Published in final edited form as:

J Periodontol. 2013 February ; 84(2): 203–211. doi:10.1902/jop.2012.110748.

Periodontal disease, hypertension and blood pressure among older adults in Puerto Rico

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Abstract

Background—Current scientific evidence addressing the relation between periodontitis and hypertension is limited to a few studies producing inconsistent results.

Methods—All participants of an on-going representative cohort of Puerto Rican elderly who were 70 years and older and residing in San Juan metropolitan area were invited to this cross-sectional study. Periodontal probing depth (PD) and attachment loss (AL) were summarized using CDC-AAP definition for severe periodontitis (2 teeth with AL ≥6mm and 1 tooth with PD ≥5mm). We averaged three repeated blood pressure (BP) measurements taken using a standardized auscultatory method. Information on hypertension history, use of anti-hypertensive medications and potential confounders (age, gender, smoking, heavy and binge drinking, diabetes, utilization of preventive dental services, flossing, body mass index, fruit and vegetable, whole wheat bread and high-fiber cereal consumption) was collected during in-person interviews. High BP was defined as average systolic BP ≥140 mmHg or diastolic ≥90 mmHg. Multivariate logistic regression models were used to study the relation between severe periodontitis, hypertension history and high BP.

Results—The study population comprised 182 adults. In multivariate analysis, there was no association between severe periodontitis and hypertension history (OR=0.99, 95% CI: 0.40–2.48). Severe periodontitis was associated with high BP, with OR of 2.93 (95% CI: 1.25–6.84), after adjusting for age, gender, smoking, and binge drinking. This association was stronger when restricted to those with hypertension or taking anti-hypertensive medications: OR=4.20 (95% CI: 1.28–13.80).

Conclusion—Our results suggest that periodontitis may contribute to poor blood pressure control among older adults.

Keywords

Periodontal diseases; periodontitis; hypertension; blood pressure

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Authors have no conflict of interest to declare.

Introduction

Hypertension is one of the major causes of cardiovascular disease and other serious health conditions. Hypertension-related mortality in the U.S. was estimated to reach 54,000 deaths in 2004.¹ As reported by Garcia-Palmieri, hypertension accounted for about 43 deaths per 100,000 inhabitants in the island in 2002.²

Periodontal disease has recently drawn increasing attention because of its potential relationship with cardiovascular disease, as a chronic inflammatory condition linked with systemic markers of inflammation and endothelial dysfunction.³ A number of research studies have suggested a possible link between chronic inflammation and hypertension, emphasizing the need for further research.⁴⁻⁷ However, to date, only a few studies have reported on the relation between oral health and hypertension, producing inconsistent results. In a large cross-sectional study, Holmlund et al.⁸ reported an increased risk of self-reported history of anti-hypertensive treatment associated with the number of diseased periodontal pockets, as well as a linear trend between periodontal disease severity and anti-hypertension treatment. A recent prospective study on periodontal disease and incident hypertension among Japanese manufacturing workers has also shown similar results.⁹ The scientific evidence was further supported by an intervention study. In a randomized controlled trial, intensive treatment for periodontal disease (subgingival scaling, root planning and local antimicrobial treatment) led to a statistically significant decrease in systolic blood pressure at the end of the second month of follow-up (7 mmHg change in the treatment arm) when compared to the baseline measurements; the reduction was greater among smokers (14 mmHg decrease from baseline).¹⁰ On the other hand, our recent analysis of Health Professionals' Follow-up Study did not show any significant associations between self-reported periodontal disease and hypertension diagnosis over 20 years of follow-up.¹¹ Similarly, the analysis of the Third National Health and Nutrition Examination Survey data did not reveal any association between periodontal disease severity and blood pressure.¹²

In this study, we aimed to evaluate the association between clinically measured periodontal disease and clinically assessed hypertension in a representative sample of elderly Puerto Ricans.

Materials and Methods

Study population

We recruited participants for the Puerto Rican Elderly Dental Health Study (PREDHS) from an on-going representative cohort of Puerto Rican Elderly (PREHCO). The PREHCO study used probability-based sampling to identify houses across Puerto Rico with at least one adult of at least 60 years of age from census track data.

The PREDHS Study population included residents of San Juan metropolitan area who were 70 years of age or older in 2007. We excluded PREHCO participants who were earlier invited to participate in another clinical study, and those who didn't pass Caban mini mental test (scored 11 points or less) and therefore were not considered mentally fit to complete the in-person exam and interview without assistance of a proxy.

A total of 392 elderly were contacted regarding the PREDHS study by various means of communication (letters, phone calls and home visits). Twenty-three participants were not reached after multiple attempts utilizing all means of communication. Out of 369 participants who were reached and introduced to the goals and procedures of the study, 107 refused participation, and 19 were found to be deceased, hospitalized or bedridden. After initial screening by phone, participants were excluded from the study sample if they had

conditions that could potentially lead to systemic complications from the periodontal exam. Participants were found to be ineligible if they were instructed by the physician to take antibiotics prior to any dental exam, were undergoing renal dialysis, taking anticoagulants or had any of the following diseases, conditions and medical procedures: specific heart conditions (i.e. congenital heart murmurs, valve problems, congenital heart disease, or endocarditis), hipbone or joint replacement, rheumatic fever, hemophilia, a pacemaker, automatic defibrillator or artificial material in cardiovascular system. The final sample of the PREDHS was comprised of 185 participants. This study was conducted in accordance with the Helsinki Declaration of 1975, as revised in 2000, and approved by the Institution Review Board for Human Subjects at the University of Puerto Rico. All participants signed a written consent form prior to all research procedures.

Three teams of dental examiners and recorders completed data collection by performing home visits. All dental examiners received training and calibration on oral health assessment and blood pressure measurement.

All participants completed an in-person interview on current oral health status, history of dental diseases and procedures, utilization of dental services, oral hygiene habits, physical activity and food intake. Resting blood pressure was measured, and a list of current prescription medications was recorded. One hundred and eighty-three participants also agreed to participate in the clinical assessment of periodontal disease status. Participants included in the final sample were similar to those who refused participation in terms of age, smoking and diabetes and include somewhat higher number of men (p-values for t-test for age differences and for chi-square test for gender, smoking and diabetes differences >0.05).

Assessment of periodontal disease status

Periodontal disease was assessed by clinical measurements of probing depth (PD) and attachment loss (AL) at 4 sites per tooth (buccal, mesio-buccal, disto-buccal, and distal-lingual) using a full-mouth design (excluding third molars). All measurements were taken with a PCP2 periodontal probe[‡], and rounded off upwards to the nearest millimeter. Clinical AL was computed as the difference of gingival recession and PD measurements for all sites. Three interproximal sites (mesio-buccal, disto-buccal, and distal-lingual) per tooth were used to derive periodontal disease status, according to the Centers for Disease Control and Prevention and the American Academy of Periodontology (CDC-AAP) definition for severe and moderate periodontal disease.¹³ Severe periodontal disease was defined as presence of at least 2 teeth with AL ≥ 6 mm in any of the interproximal sites and at least one tooth with PD ≥ 5 mm at any interproximal site. Moderate periodontal disease was defined as presence of at least 2 teeth with AL ≥ 4 mm or at least 2 teeth with PD ≥ 5 mm.

Prior to the study, all dental examiners were trained in accordance with the NHANES standards¹⁴ and calibrated by NHANES reference examiner (Dr. Bruce Dye§). Periodontal measurements taken by trained examiners were in absolute agreement with the reference examiner 87%–94% of the times, with weighted kappa coefficients ranging between 0.75 and 0.87.

Assessment of hypertension and blood pressure

During in-person interviews, all PREDHS participants were asked: “Have you ever been diagnosed by a doctor or a health professional with high blood pressure?”. Participants who responded positively to the question were classified as having hypertension diagnosis history.

Dental examiners were additionally trained and calibrated by a cardiologist (Dr. Juan C. Zevallos) † in standardized indirect blood pressure (BP) determination by auscultatory

method. Participant's arm length and circumference were first measured in order to determine the correct cuff size. After the participant has rested for at least 5 minutes, systolic (SBP) and diastolic blood pressure (DBP) measurements were taken three times within 1–2 minute intervals, in a sitting position, on the right arm of the participant, using a bell stethoscope and a mercury sphygmomanometer. Measurements were rounded off upwards to the nearest 2 mmHg, recorded and later averaged. BP was classified as high if average SBP was ≥ 140 mmHg or average DBP was ≥ 90 mmHg. We also used a secondary outcome of three-category severity of hypertension, based on systolic and diastolic blood pressure cutoff points suggested by JNC7 report¹⁵ (stage 0 if SBP<140 and DBP<90; stage 1 if $140 \leq \text{SBP} < 160$ or $90 \leq \text{DBP} < 100$; stage 2 if $\text{SBP} \geq 160$ or $\text{DBP} \geq 100$). Blood pressure measurements showed excellent reliability, with intra-class correlation coefficients of 0.97 for systolic (95% CI: 0.96–0.98) and 0.96 (95% CI: 0.95–0.97) for diastolic blood pressure.

The list of participant's current prescription medications was recorded during the in-person interview from the original medication containers provided by participants. A trained cardiologist (Dr. Juan C. Zevallos) examined the blinded medication list to identify any anti-hypertensive medications.

Assessment of potential confounders

Information on age, gender, smoking, drinking habits, and self-reported diabetes diagnosis was obtained from the responses to the PREHCO study interview (2005–2007). Height and weight measurements were taken during PREHCO study interviews and summarized into body mass index. Self-reported alcohol use was summarized into two variables: binge and heavy drinking. Heavy drinking was defined as consuming an average of more than 2 drinks per day for men and more than 1 drink per day for women. Men consuming 5 or more drinks on a single occasion and women consuming 4 or more drinks on occasion were classified as binge drinkers. Information on some additional potential confounders (food intake, utilization of preventive dental services, physical activity) was collected during PREDHS in-person interviews. Fruit and vegetable, whole wheat bread and high-fiber cereal consumption was assessed in PREDHS as the number of servings per day/week and later categorized into tertiles.

Data analysis

Statistical analysis was conducted using the SAS statistical package, version 9.2¹¹. We employed multivariate logistic regression models to evaluate the associations between periodontal disease and hypertension, as well as periodontal disease and blood pressure, while adjusting for potential confounders. Odds ratios and 95% CI were reported. We also explored the relation between severe periodontal disease and severity of hypertension (3 categories) using polynomial regression analysis. We considered the following potential confounders in our multivariate models: age, gender, smoking (never/past/current), heavy and binge drinking (yes/no), history of diabetes diagnosis, physical activity within the past month (yes/no), overweight/obesity ($\text{BMI} \geq 25 \text{ kg/m}^2$), utilization of preventive dental services within the past year (yes/no), daily flossing (yes/no) and consumption of fruit and vegetables (tertiles), whole wheat bread (tertiles) and cereal (tertiles). In order to come up with more parsimonious models for our analysis on hypertension and high blood pressure, we used a backwards elimination technique applying a 10% change-in-estimate rule¹⁶ while forcing age, gender and smoking into the model. Our final multivariate models (model 2) for hypertension diagnosis history included all the considered confounders; the final model for blood pressure included only age, gender, smoking, and binge drinking. Additional models on high blood pressure also included the number of anti-hypertensive medications and number of teeth (1–10, 11–16, 17–24, 25–32).

To evaluate the effect of periodontal disease on high blood pressure with regards to specific at risk criteria we repeated our analysis on high blood pressure within strata by anti-hypertensive medication use, smoking, diabetes and number of teeth (1–16, 17–32). We used a Wald test to test for effect modification by diabetes, smoking, number of teeth and anti-hypertensive medication use. In addition, we restricted our analysis to participants with hypertension diagnosis or taking anti-hypertensive medications, as well as to those with isolated systolic (ISH) hypertension and those with isolated systolic or systolic-diastolic (SDH) hypertension, and compared them with participants with normal systolic and diastolic blood pressure.

Missing data: Thirty-two (17.5%) participants had missing information on at least one of the confounders. Missingness on physical activity, weight, fruit and vegetable, whole-wheat bread and cereal intake was not associated with the self-reported hypertension diagnosis or high blood pressure (p-values for all chi-square tests >0.05). We excluded one participant with missing information on utilization of preventive dental services and created missing indicator variables for the remaining confounders and adjusted for them in regression analysis. After conducting sensitivity analysis we assigned missing values in food intake questions to the lowest consumption tertile (reference group), which provided the most conservative effect estimate in logistics regression analysis.

Results

Our final sample for this analysis included 182 participants (Table 1). Participants with severe periodontal disease were more likely to be male (58% vs. 26% among those without severe periodontitis), smokers (10% current smokers vs. 3.1%), heavy (8% vs. 0.6%) and binge (14% vs. 2.7%) drinkers, and to have diabetes (36% vs. 26%). They were also less likely to consume 5 or more servings of fruits and vegetables a day (9.3% vs. 12%) or have a dental checkup within the past year (20% vs. 37%).

We identified 126 participants who reported history of hypertension diagnosis by a physician and 106 participants with high blood pressure. Of the participants observed to have high blood pressure, 68 participants were classified as having stage 1 and 38 participants as stage 2 hypertension. After adjusting for all potential confounders, we did not observe any association between severe periodontal disease and history of hypertension diagnosis (Table 2, OR=0.99, 95% CI: 0.40–2.48). Participants with severe periodontal disease had 2.93 times higher odds of having high blood pressure upon examination (multivariate-adjusted OR=2.93, 95% CI: 1.25–6.84). The OR estimate for severe periodontal disease remained strong and statistically significant after additional adjustment for anti-hypertensive medications (OR= 3.00, 95% CI: 1.28–7.03) or for number of teeth (model 4 OR=2.87, 95%CI: 1.22–6.74). In our polynomial regression analysis between severe periodontal disease and stages of hypertension, we observed an OR of 3.54 for stage 1 hypertension (model 2 95% CI: 1.41–8.85), however, the OR for stage 2 hypertension was not statistically significant (model 2 OR=2.05, 95% CI: 0.69–6.07).

When we restricted our analysis to participants taking anti-hypertensive medications (Table 3), we observed more than a 4-fold increase in odds of high blood pressure associated with severe periodontal disease (model 2 OR=4.63, 95% CI: 1.20–17.94). The associations were similar among participants with history of hypertension diagnosis and/or taking anti-hypertensive medications (OR=4.20, 95% CI: 1.28–13.80). The association between severe periodontitis and blood pressure was not statistically significant among past and current smokers (OR=1.98, 95% CI: 0.48–8.10). We did not observe a statistically significant association among participants with (model 2 OR=3.76, 95% CI: 0.74–19.01) or without history of diabetes (model 2 OR=2.00, 95% CI: 0.75–5.35, p for effect modification=0.51).

When we restricted our analysis to participants with isolated systolic or systolic-diastolic hypertension and compared them with those with normal blood pressure, severe periodontitis was associated with an OR of 2.80 (model2, 95% CI: 1.19–6.59).

Discussion

In this cross-sectional study among Puerto Rican elderly, we found a significant and strong association between periodontal disease and blood pressure and no significant association between clinically measured severe periodontal disease and self-reported hypertension diagnosis. The association periodontitis and blood pressure was even stronger among participants with a known hypertension diagnosis or those taking anti-hypertensive medications.

The association between periodontitis and hypertension is of paramount importance as the progression of cardiovascular disease is highly affected by the degree of blood pressure control achieved among people with hypertension.¹⁵ The identification of modifiable risk factors for the progression of damage caused by hypertension is of high priority at a global level as it continues to be a major cause of morbidity, mortality, and a significant contributor to health care expense.

Recent scientific evidence suggests a possible connection between periodontal disease and systemic inflammation,^{3, 17–25} which in turn is associated with an increased risk of hypertension.^{4–7} Only a handful of studies have previously evaluated the association between periodontal disease and hypertension, but so far little is known about the natural history of this association. Existing studies report a variety of measures of periodontal disease, and use different definitions of hypertension outcomes.

In a cross-sectional study of 3,352 periodontal patients and 902 population controls in Sweden, Holmlund et al.⁸ reported a significant linear trend between periodontal disease severity and self-reported treatment for hypertension (OR for trend=1.32, 95% CI: 1.13–1.54, adjusting for age, gender, number of teeth and current smoking). In a recent prospective cohort of Japanese manufacturing company employees,⁹ Morita and colleagues demonstrated an increase (RR=1.5, 95% CI: 1.0–2.3) in incident hypertension risk (having 130 mmHg systolic or 85 mmHg diastolic blood pressure during the follow-up visit) associated with presence of periodontal pockets of at least 4 mm at baseline (a clinical measure of moderate-to-severe periodontal disease), after adjusting for age, gender, and binary measures for cigarette smoking, regular exercise, eating between meals and healthy body weight). One of the strengths of these reports was clinical assessment of periodontal disease status, similar to our current study; however, summary periodontal measures used in these publications were different, which makes comparisons across studies more difficult. In the recent analysis of 11,029 U.S. adults (17 and older)¹² there was no significant association between periodontal disease severity and high blood pressure (OR for severe periodontitis=1.29, 95 % CI: 0.85–1.98, adjusted for age, gender, years of education, poverty ratio, ethnicity, smoking, chronic heart diseases, cancer, diabetes, stroke, emphysema, asthma, arthritis, lupus, thyroid disease, and goiter). Similarly, there was no association among adults older than 44 years of age (OR=1.36, 95% CI: 0.80–2.33). This study used the same periodontal measures as in our current study. However, periodontal data was collected only in randomly assigned half-mouths of each participant, rather than in the whole mouth. This may have resulted in non-differential misclassification (under-diagnosis) of periodontal disease and, therefore, underestimation of the magnitude of the association between periodontitis and blood pressure.

The results from our study were in accord with the first two reports, with the magnitude of the association being much larger in our study. PREDHS participants with severe periodontal disease an almost 3-fold increase in odds of having high blood pressure, compared with those without severe periodontal disease (multivariate OR=2.93, 95% CI: 1.25–6.84). This association remained strong and statistically significant even after adjusting for anti-hypertensive medication use and number of teeth. Our study population was older compared to previous publications, which suggests that local and perhaps consequent systemic inflammation might play a greater role in blood pressure control among elderly.

Our analysis on stages of hypertension suggested a threshold relation between periodontal disease and blood pressure, rather than a linear trend. However, we had limited power among participants with stage 2 hypertension (SBP $\geq$ 160 and DBP $\geq$ 100 mmHg).

The relation between severe periodontitis and blood pressure appeared to be stronger among participants with a known diagnosis of hypertension and those taking anti-hypertensive medications, suggesting that elderly with severe periodontitis may have poorer response to anti-hypertensive treatment compared to those who have a healthier periodontium. Since the majority of PREDHS hypertensives presented with ISH (N=76) or SDH (N=26), results from the stratified analysis limited to ISH and SDH were similar to those obtained from the overall population.

Smoking and diabetes have previously been shown to be effect modifiers of the relations between periodontal disease and cardiovascular outcomes;²⁶ however, we did not observe any effect modification by these variables. In age- and gender analysis among never-smokers, periodontal disease was associated with an OR of 3.09 (95% CI: 1.12–8.57); however, we were unable to adjust for binge drinking in model 2, due to small power and instability of the model. The association between periodontitis and blood pressure was somewhat weaker and not significant among non-diabetics (model 2 OR=2.00, 95% CI: 0.75–5.35), compared to the estimates from the overall population, which might be explained by limited sample size in this stratum. At the same time, a weaker association among non-diabetics suggests potential residual confounding of our main results by severity of undetected diabetes and pre-diabetes.

Our study had several strengths, including collection of high-quality clinical data on periodontal disease and blood pressure. We conducted a full-mouth oral examination on all participants; all our dental examiners were trained according to NHANES criteria and showed excellent agreement with the reference examiner. We also collected detailed information on potential confounders, including variables reflecting health behavior, such as utilization of preventive dental services, fruit and vegetable intake, and flossing. Our study participants were not requested to refrain from their medications prior to the examination; hence, the blood pressure measurements obtained from participants on anti-hypertensive treatment reflect the true level of blood pressure control usually achieved among them.

Our study also had several limitations. The cross-sectional nature of our study does not allow causal interpretations of our findings, since we do not have information on temporality of the relation between periodontal disease and blood pressure. However, hypertension is not likely to cause periodontal disease. Since our blood pressure measurements were taken on only one occasion, day-to-day variations in blood pressure may have resulted in random misclassification of our outcome measure of high blood pressure. However, we expect that this misclassification was non-differential with regards to periodontal disease status, which would result in underestimation of the true odds ratio between periodontal disease and high blood pressure. Also, due to a relatively small sample size, we did not have enough statistical power for some of our subgroup analysis (e.g., analysis limited to diabetics, never,

past and current smokers). Our information on diabetes, one of major potential confounders of this relation, was self-reported, which does not exclude possible residual confounding; hence our results should be interpreted with caution. In addition, our study was limited to Hispanic elderly of Puerto Rican descent, which may limit the generalizability of our findings to other populations. Despite these limitations, our study demonstrates a possible strong relation between periodontal health and blood pressure control, which may have a major public health impact among elderly. Given the limitations of our study, further studies are needed to confirm this association in other populations.

Acknowledgments

This work was partially funded by the following grants: National Institute Dental and Craniofacial Research Grants R01AG1620904, G12RR03051, and K24DE16884 from the National Institutes of Health. We would like to acknowledge the PREDHS team (Dr. Enrique Santiago, Dr. Maria L. Aguilar, Dr. Ana L. Davila, Dr. Alberto Garcia, Ms. Sasha Martinez, Ms. Yari Valle, Ms. Vanesza Robles, Mr. Francisco Munoz, Mr. Michael Brunelle, Ms. Mildred Rivera, Ms. Jennifer Torres, Ms. Jennifer Guadalupe, Dr. Monik Jimenez) for their help with the study.

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Table 1

Age- and gender-adjusted characteristics of the PREDHS population, with or without severe periodontal disease*

Characteristic	Overall population	Participants with severe periodontal disease	Participants without severe periodontal disease
Number of participants	182	43	139
Age, mean (SD) [†]	78 (6.0)	77 (7.2)	78 (5.5)
Male gender, % [†]	34	58	26
Smoking habits, %			
Ever	26	33	23
Current	5	10	3.1
Diabetes diagnosis, %	22	36	26
Overweight (BMI ≥ 25 kg/m ²), %	65	65	64
No physical activity within the last month, %	61	60	60
Heavy drinking (%)	3.3	8	0.6
Binge drinking (%)	5.5	14	2.7
Consuming ≥ 5 fruits and vegetables /day (%)	12	9.3	12
Dental checkup visit within the past year, %	34	20	37
Periodontal disease status, %			
moderate	59	-	-
severe	24	-	-
Hypertension diagnosis, %	63	64	70
High blood pressure, %	58	75	55

* Values for participants with and without severe periodontal disease are standardized to age- and gender distribution of the PREDHS population, unless otherwise indicated.

[†] Values are not age- and gender-adjusted.

Table 2

OR (95% CI) for hypertension and blood pressure, according to severe periodontal disease status

Outcome	Number of cases/ participants	Model 1* OR (95% CI)	Model 2† OR (95% CI)
History of hypertension diagnosis	126/182	0.80 (0.38–1.71)	0.99 (0.40–2.48)
High blood pressure, stage 1 and 2 (SBP 140 or DBP 90 mm Hg)	106/182	2.35 (1.08–5.14) [‡]	2.93 (1.25–6.84) [§]
Stage 2 Hypertension (SBP 160 or DBP 100 mm Hg)	38	1.79 (0.66–4.86)	2.05 (0.69–6.07)
Stage 1 Hypertension (140 SBP<160 or 90 DBP<100mm Hg)	68	2.73 (1.16–6.41) [§]	3.54 (1.41–8.85) [§]

* Model 1 adjusted for age and gender.

† Model 2 for hypertension diagnosis adjusted for age, gender, smoking (past, current, never), heavy and binge drinking (yes/no), diabetes, physical activity within the past month (yes/no), overweight or obesity (BMI ≥ 25 kg/m², yes/no), consumption of fruits and vegetables (tertiles), whole wheat bread (tertiles) and high-fiber cereal (tertiles), utilization of preventive dental services (yes/no) and daily flossing (yes/no).
Model 2 for blood pressure adjusted for age, gender, smoking (past, current, never), and binge drinking (yes/no).

[‡]Significant at α=0.05 level

Table 3

OR (95% CI) for high blood pressure, according to severe periodontal disease status for selected subgroups of the PREDHS population

Subgroup	Number of cases/ Participants	Model 1* OR (95% CI)	Model 2† OR (95% CI)	P-value for effect modification
Participants taking anti-hypertensive medications	70/115	2.69 (0.90–8.02)	4.63 (1.20–17.94) [‡]	0.67
Participants not taking anti-hypertensive medications	36/67	2.34 (0.68–8.10)	3.06 (0.78–11.98)	
Participants with hypertension diagnosis or taking anti-hypertensive medications	78/135	2.49 (0.94–6.60)	4.20 (1.28–13.80) [‡]	0.62
Never smokers	76/134	3.09 (1.12–8.57) [‡]	3.09 (1.12–8.57) ^{‡,§}	
Past and current smokers	30/48	1.77 (0.45–6.90)	1.99 (0.49–8.12) [§]	
Diabetics	34/52	3.42 (0.70–16.76)	3.76 (0.74–19.01) [§]	0.51
Non-Diabetics	72/130	1.82 (0.72–4.62)	2.00 (0.75–5.35)	
Participants with ≥ 17 teeth	60/103	2.24 (0.76–6.63)	2.36 (0.74–7.53) ^{**}	0.77
Participants with <17 teeth	46/79	2.33 (0.73–7.43)	3.21 (0.88–11.65)	
Isolated systolic hypertension vs. no high blood pressure	76/152	1.96 (0.86–4.50)	2.41 (0.98–5.94)	
Isolated systolic or systolic/diastolic hypertension vs. no high blood pressure	102/178	2.28 (1.03–5.02) [‡]	2.80 (1.19–6.59) [‡]	

* Model 1 adjusted for age and gender.

† Model 2 adjusted for age, gender, smoking (never, past, current), and binge drinking (yes/no).

‡ Significant at $\alpha=0.05$ level.

§ Due to small number of binge drinkers in these strata, these models could not be adjusted for binge drinking.

** Due to small number of current smokers in this stratum, current smokers were combined with past smokers.