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Periodontitis in US Adults: National Health and Nutrition Examination Survey 2009–2014

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Abstract

Background.—This report presents weighted average estimates of the prevalence of periodontitis in the adult US population during the 6 years 2009–2014 and highlights key findings of a national periodontitis surveillance project.

Methods.—Estimates were derived for dentate adults 30 years or older from the civilian noninstitutionalized population whose periodontitis status was assessed by means of a full-mouth periodontal examination at 6 sites per tooth on all non–third molar teeth. Results are reported according to a standard format by applying the Centers for Disease Control and Prevention/ American Academy of Periodontology periodontitis case definitions for surveillance, as well as various thresholds of clinical attachment loss and periodontal probing depth.

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SUPPLEMENTAL DATA

Supplemental data related to this article can be found at https://doi.org/10.1016/j.adaj.2018.04.023.

Results.—An estimated 42% of dentate US adults 30 years or older had periodontitis, with 7.8% having severe periodontitis. Overall, 3.3% of all periodontally probed sites (9.1% of all teeth) had periodontal probing depth of 4 millimeters or greater, and 19.0% of sites (37.1% of teeth) had clinical attachment loss of 3 mm or greater. Severe periodontitis was most prevalent among adults 65 years or older, Mexican Americans, non-Hispanic blacks, and smokers.

Conclusions.—This nationally representative study shows that periodontitis is a highly prevalent oral disease among US adults.

Practical Implications.—Dental practitioners should be aware of the high prevalence of periodontitis in US adults and may provide preventive care and counselling for periodontitis. General dentists who encounter patients with periodontitis may refer these patients to see a periodontist for specialty care.

Keywords

Adults; epidemiology; NHANES; periodontal diseases; periodontitis; population surveillance; United States

In 2003, the Centers for Disease Control and Prevention (CDC) set out on a surveillance project to determine the prevalence of periodontitis in the US adult population and formed a workgroup in collaboration with the American Academy of Periodontology (AAP), with participation of other experts in periodontitis surveillance and epidemiology.[1,2] Because of the lack of globally accepted definitions, this CDC/AAP Workgroup created periodontitis case definitions specifically for periodontitis surveillance known as the "CDC/AAP periodontitis case definitions for surveillance."[3,4] These case definitions are based on a full-mouth periodontal examination (FMPE) and are part of the global standards for reporting chronic periodontitis prevalence and severity.[5]

Beginning in 2009 and ending in 2014, the National Health and Nutrition Examination Survey (NHANES) implemented an FMPE protocol to collect probing measurements from 6 sites per tooth around all teeth, except third molars, as described by Eke and colleagues.[6,7] Because of the site-specific, asymmetric distribution of periodontal tissue breakdown in a dentition, the FMPE protocol optimizes the capture of clinical measurements for surveillance of periodontitis, which results in greater accuracy in detecting and categorizing cases of periodontitis compared with estimates derived from the partial-mouth periodontal examination protocols used in previous NHANES, such as those conducted in 1988–1994 and 1999–2004.[8–10] Moreover, measurements recorded according to the FMPE protocol optimize the use of the CDC/AAP standard case definitions for surveillance of periodontitis and minimize misclassification of periodontitis.[11–16]

In 2 previous report, we presented interim findings on the prevalence of periodontitis and its adjunct population characteristics from 2 NHANES 2-year survey cycles—namely, 2009–2010[6] and 2011–2012.[7] These initial reports revealed a much higher burden of periodontitis in US adults than previously reported.[6] In this report, we provide the final estimates for all the 6 years in which the NHANES data collection protocol included clinical periodontal examinations, namely the 3 2-year NHANES cycles 2009–2010, 2011–2012, and 2013–2014, hereafter referred to as *NHANES 2009–2014*.[17]

METHODS

We analyzed data from NHANES 2009–2014.[17] NHANES is a stratified multistage probability sample of the civilian noninstitutionalized population in the 50 US states and the District of Columbia. The CDC's National Center for Health Statistics Ethics Review Board (an institutional review board equivalent) approved the oral health data collection protocols, and all survey participants provided written informed consent.[18,19]

Trained examiners, who during the 2009–2010 cycles were registered dental hygienists and who from 2011–2014 were general dentists, performed all periodontal examinations in a mobile examination center. The survey's reference examiner (B.A.D.) trained and calibrated all dental examiners. He performed both the initial training and presurvey calibration and subsequently visited each examiner in the field annually and replicated 25 to 30 periodontal examinations each time. Dye and colleagues[20] described in detail the oral health component, including its quality assurance for the 2009–2010 examinations, providing interexaminer statistics expressed as percentage agreement, *k* statistics, and intraclass correlation coefficients. For the CDC/AAP moderate and severe periodontitis case definitions combined, the *k* scores were 0.70 and 0.71 for the 2 examiners whose agreement rates with the reference examiner were 87.5% and 85.7%, respectively. The intraclass correlation coefficients for mean clinical attachment loss (CAL) were 0.80 or higher for both examiners. Hence, the level of data quality for this period is acceptable.[20] Final quality assurance reports for the later surveillance cycles will be reported in the future.

Examiners performed 2 measurements at each periodontal site, namely, gingival recession (REC) measured as the distance between the free gingival margin and the cementoenamel junction (CEJ) and periodontal probing depth (PPD) measured as the distance from the free gingival margin to the bottom of the sulcus (in periodontal health) or periodontal pocket (in periodontal disease). The examiners scored REC as a negative value when the free gingival margin was positioned apically to the CEJ and as a positive value when positioned coronally. Measurements were taken at 6 sites around each tooth other than third molars, namely, mesio-, mid-, and distobuccal and mesio-, mid-, and distolingual. The examiners positioned a periodontal probe with 2-, 4-, 6-, 8-, 10- and 12-millimeter gradations (PCP2, Hu-Friedy) parallel to the long axis of the tooth at each site, and they rounded measurements to the lower whole millimeter.[6,7,18] Recorders entered data directly into the NHANES Integrated Survey and Information System program that instantly calculated CAL as the difference between PPD and REC (PPD minus REC). Eligibility for the NHANES 2009–2014 periodontal examination was restricted to adults 30 years or older who had 1 or more natural teeth and no health conditions requiring antibiotic prophylaxis before periodontal probing. A total of 14,061 adults 30 years or older participated in the examinations in the mobile examination centers. Among them, 2,318 were excluded from the periodontal health assessment due to medical conditions or did not complete their oral examination for other reasons, while 11,753 people underwent complete oral examinations, including 1,070 who were edentulous.

Except for adding the variable of race/ethnicity, results are reported according to the standard reporting format suggested by a joint European Union/US workgroup[5] that follows

the guidelines of the STrengthening the Reporting of Observational Studies in Epidemiology (STROBE) Initiative[21] recommended by the Enhancing the QUAlity and Transparency Of health Research (EQUATOR) Network to ensure uniform and transparent reporting of observational epidemiologic studies from all over the world. The selected demographic and oral health behavior variables are in accord with the most important risk drivers for periodontitis.[22–25]

We used 3 methods to calculate the prevalence of periodontitis. First, we reported the prevalence by using the CDC/AAP case definitions for surveillance of periodontitis, which are based on periodontal probing measures at the 4 interproximal sites exclusively.[3,4] Severe periodontitis was defined as having 2 or more interproximal sites with CAL 6 mm or greater (not on the same tooth) and 1 or more interproximal sites with PPD 5 mm or greater. Second, nonsevere periodontitis comprised 2 less severe categories of disease, namely, moderate periodontitis defined as 2 or more interproximal sites with CAL 4 mm or greater (not on the same tooth) or 2 or more interproximal sites with PPD 5 mm or greater (also not on the same tooth) and mild periodontitis defined as 2 or more interproximal sites with CAL 3 mm or greater and 2 or more interproximal sites with PPD 4 mm or greater (not on the same tooth) or 1 or more sites with 5 mm or more. These subgroups are not truly as ordinal as the label suggests because many of the moderate cases had insufficient probing depth to qualify as mild, possibly resulting in some misclassification, so we combined them and used the label nonsevere for the combined group of mild and moderate periodontitis. Third, total (or any) periodontitis was defined as the presence of severe or nonsevere periodontitis; that is mild, moderate, or severe periodontitis.

Moreover, we calculated the severity and extent of CAL and PPD, respectively, by using measurements from all 6 sites per tooth. We report severity as the mean and percentage of various CAL and PPD cut points ranging from 3 to7 mm. We report the extent of disease as the mean and by the specific PPD and CAL threshold values of 5%, 10%, and 30% of sites and teeth, respectively, per person.

We stratified age as 30 to 44, 45 to 64, and 65 years or older; and we classified race/ethnicity into 5 self-reported groups: Mexican American, other Hispanic, non-Hispanic white, non-Hispanic black, and other race including multiracial people. We constructed smoking status from responses to the following 2 questions: Have you smoked at least 100 cigarettes in your entire life? Do you now smoke cigarettes? We categorized respondents who reported smoking every day or some days and had smoked at least 100 cigarettes as current smokers, respondents who reported currently not smoking but having smoked more than 100 cigarettes in the past as former smokers, and respondents who reported having smoked fewer than 100 cigarettes ever as nonsmokers.

We expressed poverty status with 2 different scales—A and B—both using the federal poverty level (FPL), which is based on family income, family size, and the number of children in the family, and on the age of the adults in the family for families with 2 or more adults.[26] Accordingly, we classified families or people with incomes below their appropriate thresholds while applying the appropriate thresholds that are updated annually by the US Census Bureau.[26] We calculated the body mass index (BMI) as weight in kilograms divided

by height in square meters. Presence of diabetes mellitus was self-reported. We analyzed data while applying mobile examination center examination weights to adjust for the effects of the complex sampling design (SAS-callable SUDAAN software release 10.0, Research Triangle Institute).

RESULTS

The NHANES 2009–2014 data contained complete periodontal measurements for 10,683 dentate participants, representing a weighted population of approximately 143.8 million civilian noninstitutionalized US adults 30 years or older. The mean age of the US population examined periodontally was 50.8 years, and approximately 49% were male (Table 1). About 17% were current smokers, and 9.6% reported having diabetes. An estimated 34.6% had a complete 28-tooth dentition, with an overall population mean of 24 teeth present. More than one-half (51.3%) of the population reported visiting a dentist in the past 6 months, and 72% reported using dental floss in the past 7 days (Table 1).

Prevalence of periodontitis classified by the CDC/AAP case definitions[4]

Overall, 42.2% (standard error, ± 1.4) of adults 30 years or older in the United States had total periodontitis, consisting of 7.8% with severe periodontitis and 34.4% with nonsevere periodontitis (Table 2). The prevalence of nonsevere (mild or moderate) and of total—but not of severe—periodontitis increased with age. The prevalence of total periodontitis was greatest among men (50.2%), Mexican Americans (59.7%), adults below 100% of the FPL (60.4%), current smokers (62.4%), and those who self-reported diabetes (59.9%). The prevalence increased with increasing number of teeth missing but not with increasing BMI. Among dental health–related behavior subgroups, the prevalence of total periodontitis was highest among adults who did not use dental floss regularly (53.1%) and increased with increasing duration since last dental visit to 54.8% of those without a dental visit the past year (Table 2).

Figure 1[4] shows that the prevalence of total and moderate periodontitis increased considerably with increasing age. However, the prevalence of severe periodontitis largely remained at 15% or less, and 10% or fewer of adults from the ages of 30 through 80 years had mild periodontitis.

Table 3 and Table 4 display the distribution of severe and total periodontitis, respectively, by socioeconomic and health-related characteristics in the 3 age groups. Comparing adults aged 30 through 44 years with those 65 years or older, the prevalence of severe periodontitis was more than 3-fold in Mexican Americans, non-Hispanic blacks, and current smokers. Similar differences are shown for nonsmokers although at relatively lower prevalence (Table 3). Across all age groups, the highest prevalence of total periodontitis was consistently found among adults 65 years or older with the highest prevalence among Mexican Americans, non-Hispanic blacks, other race including multiracial, current smokers, and people missing 6 to 27 teeth (Table 4).

Periodontitis prevalence classified by thresholds of CAL and PPD

Severity Assessed by Minimum CAL or PPD—eTable 1 (available online at the end of this article) shows the severity of CAL and PPD. At the probing site level, the mean population CAL was 1.7 mm and increased with age. About 89% of all adults had 1 or more sites with CAL 3 mm or greater, with an average of 19.0% of sites per person and an average of 37.1% of teeth per person affected. Notably, the prevalence of adults with CAL 3 mm or greater did not vary significantly with age, whereas the number of sites and teeth per person did.

The mean PPD was 1.5 mm, and it did not increase with age but stayed virtually constant in all 3 age groups (eTable 1). About 37.5% of all adults had 1 or more sites with PPD 4 mm or greater, affecting on average 3.3% of sites and 9.1% of teeth per person. The prevalence of people with PPD 4 mm or greater was lowest in the youngest age group, with one-third affected, compared with approximately 40% in both older age groups, whereas the mean number of sites and teeth affected did not vary according to age group.

Severity Assessed by Minimum CAL—When reported according to various cut points of the greatest CAL, the prevalence of the more severe CAL values was consistently higher in men, Mexican Americans, and non-Hispanic blacks (eTable 2, available online at the end of this article). The greatest prevalence occurred among the oldest age group, current smokers, adults at below 100% of the FPL, adults with self-reported diabetes, and those missing 6 to 27 teeth, of which groups, more than 50% had CAL 5 mm or greater, and more than 20% had CAL 7 mm or greater. Whereas the prevalence of both these measures increased with age, income, number of teeth missing, and increasing duration since last dental visit, neither measure changed according to BMI group as the prevalence in all 3 BMI groups was about 37.5% for CAL 5 mm or greater and about 13% for CAL 7 mm or greater. Overall, only 11.2% did not have any CAL 3 mm or greater, whereas two-thirds did not have any CAL 5 mm or greater. Figure 2 depicts the prevalence of periodontitis expressed at various cut points of minimum CAL and shows the CAL at greater levels of severity increased with increasing age, with an upsurge in the mid-50s.

Severity Assessed by Minimum PPD—Similarly, the prevalence of PPD at the various cut points was consistently higher in men, Mexican Americans, and non-Hispanic blacks, and the highest prevalence occurred among current smokers, adults below 100% of the FPL, those with self-reported diabetes, and those who did not use dental floss regularly (eTable S3, available online at the end of this article). The prevalence of these measures increased with increasing number of teeth missing, with duration since last dental visit, and with increasing BMI. The greatest prevalence occurred within low socioeconomic groups and smokers. Overall, almost two-thirds (62.5%) did not have any PPD 4 mm or greater, whereas 82.5% did not have any PPD 5 mm or greater, and 91.4% had no PPD 6 mm or greater. Figure 3 illustrates the prevalence of various PPD thresholds. For example, the prevalence of PPD of 4 mm or more varied from 30% to 50% in all age groups, whereas the prevalence of PPD 6 mm or more and PPD of 7 mm or more, respectively, stayed largely at less than 10% in all age groups.

Extent Assessed by CAL and PPD—The extent of periodontitis is displayed in eTable4 (available online at the end of this article) according to various cut points for CAL and PPD. An estimated 58.3% of adults had CAL 3 mm or greater in 5% or more sites. Overall, the mean proportion of sites with CAL 3 mm or greater was 19.0%. At the tooth level, 80.8% of adults had CAL 3 mm or greater at 5% or more of their teeth, while 47.3% had 30% or more of their teeth affected by CAL 3 mm or greater. The mean proportion of teeth with CAL 3 mm or greater was 37.1%. An estimated 15.0% of adults had PPD 4 mm or greater at 5% or more of all sites and 2.7% at 30% or more of all sites. Overall, the mean proportion of sites with PPD 4 mm or greater was 3.3%. At the tooth level, 29.3% of adults had PPD 4 mm or greater in 5% or more of their teeth, whereas 10.5% had 30% or more of their teeth affected by PPD 4 mm or greater. The overall mean proportion of teeth with PPD 4 mm or greater was slightly less than 1 in 10 (9.1%).

Trends

We used a log-linear model to test prevalence trends by increasing age for each of the 14 periodontitis outcomes illustrated by graphs, namely 4 in Figure 1 (CDC/AAP periodontitis case definitions[4]), 5 in Figure 2 (5 different CAL cut points), and 5 in Figure 3 (5 different PPD cut points). Whereas the trend for the prevalence of mild periodontitis[4] decreases significantly by age, the trends for each of the remaining 13 periodontitis outcomes increase statistically significantly by age.

DISCUSSION

In this report, we present findings regarding the burden and population characteristics of periodontitis from an unprecedented 6-year (2009–2014), cross-sectional, nationally representative, comprehensive survey of periodontitis in US adults 30 years or older that for the first time included a clinical periodontal examination at 6 sites around all teeth other than third molars.

Using the CDC/AAP case definitions and other commonly applied thresholds for periodontitis at the individual, tooth, and site levels, this report shows that the prevalence of periodontitis is high in US adults, particularly among certain racial/ethnic groups and those with co-occurring unhealthy behaviors and comorbidities. Overall, 42% of US adults had some type of periodontitis (severe, moderate, or mild), including 7.8% being severe periodontitis as defined by the CDC/AAP periodontitis case definitions. Overall, an estimated 58% of participants had CAL 3 mm or greater at 5% or more of sites, affecting a mean of 37% teeth, and 15% had 5% or more of sites and 29.3% of teeth with PPD 4 mm or greater.

Periodontitis was most prevalent among Mexican Americans followed by non-Hispanic blacks. The prevalence of periodontitis increased with increasing poverty levels to a prevalence of 60% among people with less than 100% of FPL having periodontitis.

Similarly, periodontitis was more prevalent among people reporting some modifiable behaviors and co-occurring chronic conditions. Notably, periodontitis was more prevalent among current smokers, people who did not regularly use dental floss, and those not having

visited the dentist within the past 6 months. Periodontitis significantly co-occurred with diabetes and increasing number of missing teeth but not with obesity. These patterns are consistent with previous findings using multivariable analyses to control for confounders and studies of factors associated with disparities in periodontitis prevalence in the adult US population, although only uncontrolled diabetes has been found to be associated with severe periodontitis.[23–25]

Overall, the prevalence of total periodontitis increased with age, as expected because of the chronicity and accumulative nature of the disease (Figure 1).[4] However, it turned out that periodontitis of the moderate severity is the main driver of this age-related increase in prevalence of total periodontitis, whereas the prevalence of both mild and severe periodontitis increases only slightly with age. Especially noteworthy is that the prevalence of severe periodontitis remains around 10% even in older age. Even though the prevalence of PPD at various minimum thresholds increases statistically significantly with age, PPD severity does not increase dramatically, as the variation by age groups is modest (Figure 3).

The extent, magnitude, duration, and representativeness of this survey have generated the most stable, accurate, and reliable estimates of the prevalence of periodontitis in US adults. Future opportunities for a similar comprehensive survey of periodontitis in US adults are not anticipated because of the costs associated with collecting data by using the FMPE that, therefore, is not sustainable on a continuous basis for national surveillance efforts.

Strengths

The greatest strengths of this report are the unprecedented size of the data set used in combining survey findings from 6 years (3 nationally representative 2-year NHANES cycles) and the application of a FMPE protocol and the CDC/AAP periodontitis case definitions that together resulted in the hitherto, most valid representation of periodontitis prevalence in people, teeth, and sites assessed. We reported a range of measurements to accommodate several criteria considered valid measures of periodontitis. Examining all 28 non–third molar teeth is superior to assessing only index teeth (or their replacements) or 7 teeth in random quadrants (excluding the third molars) in estimating disease prevalence. Because of the site-specific nature of the disease that is not distributed uniformly in the dentition, the reference standard in clinical periodontal examinations is clinical assessment for periodontal measures at 6 sites around each non–third molar tooth. For the first time in the history of NHANES, this project applied this reference standard and assessed both PPD and location of the CEJ for CAL to be calculated. This protocol allows estimation of the true presence of periodontitis, as periodontitis is defined as a combination of probing depth and attachment level/loss. Examining all teeth and probing 6 sites on each tooth for both PPD and CEJ optimizes the potential to capture true disease. In addition, the comprehensive FMPE protocol optimizes the application of various case definitions for surveillance of periodontitis and, hence, is more likely to capture true disease. Collectively, these factors ensure minimal misclassification of disease status in the population and produce a historic data set that is highly superior to data from previous NHANES data cycles for surveillance and epidemiologic research alike.

Limitations

Several factors still may have led to underestimation of disease prevalence. Notably, applying conservative case definitions that do not incorporate measurements from all 6 sites may underestimate disease. For example, the relatively conservative CDC/AAP case definitions are based on measurements from only the 4 interproximal sites because of the assumption that those sites are affected most often by periodontitis, whereas buccal or lingual sites identified as diseased might in reality represent CAL because of vigorous toothbrushing rather than disease. Thus, measurements from the midbuccal and the midlingual sites that potentially could indicate furcation involvement and, hence, severe disease are not included in the prevalence calculations. Because of time constraints, the examiners assessed neither bleeding on probing that could indicate active inflammation nor furcation involvement, although such measures could provide additional information regarding periodontal disease status when applying different case definitions.

Our prevalence estimates concern periodontitis exclusively but could include gingivitis that may accompany periodontitis cases detected. However, they do not include cases with gingivitis only because of lack of assessment of signs of gingivitis, such as bleeding and coloration. Lack of exposure of radiographs due to ethics and time constraints also excluded any radiographic assessment of periapical periodontitis. Hence, any estimation of prevalence of periodontitis cases that include all forms of periodontal disease likely would be even greater. The examiners collected no data at third molars, so they automatically missed any disease around those teeth. Finally, exclusion of people for medical reasons, incomplete oral examinations for any reason, and not sampling people who are institutionalized, such as nursing home residents, may have introduced some selection bias.

CONCLUSIONS

Periodontitis is highly prevalent and is an important oral health problem among US adults. This study provides the most comprehensive and reliable estimates of the burden and population characteristics of periodontitis in the adult US population 30 years or older. This information serves to increase awareness of periodontitis and can be useful in public health action to prevent and control periodontitis in US adults through dental practitioners' providing preventive and management care, counseling, and referral for periodontitis.■

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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ABBREVIATION KEY

AAP	American Academy of Periodontology
BMI	Body mass index

CAL	Clinical attachment loss
CDC	Centers for Disease Control and Prevention
CEJ	Cementoenamel junction
FMPE	Full-mouth periodontal examination
FPL	Federal poverty level
NHANES	National Health and Nutrition Examination Survey
NS	Not significant
PPD	Periodontal probing depth
REC	Gingival recession

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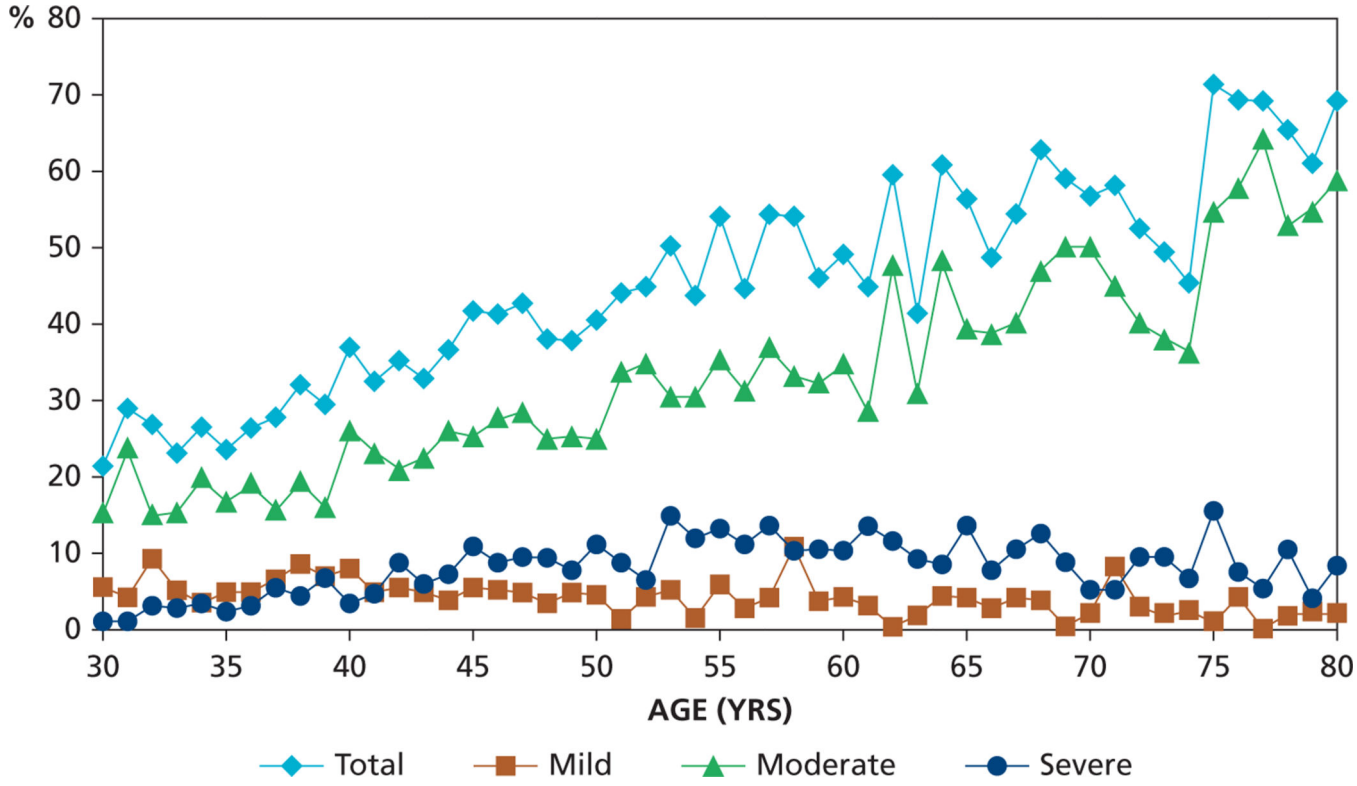

Figure 1.

Prevalence of periodontitis classified by the CDC/AAP (Centers for Disease Control and Prevention/American Academy of Periodontology) case definitions[4] according to age among dentate adults 30 years or older: total (mild, moderate, or severe; aqua), mild (brown), moderate (green), and severe (dark blue) periodontitis—National Health and Nutrition Examination Survey 2009–2014 (N = 10,683).

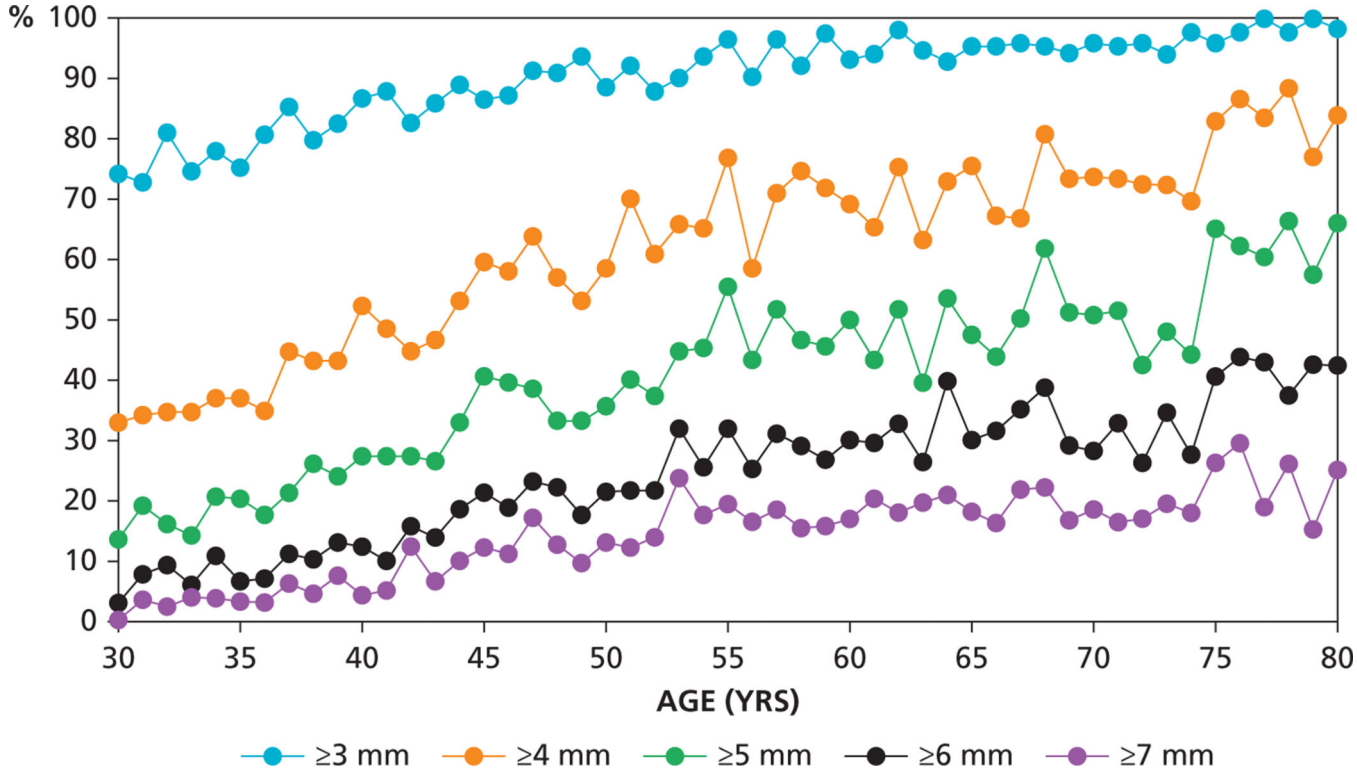

Figure 2.

Prevalence of periodontitis severity categorized by minimum clinical attachment loss according to age among dentate adults 30 years or older: 3 millimeters or greater (aqua), 4 mm or greater (orange), 5 mm or greater (green), 6 mm or greater (black), and 7 mm or greater (purple)—National Health and Nutrition Examination Survey 2009–2014 (N = 10,683).

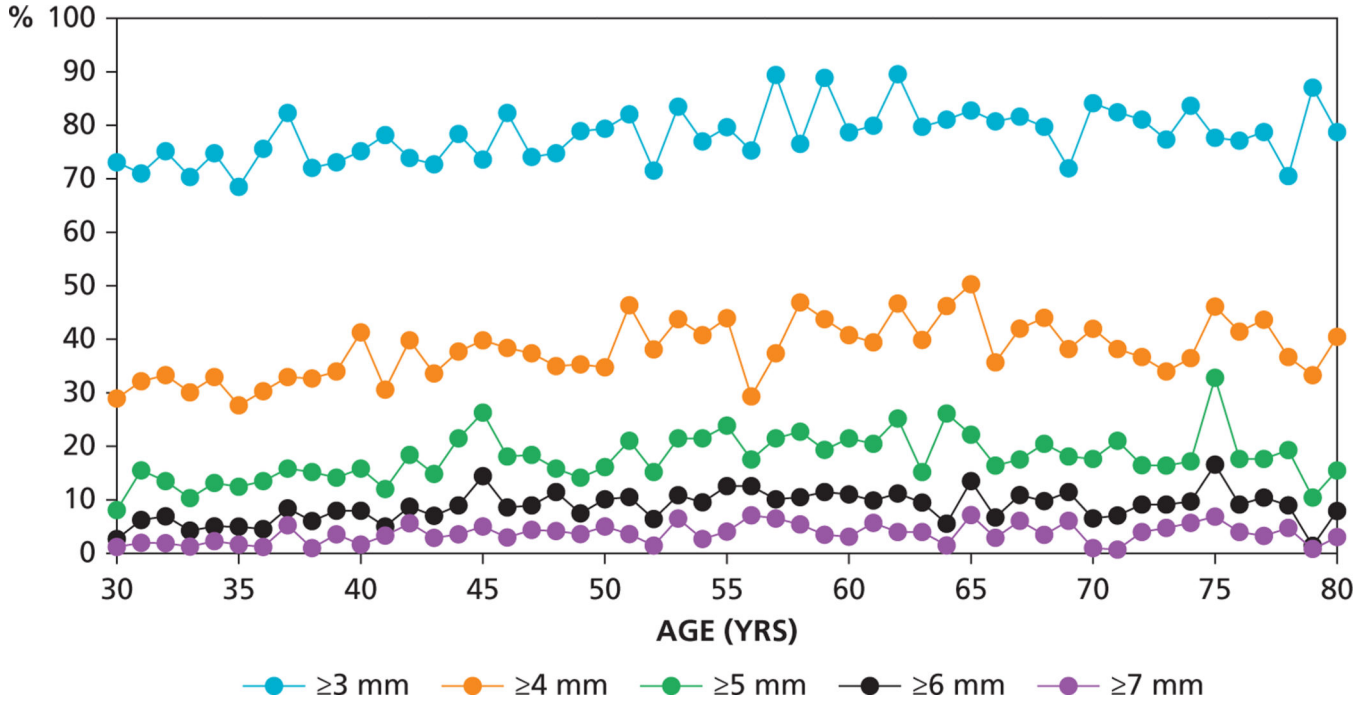

Figure 3.

Prevalence of periodontitis severity categorized by minimum periodontal probing depth according to age among dentate adults 30 years or older: 3 millimeters or greater (aqua), 4 mm or greater (orange), 5 mm or greater (green), 6 mm or greater (black), and 7 mm or greater (purple)—National Health and Nutrition Examination Survey 2009–2014 (N = 10,683).

Table 1.

Characteristics of dentate adults 30 years or older with clinical periodontal examinations according to age group, National Health and Nutrition Examination Survey 2009–2014 (N = 10,683).[*]

CHARACTERISTIC	AGE GROUP, Y (STANDARD ERROR)				TEST OF SIGNIFICANCE (*P* VALUE)
	30–44 (n = 3,854)	45–64 (n = 4,529)	65 or Older (n = 2,300)	All Age Groups (N = 10,683)	
Age, y	37.1 (0.1)	53.8 (0.1)	72.5 (0.2)	50.8 (0.2)	< .001
Male	49.8 (0.9)	49.0 (0.8)	46.2 (1.0)	48.9 (0.5)	< .05
Race/Ethnicity					
Mexican American	12.1 (1.4)	6.5 (1.0)	3.5 (0.7)	8.1 (1.1)	< .001
Other Hispanic	7.3 (1.0)	4.7 (0.7)	3.4 (0.5)	5.4 (0.7)	< .001
Non-Hispanic white	60.0 (2.2)	70.9 (2.1)	80.2 (1.4)	68.4 (1.9)	NS[†]
Non-Hispanic black	11.7 (0.9)	11.1 (1.1)	7.5 (0.8)	10.7 (0.9)	NS
Other race, including multiracia	9.0 (0.7)	6.8 (0.7)	5.4 (0.7)	7.4 (0.6)	< .001
Smoking Status					
Nonsmoker	60.4 (1.0)	54.6 (1.2)	52.9 (1.3)	56.4 (0.8)	< .001
Former smoker	17.9 (0.9)	27.5 (1.2)	40.5 (1.3)	26.2 (0.8)	< .001
Current smoker	21.7 (0.9)	17.9 (0.8)	6.6 (0.7)	17.4 (0.5)	< .001
Socioeconomic Level					
Income category A[‡]					
< 100% FPL[§]	15.2 (0.9)	10.8 (0.9)	8.0 (0.8)	12.0 (0.7)	< .001
100%-199% FPL	20.7 (0.9)	16.0 (1.0)	23.4 (1.8)	19.0 (0.8)	< .001
200%-399% FPL	29.6 (1.2)	26.4 (1.6)	33.2 (1.6)	28.8 (1.1)	< .01
> 400% FPL	34.6 (1.7)	46.8 (1.9)	35.4 (1.8)	40.2 (1.5)	< .001
Income category B[‡]					
Low ≤ 130% FPL	23.8 (1.2)	16.2 (1.3)	16.2 (1.3)	19.0 (1.0)	< .001
Middle 131%–350% FPL	35.2 (1.0)	30.1 (1.5)	43.7 (1.7)	34.4 (1.0)	< .001
High ≥ 351% FPL	41.1 (1.5)	53.6 (1.9)	40.1 (2.0)	46.6 (1.5)	< .001
Body Mass Index[¶]					
< 25	28.5 (1.0)	24.6 (1.0)	29.4 (1.3)	26.9 (0.6)	< .01
25–30	33.9 (0.9)	36.5 (1.2)	36.6 (1.3)	35.5 (0.7)	NS
> 30	37.6 (0.9)	39.0 (1.3)	34.0 (1.5)	37.6 (0.8)	< .05
Diabetes Mellitus	3.7 (0.3)	10.7 (0.6)	19.2 (1.0)	9.6 (0.4)	< .001
Use of Dental Floss in Past 7 Days					
Yes	69.8 (1.1)	74.0 (0.9)	72.5 (1.3)	72.1 (0.7)	< .05
No	30.2 (1.1)	26.0 (0.9)	27.5 (1.3)	27.9 (0.7)	< .05
Last Dental Visit, mo[#]					
≤ 6	41.8 (1.6)	54.2 (1.6)	63.7 (1.6)	51.3 (1.2)	< .001
> 6–12	15.5 (1.0)	13.3 (0.8)	12.3 (0.9)	13.9 (0.6)	NS

CHARACTERISTIC	AGE GROUP, Y (STANDARD ERROR)				TEST OF SIGNIFICANCE (*P* VALUE)
	30–44 (n = 3,854)	45–64 (n = 4,529)	65 or Older (n = 2,300)	All Age Groups (N = 10,683)	
> 12 or never	42.8 (2.0)	32.5 (1.5)	24.0 (1.4)	34.8 (1.3)	< .001
No. of Teeth Missing					
0	48.6 (1.3)	30.6 (1.4)	14.9 (1.1)	34.6 (1.0)	< .001
1–5	41.3 (1.1)	43.4 (1.0)	41.2 (1.4)	42.2 (0.7)	NS
6–27	10.1 (0.6)	26.0 (1.1)	44.0 (1.3)	23.2 (0.8)	< .001
Mean No. of Teeth Present	25.9 (0.1)	23.6 (0.2)	20.9 (0.2)	24.0 (0.1)	< .001
Prevalence of Dental Implants, % (Standard Error)	0.9 (0.2)	3.2 (0.5)	6.2 (0.7)	2.9 (0.3)	< .001
Mean No. of Dental Implants per Person	0.01 (0.003)	0.05 (0.009)	0.15 (0.019)	0.06 (0.006)	< .001

[*] Third molars were excluded. χ^2 and Wald *F* tests were used for testing significance of proportion and average, respectively, according to age group.

[†] NS: Not significant.

[‡] Income values were missing in 895 respondents.

[§] FPL: Federal poverty level.

[¶] Body mass index values in kilograms per square meter were missing in 64 respondents.

[#] Based on data from the National Health and Nutrition Examination Survey 2011–2014 only.

Table 2.

Prevalence of severe and nonsevere (mild or moderate) periodontitis[4] among dentate adults 30 years or older according to demographic and health-related subgroups, National Health and Nutrition Examination Survey 2009–2014 (N = 10,683).[*]

CHARACTERISTIC	PERIODONTITIS, % (STANDARD ERROR)		
	Severe	Nonsevere (Mild or Moderate)	Total
Total	7.8 (0.5)	34.4 (1.2)	42.2 (1.4)
Age, y			
30–44	4.1 (0.3)	25.3 (1.4)	29.5 (1.5)
45–64	10.4 (0.8)[†]	35.6 (.14)[†]	46.0 (1.6)[†]
65 or older	9.0 (1.0)[†]	50.7 (1.9)[†]	59.8 (2.1)[†]
Sex			
Male	11.5 (0.8)[†]	38.8 (1.2)[†]	50.2 (1.4)[†]
Female	4.3 (0.4)	30.2 (1.4)	34.6 (1.5)
Race/Ethnicity			
Mexican American	13.4 (1.4)[†]	46.4 (1.5)[†]	59.7 (1.7)[†]
Other Hispanic	7.8 (0.9)	40.7 (1.5)[†]	48.5 (1.6)[†]
Non-Hispanic white	5.9 (0.6)	31.1 (1.5)	37.0 (1.7)
Non-Hispanic black	14.7 (1.1)[†]	42.0 (1.3)[†]	56.6 (2.0)[†]
Other race, including multiracial	9.3 (1.4)[‡]	36.9 (2.3)[‡]	46.2 (2.6)[§]
Smoking Status			
Nonsmoker	4.9 (0.5)	29.5 (1.2)	34.4 (1.4)
Former smoker	8.0 (0.7)[‡]	37.7 (1.8)[†]	45.8 (1.8)[†]
Current smoker	16.9 (1.3)[†]	45.4 (1.7)[†]	62.4 (1.7)[†]
Socioeconomic Level			
Income category A[¶]			
< 100% FPL[#]	13.9 (1.0)[†]	46.5 (1.5)[†]	60.4 (1.7)[†]
100%-199% FPL	12.1 (1.1)[†]	41.5 (1.9)[†]	53.6 (2.0)[†]
200%-399% FPL	7.2 (0.8)[†]	37.4 (1.8)[†]	44.6 (2.0)[†]
> 400% FPL	4.0 (0.6)	24.6 (1.2)	28.6 (1.4)
Income category B[¶]			
Low ≤ 130%	13.8 (1.0)[†]	45.2 (1.4)[†]	59.0 (1.7)[†]
Middle 131%–350%	8.6 (0.7)[†]	40.0 (1.7)[†]	48.5 (1.8)[†]
High ≥ 351%	4.5 (0.6)	25.3 (1.2)	29.7 (1.4)
Body Mass Index[**]			
< 25	7.6 (0.6)	31.6 (1.6)	39.2 (1.8)

CHARACTERISTIC	PERIODONTITIS, % (STANDARD ERROR)		
	Severe	Nonsevere (Mild or Moderate)	Total
25–30	8.1 (0.7)	34.0 (1.3)	42.1 (1.4)
> 30	7.7 (0.7)	36.7 (1.5)[§]	44.4 (1.5)[‡]
Diabetes Mellitus			
Yes	10.8 (1.3)[†]	49.0 (2.5)[†]	59.9 (2.2)[†]
No	7.5 (0.5)	32.8 (1.2)	40.4 (1.4)
Use of Dental Floss in Past 7 Days			
Yes	5.8 (0.5)	32.1 (1.2)	37.9 (1.3)
No	12.8 (1.0)[‡]	40.3 (1.6)[†]	53.1 (1.8)[†]
Last Dental Visit, mo[††]			
≤ 6	3.9 (0.6)	26.4 (1.6)	30.3 (1.7)
> 6–12	6.3 (1.0)[‡]	31.6 (2.2)[‡]	37.9 (2.4)[§]
> 12 or never	13.3 (1.1)[†]	41.5 (1.7)[†]	54.8 (1.8)[†]
No. of Teeth Missing			
0	2.6 (0.5)	20.9 (1.2)	23.5 (1.4)
1–5	7.0 (0.7)[†]	36.0 (1.2)[†]	43.0 (1.3)[†]
6–27	17.1 (1.2)[†]	51.5 (1.7)[†]	68.6 (1.5)[†]

[*] Third molars were excluded. A Wald χ^2 test was used for testing significance of proportion difference in each group.

[†] $P < .001$.

[‡] $P < .05$.

[§] $P < .01$.

[¶] Income values were missing in 895 respondents.

[#] FPL: Federal poverty level.

[**] Body mass index values in kilograms per square meter were missing in 64 respondents.

[††] Based on data from National Health and Nutrition Examination Survey 2011–2014 only.

Table 3.

Prevalence of severe periodontitis among dentate adults 30 years or older according to age group and demographic and health-related subgroups, National Health and Nutrition Examination Survey 2009–2014 (N = 10,683).[*]

CHARACTERISTIC	AGE GROUP, Y, % (STANDARD ERROR)		
	30–44	45–64	65 or Older
Total	4.1 (0.3)	10.4 (0.8)	9.1 (1.0)
Sex			
Male	6.0 (0.6)[†]	15.4 (1.1)[†]	13.4 (1.6)[†]
Female	2.3 (0.4)	5.6 (0.8)	5.3 (0.8)
Race/Ethnicity			
Mexican American	7.7 (1.4)[‡]	19.8 (2.2)[†]	24.0 (3.3)[‡]
Other Hispanic	4.9 (0.9)	10.2 (1.9)	12.2 (2.4)
Non-Hispanic white	3.1 (0.5)	7.4 (0.8)	7.2 (1.1)
Non-Hispanic black	6.6 (0.9)[‡]	20.8 (1.8)[†]	18.2 (2.0)[†]
Other race, including multiracial	2.6 (0.6)	15.6 (2.1)[†]	12.6 (4.3)
Smoking Status			
Nonsmoker	2.4 (0.4)	6.1 (0.8)	7.8 (1.0)
Former smoker	4.4 (0.9)[§]	10.0 (1.2)[§]	8.1 (1.1)
Current smoker	8.7 (1.0)[†]	24.1 (2.0)[†]	24.9 (5.1)[†]
Socioeconomic Level			
Income category A[¶]			
< 100% FPL[#]	8.3 (1.0)[†]	20.6 (1.9)[†]	13.3 (1.5)[†]
100%-199% FPL	6.8 (1.1)[‡]	17.4 (1.7)[†]	12.7 (1.9)[‡]
200%-399% FPL	2.1 (0.5)	11.6 (1.4)[†]	8.1 (1.5)
> 400% FPL	2.0 (0.6)	4.5 (0.7)	6.3 (1.3)
Income category B[¶]			
Low ≤ 130%	8.5 (1.0)[†]	19.8 (1.5)[†]	14.9 (1.8)[†]
Middle 131%-350%	3.4 (0.5)[§]	13.3 (1.4)[†]	9.1 (1.3)
High ≥ 351%	1.9 (0.5)	5.5 (0.8)	6.4 (1.3)
Body Mass Index[**]			
< 25	2.9 (0.4)	10.8 (1.1)	10.6 (1.7)
25–30	4.6 (0.7)	10.8 (1.2)	8.1 (1.2)
> 30	4.7 (0.5)[§]	9.9 (1.0)	8.6 (1.7)
Diabetes Mellitus			
Yes	11.3 (2.7)[§]	12.6 (1.7)	8.2 (1.8)
No	3.9 (0.4)	10.1 (0.8)	9.3 (1.1)

CHARACTERISTIC	AGE GROUP, Y, % (STANDARD ERROR)		
	30–44	45–64	65 or Older
Use of Dental Floss in Past 7 Days			
Yes	3.0 (0.4)	7.4 (0.7)	7.7 (1.0)
No	6.8 (0.7)†	18.9 (1.6)†	12.2 (1.7)‡
No. of Teeth Missing			
0	2.0 (0.4)	3.4 (0.9)	3.2 (1.1)
1–5	4.6 (0.5)†	8.8 (0.9)†	7.0 (1.4)§
6–27	12.4 (1.5)†	21.4 (1.8)†	13.0 (1.5)†
Last Dental Visit, mo††			
≤ 6	1.6 (0.5)	4.6 (0.8)	5.8 (1.0)
6–12	2.6 (0.8)	9.7 (1.8)§	6.5 (2.1)
> 12 or never	7.3 (0.8)†	19.2 (1.8)†	15.2 (2.4)†

*Third molars were excluded. A Wald χ^2 test was used for testing significance of proportion difference in each group.

†$P < .001$.

‡$P < .01$.

§$P < .05$.

¶Income values were missing in 895 respondents.

#FPL: Federal poverty level.

**Body mass index values in kilograms per square meter were missing in 64 respondents.

††Based on data from National Health and Nutrition Examination Survey 2011–2014 only.

Table 4.

Prevalence of total (mild, moderate, or severe) periodontitis[4] among dentate adults 30 years or older according to age group and demographic and health-related subgroups, National Health and Nutrition Examination Survey 2009–2014 (N = 10,683).[*]

CHARACTERISTIC	AGE GROUP, Y, % (STANDARD ERROR)		
	30–44	45–64	65 or Older
Total	29.4 (1.5)	46.0 (1.6)	59.8 (2.1)
Sex			
Male	37.5 (2.1)[†]	55.0 (1.5)[†]	66.6 (2.3)[†]
Female	21.5 (1.3)	37.4 (2.0)	53.8 (2.7)
Race/Ethnicity			
Mexican American	52.2 (1.9)[†]	67.1 (3.0)[†]	79.4 (4.4)[‡]
Other Hispanic	40.9 (2.1)[†]	52.0 (2.4)[‡]	71.0 (4.1)[§]
Non-Hispanic white	20.7 (1.9)	40.0 (1.9)	56.3 (2.5)
Non-Hispanic black	42.7 (2.9)[†]	64.6 (2.0)[†]	72.6 (2.5)[†]
Other race, including multiracial	30.6 (2.1)[†]	54.5 (3.6)[†]	73.8 (5.5)[§]
Smoking Status			
Nonsmoker	23.8 (1.6)	36.0 (1.8)	55.9 (2.5)
Former smoker	26.3 (2.3)	47.4 (2.5)[†]	61.2 (2.5)[§]
Current smoker	47.8 (2.5)[†]	74.3 (2.0)[†]	81.0 (4.2)[†]
Socioeconomic Level			
Income category A[¶]			
< 100% FPL[#]	50.7 (2.3)[†]	68.9 (2.1)[†]	70.0 (3.4)[†]
100%-199% FPL	38.9 (2.2)[†]	62.2 (2.8)[†]	66.3 (3.0)[†]
200%-399% FPL	26.5 (2.3)[†]	52.2 (2.7)[†]	63.6 (3.0)[†]
> 400% FPL	15.0 (1.7)	30.8 (1.6)	49.5 (2.4)
Income category B[¶]			
Low ≤ 130%	48.1 (2.2)[†]	67.7 (2.1)[†]	70.5 (2.4)[†]
Middle 131%-350%	30.8 (2.1)[†]	56.7 (2.2)[†]	64.6 (2.7)[†]
High ≥ 351%	15.9 (1.6)	32.6 (1.7)	50.1 (2.4)
Body Mass Index[**]			
< 25	23.8 (1.8)	43.6 (2.6)	61.9 (3.1)
25–30	28.4 (1.8)[§]	46.1 (2.0)	58.9 (2.3)
> 30	34.8 (2.0)[†]	47.3 (1.7)	58.6 (3.1)
Diabetes Mellitus			
Yes	50.0 (5.2)[†]	56.8 (3.0)[†]	68.4 (3.3)[‡]

CHARACTERISTIC	AGE GROUP, Y, % (STANDARD ERROR)		
	30–44	45–64	65 or Older
No	28.7 (1.5)	44.7 (1.6)	57.7 (2.2)
Use of Dental Floss in Past 7 Days			
Yes	26.1 (1.6)	40.1 (1.7)	56.7 (2.2)
No	37.4 (2.4)†	62.6 (1.9)†	67.0 (3.0)‡
No. of Teeth Missing			
0	20.2 (1.6)	25.2 (2.2)	37.9 (4.1)
1–5	33.9 (1.8)†	45.1 (1.7)†	56.7 (2.7)†
6–27	55.7 (2.4)†	71.9 (1.5)†	70.1 (2.1)†
Last Dental Visit, mo **			
≤ 6	16.9 (1.9)	30.1 (1.8)	49.2 (3.0)
6–12	24.5 (2.5)§	42.5 (3.2)†	60.1 (6.3)
> 12 or never	42.5 (2.3)†	63.8 (2.2)†	68.9 (3.4)†

*Third molars were excluded. A Wald χ^2 test was used for testing significance of proportion difference in each group.

†$P < .001$.

‡$P < .01$.

§$P < .05$.

¶Income values were missing in 895 respondents.

#FPL: Federal poverty level.

**Body mass index values in kilograms per square meter were missing in 64 respondents.

††Based on data from National Health and Nutrition Examination Survey 2011–2014 only.