

High levels of periodontal disease among the older adult population in San Juan, Puerto Rico

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The Puerto Rican Elderly Dental Health Study is the first to evaluate the periodontal status of a representative sample in Puerto Rico. **Objective:** To assess the periodontal status among the elderly population in San Juan. **Basic Research Design:** Three dentists were trained and standardised by the US National Health and Nutrition Examination Survey (NHANES) reference examiner. They examined elders aged 70–97 in the San Juan area from participants in a representative cohort of the Puerto Rican elderly. Probing depth (PD), attachment loss (AL), and tooth mobility were assessed among the dentate participants on 4 sites on all teeth excluding third molars. We used the CDC-AAP definitions for moderate periodontitis (≥ 2 teeth with AL ≥ 4 mm at interproximal sites or ≥ 2 teeth with PD ≥ 5 mm at interproximal sites) and severe periodontitis (≥ 2 teeth with AL ≥ 6 mm at interproximal sites and ≥ 1 teeth with PD ≥ 5 mm at interproximal sites). **Results:** The participation rate was 47%, 183 individuals, mean age 77.9 (sd 5.9), and 67% were females. Mean number of teeth was 15.8 (sd 6.8), and tooth mobility was present in 18% of participants. Mean PD was 1.5 (sd 0.6) and mean AL was 2.8 mm (sd 1.5). The prevalence of moderate and severe periodontitis (CDC-AAP) was 44.5% compared to 20.7% in the NHANES 1999–2004 survey among 75 years and older. **Conclusions:** Our study showed high levels of severe and moderate periodontal disease among Puerto Rican older adults. Further research is needed to understand the reasons for the high prevalence.

Key words: periodontal disease, prevalence, representative sample, older adults

Introduction

As the elderly population continues to live longer and experiences greater tooth retention, concerns regarding their periodontal health have increased (Douglass *et al.*, 1993). Older adults have higher prevalence and severity of periodontal diseases (Borrell *et al.*, 2004; Brown *et al.*, 1996; Dye *et al.*, 2007a; Krstrup and Petersen, 2006) compared to younger adults, primarily due to the cumulative effects of prolonged exposure to etiologic factors. A recent report mentions that more than half the 75 and older population in the US show signs of past periodontal destruction manifest as attachment loss ≥ 4 mm (Dye *et al.*, 2007b).

Even though Puerto Rico is a US territory, large-scale US surveys have not included Puerto Rico in their oral health assessments. The Hispanic Health and Nutrition Examination Survey (HHANES) collected clinical periodontal measures of 9,401 Hispanics living in the US between the years 1982 and 1984 (Ismail and Szpunar, 1990). Compared to the two other major Hispanic populations, Mexicans and Cubans, Puerto Ricans living in the US showed the highest prevalence of periodontal disease after controlling for the effects of age, sex, diabetes and oral hygiene status. To date, there are no published data on the periodontal health status of populations in Puerto Rico.

The aim of this study was to conduct the first population-based survey to assess the prevalence and severity of periodontal disease among a representative sample of the elderly from an urban region in Puerto Rico, and to compare this with published data from US populations.

Method

A large representative sample of individuals living in the San Juan was selected to participate in the Puerto Rico Elderly Dental Health Study (PREDHS) from older adults participating in the ongoing Puerto Rican Elderly Health Conditions (PREHCO) study. PREHCO is a large research project collecting information on health status, functional status, housing characteristics, and other conditions among older non-institutionalised adults via an island-wide survey. Most study participants' information was collected during face-to-face in-home interviews. The PREHCO study used a multistage stratified sample of the elderly population with oversampling of regions heavily populated by populations of African descent and of individuals over age 80 (PREHCO, <http://prehco.rcm.upr.edu>).

Participants for PREDHS were selected from the San Juan metropolitan area, which was defined using census blocks and encompassed the 8 municipalities with zip codes starting 009 (San Juan, Bayamon, Carolina, Guaynabo, Cataño, Toa Alta, Toa Baja, and Trujillo Alto). Excluded were the edentulous, those failing a mini-mental test during earlier PREHCO interviews and subjects of other PREHCO sub-studies. The Institutional Review Board of the Medical Sciences Campus University of Puerto Rico approved the PREDHS protocols.

Although the individuals in the original PREHCO study were somewhat different with respect to risk factors for periodontal disease from older adults selected

into the Behavioral Risk Factors Surveillance System (BRFSS: a representative sample drawn from the same population), the final PREDHS sample was similar to the BRFSS with respect to these risk factors except for a 1 year difference in mean age (Table 1). Hence it was considered unnecessary to weight the PREHDS analyses to assume representativeness.

The periodontal examinations were part of a comprehensive oral examination assessing gingival recession and probing depth on 4 sites per tooth (mesio-buccal, mid-buccal, disto-buccal, and disto-lingual) on all teeth present except third molars. We used the National Health and Nutrition Examination Survey (NHANES) clinical criteria and instrumentation. A dental mirror, Hu-Freidy PCP2 (Chicago, IL) periodontal probe and a portable halogen lamp were used in the participants' homes from August to November 2007. In addition, participants' tooth mobility was measured using a bi-digital technique with mobility classified according to Miller's index: Class I, first detectable sign of movement; Class II, movement >1mm in any direction; and Class III, movement of >1mm in any direction and vertical depression or rotation.

Oral health training, standardisation and calibration sessions were conducted at the School of Dental Medicine of the University of Puerto Rico 2 months before the data collection started. Calibration subjects (n=51) were examined by the NHANES reference dental examiner and by each of three trained dentists and their reliability measured.

SAS statistical software (v9.1.3, NC) was used to calculate measures of central tendency at the individual, tooth and site levels. Gingival recession and probing depth (PD) were measured in millimetres (mm) and attachment loss (AL) was calculated by subtracting the gingival recession value from PD. Finally, summary variables were created for severity and dichotomised the periodontal measures to classify participants as diseased and non-diseased to obtain prevalence measures. The distribution of periodontal disease is presented separately for age and gender subgroups and differences reported at the $p < 0.05$ level. The definitions used are those proposed by the Centers for Disease Control and Prevention and the American Academy of Periodontology (CDC-AAP) for surveillance of periodontitis in population-based studies (Page and Eke,

2007). Individuals are classified as having moderate (≥ 2 interproximal sites with AL ≥ 4 mm or ≥ 2 interproximal sites with PD ≥ 5 mm) or severe periodontitis (≥ 2 interproximal sites with AL ≥ 6 mm and ≥ 1 interproximal sites with PD ≥ 5 mm). Individuals not in either of these two groups are defined as having no or mild periodontitis.

Results

From the 1,364 individuals in the PREHCO database living in the San Juan Metropolitan area, we identified 943 non-institutionalised participants. We excluded an additional 551 participants that met the following criteria: did not pass a mini-mental exam (n=123, 13%), were previously identified for participation in another clinical study (n=158, 16%), were edentulous (n=134, 14%), and <70 years of age (n=136; 14.4%), resulting in a final sample of 392 individuals eligible for screening and recruitment. The sample for this study was 183 (47% of those 392), 61 males and 122 females, after excluding 60 individuals for medical conditions that contraindicate periodontal probing without prophylactic antibiotic therapy, 19 deceased, sick or hospitalised, 23 not contactable, and 107 who declined to participate.

The mean age of the 183 examined was 77.9 (sd 5.9, range 70 to 97). Their mean number of natural teeth was 15.8 (sd 6.7) with no significant difference by gender. Women were more likely than men to have diabetes (21.3% vs. 32.0%) and to be non-smokers (98.4% vs. 88.5%). Results from pre-study training and calibration exercises indicated very good concordance between trainees and the reference examiner. Agreement between each of the trained examiners and the reference examiner was excellent, (87% to 94%, Kappa 0.75 to 0.87, (Fleiss, 1981) similar to previously reported NHANES inter-rater statistics (Dye *et al.*, 2007a).

Table 2 presents the prevalence of individuals with at least one site with PD or AL at different severity levels by age. The prevalence at PD ≥ 7 mm is 9.8% and 50.8% for AL ≥ 7 mm. The prevalence of periodontal disease is similar across the age groups for AL, but prevalence using PD is lower among people 80 and over compared to the younger group. In the middle severity band, AL or PD of

Table 1. Characteristics of parent study participants in the Puerto Rican Elderly Health Conditions study (PREHCO) and of individuals who completed periodontal examinations in the Puerto Rican Elderly Dental Health Study (PREDHS)

	BRFSS 70+	PREHCO Phase 1	PREHCO Phase2 70+ dentate S.J.	PREDHS Participants 70+
	n=825	n=4291	n=661	n=183
Mean Age (sd)	76.8 (5.5)	77.5 (9.0)*	80.0 (7.5)	77.9 (6.0)*
Females (%)	64.4	59.5*	65.1	66.7
Skin colour: White (%)	66.1	38.4*	62.6	69.4
Black (%)	4.2	4.6	6.7	6.6
Diabetics (%)	26.8	28.0	35.5	28.4
Current smokers	4.2	9.2*	4.1	4.9

*Statistically different when compared to BRFSS ($p < 0.05$)

Table 2. Percentage prevalence (and its confidence interval) of individuals, in two age groups, with at least one tooth with probing depth and attachment loss within different severity ranges

Range	Probing Depth			Attachment Loss		
	All Ages	70-79 years	80+ years	All Ages	70-79 years	80+ years
3-4mm	79.8 (73.4, 85.0)	84.0 (76.4, 89.5)	71.9 (59.9, 81.4)	98.9 (96.1, 99.7)	99.2 (95.4, 99.9)	98.4 (91.7, 99.7)
5-6mm	29.0 (22.9, 35.9)	33.6 (25.8, 42.5)	20.3 (12.3, 31.7)	81.4 (75.2, 86.4)	81.5 (73.6, 87.5)	81.3 (70.0, 88.9)
≥7mm	9.8 (6.6, 15.0)	12.6 (7.8, 19.8)	4.7 (1.6, 12.9)	50.8 (43.6, 58.0)	51.3 (42.4, 60.1)	50 (38.1, 61.9)

Table 3. Prevalence of individuals with at least one tooth with probing depth and attachment loss by different severity bands stratified by risk factors

Category (n)	Band mm	Probing Depth	Attachment Loss
Females			
122	3-4	77.1	99.2
	5-6	19.7	77.9
	≥7	7.4	43.4
Males			
61	3-4	85.3	98.4
	5-6	47.5	88.5
	≥7	14.8	65.6
Current Smokers			
9	3-4	77.8	100.0
	5-6	55.6	100.0
	≥7	22.2	66.7
Past-smokers			
42	3-4	81.0	100.0
	5-6	33.3	83.3
	≥7	14.3	54.8
Non-smokers			
132	3-4	79.6	98.5
	5-6	25.8	79.6
	≥7	7.6	48.5
Diabetics			
52	3-4	78.9	98.1
	5-6	32.7	78.9
	≥7	11.5	61.5
Non-diabetics			
131	3-4	80.2	99.2
	5-6	27.5	82.4
	≥7	9.2	46.6

Table 4. Prevalence of periodontal disease (CDC-AAP moderate and severe periodontitis definitions) on the mesial site, across studies

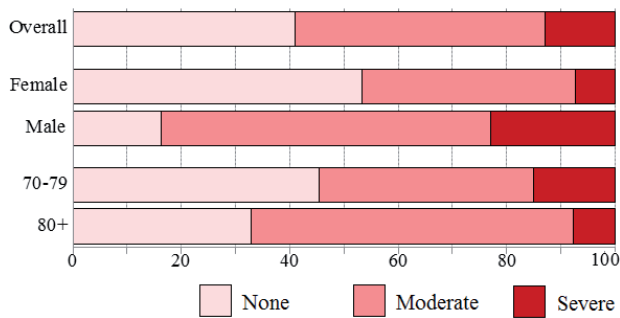
Study	Age	Population	Prevalence
NHANES 1999-2004	75+	overall US	20.7%
PREDHS 2007	75+	overall	44.5%
NHANES 1999-2004	65+	US Hispanic	24.2%
NHANES 1999-2004	65+	US male	20.6%
PREDHS 2007	70+	male	54.1%
NHANES 1999-2004	65+	US female	14.4%
PREDHS 2007	70+	female	33.3%

5-6mm, this AL prevalence was 81.4% and similar across age groups but PD prevalence was 29.0% but higher by more than 10% among people under 80 years compared to 80 and older a Mean PD for these PREDHS participants was 1.52mm (sd 0.57). Second molars had the highest mean PD (2.01mm) while the central incisors had the lowest (1.34mm). At the site level, the mesio-buccal site showed the greatest mean PD (1.74mm). Overall, the study group had a mean AL of 2.76mm (sd 1.50). The second molars showed the highest AL of all teeth examined (mean AL 3.68mm). At the site level, the disto-lingual site had the highest mean AL (2.92mm). Pathologic stages of mobility were present among 16 males (26%) and 17 females (14%) for a total of 33 (18%) of the examined individuals. Among these, 73% showed type II dental mobility and 27%, type III.

Table 3 shows the prevalence of individuals with at least one tooth with PD and AL by different severity bands stratified by gender, smoking and diabetes status. Males have higher prevalence of pocket depth compared to females across all 3 PD categories. The largest difference observed is for the 5-6 mm PD category, where 48% of males and 20% of females have at least one tooth with PD in this range. Attachment loss prevalence is similar for males and females in the lower severity category, but differences become more pronounced as severity increases. The prevalence of ≥7mm PD is higher among current smokers (78%) compared to former smokers (14%) and non-smokers who never smoked (8%). There is no significant difference in PD or AL prevalence by diabetic status. Nearly 47% of the non-diabetics had AL of ≥7mm at one periodontal site compared to 62% of diabetes.

The prevalence of moderate and severe periodontitis is shown in Figure 1 using the CDC-AAP case definition. Overall prevalence of severe periodontitis was 13% (95% CI=12.39-13.61), moderate or severe periodontitis was 59% (95% CI=58.47-59.53). Males showed higher prevalence of severe periodontitis than females, 23% (95% CI=21.88-24.12) and 7.4% (95% CI=6.57-8.23) respectively. Among those aged 80 years and older, 67% had either moderate or severe periodontitis.

Table 4 shows the prevalence of CDC-AAP defined periodontitis for both the PREDHS 2007 study and the NHANES 1999-2004 study based on the mesial periodontal site. Overall, prevalence of periodontitis was larger among PREDHS study participants than similar NHANES participants.



¹Severe periodontitis: individuals with 2 or more interproximal sites with AL greater than or equal to 6 mm and 1 or more interproximal site with PD greater than or equal to 5 mm. Moderate periodontitis: individuals with 2 or more interproximal sites with AL greater than or equal to 4 mm or 2 or more interproximal sites with PD greater than or equal to 5 mm. No or mild periodontitis: individuals that do not meet any of the two previous criteria

Figure 1. Percentage of individuals with no periodontitis, moderate periodontitis or severe periodontitis according to the CDC-AAP definition¹ by gender and age sub-groups

Discussion

Overall, the present study shows that the prevalence and severity of periodontal disease are high among the elders living in the Metropolitan area of San Juan. More than half of those examined had at least one site with attachment loss greater or equal to 7mm and almost a third had one or more sites with PD greater or equal to 5mm. The distribution of this disease among the selected sub-groups is consistent with other reports for elderly populations in the US.

Males showed higher prevalence and severity of periodontal disease than females using probing depth, attachment loss and CDC-AAP defined moderate or severe periodontitis (Dye *et al.*, 2007b; Krstrup and Petersen, 2006; Levy *et al.*, 2003). Although the number of teeth is similar between men (15.5 sd 6.3) and women (15.9 sd 7.0) suggesting that survivor bias (females having more affected teeth extracted) is unlikely. However, the men in this study were 7 times as likely to be current smokers than women (11.5% vs. 1.6%), which may explain the higher prevalence of periodontal disease among men in spite of lower diabetes rates among men compared to women (21.3% vs. 32.0%). Other factors such as access and utilisation of dental care and the type of dental treatment received may also have differentially impacted periodontal disease levels among men and women. (Dolan and Atchison, 1993; Krstrup and Petersen, 2006).

Prevalence of probing depth among the younger age group (70-79) was significantly higher than in the 80+ age group. Prevalence of attachment loss was similar between the younger and older age groups. Our findings were also consistent with other reports of molars having the highest levels of probing depth and loss of attachment, but our finding of the mesio-buccal site showing the higher probing depth contradicts reports of the disto-lingual site having the higher measures (Fox *et al.*, 1994; Hunt *et al.*, 1990; Levy *et al.*, 2003).

Different reports from the NHANES have stated that Mexican-Americans (referring to Hispanic individuals) show a higher prevalence of probing depth and loss of attachment than non-Hispanic whites (Brown *et al.*, 1996; Dye *et al.*, 2007b; Hyman and Reid, 2003). The NHANES showed that Puerto Ricans had higher levels of periodontal disease than other US Hispanic populations (Ismail and Szpunar, 1990). In order to compare our findings with the overall US elderly population, we limited our data to match the criteria used in the last NHANES periodontal report (Dye *et al.*, 2007b). Hence for this analysis, we randomly selected one upper and one lower quadrant for each individual used only the mesio-buccal site and only included individuals aged 75 years or more. Our analysis (Table 4) showed that the prevalence of this condition among the Puerto Rican elderly was high and more than twice that in the US (44.54% vs. 20.75%). The participation rate in our study of 47% is similar to reports from other periodontal surveys (Fox *et al.*, 1994; Hunt *et al.*, 1990; Levy *et al.*, 2003). The similarity of the demographic and general health characteristics between the group with the dental exams and the parent study sample, suggest the representativeness of these results for the targeted population.

This study used the same exclusion criteria and measurement procedures as NHANES with a NHANES reference examiner conducting the training and calibration of the clinical examiners. The same periodontal probe and lighting conditions were used as the NHANES. However, in this study, we only included older adults living in the metropolitan area whereas the NHANES uses a representative sample for the 50 US states metropolitan or urban populations have generally shown lower severity of periodontal disease than rural or sub-urban populations (de Macedo *et al.*, 2006; Fox *et al.*, 1994; Krstrup and Petersen, 2006).

In 2005 the World Health Organization proposed a program to strengthen the prevention of periodontal disease in older adult populations around the globe (Petersen and Ogawa, 2005; Petersen and Yamamoto, 2005). Their approach highlighted the importance of producing databases and surveillance systems to monitor trends in oral diseases, and help in identification of risk factors and in prevention of periodontal disease and other general chronic diseases, and to enable analysis of the cost-effectiveness of oral health programs. These results serve as baseline data for surveillance of periodontal disease and for evaluation of any future interventions to reduce periodontal disease in the Puerto Rican older adult population.

The results obtained from this study demonstrate that periodontal disease among people over 75 years of age is more prevalent and more severe in the Puerto Rican population than in the overall US population, or among US Hispanics of similar age. These findings show the current oral health disparity between the older adult population residing in San Juan and US older adults, in spite of efforts from government agencies to reduce these disparities with health promotion programs. Further studies should focus on understanding the reasons for this oral health disparity and the differences between gender subgroups. Also, repeated surveillance of periodontal disease should be implemented to assess changes in prevalence of periodontal disease over time.

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