

Anthropometric indicators associated with dementia in the elderly from Florianópolis – SC, Brazil: EpiFloripa Ageing Study

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Abstract *Objective:* To investigate the association between dementia and anthropometric indicators in the elderly from Florianópolis. *Method:* This is a cross-sectional population-based survey performed with 1,197 elderly (≥ 60 years) in 2013/2014. Dementia was defined as the combined evidence of low MMSE (Mini-Mental State Examination) score and moderate/severe disability in the activities of daily living. The independent variables were body mass index (BMI), waist circumference (WC), conicity index and waist-to-height ratio (WHtR). Logistic regression (crude and adjusted) was performed to identify associated factors. *Results:* Dementia prevalence was estimated at 15.1%. After adjustment for sociodemographic characteristics, lifestyle and depressive symptoms, dementia was positively associated with the upper tertiles of the BMI (OR: 2.32; CI95%: 1.26-4.25), WC (OR: 2.22; CI95%: 1.20-4.11) and WHtR (OR: 2.30; CI95%: 1.19-4.43). *Conclusion:* Results have shown that both obesity and abdominal fat were associated with the outcome, suggesting that BMI, WC and WHtR should be considered in the investigation of this relationship.

Key words Anthropometry, Body mass index, Abdominal fat, Cognitive disorders

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Introduction

Dementia is a progressive or chronic neurodegenerative syndrome, characterized by a sufficiently severe cognitive decline, to the point of negatively affecting social functions and the ability to perform activities of daily living¹. By 2015, 46.8 million individuals with dementia were estimated worldwide. Of these, 58% would be from low- and middle-income countries. Brazil estimated 1.6 million elderly with this characteristic². It is believed that more people will develop dementia with life expectancy increase.

Although its association with age², lower income, educational level³ and depression⁴, dementia can be prevented since several modifiable risk factors such as tobacco use⁵, alcohol consumption⁶ and physical inactivity⁷ contribute to its occurrence. In addition to these factors, overweight/obesity and abdominal (visceral) fat have been studied as potentially modifiable factors associated with dementia^{8,9}. Body mass index (BMI) and different anthropometric indicators of abdominal obesity are used in epidemiological surveillance¹⁰ and risk assessment of developing metabolic, cardiovascular, musculoskeletal diseases and certain types of cancer, and many of these diseases are risk factors for dementia¹¹. More recently, anthropometric indicators (BMI, waist circumference, waist-to-height ratio, conicity index) have been used in association with dementia and this relationship is not yet fully established^{8,9,12-14}. In addition, there are ongoing discussions on whether overweight/obesity and abdominal fat play a similar role in the association with dementia¹⁵.

As with dementia, the prevalence of overweight/obesity has been increasing worldwide, with projections of increases in the coming decades^{16,17}. These conditions contribute to the increase of the expenses in the health system, and with implications in the individual, familiar and social scope^{18,19}. The identification of health markers associated with dementia is important to the health system, since it allows establishing those at greater risk of developing dementia, preventing and/or treating risk factors, improving the quality of life and the autonomy of individuals. Thus, this study aimed to investigate the association between dementia and anthropometric indicators in the elderly from Florianópolis.

Methodology

This is a cross-sectional, population-based epidemiological survey performed with data from the second wave of the cohort study entitled Epi-Floripa Ageing. This study investigates the health conditions of people 60 years of age or older living in the city of Florianópolis.

Population details, sample selection and site characterization have been previously published²⁰. At the survey's baseline (2009/2010), 1,702 individuals were interviewed (response rate of 89.1%). In the second wave of the study conducted in 2013/2014, 217 deaths were excluded, which resulted in 1,488 eligible elderly. The analytical sample of this study includes the 1,197 individuals that were part of the 2013/14 household interviews.

The Committee of Ethics in Research with Human Beings of the Federal University of Santa Catarina approved the project, and an Informed Consent Form was signed.

Dependent variable

Dementia

Dementia was investigated for the presence of low score in the Mini-Mental State Examination (MMSE) and moderate to severe activities of daily living (ADL) disability. The MMSE was categorized considering the educational level²¹ (probable cognitive impairment – no cognitive impairment). ADL disability was assessed using the Brazilian Questionnaire for Multidimensional Functional Assessment, validated in Brazil²², using the following classification: no disability (difficulty/disability in zero to three activities) and with disability (difficulty/disability in four or more activities).

Independent variables

Body mass and height were measured using standardized procedures, and from these measurements body mass index (BMI) [BMI (kg/m²) = body mass (Kg)/height (m)²] was calculated. The waist circumference (WC) was measured according to the standardization of Callaway *et al.*²³. The waist-to-height ratio (WHtR) was calculated by dividing WC (cm) by height (cm). The conicity index (CI) was verified through the waist circumference (m) over 0.109 $\sqrt{\text{weight (Kg) / height (m)}}$ [WC / 0.109 $\sqrt{\text{Weight (Kg) / height (m)}}$]²⁴.

All independent variables were classified in tertiles (\leq lower tertile, medium tertile and \geq upper tertile).

Adjustment variables

Adjustment variables were: sex; age group (60-69 years, 70-79 years and 80 years and older); educational level (no formal education, 1 to 4 years, 5 to 8 years, 9 to 11 years and 12 years and over); household income in minimum wages (≥ 1 MW, greater than <1 MW ≥ 3 MW, < 3 MW ≥ 5 MW, <5 MW ≥ 10 MW, <10 MW); smoking (never smoked, former smoker and current smoker) and alcohol consumption (non-consumption, non-abusive consumption and abusive consumption) verified through the first three questions in the AUDIT questionnaire (The Alcohol Use Disorders Identification Test)²⁵. Depressive symptoms were assessed using the Geriatric Depression Scale²⁶ (normal < 6 ; suspected depression ≥ 6). Leisure physical activity was verified by means of the long version of International Physical Activity Questionnaire (IPAQ)²⁷, and categorized as: insufficiently active (< 150 minutes of physical activity in weekly leisure) and physically active (≥ 150 minutes of physical activity in the weekly leisure).

Statistical analysis

Descriptive analyses were performed using prevalence and confidence intervals (95% CI) (categorical variables) and mean, 95% CI, minimum and maximum values and tertile distribution (continuous variables).

The association between dementia and anthropometric indicators was identified through logistic regression models (crude and adjusted analyzes), in which odds ratios (OR) with their respective 95% CI were estimated. The statistical significance level considered was 5%.

Data analyses were conducted in the statistical program Stata SE 13.0 (Stata Corp. College Station, USA). All analyses took into account the effect of the study design, using the *svy* command.

Results

The sample of this study consisted of 1,197 individuals with mean age of 73.9 ± 7.3 years. Most individuals were female, aged between 70 and 79 years, with a household income of less than three MW, never smoked, no alcohol consumption, insufficiently active in leisure and without suspected depression (Table 1). The estimated prevalence of dementia was 15.1% (95% CI: 12.6-18.0).

Table 2 shows mean values, standard deviations, minimum and maximum values and the distribution of anthropometric indicators values in tertiles. The upper tertiles were: BMI ≥ 29.53 ; WC ≥ 100.00 ; WHtR ≥ 100.00 and CI > 1.36 .

The crude and adjusted analyses of the association between anthropometric indicators and dementia are shown in Table 3. In the crude analysis, dementia was only associated with the upper tertiles of the WHtR and the conicity index. After adjustment, the WHtR maintained the association and dementia was also associated with BMI and WC. The probability of outcome was approximately two-fold higher in those in the upper tertile of BMI, WC and the WHtR, when compared to the lower tertile.

Discussion

This study verified the association of dementia with BMI, WC, conicity index and WHtR in the elderly from Florianópolis. According to results, dementia showed an independent association with the highest tertile of all anthropometric indicators, except the conicity index. The strength of association was similar for all three indicators.

In this study, the estimated prevalence of dementia (15.1%) and prevalence rates differ little from that reported in other studies^{3,28}. In the study by Correa Ribeiro et al.²⁸ (Network for Research on Frailty of the Brazilian Elderly – Rio de Janeiro Section, FIBRA-RJ), carried out with 683 health insurance clients (≥ 67 years) of Rio de Janeiro, the estimated prevalence was 16.9%. However, in the study by Bottino et al.³, conducted with a random sample of community-dwelling elderly living in 3 districts of the city of São Paulo ($n=1,563$), the prevalence adjusted for study design was 12.5% among people aged 60 and older. Differences in prevalence estimates may be related to the use of different instruments and/or categorization used to verify dementia in the studies, methods of sampling/data collection.

The results showed that dementia was positively associated with the upper tertile of BMI, as was identified in a systematic review study¹². Data from prospective studies have shown controversial results^{13,29,30}. In the follow-up study conducted by Qizilbash et al.¹³, carried out with 1,958,191 individuals (40 years of age or older) receiving primary care in the United Kingdom, the risk of dementia was higher in those with low weight, while overweight had a protective role. However, unlike this study and as pointed out by Kivimä-

Table 1. Sample description according to sociodemographic and health characteristics. Florianópolis, Santa Catarina, Brazil, 2013/2014.

Variables	n	% (95% CI)
Sex (n = 1,197)		
Male	419	36.9 (33.6-40.3)
Female	778	63.1 (59.7-66.4)
Age group (n = 1,197)		
60-69 years	412	33.9 (30.3-37.8)
70-79 years	509	42.8 (38.9-46.8)
80 years and older	276	23.3 (21.0-25.7)
Household income in minimum wages* (n = 1,141)		
Below or equal to 1	92	6.9 (5.2-9.2)
Over 1 MW and less than or equal to 3 MW	327	28.6 (25.1-32.4)
Over 3 MW and less than or equal to 5 MW	227	19.4 (16.4-22.7)
Over 5 MW and less than or equal to 10 MW	274	23.9 (20.5-22.7)
Over 10 MW	221	21.2 (16.6-26.6)
Tobacco use (n = 1,196)		
Never smoked	731	59.7 (56.1-63.1)
Former smoker	382	33.2 (30.0-36.6)
Current smoker	83	7.1 (5.3-9.6)
Alcohol intake (n = 1,196)		
Non-consumption	751	62.2 (57.8-66.4)
Non abusive consumption	268	22.1 (18.9-25.8)
Abusive consumption	177	15.6 (13.0-18.8)
Leisure Physical Activity (n = 1,192)		
Insufficiently active	879	73.0 (68.6-77.1)
Physically active	313	27.0 (22.9-31.4)
Geriatric Depression Scale (GDS)‡ (n = 1,130)		
Normal	907	81.0 (77.5-84.0)
Suspected depression	223	19.0 (16.0-22.5)
Cognitive impairment† (n = 1,182)		
No cognitive impairment	876	75.3 (71.1-79.0)
Probable cognitive impairment	306	24.7 (21.0-28.9)
ADL disability (n = 1,193)		
No	821	69.8 (66.36-73.02)
Yes	372	30.2 (26.98-33.64)
Dementia (n = 1,178)		
No	999	84.9 (82.0-87.4)
Yes	179	15.1 (12.6-18.0)

Caption: MW – minimum wages; GDS – Geriatric Depression Scale; 95% CI: Confidence Interval of 95. * 2013 minimum wage = R\$678.00 and in 2014, R\$ 724.00. † Categorized according to Almeida²¹. ‡ Categorized according to Almeida & Almeida²⁶

ki et al.³¹, Qizilbash et al.¹³ did not consider the covariates related to the lifestyle and educational level of the participants. In addition, the same nutritional status score (BMI) was used for individuals of different age groups, both for those aged less than and over 60 years, including for the elderly aged 80 and older. In the study by Jeong et al.³⁰ conducted with 467 elderly (≥ 65 years) from three rural communities in South Korea, authors found that high BMI was associated with demen-

tia only in individuals with elevated WC. In people whose WC was normal, the BMI lost the association. Data from systematic review, meta-analysis, and prospective studies³²⁻³⁴ have shown that being overweight at middle age increases the risk of dementia at advanced age, which is in line with the results of this study, although BMI cutoff points values have been different.

The reason why overweight/obesity is associated with dementia is not yet fully understood,

Table 2. Means, confidence intervals, minimum / maximum values and the distribution of anthropometric indicators values. Florianópolis, Santa Catarina, Brazil, 2013/2014.

Variables	n	Mean (95% CI)	[Min-Max]	Lower tertile	Medium tertile	Upper tertile
Body Mass Index (Kg/m ²)	1,148	28.22 (27.78-28.65)	[15.38-54.19]	< 25.72	25.72-29.51	≥ 29.53
Waist circumference (cm)	1,160	95.56 (94.58-96.53)	[50.00-143.10]	≤ 89.00	89.10-99.95	≥ 100.00
Waist-to-Height ratio	1,150	0.61 (0.60-0.61)	[0.36-0.93]	< 0.57	0.57-0.63	> 0.63
Conicity Index	1,147	1.32 (1.31-1.33)	[0.91-1.70]	< 1.28	1.28-1.36	> 1.36

Caption: 95% CI: Confidence Interval of 95. Min – minimum; Max: maximum.

Table 3. Crude and adjusted analysis in relation to the anthropometric indicators and dementia. Florianópolis, Santa Catarina, Brazil, 2013/2014.

	Crude OR (95% CI)	P	Adjusted OR* (95% CI)	P
Body Mass Index (Kg/m ²)		0.171		0.007
Lower tertile	1.00		1.00	
Medium tertile	0.68 (0.41-1.13)		1.16 (0.62-2.17)	
Upper tertile	1.37 (0.86-2.18)		2.32 (1.26-4.25)	
Waist circumference (cm)		0.398		0.009
Lower tertile	1.00		1.00	
Medium tertile	0.75 (0.45-1.23)		1.25 (0.62-2.53)	
Upper tertile	1.18 (0.79-1.76)		2.22 (1.20-4.11)	
Waist-to-Height ratio		< 0.001		0.007
Lower tertile	1.00		1.00	
Medium tertile	0.89 (0.50-1.57)		1.03 (0.46-2.32)	
Upper tertile	2.32 (1.44-3.74)		2.30 (1.19-4.43)	
Conicity Index		0.006		0.054
Lower tertile	1.00		1.00	
Medium tertile	1.34 (0.80-2.24)		1.37 (0.71-2.64)	
Upper tertile	1.82 (1.18-2.80)		1.92 (0.98-3.74)	

Caption: OR: Odds Ratio; 95% CI: Confidence Interval of 95%. * Adjusted for sex, age, household income in minimum wages, tobacco use, alcohol intake, leisure physical activity and the geriatric depression scale.

probably due to the complexity of its determinants, which involve environmental, behavioral, metabolic, genetic and hereditary factors³⁵. In addition to the effects mediated by chronic diseases that are risk factors for dementia (diabetes, high cholesterol, cardiovascular disease and hypertension), it is believed that overweight/obesity has a negative influence on the brain long before the onset of dementia symptoms³⁶. In addition to changes in brain structure³⁵, oxidative stress, deregulation in the hormones leptin and insulin³⁷ and a variety of metabolites bioavailable by adipose tissue affect the brain directly through the blood-brain barrier³⁶. However, other authors postulate that the risk for dementia is related to visceral adiposity³⁸.

In this study, dementia was also associated with the highest tertile of two indicators of centralized fat, WC and WHtR, similar to other studies^{8,9,14}. The strength of association was similar for both indicators. Data from the Sacramento Area Latino Study on Aging (SALSA) study with 1,351 community-dwelling individuals (aged 60 to 101 years) showed that the largest WC in the baseline period (1998-99) was associated with a higher rate of dementia after about 7 years⁹.

In the follow-up study (1992-2003) by Luchsinger et al.⁸, involving a random sample of subjects (≥ 65 years old) living in the northern part of New York City, attended by Medicare, the largest WC was associated with a higher risk of dementia in those aged under 76 years. Brito et

al.¹⁴ found an association between dementia and WHtR in the elderly (61 to 90 years) of the Federal District (Brazil), and found no association with CI, as in this study. However, it is noteworthy that this study was performed with only 84 elderly people living in the community.

There are some potential factors that explain the relationship between visceral fat and dementia, in addition to factors related to overweight/obesity. Visceral and subcutaneous fat secretion profiles are distinct, and the former is the more damaging one. Visceral fat is metabolically active and secretes proinflammatory cytokines that can affect tissues locally and systematically³⁸. Systemic inflammation is related to metabolic syndrome, insulin resistance, diabetes, dyslipidemias and cardiovascular diseases, conditions that increase the risk of dementia^{38,39}.

Among the positive aspects of this research is the fact that the study is population-based, with a representative sample of elderly people, with a good response rate (89.1%), that is, without significant loss of participants between baseline and follow-up. The methodology used in data collection, training of interviewers, standardization of measures and the use of validated questionnaires for the target population also reinforce data quality of this study. The adjustment for characteristics that has an association with dementia and

overweight/obesity is also highlighted. The use of respondent proxy in issues related to ADL disability and the use of self-reported questions are the limitations of this study.

In conclusion, according to the results, dementia was positively associated with the highest values (upper tertile) of BMI, WC and WHtR, that is, both obesity and abdominal fat were associated with the outcome. It is important to note that there is no consensus regarding the best BMI value for the elderly, however, the value of the upper tertile identified in this study is higher than the value used in Brazil by the Food and Nutrition Surveillance System¹¹. Regarding WC, there is still no consensus regarding the cutoff point value for the elderly and different populations⁴⁰. Similarly, WHtR and conicity index are still poorly used in studies involving the elderly, especially in association with dementia. However, it should be noted that these are non-invasive, easy to apply and low cost indicators that can be used together in clinical practice, health surveillance and planning.

Since overweight/obesity prevalence is increasing worldwide^{16,17}, the association of anthropometric indicators of overweight/abdominal obesity with dementia should be taken into account, although other studies, including follow-up studies, should investigate better this association.

Collaborations

SC Confortin contributed substantially to the design, planning, analysis, interpretation of the data, drafting of the draft, critical review of the work and approval of the final version of the work. V Meneghini contributed to the conception, planning, analysis, interpretation of the data, preparation of the draft, critical revision of the work and approval of the final version of the work. LM Ono contributed to the design, analysis and interpretation of data, critical review of content and final approval of the work. KC Garcia contributed to the design, planning, analysis and interpretation of data, critical review of content and final approval of the work. IJC Schneider has contributed substantially to the design, planning, analysis, interpretation of data, drafting of the draft, critical review of the work and approval of the final version of the work. E d'Orsi contributed to the design, planning and interpretation of data, critical review of content and final approval of the work. AR Barbosa contributed to the design, planning, analysis and interpretation of data, critical review of content and final approval of the work.

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