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# The role of contextual and individual factors on periodontal disease in Uruguayan adults

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**Abstract:** The present study aimed at understanding the relationship between periodontitis and socio-contextual and individual determinants of health. Data from "The First Uruguayan Oral Health Survey, 2011", which included 223 and 455 individuals with 35–44 and 65–74 years old respectively, were used. A stratified, multistage cluster sampling design was adopted (cities with ≥ 20.000 residents). Periodontitis was assessed using the modified Community Periodontal Index (CPI) and clinical attachment loss (CAL) (periodontal pocket and CAL ≥ 4 mm). Independent variables included contextual socioeconomic status (SES) measured by proportion of houses with Unsatisfied Basic Needs (UBN) and individual demographic and behavioral factors. Logistic regression multilevel models were generated. Living in contexts with a higher UBN was associated with higher odds for periodontitis in both age groups, even when adjusting for individual level variables (odds ratio [OR] = 1.51, 95%CI = 1.42–1.60 and 1.31, 95%CI = 1.21–1.42, respectively). Being male or heavy smoker increased the odds of periodontitis in this population for both age groups. Social structure impacts periodontal disease by modifying individual socioeconomic situations: in better socioeconomic context, UBN acts increasing the protector role of socioeconomic situation but in a poverty context the role is attenuated. Conclusions for this study are that periodontitis varies across contextual socio-demographic groups being higher in the population with a lower SES, challenging health authorities to integrate oral health into national non-communicable diseases programs.

**Keywords:** Periodontal Diseases; Socioeconomic Factors; Dental Health Surveys; Health Status Indicators; Multilevel Analysis.

## Introduction

Periodontitis is a chronic inflammatory disease caused by bacterial infection of the supporting tissues around teeth.[1] The disease is a significant cause of tooth loss among adults, affecting more than 537 million people worldwide, with a prevalence of 7.6% for all ages combined.[2]

Studying the factors that are associated with periodontitis is crucial for health planning and the delivering of more effective and efficient health interventions. The existing theoretical model[3] on the occurrence of

chronic diseases, such as periodontitis, explains the pathways through which social structure, behavioral, and genetic factors may influence periodontitis and how these factors may interrelate. This model postulates that social structure impacts periodontitis through material and contextual factors and that health behaviors influence pathophysiological changes.[4] Thus, the individual micro-level and group-level characteristics are accounted for at the same time;[5] as a consequence, methodological aspects become relevant when considering individual and contextual variables in order to deal with multi-level data[5]. Accordingly, it has been observed that periodontitis is more common in relatively socially deprived population groups.[6,7]

There are only few studies on the socio-contextual determinants of periodontitis based on data from national surveys.[6,8,9,10] No association was found in two of them.[8,9] On the other hand, studies conducted in Brazil in 2010 and in China in 2005 reported a positive association between the presence of periodontitis and contextually deprived socio-economic status (SES).[6,10]

Data regarding periodontitis in countries from Latin America are still scarce.[6,9,11] In addition, there is a lack of studies assessing contextual determinants of periodontitis in Uruguay. In 2011, a national oral health survey that included periodontal conditions and several associated factors for general and oral health was conducted[12] and the prevalence of periodontal conditions and its association with some individual factors was reported for the first time[13] The present study aimed at understanding the relationship between periodontitis and socio-contextual and individual determinants of health using data from the First National Survey on oral health in Uruguayan adult population. The hypothesis is that contextual socioeconomic disadvantage is associated with an increase of periodontal disease.

## Methodology

### Population data

This cross-sectional study was part of "The First National Survey of Oral Health in young and adult population in Uruguay" carried out during 2010-2011. Uruguay is a small country in the South-eastern region of South America with approximately 3.3 million inhabitants, characterized by a high income per capita (based on its gross national income) and low level of inequality and poverty.

The survey was performed as part of the National Health System implementation, following the World Health Organization (WHO) guidelines (fourth edition) for oral health surveys[14] The sample was planned to be representative of the country's regions (capital and countryside). The target population was Uruguayan adults aged 35–44 and 65–74 (as recommended by WHO) living in the countryside and the reference population was 412,335 individuals living in cities with ≥ 20,000 residents.

### Sample design and sample size

A stratified, multistage cluster sampling design was adopted. The sample design of the National Statistics Institute Household Survey (ECH)[15] was considered as the first sampling phase, which took into account SES. To reach the specified sample size in each of the selected age groups, four sections from the ECH were required, comprising 10 of the possible 19 country departments, because the sampling design was a sub-sample of the Household Survey.

For sample size calculation of the survey, a prevalence of dental caries of 85% was considered for both middle aged and older adults. To calculate prevalence for the Uruguayan national survey, the 2010 Brazilian National Survey was used. For the 35–44 and 65–74, the prevalence of caries was the value that was closer to 50% (offering the most conservative option) and for this reason, it was used as the reference for both age groups. The calculation also took into consideration a type I error of 5%, a power of 80%, and a design effect of 1.5, and an added 20% for non-responses. According to this calculation, a sample size of 788 individuals (394 people aged between 35–44 years and 394 aged between 65–74 years) was sufficient to detect an OR of at least 1.45 and 1.18 in the "adults" and "elders" group, respectively, considering periodontitis as outcome.

A post-calibration process of the sample was carried out to compensate for age and gender imbalances. Detailed information of the methodology is available elsewhere.[12]

### Exam

Data collection consisted of clinical examination and interview. The fieldwork team comprised six dentists and six dental students from the School of Dentistry, Universidad de la República (UDELAR). The clinical examination was carried out and the questionnaire with socioeconomic, demographic, and behavioral characteristics was administered at the participants' homes. Participants were examined sitting under artificial illumination. Two calibration processes were performed during fieldwork, in which 40 individuals were examined in each opportunity. Inter-examiner reliabilities were calculated using kappa statistics. For periodontal pocket conditions, the values ranged from 0.6 to 1 and intra-examiner values varied from 0.67 to 0.98.

### Outcome

Periodontal status was assessed based on the modified version of the Community Periodontal Index (CPI).[6,14] A clinical evaluation was performed using the CPI probe, examining six sites in index teeth in each sextant. The presence of periodontal pockets was classified as "absent", when the pocket depth was from 0-3 mm or "present", when the pocket depth was ≥4 mm. All periodontal conditions were assessed and recorded separately in each tooth. Clinical attachment loss (CAL) was also assessed in all sextants using WHO categories.[13] Periodontal disease was defined as moderate to severe when CPI > 2 (periodontal pocket ≥ 4 mm) and CAL ≥ 4 mm. The pocket depth and CAL were not necessarily in the same sextant. [6]

### Contextual variable

The contextual grouping variable used in this study was based on Unsatisfied Basic Needs (UBN), developed by the Latin American and Caribbean Economic Commission to measure socioeconomic deprivation. In Uruguay, this indicator includes six dimensions: housing and minimum domestic household equipment, sanitation facilities, access to education, electricity, and clean drinking water. The absence of one of these dimensions is considered a positive case.[16] The National Statistics Institute provides the proportion of houses with UBN for census tracts. In Uruguay, the proportion of individuals, for the considered provinces, with one or more UBN, varies between 25.1% (Colonia) to 48.0% (Artigas) for ages between 35–64 and 21.5% (Colonia) and 41.8% (Artigas) for people 65 years old or older. We calculated the mean UBN proportion for each of the 10 provinces visited in the national oral health survey. Provinces were dichotomized using the median of UBN proportion as cut-off point and considered as follows: higher contextual poverty (higher than the median) and lower contextual poverty.

### Individual independent variables

Independent variables included socio-demographic and behavioral factors. Socio-economic status was assessed with the simplified version of the Socioeconomic Status Index (SEI) and validated for the Uruguayan population by the UDELAR School of Social Sciences.[17] The index uses the following information to define SES: head-of-household's occupation, number of income-earning individuals in the household, at least one family member with a university degree, home appliances, home furnishings, at least one family member with an international credit card, and car ownership. The resulting score ranges from 0 to 100. Participants' age was collected in years and then categorized in the following groups: 35–44 or 65–74.[14] Tooth brushing frequency was collected in seven categories and then categorized in "twice or more/day" or "less than twice a day".[13]

Behavioral variables were assessed by a questionnaire based on the WHO[18]. Stepwise approach to non-communicable diseases (NCD) surveillance, modified by the Uruguay Ministry of Health in 2006 was used. Smoking habits were assessed by asking whether the individual currently smoked daily and the number of cigarettes per day. Then, individuals were categorized into two groups: "heavy smokers" (more than 10 cigarettes/day) and "non-heavy smokers".[19] Alcohol consumption was assessed by asking whether the individual currently drank and how often. Then, the variable was categorized into two groups: "does not drink or drinks monthly" or "drinks daily or weekly". This cut-off point was adopted because there were very few participants in the sample who drank daily or more than four times a week. Diet

was investigated by asking the following questions: "In a week, how many days do you consume fresh fruits and vegetables (except potatoes and sweet potatoes)?" and "On those days, how many servings do you consume?" This variable was then categorized into two groups: low frequency of consumption of fruits and vegetables (less than 5 servings/day) or high frequency (5 or more servings/day).[18]

### Data analysis

A multivariable analysis was performed using multilevel-hierarchical logistic regression models. For the hierarchical approach[20], three levels of data organization from distal to the most proximal determinants were used: a) contextual disadvantage socioeconomic index; b) individual socio-demographic and c) behavioral (Figure). Each block of data organization determined the sequence in which the variables were entered in the models. All the associations were adjusted for covariates positioned in the same and in the upper levels of the model. To remain in each phase of the analysis (block 1 and full model) variables had to present a p-value ≤ 0.25. A stepwise backward selection procedure was performed in each phase of the model. Multivariate analyses were performed by age groups (adults and elderly).

Collinearity between UBN and SES was analyzed using Variance Inflation Factor (VIF) and as it was lower than 1.5 in all cases, both variables were kept in the models.

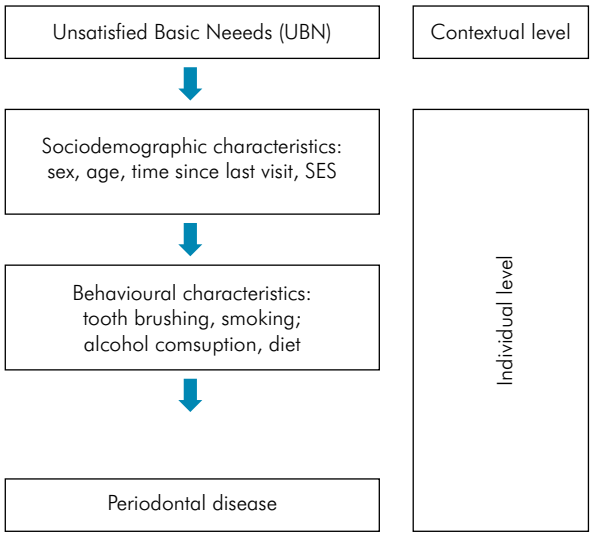


**Figure.** Hierarchical model of the relationship between contextual and individual explanatory variables of periodontal disease.

The statistical package STATA 11.1 (Stata Corporation; College Station, TX, USA) was used to perform bivariate (Rao Scot test) and multivariate analyses (using the GLLAMM framework, a complementary library of Stata Statistical package to analyze multivariate models based on complex sample designs).[21,22] All the analyses considered the study design and sample weights. Multilevel models were used to evaluate the effect of contextual variables on periodontitis across UBN groups and adjusted for individual socio-demographic and behavioral characteristics (fixed effects). The UBN groups' variance (random effects) in periodontitis in relation to the individual variables was assessed using the median of the odds ratio (MOR) between the groups. The MOR was calculated as a measure of heterogeneity. Interaction between contextual disadvantage and individual socioeconomic status (SEI) was also tested.

### Ethical aspects

The study protocol was approved by the Ethics Committee of UDELAR School of Dentistry. All the participants provided written consent.

## Results

A total of 484 subjects were assessed. From this sample, 46.5% were adults and 53.5% were elderly (Tables 1 and 2). The average non-response rate was 43% and 34% for adults and elders, respectively. Mean number of lost teeth was 9.8 among aldults and 22.2 among elderly. Prevalence of periodontal disease was 18% in adults and 22% in elderly.

The characteristics of the sample compared to the Uruguayan population data that was available is shown in Table 3; the sample was in concordance with data from the 2011 Uruguayan census.

Proportion of houses with UBN in the studied provinces varied between 57% and 24%. Living in poorer context (higher UBN) increased the odds of periodontal disease in 51% (OR = 1.51, 95%CI = 1.42–1.60) and 31% (OR = 1.31 95%CI = (1.21–1.42) for adults and elders, respectively, compared to those living in areas with lower UBN (higher contextual SES) (Tables 1 and 2).

**Table 1.** Prevalence, and unadjusted and adjusted OR between periodontal disease (PD) and risk factors in the 35–44 age group.

| Variables | n | PD%[a] | OR (95%CI)[b] | Adj-OR (95%CI)[c] |
|---|---|---|---|---|
| Contextual variables | | | | |
| Contextual Poverty (UBN[d]) | | | | |
| Greater | 100 | 20.2 | 1 | 1 |
| Lower | 125 | 16.9 | 1.51 (1.42–1.60) | 1.51 (1.42–1.60) |
| Individual variables | | | | |
| Sociodemographic level | | | | |
| Sex | | | | |
| Female | 140 | 9.1 | 1 | 1 |
| Male | 85 | 29.4 | 3.87 (1.99–7.52) | 3.93 (2.08–7.60) |
| Time since last visit | | | | |
| Less than one year | 105 | 15.5 | 1 | |
| More than one year | 120 | 21.2 | 1.29 (0.59–2.54) | |
| SEI[e] | | | 0.94 (0.89–0.99) | 0.88 (0.84–0.91) |
| UBN x SEI | | | | 1.12 (1.05–1.20) |
| Behavioral level | | | | |
| Heavy smoker | | | | |
| No | 191 | 16 | 1 | |
| Yes | 34 | 28.8 | 2.15 (0.58–7.96) | |
| Diet[f] | | | | |
| More than 5 servings a day | 62 | 7.3 | 1 | |
| Less than 5 servings a day | 163 | 22.7 | 3.37 (0.97–11.77) | |
| Drinking | | | | |
| Less than 4 times per week | 186 | 17.9 | 1 | |
| Weekly/daily | 38 | 19.8 | 1.36 (0.39–7.65) | |
| Tooth brushing | | | | |
| Twice a day | 188 | 16.2 | 1 | |
| Less than twice a day | 37 | 27.9 | 1.84 (0.72–4.70) | |
| MOR[g] | | | | 1.62 |

a: Periodontal disease prevalence; b: Unadjusted odds ratio; c: Adjusted odds ratio; d: Unsatisfied basic needs; e: Socio economic index (mean); f: Fresh fruits and vegetables; g: Median odds ratio.

The variation of periodontitis between the contexts is shown using MOR (1.62 and 1.48 for adults and elderly, respectively). It indicates that if a person with lower UBN moves to a context with a higher UBN, the odds of getting the disease increase by 62% and 48% in adults and the elderly, respectively.

Considering individual variables in adults, adjusted analysis revealed that people with better individual SES presented lower prevalence of periodontitis (mean SEI = 0.88 (0.84–0.91)

Regarding the elderly, after adjustments, being male (OR = 5.12, 95%CI = 2.82–9.30), heavy smoker (OR = 2.53, 95%CI = 2.03–10.85) and brushing the teeth less than twice a day (OR = 2.41, 95%CI = 1.82-9.61) was associated with increased odds for periodontitis (Table 1).

Interactions between contextual poverty and individual socioeconomic status (SEI) were statistically significant only in adults. When considering individuals living in more affluent contexts, the odds of having the disease decreased 12% for each increased unit of SEI.

**Table 2.** Prevalence, and unadjusted and adjusted OR between periodontal disease (PD) and risk factors in the 65–74 age group.

| Variables | n | PD%[a] | OR (95%CI)[b] | Adj-OR (95%CI)[c] |
|---|---|---|---|---|
| Contextual variables | | | | |
| Contextual Poverty (UBN[d]) | | | | |
| Greater | 123 | 21.9 | 1 | 1 |
| Lower | 136 | 21.5 | 1.31 (1.21–1.42) | 1.31 (1.21–1.42) |
| Individual variables | | | | |
| Sociodemographic level | | | | |
| Sex | | | | |
| Female | 163 | 11.3 | 1 | 1 |
| Male | 96 | 37.4 | 5.06 (2.83–9.04) | 5.12 (2.82–9.30) |
| Time since last visit | | | | |
| Less than one year | 62 | 17.9 | 1 | |
| More than one year | 197 | 22.8 | 1.37 (0.43–4-36) | |
| SEI[e] | | | 0.98 (0.96–1.01) | |
| UBN x SEI | | | | |
| Behavioral level | | | | |
| Heavy smoker | | | | |
| No | 244 | 19.9 | 1 | 1 |
| Yes | 15 | 49.1 | 4.75 (2.08–10.86) | 2.53 (2.03–10.85) |
| Diet[f] | | | | |
| More than 5 servings a day | 106 | 12.9 | 1 | |
| Less than 5 servings a day | 153 | 28.1 | 2.32 (1.13–4.77) | |
| Drinking | | | | |
| Less than 4 times per week | 192 | 16.6 | 1 | |
| Weekly/daily | 59 | 41.4 | 2.90 (1.40–6-01) | |
| Tooth brushing | | | | |
| Twice a day | 186 | 15.8 | 1 | 1 |
| Less than twice a day | 73 | 34.6 | 4.15 (1.93–8.95) | 2.41 (1.82–9.61) |
| MOR[g] | | | | 1.48 |

a: Periodontal disease prevalence; b: Unadjusted odds ratio; c: Adjusted odds ratio; d: Unsatisfied basic needs; e: Socio economic index (mean); f: Fresh fruits and vegetables; g: Median odds ratio.

## Discussion

Contextual poverty was associated with periodontitis, i.e., households with more unsatisfied basic needs had increased odds for periodontal disease. Our results have contributed to improving the understanding of periodontitis as a socially related condition, providing useful information for planning health interventions within the national health system recently developed in Uruguay.[23]

The interaction between UBN and individual SEI indicates that people living in more affluent contexts had considerably decreased chances of getting the disease when SEI was increased, but for those living in more disadvantaged contexts, increasing any unit of SEI did not decrease the risk for periodontal disease. The latter may suggest that contextual disadvantage has a crucial role as a social determinant.[3,4] Social structure impacts periodontal disease by modifying individual socioeconomic situations differently. In better contextual situations, UBN acts increasing the protecting role of SEI but in worse contextual situations (poverty) the role of SEI is attenuated.

Recent investigations have addressed inequalities on periodontitis using data from national surveys and multilevel analysis.[6,8,10] The findings of the current study differ from the results obtained in both the 2003 Brazilian Oral Survey[9] and the 1998 Adult Oral Health Survey in the UK.[8] In the former, the Gini index was used and in the latter, the deprivation area postal code was used. The different criteria used for social context may explain the differences. The association between periodontitis and contextual SES found in this study

**Table 3.** Characteristics of the sample and the population of 35–44 and 65–74.

| Variable | National oral health survey (n = 484) | | | Uruguay National Census |
|---|---|---|---|---|
| | n | % | CI | % |
| UBN (n = 473) | | | | |
| 35–44 | 225 | 36.27 | 33.59–38.96 | 27.9 (35–64) |
| 65–74 | 259 | 29.89 | 27.73–32.04 | 23.2 (more than 65 years)* |
| Age group | | | | |
| 35–44 | 225 | 62.36 | 57.29–67.46 | 64 |
| 65–74 | 259 | 37.63 | 32.55–42.72 | 36 |
| Sex | | | | |
| 35–44 | | | | |
| Female | 140 | 54.47 | 46.16–62.80 | 51 |
| Male | 85 | 45.52 | 37.20–53.83 | 49 |
| 65–74 | | | | |
| Female | 163 | 60.30 | 53.19–67.42 | 56 |
| Male | 96 | 39.69 | 33.69–46.80 | 44 |
| SES (SEI)** | | | | |
| 35–44 | 225 | 38.18 | 36.08–40.28 | Not available |
| 65–74 | 259 | 31.31 | 29.42–33.21 | |
| Time since last dental visit (more than 1 year) | | | | |
| 35–44 | 120 | 50.09 | 41.90–58.28 | Not available |
| 65–74 | 197 | 76.20 | 70.30–82.12 | |
| Behavioral | | | | National Behavioral factors survey: 2006*** |
| Tooth–brushing (more than less twice a day) | | | | |
| 35–44 | 37 | 18.20 | 11.29–25.11 | |
| 65–74 | 73 | 31.06 | 24.16–37.92 | Not available |
| Fruit and vegetables (less than 5 servings/day) | | | | |
| 35–44 | 37 | 71.79 | 64.40–79.17 | 85 (83.2–86.6) |
| 65–74 | 63 | 57.23 | 50.12–64.34 | (25–64 years) |
| Drinking (daily) | | | | |
| 35–44 | 6 | 4.50 | 3.28–8.68 | 7.1 (5.05–8.7) |
| 65–74 | 34 | 13.59 | 8.44–18.73 | (Daily, 25–64 years) |
| Daily smokers | | | | |
| 35–44 | 55 | 27.38 | 19.32–35.44 | 32.7 (30.5–34.9) |
| 65–74 | 29 | 11.32 | 6.76–15.89 | (Daily smokers, 25–64 years) |

* Calvo 2011; **mean.

is in accordance with another Brazilian investigation, which used data from the 2011 national survey and the same criteria for periodontitis, but with a different contextual index.[6] Our findings also corroborate recent published findings from the Chinese national survey, which found that provincial average income was associated with presence of periodontal disease in the same age-groups.[10]

The association of periodontitis with a higher proportion of houses with UBN highlight the presence of inequalities on periodontitis distribution according to contextual characteristics. This confirms previous reports on the role of social inequalities as determinants of periodontal disease both at the individual and the contextual level.[6] Because the proportion of houses with UBN is considered a structural indicator, which includes housing, minimum domestic household equipment, sanitation facilities, access to education, electricity, and clean drinking water, the conditions mentioned above might have been operating for a long time (especially in the elderly), affecting the general susceptibility to periodontitis.[24] Our finding is in accordance with the embodiment concept of the Eco social theory[25] and reinforces the need for understanding the role that contextual determinants play on health inequalities.

The explanatory mechanism on the link between social determinants and periodontitis is diverse. Inequalities may influence periodontitis through degradation of the interpersonal relationships between members of a community.[6] According to Brunner and Marmot's theoretical model that connects periodontitis as a chronic degenerative disease to social structure, the impact of socioeconomic factors on periodontitis occurs through material and contextual factors.[4] The physical and social environment (social cohesion and violence) are elements of the context where people live. The environment may be hazardous and limit the choices and resources available to individuals. Exposing people repeatedly to stressful conditions (i.e. work), may have a direct effect on health (chronic activation of the neuroendocrine system) and an indirect effect (through health behaviors as a coping mechanism).[10] The physical and social environments may affect periodontal status through neighborhood characteristics, ways of living, sub-cultures that shape people behaviors such as tobacco use, alcohol intake, type of diet (fruits and vegetables consumption), and oral health habits (tooth brushing). Research has recognized the importance of neighborhood environments in shaping individual lives[26] and of individuals shaping their neighborhoods.[8] Thus, unfavorable contextual conditions, measured using UBN, could lead to the adoption of individual unhealthy behaviors. In fact, an increase of time exposed to an unfavorable context could lead to an increase in risk for disease. However, this was a cross-sectional study that did not assess time of exposure to contexts. Moreover, due to the high prevalence of tooth loss in elders, the prevalence of periodontitis was similar between age groups (18 and 22%). In this case, differences in effect size are minimized.

Considering risk factors such as diet, alcohol intake, smoking, and tooth brushing, and taking into consideration the differences between adults and elderly, the response rate was better in the elderly. This conferred high statistical power to detect differences between individuals with and without the risk indicators in the elderly compared to adults. Besides, time of exposure, which is related to periodontitis as a chronic disease, was probably greater for the elderly. Harmful habits take time to act as risk factors. This could explain the fact that smoking habits was associated to periodontitis only in elders. On the other hand, the smoking variable lacked the information about time of exposure, which is a limitation and might have influenced the results.

The evidence of the association between individual SES and periodontitis is unequivocal.[8] However, SES was only associated with periodontitis in adults, which could be explained by considering that the lifestyle has changed faster for those who were born in the 1970s (adults) compared to elders. Besides, older people may be a more homogenous group because most of them received pensions, which is less income than when they were working.

## Strengths and limitations

Despite the relatively high non-response rate of adults, a post-calibration of the sample was conducted to compensate for the initially different proportion between gender and age. The post-calibration consisted of adjusting sample weights according to the Uruguayan population when considering age and gender. Even with post-calibration of the sample, the high non-response rate may have biased the results, mainly because we could not have information about socioeconomic status of losses.

Also, the associations should be interpreted with caution due to the cross-sectional design of the study. Another constraint was the use of CPI,[14] which has important limitations,[27] such as being biased by tooth loss in older ages (4.5 mean excluded sextants in 65–74 age group and 1.6 in the 35–44 group). In addition, CPI has a partial examination protocol, which leads to an underestimation of disease prevalence, although this limitation is more important in younger populations.[27] Use of full-mouth protocols would be preferred, mainly in longitudinal assessments. However, studies have shown that partial protocols were useful to identify risk factors.[27] CPI is widely used in epidemiological surveys around the world, thus, conferring comparability of our findings with those from other countries. In addition, the fact that the CPI index was modified and that Brazilian national oral health survey criteria were used allowed us to measure each periodontal condition separately and not only the worst condition, as is expected using the original CPI index.

The present study has also some important strengths that should be mentioned: a) the socio-demographic and behavioral characteristics of the participants were compared with those of the Uruguayan population and were similar, which added to sample design, confers external validity to the study; b) The combination of probing depth and CAL to determine periodontitis can be highlighted as an effort to obtain detailed information on periodontal status and on the cumulative tissue destruction;[28] c) The calibration of examiners (CPI) confered reliability to our findings and made this adult oral health survey a useful input for the country; d) Health determinants for periodontal disease have been addressed to better understand the disease and plan health care programs. Also, the fact that periodontitis was associated with well-known risk factors for periodontitis, such as smoking status, confers validity to our results.

## Conclusion

The presence of periodontal disease was associated with poorer contextual socioeconomic conditions. Therefore, health authorities should develop national oral health programs taking into consideration contextual characteristics.

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