Periodontal conditions and associated factors among adults and the elderly: findings from the first *National Oral Health Survey* in Uruguay

Enfermedad periodontal y factores asociados en la población adulta y adulta mayor: primer *Relevamiento Nacional de Salud Bucal* en Uruguay

A doença periodontal e fatores associados entre adultos e idosos: dados da *Pesquisa Nacional de Saúde Bucal* no Uruguai

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Abstract

The aims of this study were to assess the prevalence of periodontal conditions in the Uruguayan adult and elderly population and its association with socioeconomic and behavioral characteristics. Data from adults (35-44, n = 358) and elderly (65-74, n = 411) who participated in the first National Oral Health Survey, Uruguay, 2011, were used. The survey included a household questionnaire addressing socioeconomic characteristics, and tobacco use. Bleeding on probing (BOP), periodontal pockets (CPI) and clinical attachment loss (CAL) were measured by clinical examination. A multivariable analysis was carried out. Considering both age groups, the prevalence of mild/severe periodontal disease was 21.8% and 9.12% for severe periodontal disease. Adjusted analyses revealed an association between high education and all outcomes. Attendance at dental services was negatively associated with BOP and mild to severe periodontitis. Periodontal outcomes were higher in disadvantaged socioeconomic groups. Tobacco consumption has a strong association with periodontal disease in the elderly.

Periodontal Diseases; Dental Health Surveys; Adult; Aged

Resumen

El objetivo del estudio fue conocer la prevalencia de enfermedad periodontal en la población adulta y anciana uruguaya y su asociación con factores comportamentales y socioeconómicos. Se utilizaron datos de adultos (35-44, n = 358) y ancianos (65-74, n = 411) participantes en el primer Relevamiento Nacional de Salud Bucal en Uruguay. El relevamiento incluyó un cuestionario sobre factores de riesgo, incluyendo tabaco. Sangrado al sondaje bolsa periodontal (IPC) y pérdida de inserción (PIP) fueron valorados mediante examen clínico. Considerando las dos edades, la prevalencia de enfermedad moderada/severa fue de 21,8% y 9,12% para severa. En el análisis multivariado, se observó asociación entre nivel universitario de educación y todas las variables de respuesta. La asistencia odontológica estuvo negativamente asociada con la enfermedad periodontal moderada a severa. La prevalencia fue mayor en el grupo con menor nivel socioeconómico. En los ancianos, el hábito de fumar estuvo fuertemente asociado con la enfermedad periodontal.

Enfermedades Periodontales; Encuestas de Salud Bucal; Adulto; Anciano

Introduction

Periodontal diseases are one of the most important oral health conditions affecting populations around the world. These are a major cause of tooth loss, particularly among the elderly, and significantly impact the quality of life of individuals, representing a public health problem [1].

There are different manifestations of plaque-induced periodontal diseases and these can vary from initial stages such as plaque-induced gingival disease to more severe conditions such as periodontitis [2]. The understanding of the distribution and factors associated with these conditions can provide useful information in planning public health actions [3]. For all of these reasons, epidemiological analysis of data provided by nationwide surveys is a crucial tool for better distribution of financial and available human resources.

The prevalence of the periodontal conditions varies significantly between ages and countries. In Europe, epidemiological evidence indicates that mild gingival inflammation and mild to moderate loss of periodontal attachment in specific sites are prevalent in the adult population but epidemiological studies available from most Eastern European countries are limited [4,5]. Data from the 2009-2010 *National Health and Nutrition Examination Survey* (NHANES) revealed that the prevalence of periodontitis in the adult population (35-49 years) was 36.6% while in the elderly it was 70.1% [6]. In this context, little data is available for Latin America [7]; considering the last Brazilian national survey performed in 2010, the prevalence of bleeding on probing in middle-age adults was 45.8% and in older adults 18.1%. For periodontal disease, the prevalence of "moderate to severe" symptoms in adults, ranged from 15.3% to 5.8 % for "severe" [8].

Considering associated factors, such as other chronic diseases, periodontal conditions share both systemic and local determinants [9]. The common risk factor approach (CRFA) considers that oral diseases, such as periodontal diseases, share common factors with systemic non-communicable diseases and this approach allows for more efficient public health planning [10,11]. As for systemic factors, some findings suggest that patients with type I and II diabetes, obesity and stress are more prone to presenting periodontal diseases [12,13,14,15,16]. In addition, behavioral variables, such as tobacco use, dietary and hygiene habits are also associated with this condition [17,18,19]. Finally, there is also a strong relationship between socioeconomic factors and periodontal conditions, where an important social gradient can be found [20,21].

In the case of Uruguay, a recent *National Oral Health Survey* was carried out in the adult population in 2010-2011. Preliminary analyses revealed that for the population living in the countryside, the prevalence of bleeding and of shallow periodontal pockets was 36.1 and 28.5%, respectively [22,23]. However, comprehensive data for the whole population, considering provinces and the capital, for different age ranges and factors associated with the different periodontal conditions, are not available. Therefore, the aims of this study are to assess the prevalence of periodontal outcomes in the Uruguayan adult population and investigate its association with demographic, socioeconomic and behavioral characteristics.

Methods

This cross-sectional study is part of the first *National Oral Health Survey* in the young and adult population of Uruguay. Uruguay is a South American country situated between Argentina and Brazil, with an area of 176,215km^2 and a population of 3,334,052 inhabitants (Instituto Nacional de Estadística. Censo 2011. http://www.ine.gub.uy/censos2011/index.html, accessed on 09/Jan/2015). Its economy is based on agriculture and services.

The survey was performed in the context of the implementation of the Uruguayan National Health System, following World Health Organization (WHO) guidelines for oral health surveys [8,24]. A stratified, double phase cluster sampling design was adopted. In fact, we used the sample design of the National Statistics Institute which took into account socioeconomic positions. This was the first sampling phase of the study. The sample calculation was performed in order to obtain representative sub-samples by region (capital and the provinces) and age groups: 15-24, 35-44, 65-74 years. The National Statistics Institute randomly selected the sample. The capital and the rest of the provinces were considered in two independent samples: one for the provinces (n = 1,503: 715 – 15-24 years; 394 – 35-44 years; 394 – 65-74 years) and another for the capital (n = 1,503: 715 – 15-24 years; 394 – 35-44 years; 394 – 65-74 years). The total number for the sample considered the two most prevalent diseases: caries and periodontal conditions. For the calculation of the sample size, a prevalence of dental caries of 85% was considered for both middle aged and older adults. For young adults, the outcome used was the prevalence of periodontal disease of 54%. The calculation also took into consideration a type I error of 5%, a power of 80% and a design effect of 1.5 and added 20% for non-responses. According

to these calculations, the total number expected for the sample corresponding to adults and elderly was 1,576 individuals: 788 for each age group (394 for the countryside and 394 for Montevideo in each age group). In order to achieve this sample size, four waves corresponding to continuous household survey information [22] were used. The continuous household survey is a multistage stratified cluster survey where the final sampling units are the households. This survey is conducted every two months. The latter is considered the first sampling phase.

In the second phase, four waves of the survey were used to select the minimum necessary to achieve the calculated sample size for each age group. We have a total of 4,000 people, of which 1,430 belonged to the age group of 15-24, the remaining 2,500 belonged to adults and elderly. Therefore, the required 1,576 were selected by simple random sampling.

The study was performed in 2010-2011 and comprised a clinical examination that included several oral conditions (caries, periodontal diseases, malocclusions and mucosal lesions) and a questionnaire with socio-demographic, socioeconomic and behavioral variables. A post calibration process of the sample was carried out to compensate for age and gender imbalances. More details about the methods of this population-based study are available elsewhere [22].

Outcomes

Periodontal outcomes were assessed based on the modified Community Periodontal Index (CPI) [24]. Clinical evaluation was performed in all sextants using the CPI probe. In each sextant, the index teeth were probed in six sites (mesio-bucal, mid-buccal, disto-buccal, disto-lingual, mid-lingual and mesio-lingual). Bleeding on probing (BOP) was assessed in all sextants and then the individuals categorized in "present "or "absent" for both conditions. Presence of periodontal pockets was measured as the distance from the free gingival margin to the bottom of the gingival sulcus and individuals were classified using the following categorization: "absent", when the pocket depth was from 0 to 3mm and; "present" when the pocket depth was ≥ 4mm. Individuals with absence of teeth in all sextants were considered as "missing". The Brazilian national oral health survey modification for CPI was used. It consisted of measuring all periodontal conditions (BOP, calculus, periodontal pockets and clinical attachment loss – CAL) in each index tooth and reporting the value for each condition, not only the worst situation by sextant as the original CPI index does. CAL was also performed in all sextants

using the following categories: (0) up to 3mm; (1) 4-5mm; (2) 6-8mm; (3) 9-11mm and; (4) 12mm or more (Instituto Nacional de Estadística. Censo 2011. http://www.ine.gub.uy/censos2011/index. html, accessed on 09/Jan/2015). Outcomes were analyzed considering two variables: CAL and CPI. Periodontal disease was defined as: (i) moderate to severe when CPI > 2 (periodontal pocket ≥ 4mm) and CAL > 0 (CAL ≥ 4mm) and; (ii) severe when CPI > 2 (periodontal pocket ≥ 4mm) and CAL > 1 (CAL ≥ 6). Although CPI > 2 was used as the cut-off point, CPI = 5 (excluded sextants) was not included because neither the cause of the tooth loss nor the status of the possible remaining tooth in the sextant were known.

Independent variables

The following independent variables were considered: sex, age, region and socioeconomic status, health service coverage, time since the last dental visit, smoking habits and tooth brushing frequency.

Age was noted in years and then categorized in the following groups: 35-44, 65-74 years. Region of the country was considered as "capital", for Montevideo inhabitants, and provinces for other regions. The presence of at least one person with a university degree in the household (yes/no) was used as a socioeconomic categorical variable.

Type of health service used was assessed by the question: "Which type of health service do you attend when you feel sick?" and then categorized as public or private. In Uruguay the Health Care System integrates both public and private sectors. Economically this resembles an insurance system where the working population is requested to pay an amount proportional to their incomes while the State is responsible for the payments of unemployed people. All the gathered financial resources are distributed between public and private providers according to the composition of the covered population, depending on age and sex. Users have the possibility of choosing between the public and private sectors whereby in the private sector most services should be paid for and there is no free of charge dental care for adults and the elderly, while in the public sector all health care benefits are free of charge for the users.

Time since the last dental visit was assessed in months and categorized in "up to 12 months", "more than 12 months" and "never visited".

Toothbrushing frequency was determined using the following options: never, once a month, twice or three times/month, once a week, twice to six times/week, once a day and twice or more/

day. This variable was then dichotomized in "twice or more/day" and "less than twice a day".

Smoking habits were assessed by asking if currently, the individual smokes daily and the number of cigarettes per day. Then the variable was categorized in three groups: does not smoke/smokes but not daily, smokes up to 10 cigarettes/day and smokes more than 10 cigarettes/day.

Fieldwork

The fieldwork team was comprised of six dentists assisted by dental students from the University of the Republic School of Dentistry. All examinations were performed at the individual's home. Participants were examined sitting under artificial illumination (a head lamp). The examiners were properly dressed, and all safety and biohazard measures were adopted. CPI probes and buccal mirrors were used to conduct the dental examination.

All examiners and interviewers were trained and calibrated by a researcher with experience in this type of epidemiological study. Two calibration processes were performed during the fieldwork and 40 individuals were examined in each opportunity to ensure the inter-examiner reliability. The *Brazilian National Oral Health Survey* methodology was used [25]. The calibration process consisted of a twofold process: firstly a theoretical phase where all diagnostic criteria were discussed and secondly a practical phase where 40 individuals were dentally examined twice, in order to calculate intra and inter examiner reliability indexes. For the inter examiner reliability calculation a gold standard examination was obtained in consensus between the examiners and the instructor. This consensus method consisted of a discussion after all examinations, of the discrepancies among the findings of the examiners in each participant. Inter-examiner reliabilities were calculated using weighted and simple kappa tests when appropriate. For periodontal pocket conditions, the values vary from 0.6 to 1 (mean value = 0.74 in the first calibration and 0.90 in the second). Intra examiner values vary from 0.67 to 0.98.

Statistical analysis

Data analysis was performed using Stata 11.2 (StataCorp LP, College Station, USA). All analyses considered the study design and sample weight of the survey, employing the *svy.* commands complex data samples. Distribution of periodontal outcomes (BOP, mild to severe periodontal disease and severe periodontal disease) by independent variables was assessed by descriptive analysis and bivariate analyses were performed using the Rao Scott test. Multivariate analysis was performed using Poisson regression models for the three outcomes which allowed the estimation of the prevalence ratio (PR) and respective 95% confidence intervals (95%CI). A hierarchical approach was used in the multivariate analysis. For this purpose, independent variables were divided in two blocks in order to determine their entrance in the models. The first block comprised demographic and socioeconomic variables and the second block included behavioral characteristics. Variables from block 1 were adjusted by the variables of the same block. Block 2 variables were adjusted by block 1 and block 2 variables. To remain in each phase of the analysis (block 1 and full model) variables had to present a p-value ≤ 0.250. A stepwise backward selection procedure was performed in each phase of the model. Multivariate analyses were also performed stratified by age groups (adults and elderly).

Ethical aspects

The study protocol was approved by the University of the Republic School of Dentistry Ethics Research Committee. All participants provided written informed consent and people were informed about their health status and directed to the nearest health center.

Results

The total sample comprised 769 individuals: 484 for the countryside: 225 – 35-44 years; 259 – 65-74 years and 285 for the capital: 133 – 35-44 years; 152 – 65-74 years. The response rate was 51.2%.

The response rate was higher in Montevideo (74.8%) and among women (77%). The worst response rate was in Canelones province (33%). From the total sample, 358 (61.6 %) were from the 35-44 age group and 411 (38.4%) were from the 65-74 age group. Regarding demographic variables, 50.6% of the participants were women and 49.8% were from the capital (Montevideo).

Considering adults and the elderly, the prevalence of BOP was 40.8% (CI95%: 35.9-46.0), 21.8% (17.9-26.3) for the mild/severe periodontal disease and 9.12% (6.8-12.1) for the severe periodontal disease case. Nearly 1/6 of participants had all sextants excluded due to missing teeth (2% of adults and 35% of elderly). The population with at least one excluded sextant was 51.4% (45.0-57.8) for the adult population and 86.4% (81.0-90.4) of the elderly, respectively.

The distribution of outcomes by independent variables is displayed in Table 1. Males presented

Table 1

Distribution of periodontal conditions according to independent variables in Uruguayan adult and elderly populations: unadjusted, bivariate analysis.

Independent variable	BOP (n = 604)	Periodontal disease moderate/severe	
		Moderate/Severe (n = 612)	Severe (n = 612)
	% (95%CI)	% (95%CI)	% (95%CI)
Block 1			
Sex			
Female	35.6 * (29.7-42.0)	12.9 ** (9.7-17.0)	6.5 * (4.5-9.4)
Male	45.9 * (38.1-53.9)	30.1 ** (23.8-38.2)	11.7 * (7.8-17.2)
Region			
Provinces	37.3 (31.2-43.8)	23.3 (18.3-29.2)	11.2 ** (8.1-15.1)
Capital	43.8 (36.3-51.4)	20.6 (15.2-27.4)	7.5 ** (4.4-12.4)
Age group (years)			
35-44	43.8 (36.9-49.8)	16.5 ** (12.1-22.0)	5.9 (3.6-9.5)
65-74	35.0 (28.2-42.5)	34.7 ** (27.7-42.4)	17.0 (12.1-23.2)
University degree			
Yes	30.6 ** (22.6-39.8)	14.8 * (9.7-21.9)	3.9 ** (2.1-7.2)
No	46.0 ** (40.0-52.2)	25.6 * (20.5-31.4)	11.8 ** (8.5-16.1)
Block 2			
Type of health services			
Private	37.6 *** (31.4-44.2)	21.4 (16.5-27.4)	8.8 (6.0-12.6)
Public	46.7 *** (38.6-66.1)	22.2 (16.4-29.3)	9.9 (6.2-15.6)
Time since last dental visit			
Up to 12 months	34.0 * (26.9-41.8)	18.4 ** (13.1-25.2)	7.3 (4.4-11.9)
More than 12 months	46.9 * (40.1-53.8)	24.6 ** (19.2-30.9)	10.9 (7.6-15.5)
Never used dental services	90.3 * (46.1-99.0)	94.6 ** (0.6-99.5)	25.3 (4.4-71.3)
Tooth brushing			
≥ twice a day	36.1 * (30.8-41.9)	17.9 ** (14.0-22.7)	8.1 (5.7-11.4)
< twice a day	57.1 * (45.8-67.7)	35.1 ** (25.4-46.2)	12.5 (7.2-20.9)
Tobacco use			
Do not smoke/not daily	39.3 (33.8-44.9)	20.6 (16.3-25.7)	8.6 (6.0-12.1)
Up to 10 cigarettes/day	54.5 (32.9-74.4)	23.5 (11.6-41.7)	9.3 (2.6-28.1)
More than 10 cigarretes/day	44.8 (31.6-58.8)	27.7 (17.6-41.7)	11.9 (6.7-20.4)

95%CI: 95% confidence interval; BOP: bleeding on probing.

* p-value ≤ 5%;

** p-value ≤ 1%;

*** p-value ≤ 10%.

a higher prevalence of all periodontal outcomes compared with females. The prevalence of moderate to severe periodontal disease was higher in the elderly than in adults. The presence of a university degree in the household presented lower levels of all periodontal conditions (BOP, moderate to severe and severe periodontal disease). In addition, people who live in the provinces have a greater prevalence of severe periodontal disease than those living in the capital. The time since the last dental visit was also associated with BOP and periodontal disease (moderate/severe). People that have never used dental services presented a higher prevalence of BOP and mild/severe periodontitis. The prevalence of BOP and moderate/severe periodontal disease was also higher in people who reported brushing their teeth less than twice a day. In bivariate analysis, smoking habits were not associated with any periodontal conditions (neither moderate/severe nor severe periodontitis).

Adjusted analyses showed that individuals who live without a person with a university degree in the household presented a greater pre-

valence of all the outcomes, having almost three times greater the prevalence of severe periodontitis compared with those living with a person with a high level of education. In addition, people who had never used dental services in their life presented a greater prevalence of BOP and moderate/severe periodontitis compared with those who have visited the dentist in the last 12 months (Table 2).

Tables 3 and 4 illustrate the results of multivariate analyses of periodontal outcomes, stratified by age groups. The results for adults are displayed in Table 3. In this age group, males presented a prevalence of mild to severe periodontal disease that was almost three times higher than females.

In addition, participants who did not have a person with a university degree in the household presented the highest prevalence rate for all three evaluated outcomes.

Adjusted analysis in the elderly population revealed that the use of tobacco was associated with all outcomes. People who reported smoking more than 10 cigarettes per day presented a prevalence almost twice as large of BOP and mild/severe periodontitis compared with those who reported not smoking or not smoking daily. In addition, the prevalence of severe periodontitis was more than three times higher in the heavy smoker group than in those who do not smoke or do not smoke daily (Table 4).

Table 2

Association between periodontal conditions and independent variables in adults and elderly in Uruguay: multivariate poisson regression analysis.

Independent variables	BOP (n = 588)			Periodontal disease					
				Moderate/severe (n = 599)			Severe (n = 599)		
	$PR_{adjusted}$	95%CI	p-value	$PR_{adjusted}$	95%CI	p-value	$PR_{adjusted}$	95%CI	p-value
Block 1									
Sex			0.077			< 0.001			0.065
Female	1.00			1.00			1.00		
Male	1.24	0.98-1.59		2.25	1.57-3.23		2.00	1.03-2.93	
Region			0.120						
Provinces	1.00						1.00		
Capital	1.20	0.95-1.54					0.68	0.37-1.23	
Age group (years)			0.092			< 0.001			< 0.001
35-44	1.00			1.00			1.00		
65-74	0.81	0.63-1.04		2.09	1.47-2.98		2.97	1.66-5.29	
University			0.010			0.018			< 0.001
Yes	1.00			1.00			1.00		
No	1.51	1.10-2.07		1.71	1.10-2.67		2.93	1.49-5.77	
Block 2									
Type of health services			0.236						
Private	1.00								
Public	1.07	0.84-1.37							
Time since last dental visit			0.001			0.032			0.583
Up to 12 months	1.00			1.00			1.00		
12 or more months	1.30	1.00-1.68		1.10	0.75-1.61		1.16	0.91-2.86	
Never used dental services	2.00	1.35-2.98		2.63	1.29-5.38		1.54	1.37-6.14	
Tooth brushing			0.024			0.156			0.895
≥ twice a day	1.00			1.00			1.00		
< twice a day	1.37	1.04-1.79		1.37	0.89-2.10		1.03	0.54-1.95	
Tobacco use			0.980			0.550			0.392
Do not smoke /not daily	1.00			1.00			1.00		
Up to 10 cigarettes/day	1.30	0.84-2.25		1.10	0.57-2.10		1.05	0.26-4.24	
10 or more cigarretes/day	1.00	0.71-1.42		1.33	0.81-2.16		1.65	0.79-3.44	

95%CI: 95% confidence interval; BOP: bleeding on probing; PR: prevalence ratio.

Table 3

Association between periodontal conditions and independent variables in adult population (aged 35-44 years) in Uruguay: multivariate poisson regression analysis.

Independent variables	BOP (n = 338)			Periodontal disease					
				Moderate/severe (n = 347)			Severe (n = 347)		
	PR$_{adjusted}$	95%CI	p-value	PR$_{adjusted}$	95%CI	p-value	PR$_{adjusted}$	95%CI	p-value
Block 1									
Sex			0.180			< 0.001			0.192
Female	1.00			1.00			1.00		
Male	1.22	0.93-1.68		2.93	1.64-5.25		1.82	0.71-4.62	
Region			0.060						
Provinces	1.00								
Capital	1.32	0.94-1.69							
University			0.026			0.060			0.007
Yes	1.00			1.00			1.00		
No	1.57	0.86-1.60		2.22	0.98-5.03		7.93	1.76-35.8	
Block 2									
Type of health services			0.331						0.336
Private	1.00						1.00		
Public	1.16	0.86-1.56					1.41	0.56-5.54	
Time since last dental visit			0.002						
Up to 12 months	1.00								
12 or more months	1.19	0.88-1.61							
Never used dental services	1.88	1.32-2.67							
Tooth brushing			0.087			0.111			
≥ twice a day	1.00			1.00					
< twice a day	1.35	0.96-1.90		1.71	0.89-3.30				
Tobacco use			0.761			0.780			0.687
Do not smoke/not daily	1.00			1.00			1.00		
Up to 10 cigarettes/day	1.15	0.65-2.04		1.28	0.55-2.98		1.68	0.41-6.91	
10 or more cigarretes/day	0.90	0.61-1.34		1.21	0.61-2.37		0.87	0.28-2.69	

95%CI: 95% confidence interval; BOP: bleeding on probing; PR: prevalence ratio.

Discussion

This was the first population-based study that assessed periodontal conditions in the adult and elderly population of Uruguay. The response rate obtained could be considered a weakness; however, in order to address this limitation, a calibration process was performed in the sample to allow the sex and age range to be kept proportional to the Uruguayan population [22].

Despite the relatively high non-response rate, a post-calibration process of the sample was carried out in order to compensate the initial different proportion between gender and ages. The post-calibration process consisted in adjusting sample weights according to the Uruguayan population when considering age and gender. This procedure makes our findings of fundamental importance to planning oral health strategies in the context of the new national health system implemented recently by the Uruguayan government [27]. Associations should be interpreted with caution due to the cross-sectional design used in this survey. As a Stata statistic program was used, we applied a specific test to analyze associations (Rao Scott) that considered sample weights and inflated these weights. Some associations could not have been detected due to the sample size which impacted negatively on the power to detect differences between groups. In fact, the sample size design was planned to calculate prevalence rather than to estimate differences. In the elderly, the stratification by age in the data analysis allows us to detect some differences between heavy daily smokers and people who do not smoke or smoke only a few cigarettes. The worst

Table 4

Association between periodontal conditions and independent variables in the elderly (aged 65-74 years) in Uruguay: multivariate poisson regression analysis.

Independent variables	BOP (n = 250)			Periodontal disease					
				Moderate/severe (n = 265)			Severe (n = 265)		
	PR$_{adjusted}$	95%CI	p-value	PR$_{adjusted}$	95%CI	p-value	PR$_{adjusted}$	95%CI	p-value
Block 1									
Sex			0.153			0.012			0.110
Female	1.00			1.00			1.00		
Male	1.33	0.98-1.83		1.69	1.12-2.56		1.64	0.89-3.30	
Region			0.690			0.220			0.115
Provinces	1.00			1.00			1.00		
Capital	0.92	0.62-1.37		1.35	0.83-2.19		0.57	0.29-1.15	
University			0.166			0.925			0.093
Yes	1.00			1.00			1.00		
No	1.38	0.87-2.20		0.98	0.66-1.46		1.90	0.90-4.03	
Block 2									
Type of health services			0.408						
Private	1.00								
Public	0.82	0.53-1.29							
Time since last dental visit			0.128			0.806			0.618
Up to 12 months	1.00			1.00			1.00		
12 or more months	1.66	1.02-2.72		1.04	0.67-1.63		0.79	0.43-1.46	
Never used dental services	1.61	0.59-5.01		1.44	0.70-2.97		1.10	0.47-2.56	
Tooth brushing			0.231			0.624			
≥ twice a day	1.00			1.00			1.00		
< twice a day	1.28	0.86-1.90		1.11	0.79-1.75		1.05	0.57-1.95	
Tobacco use			0.016			0.009			< 0.001
Do not smoke /not daily	1.00			1.00			1.00		
Up to 10 cigarettes/day	1.72	1.05-2.83		0.72	0.20-2.59		3.58	1.36-1.94	
10 or more cigarretes/day	1.81	1.16-2.83		1.92	1.25-2.97		3.59	1.84-7.00	

95%CI: 95% confidence interval; BOP: bleeding on probing; PR: prevalence ratio.

situation was in adults because the non-response rate was higher than in the elderly group. The population-based sample could be considered an important strength, allowing the extrapolation of the present findings (prevalence) to the whole country. In addition, the calibration process of examiners confers reliability to our results and complex statistical procedures have improved the external validity of our study.

Another limitation for our study was found: the use of CPI index [24] has important limitations such as the underestimation of prevalence of periodontal conditions due to the use of index teeth [27,28]. However, CPI is widely used around the world, conferring comparability to our results between countries. In addition, the fact that the CPI index was modified and national Brazilian oral health survey criteria were used allows us to measure each periodontal condition separately

and not only the worst condition, as is expected using the original CPI index. On the other hand, the combination of probing depth and clinical attachment loss as well as the use of two cut-off points to determine periodontal disease can all be highlighted as an effort to obtain detailed information about the periodontal status of the studied population.

CAL was not calibrated in this study in the same way as in the Brazilian national survey and this can be considered a limitation of our study.

The prevalence of periodontal outcomes was similar to those found in South American countries bordering Uruguay [3]. In comparison with the most recent national study performed in Brazil in 2010 (*SBBrasil* 2010) [29] which used the same methodological approach, the results of periodontal conditions found in Uruguay were very similar to conditions observed in Brazil. On the

other hand, prevalence of BOP was significantly higher in the Uruguayan population. The adult population in Uruguay also has more excluded sextants than in Brazil. This fact could be related to the absence of oral health care coverage for this age group in Uruguay.

Gender differences were found in the presence of periodontal disease. Males presented worse periodontal conditions, corroborating with previous findings [8,19]. This association can be explained by the fact that females tend not only to have better health behaviors but are also more likely in the long term to maintain oral health beliefs and smoke less [21]. An increase in the prevalence of periodontal disease was also observed in the elderly in comparison with adults. This is expected due to the chronic characteristics of periodontal disease and corroborates with previous studies [6].

The influence of socioeconomic gradients in general and oral health outcomes as well as in periodontal conditions [1,3,6,11,18] are well established in the literature. In the present study, the presence of a person with a university degree in the household was used as a socioeconomic indicator. Although the individual level of schooling would provide more sensitive information, this data was not available for the studied population. Education is a strong determinant of employment and income [30], so it is expected that the socioeconomic status of families with at least one member with a university degree should be higher in comparison with those without people with completed university studies.

The effect of socioeconomic status on periodontal disease can be explained using largely complementary theoretical frameworks. Material resources can improve nutrition and the ability to afford oral care products. Another way to explain this effect can be through the immunosuppressive effect of stress in response to social determinants. Psychosocial stress caused by poverty, unemployment and poor living conditions negatively affect health [10]. Stress can alter the inflammatory mediators and defense cells leading to periodontal disease. Also, psychological factors can affect behaviors associated with periodontal conditions, such as oral health behaviors and tobacco use. All these factors are affected by contextual factors, such as social structure and environment, which act as upstream influences that shape individual and proximal conditions affecting periodontitis [21].

The fact that the presence of a person with a university degree in the household was found to be associated with periodontal disease in adults but not in the elderly could be due to the difference in the proportion of excluded sextants between the adults and the elderly. Periodontal disease outcomes may be associated with the proportion of excluded sextants and the latter with socioeconomic status. As the proportion of excluded sextants may be greater among individuals who do not have a person with a university degree in the household, there may be fewer individuals to evaluate with the CPI index (more than two teeth should be present for the sextant to be considered).

Considering the presence of at least one person with a university degree in the household, our data are in concordance with national figures. Using the Centro de Investigaciones Económicas (CINVE) report [31], the proportion of households with a person with a university degree varies from 20% to 37%, according to the socioeconomic level: medium-upper and high-inferior, respectively. The mean values for all the population are similar in our study (30%).

With respect to smoking habits in the elderly, heavy smokers presented more periodontal disease (moderate and severe) than those who reported that they did not smoke or did not smoke daily. There is a lot of evidence showing the effects of tobacco use on periodontal health [9,20,32]. Dose-dependent association between smoking and periodontitis using the number of cigarettes smoked per day is well documented in the literature [9,33]. It is important to mention that data from the first Uruguayan survey of risk factors for chronic diseases showed that nearly one third of the Uruguayan adult population have daily smoking habits, being more prevalent in males than in females. These figures coincide with our findings in the adult population. However, we do not have the possibility to compare with elderly smokers because the age groups that were considered in both surveys are different (55-64 years: risk factors survey) [34].

Strategies focused on the reduction of tobacco use are under way in Uruguay. It has been the first country to adopt a national program of tobacco use. In addition, a reduction in the number of smokers is expected for the next years, which may reduce the risk for development of several chronic conditions, including periodontal disease.

People who visited the dentist in the last year had better gingival conditions than those who did not. Other studies describe the relationship between visiting the dentist and periodontal conditions [6,17]. This finding is related to the fact that these people are more concerned about their oral health and in better positions to take care of it. On the other hand, people who attend health services and manage to obtain oral health treatment are probably those with a better socio-

economic status and this factor was also associated with worse periodontal condition in adults. An aspect that should be analyzed is the reduced offer of public oral health care for the adult and elderly populations in Uruguay, which is focused on emergency demands only. The high prevalence of outcomes in people who have never used a dental service draws attention to the need for the establishment of policies focused on oral health in the context of the Uruguayan National Health Service.

Previous data about the periodontal status of the Uruguayan population were included in a recent review about the global burden of periodontal diseases [3]. However, it is important to highlight that this previous study was carried out in the 1980s in a non-representative sample of Uruguay, including only the individuals from the capital, and did not include older adults, which makes the comparison of the findings and the extrapolation of this data difficult.

To conclude, it could be stated that considering the prevalence of periodontal outcomes, a global national program promoting oral health that includes the prevention and treatment needs of periodontal conditions should be implemented. It might be integrated into national general health programmes of non-communicable diseases. It should also include the population approach using common risk factor approach (CRFA) and some group risk actions according to socioeconomic satatus and regional differences. This will contribute towards addressing health inequalities and save financial resources in the context of national health.

Resumo

O objetivo do estudo foi determinar a prevalência da doença periodontal em adultos e idosos uruguaios e sua associação com fatores comportamentais e socioeconômicos. Foram utilizados dados de adultos (35-44, n = 358) e de idosos (65-74, n = 411) participantes da primeira Pesquisa Nacional de Saúde Bucal, *no Uruguai, em 2011. A pesquisa incluiu um questionário sobre fatores de risco, incluindo fumo. Sangramento ao sandagem bolsa periodontal (IPC) e perda de inserção (PIP) foram avaliados por meio de exame clínico. Considerando-se as duas idades, a prevalência da doença moderada/grave foi de 21,8% e 9,12%. Na análise multivariada, foi observada associação entre a educação de nível universitário e todas as variáveis de resposta. O atendimento odontológico foi negativamente associado com a doença periodontal moderada e grave. A prevalência foi maior no grupo com menor nível socioeconômico. Dentre os idosos, o tabagismo foi fortemente associado à doença periodontal.*

Doenças Periodontais; Inquéritos de Saúde Bucal; Adulto; Idoso

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