies in Brazil usually consist of telephone interview and are frequently based on self-reported weight, height, and waist circumference, which did not occur in the Sabe study because these items were measured by professionals trained for the task.

This study presents the costs related to hypertension and DM, chronic diseases that require long-term treatment and whose costs increase in older adults, especially when uncontrolled. The fact that the costs are lower in individuals without excess abdominal fat may be an intervention strategy to spend less on the most prevalent diseases in older adults.

As mentioned earlier, this is the first population-based study of this nature to include older hypertensives and diabetics from the city of *São Paulo*. More studies are needed to analyze the relationships between obesity, excess abdominal fat, and costs with health procedures related to the other chronic diseases to provide a foundation for public health strategies and evidence-based health economy, especially preventive strategies as they are less expensive than merely curative approaches.

In conclusion, excess abdominal fat is directly associated with higher costs of health

procedures related to hypertension and diabetes in older adults from the municipality of *São Paulo*, regardless of gender, level of physical activity, and age.

CONTRIBUTORS

DR BUENO helped to conceive and write the article, and to statistically analyze the data. MF MARUCCI helped to conceive, elaborate, and write the final version of the article; LA GOUVEIA helped to write the article and discuss the results. YA DUARTE helped to idealize the study and approve the final version of the manuscript; ML LEBRÃO helped to idealize the study and approve the final version of the manuscript.

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