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Chewing impairment and associated factors among adults

ABSTRACT

OBJECTIVE: The aim of this study was to estimate the prevalence of chewing impairment according to sex, and its associated factors in adults.

METHODS: A cross-sectional population-based study was carried out with 2,016 subjects aged between 20 and 59 years in Florianopolis, SC, Southern Brazil, in 2009. The sampling was undertaken in two stages, census tracts and households. The outcome 'chewing impairment' was obtained from the question "How often do you have chewing impairment due to teeth or denture problems?". Analyses were carried out with demographics and socioeconomic factors, dental services utilization, and self-related oral health using multivariable logistic regression and stratified by sex.

RESULTS: The response rate was 85.3% (1,720 adults). The prevalence of chewing impairment was 13,0% (95%CI 10.3;15.8) and 18,0% (95%CI 14.6;21.3) among men and women, respectively. Women and men fifty years old and over, who had ten or fewer natural teeth and those who reported toothache were more likely to have chewing impairment. The combination of tooth loss and toothache on chewing impairment was almost four times higher among women.

CONCLUSIONS: The magnitude of the associations among socioeconomic, demographics and self-related oral health factors was different according to sex, in general higher for women, with emphasis on toothache. The findings suggest that the impact of oral conditions varies by sex.

DESCRIPTORS: Adult. Mastication. Socioeconomic Factors. Gender and Health. Oral Health. Dental Health Surveys.

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INTRODUCTION

Mastication is one of the principle oral functions and an impairment in its ability, understood by assessing the individual on difficulty chewing,[5] is one of the most immediate consequences of oral health problems and disorders, such as missing teeth.[16] The number of teeth influences fiber intake, in a positive relationship with chewing: the more teeth, the better the individual can chew and the greater the untake of foods rich in fiber, vitamins, folic acid, calcium and protein.[11,14,21] Difficulty in chewing fiber rich foods can be associated with increased risk of systemic illness, such as cardiovascular disease, and with oral diseases, such as oropharyngeal cancer.[14,23] In a health survey of adults in the South of Brazil, it was highlighted that 27.0% of individuals had difficulty chewing.[1] A nationwide study in Brazil in 2010 showed a 31.0% prevalence of difficulty chewing in adults.[a]

Mastication perceived as regular or bad in adults is associated with the external environment (for example, location of residence) and with individual characteristics (sex, age, self-reported skin color, income and schooling).[6,7] Adults from low income groups, who reported having black skin color, with low levels of schooling, tooth loss and no use of dental prosthesis reported being more dissatisfied with their ability to chew, compared with their peers.[6] Health related behavior such as making little use of health care services and poor self-perceived oral health have a negative influence on reports of difficulty chewing.[7]

Men and women have different attitudes to health related behavior.[13] There are differences between sexes in the rates of prevalence in the assessment of ability to chew, as women more often reported difficulty chewing.[7,16,20] Although there are studies on difficulties chewing,[1,6,7,16,20,21] no study was found which investigated these factors according to sex. The pattern of oral health problems may affect mastication in different ways in men and women.

The aim of this study was to estimate the prevalence in adults of difficulties chewing, according to sex, and to analyze associated factors.

METHODS

This is a part of a cross-sectional population based prospective study of adults in the urban zone of Florianópolis, SC, Southern Brazil, named *Epi*Floripa *Adultos*.[b] The data were collected between September 2009 and January 2010, and the target population of the study (n = 249,530) was composed of adults aged 20 to 59 years old, resident in the urban area of the municipality of Florianópolis, state of Santa Catarina, with an estimated population in 2009 of 408,161 inhabitants.[c] This age group included approximately 60.0% of the population of the municipality in 2009.

To calculate the sample size the following parameters were taken into consideration: target population (N = 249,530 individuals) 95% confidence interval, prevalence of unknown outcomes (50.0%), sampling error of 3.5 percentage points, design effect = 2, an additional 10.0% to cover losses and refusals and another 15.0% to control for confounders. The calculated sample size was 2,016 individuals after applying these parameters. The sample size was calculated to test associations of the outcome, stratified by sex. The final sample size was 1,720 individuals, and the response rate was 85.3%, sufficient to obtain a statistic power of 80.0% or more to test associations between age, income, schooling, number of natural teeth, toothache and difficulty chewing in men and women. Frequency of exposure between 7.0% and 47.0%, an alpha error of 5% and minimum prevalence ratios between 1.6 and 1.7 were considered. Self-reported skin color, most recent dental appointment, place of the appointment, symptoms of dry mouth and wearing full dental prosthesis had a power of < 80.0%.

The urban census tracts, a total of 420, were stratified according to the head of household income deciles and had values from R$ 192.80 to R$ 13,209.50 (based on the 2000 census). The sampling selection process took place in two stages: selecting first the census tracts and then the households. First, 60 census tracts were systematically selected, six for each income decile. Residences in these tracts, varying between 61 and 810, were contacted by the research team. Second, to reduce variability between the number of residences in each census tract, some were merged and some were divided, giving a total of 63 tracts. The initial coefficient of variation was 55.0% (n = 60 tracts) and the final one was 32.0% (n = 63 tracts). Finally, the households were systematically selected, 18 in each tract, totaling 1,134 households.

Losses were defined as refusals to take part or not finding the adult at home after four attempts on

[a] Ministério da Saúde, Secretaria de Atenção à Saúde, Departamento de Atenção Básica, Coordenação Nacional de Saúde Bucal. Pesquisa Nacional de Saúde Bucal, SBBrasil 2010: resultados principais. Brasília (DF); 2011.

[b] The *Epi*Floripa study aimed to investigate the health and life conditions of the adult population of Florianopolis City, SC, Southern Brazil. The conditions included: self-assessed health, self-reported comorbidities, self-reported oral health status, use of health services and major risk factors for chronic diseases (demographic and socioeconomic data, dietary habits, physical activity, blood pressure, anthropometric measurements, alcohol and tobacco). Available from: http://www.epifloripa.ufsc.br

[c] Instituto Brasileiro de Geografia e Estatística. População brasileira. Rio de Janeiro; 2012 [cited 2012 Feb 5]. Available from: http://www.ibge.gov.br

different days and at different times during the week, with at least one attempt being made at the weekend and one at night.

Structured face to face interviews were carried out by 35 interviewers with all of the adults residing in the selected households. The interviewers were trained by the study coordinators and supervisors and technicians from the Brazilian Institute of Geography and Statistics (IBGE). The questionnaire was pretested with 30 adults in the same age group as the study in an area of the municipality covered by a primary health care unit. After the interviewers were trained, a pilot study took place with 100 individuals in two census tracts selected, with the results not being included in this study. Data were collected by the interviewers using Personal Digital Assistants (PDA) by face to face interviews, which lasted on average an hour.

Telephone interviews were conducted with nearly 15.0% of the sample (n = 248) using a reduced form of the questionnaire composed of ten questions, in order to control the quality of data. Kappa statistics and intra-class correlation coefficient were calculated, with values between 0.6 and 0.9.

The dependent variable was obtained by asking each of the interviewees: "How often do you have difficulty eating because of problems with your teeth or dentures?" (never, rarely, sometimes, often, always).[12] The outcome was categorized as never and sometimes/often/always.

The independent variables were age in complete years (20 to 29, 30 to 39, 40 to 49 and 50 to 59), self-reported skin color (white, *parda* [brown] and black – subjects who referred to themselves as yellow or indigenous were excluded from the analyses due to their low frequency, n = 17 and 20, respectively), *per capita* household income (in reais) and categorized into terciles (1st tercile: ≤ R$ 560.00; 2nd tercile: R$ 561.00 - R$ 1,300.00 and 3rd tercile: ≥ R$ 1,314.00),[d] and schooling in completed years of study (fewer than five years, five to eight years, nine to 11 years and ≥ 12 years). With regards use of health care services, the selected variables were last visit to the dentist (< 1, one to two and ≥ 3 years) and type of service used (private, public and other). For self-reported oral health, the variables were dry mouth (never/sometimes and often/always),[22] wearing full dentures, dichotomized as no (no prosthesis used) and yes (full dentures for at least one dental arch), number of natural teeth (more than ten teeth in dental arches, fewer than ten teeth in at least one arch and no natural teeth) and having experienced toothache in the last six months, dichotomized into no/yes.

Stata 9.0 statistical software was used. Complex sample design and sampling weights were considered in the statistical analyses. Descriptive analysis and association of prevalence was carried out according to the exploratory variables stratified by sex. A 5% value of significance was adopted and the Rao-Scott Chi-square test, which adjusts analyses for design effect, was used. Non-conditional logistic regression was carried out in the univariate and multivariable analysis to estimate odds ratios (OR) and respective confidence intervals (95%CI). Potential confounders were those variables identified as such in the literature and were associated with exposure and with the outcome with $p < 0.20$.

The determination model based on Victora et al[24] and Bastos et al[4] was followed in the multivariable analyses in order to hypothetically assume a temporal and determination relationship between the exposure variable and the outcome. The demographic variables of age and self-reported skin color may influence socioeconomic conditions in the case of income and schooling, which in turn influence use of health care services, which can determine oral health conditions such as dry mouth, use of prosthesis and number of natural teeth, which have a closer relationship with the self-reported condition of difficulty chewing.

Interactions between number of natural teeth (two categories: > 10 teeth in both dental arches < 10 teeth in at least one dental arch) and dichotomized toothache (yes/no) with difficulty chewing were tested, controlling for confounders. Statistical significance was determined by the Wald test and p values below 5% were considered statistically significant.

The study was approved by the Research Ethics Committee of the *Universidade Federal de Santa Catarina* (Process no. 351/2008) and participants were asked to sign a consent form.

RESULTS

The mean age of the interviewees was 38 years old (standard deviation – SD = 11.6 years) and 55.8% were women. Fewer than half of the men and women had more than 12 years of studies. Most men and women had visited a dentist within the past year and had more than ten natural teeth in both dental arches (Table 1).

Around 1/6 of the participants reported difficulty chewing due to oral health problems. The prevalence of difficulty in chewing was higher in women than in men ($p = 0.009$). Higher prevalence of difficulty chewing was observed in older men and women (50 to 59 years old) compared with the younger ones (20 to 29 years old); among those in the first income tercile compared with those in the third tercile; in those with fewer than four

[d] Equivalent dollar: 1st tercile: ≤ US$244.00, 2nd tercile: US$245.00-US$565.00 and 3rd tercile: ≥ US$566.00

Table 1. Total sample and stratified by sex, according to socioeconomic and demographic characteristics, access to dental services and self-reported oral health condition. Florianopolis, SC, Southern Brazil, 2009. (N = 1,720)

Variable	Sample		Men		Women	
	n	%	n	%	n	%
Age (years) (n = 1,720)						
20 to 29	540	32.7	260	34.8	280	30.9
30 to 39	392	22.9	172	22.9	220	23.0
40 to 49	438	25.0	181	23.7	257	26.0
50 to 59	350	19.4	148	18.6	202	20.1
Self-reported skin color (n = 1,678)						
White	1,444	86.0	642	85.1	802	86.3
Parda/Black	234	14.0	108	14.9	126	13.7
Per capita income in terciles (reais) (n = 1,685)						
3rd tercile (highest income)	559	34.1	258	35.7	301	32.9
2nd tercile	562	33.3	258	34.4	304	32.4
1st tercile (lowest income)	564	32.6	229	29.9	335	34.7
Schooling (years of study) (n = 1,716)						
≥ 12	737	43.9	318	43.0	419	44.6
9 to 11	568	33.3	263	34.5	305	32.5
5 to 8	253	14.0	108	13.7	145	14.2
≤ 4	158	8.8	69	8.8	89	8.7
Most recent dental visit (years) (n = 1,705)						
< 1	1,136	66.9	453	60.2	683	72.2
1 to 2	381	22.4	194	25.5	187	19.9
≥ 3	188	10.7	109	14.3	79	7.9
Type of service (n = 1,707)						
Private	1,293	76.3	563	75.1	730	77.3
Public	331	19.0	150	19.3	181	18.7
Other	83	4.7	44	5.6	39	4.0
Dry mouth (n = 1,716)						
Never/Sometimes	1,564	91.5	704	93.1	860	90.1
Often/Always	152	8.5	55	6.9	97	9.9
Wearing full prosthesis (n = 1,698)						
No	1,575	93.0	711	94.1	864	91.9
Yes	123	7.0	41	5.9	82	8.1
Number of natural teeth (n = 1,717)						
≥ 10 in both dental arches	1,394	82.0	629	83.3	765	81.0
< 10 in at least one arch	279	15.6	116	14.7	163	16.2
None	44	2.4	15	2.0	29	2.8
Toothache (n = 1,717)						
No	1,463	85.4	661	87.5	802	83.8
Yes	254	14.6	100	12.5	154	16.2
Difficulty chewing (n = 1,712)						
Never	1,443	84.2	653	87.0	790	82.0
Sometimes/Often/Always	269	15.8	104	13.0[a]	165	18.0[a]

[a] Prevalence of the outcome, stratified by sex, according to the Rao-Scott test, p = 0.009

years of schooling compared with those with more than 12 years of studies. Higher prevalence was observed among those who wore full dentures, those with fewer than ten natural teeth in at least one dental arch or who were edentulous and those who reported toothache within the last six months. Men who used public dental services and women who reported dry mouth had a higher prevalence of difficulty chewing (Table 2).

In the multivariable analysis for men, it was observed that those aged between 50 and 59 had an almost three times greater chance of having difficulty chewing

Table 2. Prevalence of difficulty chewing in men and women according to socioeconomic and demographic characteristics, access to dental services and self-reported oral health condition. Florianopolis, SC, Southern Brazil, 2009. (N = 1,720)

Variable	Men			Women		
	%	95%CI	p[a]	%	95%CI	p[a]
Age (years)			< 0.001			0.049
20 to 29	7.3	3.8;10.9		12.7	8.5;17.0	
30 to 39	15.4	9.9;20.9		18.2	12.6;23.8	
40 to 49	12.4	7.5;17.3		20.1	14.1;26.0	
50 to 59	21.6	14.9;28.3		23.1	15.4;30.8	
Self-reported skin color			0.191			0.082
White	13.5	10.3;16.7		17.2	13.6;20.9	
Parda/Black	10.0	6.1;13.9		23.6	16.8;30.5	
Per capita income in terciles (reais)			0.008			0.006
3rd tercile (highest income)	8.5	4.6;12.4		12.6	17.5;28.2	
2nd tercile	13.2	8.7;17.7		17.8	12.5;23.2	
1st tercile (lowest income)	18.9	13.7;24.1		22.9	8.7;16.6	
Schooling (years of study)			< 0.001			0.004
≥ 12	8.7	5.6;11.9		13.2	9.9;16.5	
9 to 11	12.0	7.6;16.5		20.6	14.9;26.3	
5 to 8	18.0	9.4;26.6		21.1	14.5;27.7	
≤ 4	31.0	19.5;42.5		27.9	17.3;38.6	
Most recent dental visit (years)			0.102			0.061
< 1	12.2	8.8;15.6		19.5	15.4;23.6	
1 to 2	11.4	5.7;17.0		10.2	5.1;15.4	
≥ 3	20.1	13.1;27.0		19.4	8.1;30.7	
Type of service			0.011			0.599
Private	12.4	9.4;15.3		17.0	13.6;20.4	
Public	19.2	12.3;26.0		20.4	12.7;28.1	
Other	2.2	0.0;6.7		18.4	7.1;29.6	
Dry mouth			0.512			0.010
Never/Sometimes	13.3	10.4;16.2		16.6	13.6;19.7	
Often/Always	10.1	2.0;18.2		30.0	17.3;42.8	
Wearing full dentures			0.013			0.006
No	12.4	9.7;15.1		17.1	14.0;20.2	
Yes	26.5	11.8;41.3		29.4	17.7;41.1	
Number of natural teeth			< 0.001			< 0.001
≥ 10 in both dental arches	9.1	6.7;11.5		14.6	11.9;17.3	
< 10 in at least one arch	31.8	21.7;41.8		30.7	21.7;39.7	
None	37.6	15.2;60.1		42.1	22.4;61.8	
Toothache			0.002			< 0.001
No	11.6	8.8;14.3		12.3	9.7;14.8	
Yes	23.3	15.0;31.7		47.0	35.6;58.4	

[a] Rao-Scott test

than those aged 20 to 29. Schooling was partially and positively confounded by age and *per capita* income, attenuating the effect of the OR among those with lower levels of schooling compared with those with 12 or more years of studies. The association between wearing dentures and difficulty chewing ceased to be significant when age, *per capita* income and schooling were considered. Edentulous males had an OR almost six times greater for having difficulty chewing than those with ten or more teeth in both dental arches. Having reported toothache increased the chance of difficulty chewing by more than two times (Table 3).

Table 3. Association between difficulty chewing in men aged 20 to 59 years and independent variables. Florianopolis, SC, Southern Brazil, 2009. (N = 761)

Variable	Unadjusted analysis		Model 1[a]		Model 2[b]		Model 3[c]	
	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI
Demographic block								
Age (years)	p < 0.001		p < 0.001					
20 to 29	1		1					
30 to 39	2.3	1.2;4.4	2.4	1.3;4.5				
40 to 49	1.8	0.9;3.6	1.8	0.9;3.6				
50 to 59	3.5	1.9;6.3	3.4	1.9;5.9				
Self-reported skin color	p = 0.192		p = 0.440					
White	1		1					
Parda/Black	0.7	0.4;1.2	0.8	0.5;1.4				
Socioeconomic block								
Per capita income terciles (reais)	p = 0.002				p = 0.083			
3rd tercile (highest income)	1				1			
2nd tercile	1.6	0.9;3.2			1.4	0.7;2.8		
1st tercile (lowest income)	2.5	1.4;4.6			2.0	0.9;2.1		
Schooling in years of study	p < 0.001				p = 0.017			
≥ 12	1				1			
9 to 11	1.4	0.8;2.6			1.2	0.7;2.1		
5 to 8	2.3	1.2;4.6			1.4	0.7;3.0		
≤ 4	4.7	2.5;8.9			2.4	1.1;5.2		
Use of dental services block								
Most recent dental visit (years)	p = 0.100						p = 0.755	
< 1	1						1	
1 to 2	0.9	0.5;1.7					0.9	0.5;1.7
3	1.8	1.1;3.1					1.2	0.6;2.3
Type of service	p = 0.930							
Private	1							–
Public	1.7	1.0;2.7						–
Other	0.2	0.02;1.3						–
Bloco de condições bucais autorreferidas								
Wearing full dentures	p = 0.016						p = 0.147	
No	1						1	
Yes	2.6	1.2;5.4					0.5	0.2;1.4
Number of natural teeth	p < 0.001						p < 0.001	
≥ 10 in both arches	1						1	
< 10 in at least one arch	4.6	2.8;7.6					3.9	2.1;7.1
None	6.0	2.3;15.9					6.1	1.7;21.8
Toothache	p = 0.002						p = 0.002	
No	1						1	
Yes	2.3	1.4;3.9					2.2	1.3;3.8
Number of natural teeth x toothache							p < 0.001	
							1.8	1.4;2.2

p < 0.20 and Multivariable Logistic Regression (odds ratio - 95%CI)
[a] Model 1: block 1 variables adjusted for variables in the same block.
[b] Model 2: block 2 variables adjusted for variables in the same block and for age.
[c] Model 3: block 3 variables adjusted for variables in the same block and for age, income and schooling.
[d] p > 0.20

In women, dissatisfaction with chewing increased with age and with decreasing income. Although at the limit of statistical significance, women whose self-reported skin color was *parda* or black had a 60.0% higher chance of being dissatisfied with chewing than those whose self-reported skin color was white. Edentulous women had an almost seven times higher chance of the outcome compared with those with ten or more natural teeth in both dental arches. A similar figure was obtained for those who had reported toothache, compared with those without pain (Table 4).

There was significant interaction between the number of teeth and toothache in both men and women. However, the magnitude of the association of the combined effect among having more than ten teeth in the dental arches and the presence of toothache was almost four times greater among women (Figure 1).

DISCUSSION

There was a higher prevalence of difficulty chewing among women. Although the factors associated with difficulty chewing were similar between the sexes, the effect of simultaneously having more than ten teeth in both dental arches and toothache was almost four times higher among women.

The prevalence of difficulty chewing in the total sample was lower than the findings in international literature, which indicated prevalence ranging from 20.0% in adults aged 45 and over in Florida[20] to 30.0% in adults aged over 45 in Taiwan.[11] The prevalence of the outcome in adults in Brazil was 31.0%.[a] The difference between this study and the findings of the national survey can be explained by living an health care conditions in Florianópolis, which are above average for Brazil.[b] The rates of prevalence between the sexes confirm what is found in the literature. A study with adults in the USA[20] showed that the prevalence of difficulty chewing in women was double that in men. In Brazil, the prevalence of this outcome for men was 25.0%, and 34.0% for women.[a]

The chance of experiencing the outcome increases with age among men, as in the study of adult and older men in the USA.[14] This study indicates that, the greater the age, the more compromised natural dentition is and the lower the intake of food considered to be healthy, such as fruit and fiber. Although this study does not assess quality of food intake, previous studies[12,14,21,23] have shown a positive association between age and difficulty chewing and stressed that not eating foods deemed healthy affects general health.

Men with lower levels of schooling had a greater chance of being dissatisfied with chewing. Men at lower socioeconomic levels are more dedicated to providing for their household than to looking after themselves and make less use of health care services than women.[9] In addition, they are more prone to stressful environments, tend to adopt less healthy lifestyles, with higher alcohol and tobacco consumption. These substances can lead to chronic health problems,[10] including mouth cancer, which is more prevalent among men and produces countless negative impacts on the individual, including difficulty chewing.[18]

Parda and black women had more chance of having difficulty chewing. Black women tended to report more difficulty chewing[20] and more tooth loss than white women.[3] A possible explanation for this is that black women usually work in poorly paid positions demanding lower qualifications, live in areas with poorer basic infrastructure and experience limitations to health care service use.[2] The results of this research confirm those in the literature. When considering the socioeconomic position of women, skin color is confounded with income and schooling, and remains at the limit of statistical significance.

In both men and women, having no natural teeth increases the chance of having difficulty chewing by at least six times, compare with those who have more than ten natural teeth in at least one dental arch. On the other hand, authors have shown differences in reports of satisfaction with chewing between the sexes in the absence of natural teeth. Women wearing conventional dentures show more dissatisfaction with chewing than men and report more perioral sensitivity to the movement of the prosthesis.[19]

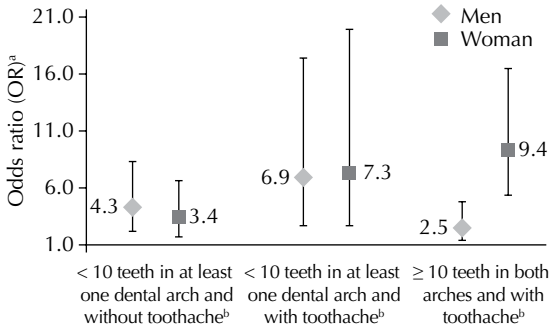
The results of this study indicate differences in the magnitude of the association between difficulty chewing and toothache in men and women. A study of adults and the older individuals in Spain showed a greater prevalence of toothache in women than in men.[17] There was a stronger association between having more teeth and suffering toothache among women than men. Men and women, due to social and cultural issues, tend to have different concepts of painful sensations and well-being associated with the mouth. Women pay more attention to the fact that missing teeth or toothache can determine quality of life, whether because it affects appearance and mood or whether providing better opportunities in the job market.[13] According to Pan et al,[19] difference related to biological aspects in adult women, such as hormonal alterations, menopause or osteoporosis should be considered in reports of dissatisfaction with chewing.

There are some limitations to this research. Although the statistical power diminished due to stratifying the sample by sex, a power above 80.0% was observed in both sexes for the variables of age, income, schooling, number of natural teeth and toothache. Other limitations of the study were obtaining measures of oral health using

Tabla 4. Association between difficulty chewing in women aged 20 to 59 years and independent variables. Florianopolis, SC, Southern Brazil, 2009. (N = 959)

Variable	Unadjusted analysis		Model 1[a]		Model 2[b]		Model 3[c]	
	RC	95%CI	RC	95%CI	RC	95%CI	RC	95%CI
Demographic block								
Age (years)	p = 0.006		p = 0.002					
20 to 29	1		1					
30 to 39	1.5	0.8;2.8	1.6	0.8;2.9				
40 to 49	1.7	1.1;2.6	1.8	1.2;2.8				
50 to 59	2.1	1.2;3.5	2.1	1.3;3.6				
Cor da pele autorreferida	p = 0.084		p = 0.055					
White	1		1					
Parda/Black	1.5	0.9;2.3	1.6	(1.0;2.4)				
Socioeconomic block								
Per capita income terciles (reais)	p = 0.001				p = 0.021			
3rd tercile (highest income)	1				1			
2nd tercile	1.5	0.9;2.4			1.5	0.9;2.8		
1st tercile (lowest income)	2.1	1.3;3.1			1.9	1.1;3.2		
Schooling in years of study	p = 0.001				p = 0.499			
≥ 12	1				1			
9 a 11	1.7	1.1;2.7			1.4	0.8;2.3		
5 a 8	1.8	1.1;2.8			1.2	0.7;2.0		
≤ 4	2.6	1.4;4.6			1.3	0.6;2.8		
Use of dental services block								
Most recent dental visit (years)	p = 0.309						[d]	
< 1	1							–
1 to 2	0.5	0.3;0.9						–
3	1.0	0.5;2.1						–
Self-reported oral health conditions block								
Dry mouth	p = 0.012						p = 0.082	
Never/Sometimes	1						1	
Often/Always	2.2	1.2;3.9					1.8	0.9;3.3
Wearing full dentures	p = 0.006						p = 0.192	
No	1						1	
Yes	2.0	1.2;3.3					0.5	0.2;1.3
Number of natural teeth	p < 0.001						p = 0.005	
≥ 10 in both arches	1						1	
< 10 in at least one arch	2.6	1.7;3.9					2.2	1.1;4.3
None	4.3	1.9;9.3					6.6	1.8;24.4
Toothache	p < 0.001						p < 0.001	
No	1						1	
Yes	6.4	4.0;10.0					6.8	4.1;11.3
Number of natural teeth x toothache							p < 0.001	
							2.5	2.0;3.3

p < 0.20 and Multivariable Logistic Regression (odds ratio - 95%CI)
[a] Model 1: block 1 variables adjusted for variables in the same block.
[b] Model 2: block 2 variables adjusted for variables in the same block and for age.
[c] Model 3: block 3 variables adjusted for variables in the same block and for age, income and schooling.
[d] p > 0.20



[a] Context of the final modelling for men and women adjusted for sociodemographic and economic variables and use of services.
[b] Comparison with best category ≥ 10 teeth in both arches and without toothache1

Figure. Interaction between number of natural teeth and toothache on difficulty chewing, in adults according to sex. Florianópolis, SC, 2009. Test for heterogeneity ($p < 0.001$)

self-reporting questions.[b] However, the self-reported number of teeth has been shown to be a valid measure in other contexts.[8] Another limitation of the study could be that it is not possible to generalize it to apply to other contexts, as Florianópolis has better living and health care conditions that most Brazilian cities.[b]

High internal validity was identified, as the estimates of the IBGE for sex, age and income for the adult population of Florianopolis in 2009[b] were shown to be similar to those in this study. Although the questions used in this study had not been validated for Brazil, a strong point was using questions that had been used in other national[15,a] and international[22] surveys. High rates of reliability were observed between the interviewees for the self-reporting questions and the interviewer guide for the research questions, suggesting that there was no observation bias. The multivariable analysis was guided by a theoretical model that enabled possible confounding factors to be controlled, as well as testing plausible interactions. Moreover, the self-reporting question used in the study: "How often do you have difficulty eating because of problems with your teeth or dentures?" enables systematic assessment to be carried out by a long-term health surveillance system for the outcome in question. It is suggested that this question be included in population surveys. There are different magnitudes in the factors associated with difficulty chewing between men and women, generally higher among women, with toothache standing out. The results suggest that the impact of oral health conditions varies according to sex.

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The authors declare that there are no conflicts of interest.