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Gender differences in the association between tooth loss and obesity among older adults in Brazil

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ABSTRACT

OBJECTIVE: To analyze if differences according to gender exists in the association between tooth loss and obesity among older adults.

METHODS: We analyzed data on 1,704 older adults (60 years and over) from the baseline of a prospective cohort study conducted in Florianopolis, SC, Southern Brazil. Multivariable logistic regression models were used to assess the association between tooth loss and general and central obesity after adjustment for confounders (age, gender, skin color, educational attainment, income, smoking, physical activity, use of dentures, hypertension, and diabetes). Linear regressions were also assessed with body mass index and waist circumference as continuous outcomes. Interaction between gender and tooth loss was further assessed.

RESULTS: Overall mean body mass index was 28.0 kg/m². Mean waist circumference was 96.8 cm for males and 92.6 cm for females. Increasing tooth loss was positively associated with increased body mass index and waist circumference after adjustment for confounders. Edentates had 1.4 (95%CI 1.1;1.9) times higher odds of being centrally obese than individuals with a higher number of teeth; however, the association lost significance after adjustment for confounders. In comparison with edentate males, edentate females presented a twofold higher adjusted prevalence of general and central obesity. In the joint effects model, edentate females had a 3.8 (95%CI 2.2;6.6) times higher odds to be centrally obese in comparison with males with more than 10 teeth present in both the arches. Similarly, females with less than 10 teeth in at least one arch had a 2.7 (95%CI 1.6;4.4) times higher odds ratio of having central obesity in comparison with males with more than 10 teeth present in both the arches.

CONCLUSIONS: Central obesity was more prevalent than general obesity among the older adults. We did not observe any association between general obesity and tooth loss. The association between central obesity and tooth loss depends on gender – females with tooth loss had greater probability of being obese.

DESCRIPTORS: Aged. Tooth Loss, epidemiology. Obesity, epidemiology. Gender and Health. Socioeconomic Factors. Risk Factors. Cross-Sectional Studies.

INTRODUCTION

The World Health Organization (WHO) reports that the worldwide prevalence of obesity doubled between 1980 and 2008.[27] Identified as a growing global public health burden, obesity is associated with increased risk of cardiovascular diseases, diabetes, cancers and other chronic diseases.[4]

The prevalence of obesity is increasing in all age groups, including older populations throughout the world.[10] When compared with the younger age groups, the absolute rise in mortality rates associated with obesity is greater among older adults. Reviews on obesity in older adults have reported its association with hypertension, diabetes, cardiovascular diseases, and stroke as well as lower cognitive skills, frailty, degenerative osteoarthritis, sexual dysfunction, urinary incontinence, and renal disease.[26] Obesity in older adults is further associated with physical immobility,[8] which can severely affect their quality of life by restricting movements in day-to-day life.

Ageing also leads to greater susceptibility to loss of teeth due to a cumulative effect of previous oral diseases.[24] Because tooth loss reduces masticatory functions, older adults tend to adapt their dietary intake for ease of eating food items.[14] Consequently, a decrease in fibrous fruits and vegetable and an increase in the intake of soft processed food may occur.[15] Thus, older adults with tooth loss have higher intake of fat, saturated fat and cholesterol, which may lead to obesity.[21,23]

Studies have assessed and established associations between tooth loss and obesity among adults[2,6,11,16] using different measurements.[6,11,13,22,25] Central (or abdominal) obesity is widely measured by waist circumference (WC) or waist to hip ratio. Even with normal body mass index (BMI), elevated WC measures can mean a two to threefold increase in the risk of cardiovascular disease and premature death.[20] Fewer studies have assessed the association between tooth loss and obesity using the measurement of WC or both WC and BMI.[2,17,18]

Patterns of weight and its progression to obesity differ in females and males.[9] WHO statistics report that females are more obese than males in all WHO regions.[27] This highlights the need for studies to consider gender wise variations while studying obesity and its risk factors. Gender wise differences have also been reported in tooth loss in Brazil[5] and globally.[18] In a Swedish study, women showed stronger association between edentulism and obesity than men.[19] Despite Sweden and Brazil differ in cultural context, no Brazilian study has assessed the role of gender in the association between tooth loss and obesity in older adults. Furthermore, no other study has assessed the role of gender in this association for this age group in any lower and middle income country. As a study has previously assessed and reported the association between tooth loss and obesity in a younger sample in Florianopolis,[2] and considering the significant gap in the literature, the current study aimed to analyze if differences according to gender exists in the association between tooth loss and obesity among older adults.

METHODS

In this cross-sectional study, we analyzed the baseline data of a population-based prospective cohort, EpiFloripa Aging, carried out with older adults aged 60 years or over in Florianopolis, Southern Brazil, from September 2009 to June 2010.

A two-stage cluster sample selection was drawn. Eighty out of 420 census tracts were ordered according to mean monthly income of the family head, and a systematic selection was conducted, allowing the selection of eight census tracts in each decile of monthly income. The number of households in these census tracts was counted and updated before data collection by fieldworkers, who estimated the number of households to be visited to achieve 1,911 individuals. The households were systematically selected and every older adult was invited to participate.

All individuals aged 60 years or over residing in the selected households were eligible to participate. Institutionalized older people were excluded from the study. Non-response was defined as either four unsuccessful interview attempts (due to, for example, people being away from home) or refusals. There were no substitutions. Out of the 1,911 invited individuals, a total of 1,705 interviews, health examinations and anthropometric measurements were completed. A detailed explanation about the study sampling has been published elsewhere.[3]

Thirty-four trained interviewers carried out data collection by applying a pre-coded structured questionnaire with personal digital assistants. A pilot study was conducted with 99 individuals within census tracts not selected for the study sample. Data quality control consisted of applying a short version of the questionnaire by telephone with approximately 10.0% of the sample (n = 150). Reliability measures were assessed using kappa statistics.

The main exposure was tooth loss. The number of self-reported natural teeth for each dental arch was recorded as follows: 10 or more natural teeth, less than 10 natural teeth, no natural teeth (edentate). We categorized the loss of teeth as: 10 or more natural teeth in both arches, less than 10 teeth in at least one arch, and edentate (no natural teeth in both arches).

The measures of obesity included BMI and WC. Weight (kg) was measured twice with portable scales of 100 g graduation calibrated before training and fieldwork. Height (m) was the mean of two measures obtained with a stadiometer of 1 mm graduation. Participants were asked to stand in front of the stadiometer without shoes and wearing light clothes. BMI was estimated as weight divided by square height. WC was assessed twice using an anthropometric inelastic tape with 1 mm markings (Sanny®), measured at the narrowest waist level, or, if this was not apparent, at the midpoint between the lowest rib and the top of the iliac crest. The examiners were instructed to make sure that the tape was not too tight or too loose and that it was lying flat and on the skin and horizontal when recording. The individual's WC considered was the mean of both measurements.

We analyzed general obesity using BMI as a binary variable (obese: ≥ 30 kg/m² and non-obese: < 30 kg/m²) and central obesity using WC (obese: ≥ 102 cm for males and ≥ 88 cm for females; non-obese: < 102 cm for males and < 88 cm for females). We used BMI and WC as continuous variables.[2]

Covariates included sex, age (60 to 64; 65 to 69; 70 to 74; 75 to 79; and ≥ 80 years); educational attainment (≤ 4; 5 to 8; 9 to 11; ≥ 12 years), equivalized monthly family income (divided into quartiles), and self-reported skin color/race (white, *parda* [mixed race involving African ancestry], black, Asian or indigenous). To assess equivalized income, the total household income was divided by the square root of the total number of household members and then divided into tertiles. The first tertile included individuals with incomes ranging from 0.00 to 452.00 BRL; the second, from 453.00 to 1,130.00 BRL; and the third, 1,130.00 BRL or more (1.00 USD corresponded to approximately 1.70 USD). The statistical models also included the following variables as covariates: self-reported use of dental prosthesis, diabetes, hypertension, and smoking status (never smoked; former smoker; current smoker); physical activity in leisure time measured by the long version of the International Physical Activity Questionnaire (IPAQ), adapted and validated for Brazilian older adults[1] (inactive: less than 10 min weekly; insufficiently active: 10 to 149 min weekly; and active: active for up to 150 min weekly).

Unadjusted and adjusted linear and logistic regression analyses were used to assess the associations between tooth loss and obesity. Adjusted analyses were performed step by step. First, we included tooth loss and demographic variables (age and skin color/race); second, we added socioeconomic variables (educational attainment and income). Smoking and physical activity were included in the third step, followed by the addition of self-reported use of dental prosthesis in the fourth model. We further added self-reported hypertension and diabetes in the next model. The associations were adjusted for gender in the final model. In the multivariable analysis, $p \leq 0.20$ in the bivariate association between each covariate and the outcome was used as an entry criterion. Interaction between gender and tooth loss was graphically displayed and assessed in the context of multivariable modeling, controlling for educational attainment, income, skin color/race, smoking, physical activity, use of dentures, hypertension and diabetes. The joint effect of tooth loss and gender was further estimated by fitting logistic regression models for the outcome of obesity with a composite variable of tooth loss and gender, and adjustment for the abovementioned confounders. Survey commands were used to control the design effect and perform weighted analysis. Statistical significance in the models was determined by Wald's test and $p < 0.05$ was considered statistically significant. All analyses were done using Stata v.11. This study was approved by the research ethics committee at Universidade Federal de Santa Catarina (Process 352/08). All participants signed an informed consent form.

RESULTS

The mean equivalized family income *per capita* of the sample was 1,514.16 BRL (890.70 USD). Many participants had less than 10 teeth in at least one of the dental arches (39.7%), while 33.5% were edentate and 26.8% had 10 or more teeth in both dental arches. Loss of teeth was significantly associated with gender, age, skin color/race, educational attainment, income and hypertension ($p < 0.05$) (Table 1).

Overall mean BMI was 28 kg/m² and overall mean WC was 96.8 cm for males and 92.6 cm for females. We observed a higher prevalence of central obesity (54.1%) than general obesity (31.1%). Females were more obese than males and current smokers were less obese than former smokers as well as non-smokers. Central and general obesity were significantly less prevalent among those who reported to be physically active in leisure time when compared with those who reported insufficient activity or inactivity. Both central and general obesity were significantly higher among those who reported hypertension or diabetes and among those who were not using dentures, compared with those using dentures (Table 1).

The crude estimates from logistic regression showed that the odds of edentate individuals having general or central obesity were, respectively, 1.2 and 1.4 times higher than individuals with more than 10 teeth in each arch. We observed significant associations. Edentulousness was associated with central obesity ($p < 0.05$) but not with general obesity ($p > 0.05$). The association between central obesity and edentulousness remained significant after adjusting for demographic variables (age

Table 1. Sample characteristics according to general and central obesity prevalence, Florianopolis, Southern Brazil, 2009 to 2010. (N = 1,704)

Characteristic	n	%*	General obesity		Central obesity	
			%	95%CI	%	95%CI
Gender						
Male	616	37.6	21.2	17.2;25.9	35.6	31.5;39.9
Female	1,088	62.4	37.1	34.3;39.9	65.3	61.6;68.8
Age years						
60 to 64	470	28.0	32.4	27.8;37.5	50.7	45.9;55.5
65 to 69	384	23.1	33.6	27.3;40.6	53.9	47.4;60.3
70 to 74	340	19.5	31.9	26.5;37.8	59.1	51.9;65.9
75 to 79	272	15.8	26.2	20.7;32.4	53.0	46.5;59.4
≥ 80	238	13.6	28.7	22.6;35.7	55.8	47.9;63.3
Self-reported skin color						
White	1,444	86.8	30.8	28.2;33.4	55.1	52.2;58.0
Parda	131	7.2	32.3	25.3;40.1	46.9	39.4;48.6
Black	84	4.3	28.7	17.7;43.1	41.3	28.6;55.3
Asian	12	0.7	19.7	4.2;58.0	13.7	1.8;57.5
Indigenous	17	1.0	35.2	15.3;62.0	71.0	42.9;88.9
Educational attainment (years of schooling)						
≤ 4	745	40.6	34.6	30.6;38.8	57.3	52.1;62.4
5 to 8	321	18.5	28.3	23.0;34.3	50.6	44.4;56.7
9 to 11	234	15.9	29.3	23.4;36.0	48.4	40.4;56.4
> 12	393	25.0	28.6	23.3;34.5	55.5	49.3;62.5
Income						
3rd tertile	568	35.5	29.2	24.8;34.1	53.6	48.0;59.1
2nd tertile	566	33.1	33.5	29.0;38.3	55.5	50.6;60.4
1st tertile	571	31.4	30.6	26.3;35.4	53.4	48.7;58.0
Number of natural teeth						
≥ 10 in both arches	395	26.8	29.1	22.9;36.2	49.8	42.5;57.0
< 10 in at least one arch	673	39.7	31.9	28.2;35.9	52.8	48.4;57.1
Edentate	582	33.5	32.0	28.2;36.1	58.6	53.4;63.6
Smoking						
Never smoked	1,038	59.6	34.1	30.9;37.5	58.5	54.2;62.6
Former smoker	523	32.0	29.5	24.6;34.9	50.9	47.2;54.5
Current smoker	141	8.4	15.8	10.0;24.1	35.8	27.0;45.6
Physical activity in leisure time						
Inactive	932	53.2	34.2	30.9;37.7	55.6	51.8;59.3
Insufficiently active	279	16.0	35.1	28.9;41.8	60.1	53.3;66.5
Active	494	30.8	23.6	19.6;28.2	48.6	42.4;54.9
Self-reported use of dental prosthesis						
Yes	944	51.6	30.9	27.8;34.2	55.4	52.0;58.7
No	760	48.4	31.3	27.2;35.6	52.8	48.4;57.2
Hypertension						
No	698	42.0	20.3	16.2;25.1	42.6	37.2;48.2
Yes	1,007	58.0	38.9	35.8;42.1	62.5	59.3;65.6
Diabetes						
No	1,329	78.4	26.7	24.0;29.5	49.6	46.1;53.1
Yes	376	21.6	47.1	40.6;53.6	70.7	64.9;75.9
General obesity						
Non-obese	1,179	68.9				
Obese	525	31.1				
Central obesity						
Non-obese	799	45.9				
Obese	905	54.1				

* All percentages are weighted.

and skin color), but became marginally insignificant on inclusion of socioeconomic variables (income and educational attainment). The association regained its significance after adjustment for smoking and physical activity. However, this association became marginally insignificant after the inclusion of self-reported use of dentures in the next model. The association could not regain the statistical significance after the addition of hypertension and diabetes in the following model. The addition of gender reduced edentates' odds of having central obesity (OR = 1.3, 95%CI 0.8;2.1) in the final model. The odds of individuals with less than 10 teeth in one arch to have general or central obesity were 1.1 times higher than those with 10 or more teeth in both arches. The associations were statistically insignificant (p > 0.05) and failed to gain statistical significance after adjusting for demographic, socioeconomic, and behavioral variables along with adjustment for chronic conditions and use of dentures (Table 2).

The continuous outcomes of BMI and WC were associated with the number of natural teeth in the crude estimates from the multiple linear regression, showing increasing BMI and WC with the decrease in natural teeth throughout the models. However, the associations were insignificant for all models (p > 0.05) (Table 3). We also observed a

Table 2. Multivariable logistic regression models for the association of general obesity, central obesity and number of natural teeth. Florianopolis, SC, Southern Brazil, 2009 to 2010. (N = 1,704)

Number of natural teeth	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7	
	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI
General														
≥ 10 in both arches	1		1		1		1		1		1		1	
< 10 in at least one arch	1.1	0.8,1.7	1.2	0.8,1.8	1.2	0.8,1.8	1.2	0.8,1.8	1.2	0.8,1.8	1.2	0.7,1.8	1.1	0.7,1.6
Edentate	1.2	0.8,1.7	1.3	0.9,1.9	1.1	0.7,1.8	1.2	0.8,1.8	1.2	0.7,1.9	1.1	0.6,1.9	1.0	0.6,1.7
Tooth loss*gender														p < 0.001
Males ≥ 10 teeth in both arches											1			
Females ≥ 10 teeth in both arches											1.4	0.8,2.5		
Males ≤ 10 teeth in at least one arch											1.0	0.5,1.9		
Females ≤ 10 teeth in at least one arch											1.7	0.9,3.2		
Edentate males											0.7	0.3,1.5		
Edentate females											1.8	0.9,3.6		
Central														
≥ 10 in both arches	1		1		1		1		1		1		1	
< 10 in at least one arch	1.1	0.8,1.6	1.1	0.8,1.7	1.1	0.8,1.7	1.2	0.8,1.6	1.2	0.8,1.8	1.2	0.7,1.8	1.0	0.7,1.5
Edentate	1.4	1.1,1.9	1.4	1.0,2.0	1.4	1.0,2.1	1.5	1.0,2.2	1.5	1.0,2.4	1.5	0.9,2.3	1.3	0.8,2.1
Tooth loss*gender														p < 0.001
Males ≥ 10 teeth in both arches											1			
Females ≥ 10 teeth in both arches											2.1	1.3,3.4		
Males ≤ 10 teeth in at least one arch											0.8	0.5,1.3		
Females ≤ 10 teeth in at least one arch											2.7	1.6,4.4		
Edentate males											0.8	0.5,1.5		
Edentate females											3.8	2.2,6.6		

Model 1: Crude estimates; Model 2: Adjusted for demographic variables (age, skin color/race); Model 3: Adjusted for demographic variables and socioeconomic variables (wealth, educational attainment); Model 4: Adjusted for demographic variables, socioeconomic variables, smoking and physical activity; Model 5: Adjusted for demographic variables, socioeconomic variables, smoking, physical activity and use of dentures; Model 6: Adjusted for demographic variables, socioeconomic variables, smoking, physical activity, use of denture, hypertension and diabetes; Model 7: Adjusted for demographic variables, socioeconomic variables, smoking, physical activity, use of dentures, hypertension, diabetes and gender

Table 3. Multivariable linear models for the association of general obesity, central obesity and number of natural teeth. Florianopolis, SC, Southern Brazil, 2009 to 2010. (N = 1,704)

Number of natural teeth	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7	
	β Coefficient	95%CI	β Coefficient	95%CI	β Coefficient	95%CI	β Coefficient	95%CI	β Coefficient	95%CI	β Coefficient	95%CI	β Coefficient	95%CI
BMI														
≥ 10 in both arches	Ref		Ref		Ref		Ref		Ref		Ref		Ref	
< 10 in at least one arch	0.2	-0.6;1.0	0.5	-0.3;1.3	0.4	-0.5;1.2	0.4	-0.4;1.3	0.4	-0.4;1.2	0.3	-0.5;1.1	0.2	-0.6;0.9
Edentate	0.1	-0.6;0.9	0.6	-0.2;1.4	0.4	-0.4;1.2	0.5	-0.4;1.3	0.5	-0.4;1.3	0.2	-0.7;1.1	0.1	-0.8;0.9
WC														
≥ 10 in both arches	Ref		Ref		Ref		Ref		Ref		Ref		Ref	
< 10 in at least one arch	0.1	-1.9;2.1	0.4	-1.6;2.5	0.2	-1.8;2.2	0.1	-1.8;2.0	0.3	-1.6;2.0	0.0	-1.7;1.7	0.7	-1.0;2.5
Edentate	0.4	-1.9;2.6	1.1	-1.1;3.3	0.7	-1.6;2.9	0.4	-1.8;2.6	0.8	-1.5;3.3	0.5	-1.8;2.8	1.1	-1.1;3.3

BMI: body mass index; WC: waist circumference; Ref: Reference
Model 1: Crude estimates; Model 2: Adjusted for demographic variables (age, skin color/race); Model 3: Adjusted for demographic variables and socioeconomic variables (wealth, educational attainment); Model 4: Adjusted for demographic variables, socioeconomic variables, smoking and physical activity; Model 5: Adjusted for demographic variables, socioeconomic variables, smoking, physical activity and use of dentures; Model 6: Adjusted for demographic variables, socioeconomic variables, smoking, physical activity, use of denture, hypertension and diabetes; Model 7: Adjusted for demographic variables, socioeconomic variables, smoking, physical activity, use of dentures, hypertension, diabetes and gender

significant association suggesting bidirectional relationship as those with central obesity were 1.3 times more likely to be edentate (OR = 1.3, 95%CI 1.0;1.7).

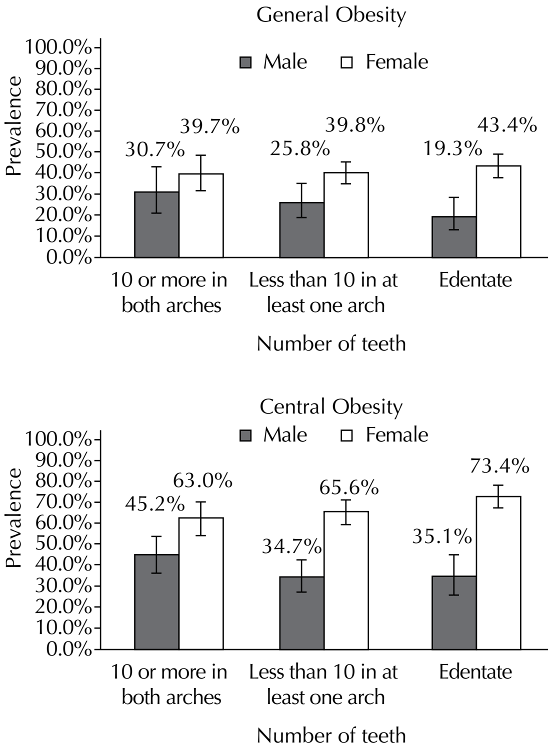
We observed significant interaction terms between tooth loss and gender for both categorical outcomes (Table 2). In comparison with males with at least 10 teeth present in each arch, females who were edentate or with less than 10 teeth in one arch had 3.8 and 2.7 times higher odds of being centrally obese, respectively (Table 2). The concomitant odds ratio (OR = 3.8, 95%CI 2.2;6.6) of edentulousness and female gender for central obesity was higher than the independent odds of either edentulousness (OR = 1.3, 95%CI 0.8;2.1) (adjusted for age, skin color, educational attainment, income, smoking, physical activity, use of dentures, hypertension and diabetes) (Table 1) or female gender (OR = 3.2, 95%CI 2.4;3.49, further adjusted for tooth loss; not reported in the table) alone. We observed marked differences in the adjusted prevalence (adjusted for age, skin color, educational attainment, income, smoking, physical activity, use of dentures, hypertension and diabetes) of obesity between males and females. Edentate females had more than double the prevalence of general and central obesity compared with males in the same category of tooth loss. Females with less than 10 teeth in any arch had a 1.9 times higher prevalence of central obesity in comparison with males in the same category of tooth loss (Figure).

DISCUSSION

Edentates had greater probability of being centrally obese, but the association was explained by confounders. The association between tooth loss and obesity varied according to gender. The significant interaction term between gender and edentulousness highlighted the differences by gender in the association between tooth loss and obesity. This association varied between presence of less than 10 teeth in at least one of the dental arch and edentulousness with central obesity.

Studies have assessed the association between tooth loss and obesity in adults[2,11,17] and older adults.[6,25] Edentulousness has been reported to be associated with underweight as well as overweight and obesity in Brazil.[25] Marcenes et al[11] reported similar but insignificant estimates for the association between edentulousness and obesity. Hilgert et al[6] reported varying results: edentate participants who used both upper and lower dentures had an inverse association with obesity, while those wearing only upper dentures had higher odds of being obese. The findings of our study are inconsistent with evidence, since we did not observe any association between tooth loss and general obesity. The association between edentulousness and central obesity was partially explained by gender.

The current study also had contrasting results in comparison with the findings of a previous study[2] on



* Prevalence adjusted for age, self-reported skin color, income, educational attainment, smoking, physical activity, use of dentures, self-reported diabetes and self-reported hypertension.

Figure. Adjusted prevalence* of general and central obesity among older adults according to gender and tooth loss. Florianopolis, SC, Southern Brazil, 2009 to 2010.

a younger sample from EpiFloripa with similar objectives. While the prevalence of central and general obesity was similar in the younger sample,[2] it was different in the older adults from the same city in the current study. This difference was also far more pronounced in females than in males in this study. Furthermore, they highlighted age-wise variation in the association between tooth loss and obesity, but did not find any differences in this association between males and females; that contrasts our finding of significant gender wise variation in the association in a geriatric sample. These differences could reflect variation in job activities: the younger population may be more active and heterogeneous in terms of health behaviors depending on different jobs, while the older population is more homogenous as a great proportion of is retired or participates in inactive employment. Thus, age would play a key role among younger adults while gender differences are more important among older adults.

A Swedish study with older adults reported that the association between edentulousness and obesity was stronger for females than males,[19] similarly to the current study. The gender differences in the association between tooth loss and obesity points towards the need to investigate the dietary behaviors and their determinants in the older population. The differences in dietary preferences between older males and females in Brazil could possibly explain this difference. According to the VIGITEL 2009 report,[a] males had significantly higher consumption of beans and more than double the consumption of meat with visible fat (rich sources of protein) when compared with females. Females had a higher consumption of fruits and vegetables than males and there were no significant differences between the consumption of soft drinks among older adults aged 65 years and above.[7] Loss of teeth may lead to reduction in the intake of fruits and vegetables among older females.[15] The consumption of other carbohydrate sources may increase as tooth loss can further limit females' dietary intake of proteins. This can explain the higher prevalence of central obesity in comparison to general obesity, particularly among females. This has been highlighted in a study where substitution of carbohydrates with proteins was associated with reduced central obesity.[12] Hence, we suggest further research to study the relation between dietary alterations caused by tooth loss and the two different outcomes of obesity.

This study had several strengths and some limitations. To our knowledge, this is the only population-based study carried out to assess the role of gender in the association between oral health and obesity in Brazil. Moreover, this study used standardized anthropometric measures, presenting highly reliable data. Few studies[18] have assessed the association of tooth loss with both central and general obesity in older adults using BMI and WC. One reason for this could be that fewer studies are planned to assess such associations, which results in limited choice of investigators to use the variables available in the datasets. The other reason could be that, with the recent epidemiological transition and particularly emphasis on central obesity as a risk factor for cardiovascular disease independent of general obesity, recent studies tend to collect detailed data on multiple factors and type of obesity.

However, because of the cross-sectional design, we cannot establish a causal relationship. The linkages between tooth loss and obesity could not be completely explained because we did not have data on participants' dietary intake. Also, tooth loss was self-reported, which can cause recall bias, and proxies were used for individuals having cognitive difficulties (n = 42). We used three wide categories of tooth loss as exposure, while other studies may have used more reliable measures of self-reported number of teeth.

[a] Ministério da Saúde, Departamento de Análise de Situação de Saúde, Secretaria de Vigilância em Saúde. Vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico, Vigitel, 2009. Brasília (DF): Ministério da Saúde; 2010.

A bidirectional relationship in this association cannot be ruled out, with the higher odds of the centrally obese being edentate. Hence, biological plausibility should be assessed with well-designed population-level studies with detailed information on the dietary intake of the participants. Future research from the EpiFloripa Aging cohort study may clarify the association between tooth loss and obesity.

The prevalence of central obesity was higher in comparison with the general obesity among older adults. The association between edentulousness and central obesity depended on gender, while no association was found between tooth loss and general obesity. Females with tooth loss had greater probability of being obese than males. The gender differences in the association may be addressed by population-based strategies to prevent and control behaviors leading to obesity. These strategies should be tailored to the vulnerability of the population groups and appropriately designed to the cultural context.

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