# Cigar, Pipe, and Cigarette Smoking as Risk Factors for Periodontal Disease and Tooth Loss

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**Background:** Our purpose was to test the hypotheses that cigar and pipe smoking have significant associations with periodontal disease and cigar, pipe, and cigarette smoking is associated with tooth loss. We also investigated whether a history of smoking habits cessation may affect the risk of periodontal disease and tooth loss.

**Methods:** A group of 705 individuals (21 to 92 years-old) who were among volunteer participants in the ongoing Baltimore Longitudinal Study of Aging were examined clinically to assess their periodontal status and tooth loss. A structured interview was used to assess the participants' smoking behaviors with regard to cigarettes, cigar, and pipe smoking status. For a given tobacco product, current smokers were defined as individuals who at the time of examination continued to smoke daily. Former heavy smokers were defined as individuals who have smoked daily for 10 or more years and who had quit smoking. Non-smokers included individuals with a previous history of smoking for less than 10 years or no history of smoking.

**Results:** Cigarette and cigar/pipe smokers had a higher prevalence of moderate and severe periodontitis and higher prevalence and extent of attachment loss and gingival recession than non-smokers, suggesting poorer periodontal health in smokers. In addition, smokers had less gingival bleeding and higher number of missing teeth than non-smokers. Current cigarette smokers had the highest prevalence of moderate and severe periodontitis (25.7%) compared to former cigarette smokers (20.2%), and non-smokers (13.1%). The estimated prevalence of moderate and severe periodontitis in current or former cigar/pipe smokers was 17.6%. A similar pattern was seen for other periodontal measurements including the percentages of teeth with ≥5 mm attachment loss and probing depth, ≥3 mm gingival recession, and dental calculus. Current, former, and non- cigarette smokers had 5.1, 3.9, and 2.8 missing teeth, respectively. Cigar/pipe smokers had on average 4 missing teeth. Multiple regression analysis also showed that current tobacco smokers may have increased risks of having moderate and severe periodontitis than former smokers. However, smoking behaviors explained only small percentages (<5%) of the variances in the multivariate models.

**Conclusion:** The results suggest that cigar and pipe smoking may have similar adverse effects on periodontal health and tooth loss as cigarette smoking. Smoking cessation efforts should be considered as a means of improving periodontal health and reducing tooth loss in heavy smokers of cigarettes, cigars, and pipes with periodontal disease. *J Periodontol 2000;71:1874-1881.*

**KEY WORDS**

**Periodontal diseases/etiology; smoking/adverse effects; smoking cessation; tooth loss/etiology; risk factors.**

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There is mounting evidence that cigarette smoking is an important risk factor for destructive forms of periodontal diseases.[1] A positive association between cigarette smoking and the prevalence and severity of periodontitis and the occurrence of necrotizing ulcerative periodontitis was first reported more than 4 decades ago.[2,3] Recent studies suggest that cigarette smoking may be causally associated with periodontitis[4,5] and also may contribute to a less favorable response to periodontal treatment and to a lower success rate after dental implant treatment.[1] Also, smokeless tobacco has significant unfavorable oral effects, including gingival recession and attachment loss.[6]

The effects of other smoking habits such as cigar and pipe smoking on periodontal disease are less well documented. Results from one anthropologic study suggest that eighteenth century slaves in Barbados, West Indies, among whom pipe-smoking was a common cultural practice, also had

high prevalences of periodontal diseases and tooth loss.[7] A recent study found that men who smoke cigars were at higher risk of having alveolar bone loss, and persons who smoke cigars or pipes had higher number of missing teeth than non-smokers.[8] Another study, however, found that the prevalence of probing depth in cigar/pipe smokers did not differ from non-smokers.[9]

It has been reported that cigarette smokers usually have more dental calculus and less gingival bleeding than non-smokers.[10-12] There is little information about the prevalence of dental calculus and gingival inflammation in cigar/pipe smokers. One study found that cigarette smokers show significantly more calculus deposits than cigar/pipe smokers.[9]

Cigar and pipe smoking habits are becoming more popular in the United States, particularly among young, affluent men, but also among women.[13-16] The aims of this study were to test the hypotheses that cigar and pipe smoking have significant associations with periodontal disease similar to that of cigarette smoking and that cigar, pipe, and cigarette smoking behaviors are associated with tooth loss. We also investigated whether a cessation of smoking may reduce the risk for periodontal disease and tooth loss.

## MATERIALS AND METHODS

### *Study Population*

The study population included 705 individuals (age range of 21 to 92 years; mean 56.9 years; SD 16.4 years). There were 366 (51.9%) males and 339 (48.1%) females, of whom 612 (86.8%) were whites and 83 (11.8%) were African-Americans. These individuals were volunteer participants in the oral physiology component[17] of the Baltimore Longitudinal Study of Aging (BLSA), the aim of which was to study various aspects of the aging process in humans.[18] BLSA participants were, in general, in good health, of middle or higher socioeconomic class, and more than 60% had at least one college degree. The participants were recruited to meet targets set for particular age groups and no specific attention was given to demographic characteristics.

### *Medical Examinations*

The BLSA study protocol included longitudinal medical examinations of the participants through periodic visits to the National Institute on Aging's Gerontology Research Center in Baltimore, Maryland. At each visit the participant had a comprehensive medical examination over a period of two or two-and-a-half days that also included a dental examination. Between visits, the persons and/or their physicians received a summary of the findings from the medical portion of their examination and were advised of any significant problems.

### *Periodontal Examination*

Three trained dentists examined 96% of the participants, and a fourth trained dentist examined the remaining 4%. The dentists were trained and calibrated by a "gold standard" examiner who also participated in calibrating other dental examiners in major national surveys at the National Institute of Dental and Craniofacial Research (NIDCR). The periodontal assessments included measurement of attachment loss, probing depth, gingival recession, gingival bleeding, dental calculus, and number of extracted teeth.

The periodontal examination was carried out at 6 sites per tooth on all fully erupted teeth, excluding third molars. To assess gingival bleeding, the teeth were dried with air, and the NIDCR periodontal probe was inserted not more than 2 mm into the gingival sulcus. Bleeding sites were scored after the sites of a single quadrant were probed.

The distance from the cemento-enamel junction (CEJ) to the free gingival margin (FGM) and the distance from the FGM to the bottom of pocket/sulcus were assessed using the NIDCR periodontal probe. The measurements were made in millimeters and were rounded to the lowest whole millimeter. Probing depth was defined as the FGM to sulcus measurement. The CEJ/FGM distance was given a negative sign if the gingival margin was located on the root. Attachment loss was defined as the distance from the CEJ to the bottom of pocket/sulcus and was calculated as the difference between the CEJ/FGM and FGM/sulcus distances (or the sum of the 2 distances if the FGM was on the root). Gingival recession was defined as the FGM-CEJ distance. When the gingival margin was located at or coronal to the CEJ the FGM to CEJ distance was recorded as zero.

The teeth were again dried with air and assessed for dental calculus using the NIDCR periodontal probe. Supragingival calculus was defined as calcified deposits located on exposed crown and root surfaces and that extend up to 1 mm below the FGM. Subgingival calculus was defined as calcified deposits located more than 1 mm below the FGM. Each site was scored as supragingival calculus only present, subgingival calculus only present, or supragingival and subgingival calculus both present.

### *Periodontal Parameters*

The prevalence and extent of periodontal parameters were calculated. These included: 1) attachment loss ≥5 mm; 2) probing depth ≥5 mm; 3) gingival recession ≥3 mm; 4) total dental calculus score (presence of supragingival and/or subgingival calculus); and 5) subgingival calculus. Prevalence of a given periodontal condition was defined as the percentage of persons having at least one site with that condition, and the

extent was defined as the percentage of teeth per person displaying that condition.

The subjects were classified by the extent of gingival bleeding into extensive, limited, or no gingival inflammation groups according to the classification described by Albandar and Kingman.[19] Subjects who had ≥8 teeth or ≥50% of their teeth with gingival bleeding were classified in the extensive gingival inflammation group, and subjects who had 3 to 7 teeth or 25 to 49% of their teeth with gingival bleeding were classified in the limited gingival inflammation group.

The subjects were also classified by the extent and severity of periodontitis into advanced, moderate, mild, or none groups.[20] And, as proposed by Albandar et al.[20] the severity of periodontitis at a given site was determined by the amount of probing depth apical to the CEJ (true pocket). Accordingly, subjects with ≥5 mm probing depth in 4 or more teeth (or ≥30% of teeth), or had ≥4 mm probing depth in 8 or more teeth (or ≥60% of teeth) were classified in the advanced periodontitis group. Subjects with ≥5 mm probing depth in 2 to 3 teeth, or had ≥4 mm probing depth in 4 to 7 teeth (or 30 to 59% of teeth) were classified in the moderate periodontitis group. Subjects who had ≥4 mm probing depth in one or more teeth, or had ≥3 mm probing depth in 2 or more teeth were classified in the mild periodontitis group.

### *Smoking Habits*

A structured interview was used to assess the smoking behavior of the participants with regard to cigarette, cigar, and pipe smoking. The interview included questions as to whether they had ever used each tobacco product, the age at which the behavior started, frequency of use, and the number of years they smoked. The data were then used to classify subjects into groups defined by their smoking behavior. Current cigarette smokers were defined as individuals who at the time of examination smoked cigarettes daily. Former heavy cigarette smokers were defined as individuals who had smoked cigarettes daily for 10 or more years and then quit. The infrequent/non-smokers group included individuals who had quit smoking cigarettes after smoking for less than 10 years and those with no history of smoking cigarettes.

The study subjects were classified into cigar and into pipe smoking categories using similar definitions as for cigarette smoking. The cigarette, cigar, and pipe smoking categories were not mutually exclusive.

### *Data Analysis*

Initially, distributions of periodontal variables and smoking patterns were examined to describe the study group. The analysis of variance for unbalanced data was used to compare the prevalence, extent, and severity of periodontal condition among smoking groups. The model adjusted for the effect of age, gender, and race-ethnicity. Multiple regression analysis was then used to assess the relative significance of the cigarette, cigar, and pipe smoking habits and the 3 demographic variables: age (21 to 39, 40 to 59, 60 to 92 years), gender, and race-ethnicity (white, African-American) on the various periodontal parameters.

## RESULTS

In this group 4.6%, 7.6%, and 31.2% of the subjects had advanced, moderate, and mild periodontitis, respectively, and 56.6% did not have periodontitis. In addition, 5.3% and 12.5% of the subjects had extensive and limited gingivitis, respectively, and 82.2% had a normal gingival condition.

When the study subjects were asked if they ever had smoked tobacco products, 60.7% answered positively for smoking cigarettes, 29.9% had smoked cigars, and 26.8% had smoked pipes (Table 1). Comparison of tobacco smoking history by gender showed that 67.5%, 51.9%, and 48.9% of males, and 53.4%, 6.2%, and 3% of females smoked cigarettes, cigars, and pipes, respectively. Comparison by race showed that 61.9%, 31.9%, and 28.3% of whites, and 52.7%, 17.2%, and 17.2% of African-Americans smoked cigarette, cigar, and pipe, respectively.

The percentage of males who were former heavy cigarette smokers (i.e., had smoked for 10 or more years and quit smoking) was about twice that of females (29.8% versus 17.1%), whereas the percentages of males and females who were current cigarette smokers were similar (5.5% versus 4.7%) (Table 2). None of the females, and only 4.4% and 11.7% of males were current/former cigar and pipe smokers, respectively.

**Table 1.**

### Subjects With a History of Using Smoking Tobacco Products by Gender, Race, and Age

| | Cigarette | | Cigar | | Pipe | |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| Gender | | | | | | |
| Male | 247 | 67.5 | 190 | 51.9 | 179 | 48.9 |
| Female | 181 | 53.4 | 21 | 6.2 | 10 | 3.0 |
| Race | | | | | | |
| White | 379 | 61.9 | 195 | 31.9 | 173 | 28.3 |
| African-American | 49 | 52.7 | 16 | 17.2 | 16 | 17.2 |
| Age (years) | | | | | | |
| 21-39 | 56 | 54.9 | 21 | 20.6 | 8 | 7.8 |
| 40-59 | 184 | 62.4 | 80 | 27.1 | 72 | 24.4 |
| 60-92 | 188 | 61.0 | 110 | 35.7 | 109 | 35.4 |
| Total | 428 | 60.7 | 211 | 29.9 | 189 | 26.8 |

**Table 2.**

## Frequency of Smoking Status by Gender and Race

| | Gender | | | | Race | | | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Male | | Female | | White | | African-American | | | |
| Smoking Status | N | % | N | % | N | % | N | % | N | % |
| Cigarette | | | | | | | | | | |
| Current smokers | 20 | 5.5 | 16 | 4.7 | 32 | 5.2 | 4 | 4.3 | 36 | 5.1 |
| Former heavy smokers | 109 | 29.8 | 58 | 17.1 | 153 | 25.0 | 14 | 15.1 | 167 | 23.7 |
| Infrequent smokers/non-smokers | 237 | 64.7 | 265 | 78.2 | 427 | 69.8 | 75 | 80.6 | 502 | 71.2 |
| Cigar | | | | | | | | | | |
| Current smokers | 3 | 0.8 | 0 | 0 | 3 | 0.5 | 0 | 0 | 3 | 0.4 |
| Former heavy smokers | 16 | 4.4 | 0 | 0 | 16 | 2.6 | 0 | 0 | 16 | 2.3 |
| Infrequent smokers/non-smokers | 347 | 94.8 | 339 | 100 | 593 | 96.9 | 93 | 100 | 686 | 97.3 |
| Pipe | | | | | | | | | | |
| Current smokers | 4 | 1.1 | 0 | 0 | 4 | 0.7 | 0 | 0 | 4 | 0.6 |
| Former heavy smokers | 43 | 11.7 | 0 | 0 | 41 | 6.7 | 2 | 2.2 | 43 | 6.1 |
| Infrequent smokers/non-smokers | 319 | 87.2 | 339 | 100 | 567 | 92.6 | 91 | 97.8 | 658 | 93.3 |
| Total | 366 | 100 | 339 | 100 | 612 | 100 | 93 | 100 | 705 | 100 |

There were also notable differences by race. The percentage of infrequent or non-smokers of cigarettes was higher among African-Americans compared to whites, but the percentages of current cigarette smokers were similar (Table 2). African-Americans rarely smoked cigars or pipes routinely. Subjects 21 to 39 years old were least likely to have smoked cigarettes, whereas subjects 40 to 59 and 60 to 92 years old had a similar frequency of cigarette smoking history. Also there was a general pattern of a lower prevalence of cigar and pipe use in the younger age groups (Table 1).

Of 203 (28.8%) current or former cigarette smokers, 29 (14.3%) also were current/former cigar or pipe smokers. Of the 475 (67.4%) subjects who reported that they either were non-smokers or have smoked one or more tobacco product for less than 10 years, 255 (53.7%) never smoked any tobacco product.

The current cigarette smokers had the worst periodontal status of the 3 groups, and were followed by the former heavy smokers and the non-smokers (Table 3). There was a significantly higher prevalence of moderate/severe periodontitis among current cigarette smokers ($P<0.02$) and among former heavy cigarette smokers ($P<0.02$) than in the non-smokers group. Also, current and former cigarette smokers had higher percentages of subjects and of teeth per subject with ≥5 mm attachment loss and ≥3 mm gingival recession and had higher numbers of missing teeth than non-smokers. The percentage of subjects with gingival bleeding was considerably lower in the current cigarette smokers than the non-smokers groups (6.6% versus 17.9%, $P<0.08$), whereas in the former heavy cigarette smokers this percentage was only slightly less than in the non-smokers (13.6% versus 17.9%, $P<0.2$). There also was a tendency for a higher prevalence and extent of supragingival calculus in the current smokers group but not among former cigarette smokers.

Fifty-six (7.9%) subjects, mainly white males, were current cigar/pipe smokers or had a past history of cigar/pipe smoking for 10 years or more. Of these, 9 were cigar users, 37 pipe users, and 10 subjects smoked both cigar and pipe. Within this group, 7 were also current cigarette smokers, and 22 were former cigarette smokers. Only 2 cigar/pipe smokers were African-American, and therefore the analysis in Table 4 included only white males. The current or former cigar or pipe smokers had poorer periodontal health than non-smokers as evidenced by a higher percentage of subjects with moderate/severe periodontitis (17.6% versus 6.1%, $P<0.006$), as well as a significantly higher percentage of teeth with ≥5 mm attachment loss ($P<0.0001$) and with ≥3 mm gingival recession ($P<0.01$), and a higher number of missing teeth ($P<0.0006$) (Table 4). In addition, the cigar/pipe smokers had a tendency to have a lower prevalence of gingival bleeding (8% versus 15.7%, $P=0.18$) and a lower prevalence and a more limited extent of subgingival calculus.

Age, gender, race, and smoking status explained about 25% of the variance in multiple regression models of variables that measured current severity and past history of periodontitis (extent of attachment loss

**Table 3.**

## Analysis of Variance (least square means estimates) of the Effect of Cigarette Smoking Status on Periodontal Parameters After Adjusting for Age, Gender, and Race

| | Current Smokers | | | Former Heavy Smokers | | | Non-Smokers | |
|---|---|---|---|---|---|---|---|---|
| | N = 36 | | | N = 167 | | | N = 475 | |
| Parameter | Mean | S.E. | *P* | Mean | S.E. | *P* | Mean | S.E. |
| Prevalence | | | | | | | | |
| Loss of attachment ≥5 mm | 50.7 | 7.57 | 0.3 | 51.5 | 4.18 | 0.04 | 43.1 | 2.70 |
| Probing depth ≥5 mm | 28.5 | 5.94 | 0.08 | 26.3 | 3.28 | 0.01 | 18.2 | 2.12 |
| Gingival recession ≥3 mm | 53.5 | 7.68 | 0.15 | 48.5 | 4.24 | 0.15 | 42.6 | 2.74 |
| Supra/subgingival calculus | 74.7 | 8.19 | 0.4 | 65.1 | 4.54 | 0.6 | 67.2 | 2.92 |
| Subgingival calculus | 25.7 | 7.85 | 0.6 | 27.5 | 4.35 | 0.5 | 30.1 | 2.80 |
| Extent | | | | | | | | |
| Loss of attachment ≥5 mm | 19.6 | 3.02 | 0.0003 | 13.3 | 1.67 | 0.005 | 8.7 | 1.08 |
| Probing depth ≥5 mm | 3.9 | 1.00 | 0.1 | 2.8 | 0.55 | 0.3 | 2.3 | 0.35 |
| Gingival recession ≥3 mm | 20.5 | 3.59 | 0.006 | 15.7 | 1.98 | 0.01 | 10.6 | 1.28 |
| Supra/subgingival calculus | 26.6 | 3.87 | 0.2 | 21.4 | 2.14 | 0.9 | 21.1 | 1.38 |
| Subgingival calculus | 9.9 | 2.89 | 0.7 | 8.1 | 1.60 | 0.8 | 8.6 | 1.03 |
| Moderate/severe periodontitis | 25.7 | 5.48 | 0.02 | 20.2 | 3.03 | 0.02 | 13.1 | 1.95 |
| Gingivitis | 6.6 | 6.58 | 0.08 | 13.6 | 3.64 | 0.2 | 17.9 | 2.35 |
| Number of missing teeth | 5.1 | 0.78 | 0.003 | 3.9 | 0.43 | 0.01 | 2.8 | 0.28 |

**Table 4.**

## Analysis of Variance (least square means estimates) of the Effect of Cigar and Pipe Smoking on Various Periodontal Parameters (whites males only)

| | Current/Former Smokers | | Non-Smokers | | |
|---|---|---|---|---|---|
| | N = 54 | | N = 401 | | |
| Parameters | Mean | S.E. | Mean | S.E. | *P* |
| Prevalence | | | | | |
| Loss of attachment ≥5 mm | 39.8 | 6.21 | 37.6 | 2.25 | 0.7 |
| Probing depth ≥5 mm | 11.9 | 4.20 | 7.1 | 1.52 | 0.3 |
| Gingival recession ≥3 mm | 50.1 | 6.45 | 43.3 | 2.34 | 0.3 |
| Supra/subgingival calculus | 57.5 | 6.98 | 62.0 | 2.53 | 0.5 |
| Subgingival calculus | 15.1 | 6.47 | 26.1 | 2.34 | 0.1 |
| Extent | | | | | |
| Loss of attachment ≥5 mm | 18.0 | 2.45 | 7.6 | 0.89 | 0.0001 |
| Probing depth ≥5 mm | 1.2 | 0.70 | 0.8 | 0.25 | 0.6 |
| Gingival recession ≥3 mm | 19.2 | 2.93 | 11.4 | 1.06 | 0.01 |
| Supra/subgingival calculus | 18.4 | 3.06 | 17.6 | 1.11 | 0.8 |
| Subgingival calculus | 3.5 | 2.15 | 5.8 | 0.78 | 0.3 |
| Moderate/severe periodontitis | 17.6 | 4.06 | 6.1 | 1.47 | 0.006 |
| Gingivitis | 8.0 | 5.49 | 15.7 | 1.99 | 0.18 |
| Number of missing teeth | 4.0 | 0.60 | 1.9 | 0.22 | 0.0006 |

and gingival recession) and tooth loss (Table 5). Age explained a significant proportion of this variance. Males and African-Americans had a higher extent of periodontal tissue loss than females and whites, respectively. Also being a current smoker of 1 or more of the 3 tobacco products was a significant factor for all periodontal indices, and the number of years of smoking contributed to a significantly greater extent of periodontal tissue and tooth loss. The multiple regression analysis also showed that current smokers may have an increased risk of having moderate and severe periodontitis than former smokers. Years of cigar/pipe smoking contributed significantly to the extent of attachment loss and tooth loss. Collectively, the 6 variables explained about a quarter of the variance in attachment loss, tooth loss and gingival recession, but only 4.4% of the variance in current periodontal status.

## DISCUSSION

Following decades of intensive research it is now unequivocally acknowledged that tobacco product consumption has profound negative effects on systemic health.[21] Cigars and pipe tobacco use is believed to have comparable adverse effects on health to that of cigarettes.[22-24] There is also now convincing evidence that oral consumption of tobacco may have significant dental and oropharyngeal consequences.[1,25,26]

The results of this study show that cigarette, cigar, and pipe smokers had significantly poorer periodontal health than nonsmokers. This was made evident by a higher prevalence of moderate and severe periodontitis and by higher prevalence and extent of attachment loss and gingival recession in smokers. In addition, smokers had less gin-

**Table 5.**

## Estimates of Multiple Regression Analysis of Smoking Status and Number of Years Smoked, Age, Gender, and Race on Periodontal Parameters and Tooth Loss

| | % Teeth With ≥5 mm Attachment Loss | | | | % Teeth With ≥3 mm Gingival Recession | | | |
|---|---|---|---|---|---|---|---|---|
| Predictor | ß-estimate | S.E. | *P* | $R^2$ | ß-estimate | S.E. | *P* | $R^2$ |
| Age (years) | 0.49 | 0.04 | 0.0001 | 20.0 | 0.65 | 0.05 | 0.0001 | 24.0 |
| Gender* | 2.99 | 1.39 | 0.03 | 0.5 | 3.26 | 1.57 | 0.04 | 0.5 |
| Race† | 3.36 | 1.04 | 0.001 | 1.0 | 2.35 | 1.21 | 0.05 | 0.4 |
| Current smoker‡ | 5.80 | 2.30 | 0.01 | 0.7 | 6.15 | 2.69 | 0.02 | 0.5 |
| Former smoker§ | –1.01 | 2.25 | 0.7 | 0.0 | –2.43 | 2.63 | 0.4 | 0.0 |
| N years smoked cigarettes | 0.19 | 0.06 | 0.001 | 1.6 | 0.28 | 0.07 | 0.0001 | 1.9 |
| N years smoked cigars/pipes | 0.15 | 0.07 | 0.03 | 1.0 | 0.06 | 0.08 | 0.4 | 0.0 |
| Total $R^2$ | | | | 24.8 | | | | 27.3 |
| | % Subjects With Moderate or Severe Periodontitis | | | | N Missing Teeth | | | |
| | ß-estimate | S.E. | *P* | $R^2$ | ß-estimate | S.E. | *P* | $R^2$ |
| Age (years) | 0.20 | 0.08 | 0.01 | 1.4 | 0.13 | 0.01 | 0.0001 | 20.3 |
| Gender* | 4.19 | 2.50 | 0.09 | 0.4 | –0.17 | 0.36 | 0.6 | 0.0 |
| Race† | 5.59 | 1.92 | 0.004 | 1.0 | 0.89 | 0.27 | 0.001 | 1.1 |
| Current smoker‡ | 9.43 | 4.32 | 0.03 | 0.7 | 1.66 | 0.59 | 0.005 | 0.8 |
| Former smoker§ | 7.31 | 2.89 | 0.01 | 0.9 | 0.35 | 0.58 | 0.6 | 0.0 |
| N years smoked cigarettes | –0.17 | 0.15 | 0.3 | 0.0 | 0.04 | 0.02 | 0.02 | 0.6 |
| N years smoked cigars/pipes | 0.05 | 0.13 | 0.7 | 0.0 | 0.05 | 0.02 | 0.001 | 1.6 |
| Total $R^2$ | | | | 4.4 | | | | 24.3 |

* 0 = female, 1 = male.
† 0 = white, 1 = African-American.
‡ 1 if current cigarette, cigar, or pipe smoker, zero otherwise.
§ 1 if former cigarette, cigar, or pipe smoker, zero otherwise.

gival bleeding and a higher number of missing teeth than non-smokers. Our findings also suggest that cigar/pipe smoking may have similar effects on periodontal health as cigarette smoking.

The present findings of a significant association between cigarette smoking and periodontal health are in agreement with results from other studies showing similar associations.[1,5] Also, results of other studies show that smokers have less gingival bleeding and a tendency to develop more dental calculus.[10-12] There are limited published data on the relationship between consumption of tobacco products other than cigarettes and periodontal disease and tooth loss. A recent study[8] found that cigar smokers were at higher risk of alveolar bone loss than non-smokers, and that this increase in risk is similar in magnitude to that of cigarette smokers. The study also concluded that cigar/ pipe smokers had higher numbers of lost teeth than non-smokers.

Cigars have been heavily promoted in the United States in recent years. A survey of adults conducted in 22 North American communities estimates that the prevalence rate of regular cigar use increased 133% from 1989 to 1993 and that the increase occurred in every gender, age, race, income, education, and smoking status category.[14] Data from another study show that cigar use has doubled in California, from 2.5% in 1990 to 4.9% in 1996, and that the increase was mainly in 18- to 24-year-olds of both genders.[16] Among males, the increases in cigar use were observed in all racial/ethnic groups except Asians, and among persons with higher educational attainment and higher incomes.

In contrast to the increases over time in cigar smoking, the prevalence of current pipe smoking for men in the U.S. has declined in recent years, from 14.1% in 1965 to 2.0% in 1991.[23] The study also reported that pipe smoking occurred most frequently among men age 45 years or older and was very uncommon among women. In addition, most men who smoked pipes also used other tobacco products, especially cigarettes. In the present study population approximately half of the daily cigar/pipe smokers also were current or former heavy cigarette smokers, consistent with findings in other studies.[23]

The volunteers in our study were disproportionately affluent, well-educated, and from the middle or higher socioeconomic class.[17] In this group, more men smoked

cigarettes than women, and also more whites smoked cigarettes compared to African-Americans. Nearly all of the cigar/pipe smokers were white men. A high percentage of individuals had ceased to use tobacco products by the time they participated in this study. The proportion of adults in the United States who are former cigarette smokers has increased steadily from 13.6% in 1965 to 25.7% in 1994.[27] The prevalence of former heavy cigarette smokers (individuals who had smoked daily for ≥10 years) in this study (23.7%) is very close to the prevalence of all former cigarette smokers in the United States at approximately the same time. This suggests that the figures in our study for all former smokers exceed those from the U.S. This might have been due in part to the positive motivation acquired by participation in the frequent health examinations in this ongoing study.

Recent estimates of the prevalence of periodontitis and gingival bleeding among US adults show that 3.1%, 9.5%, and 21.8% of persons have advanced, moderate, and mild periodontitis, respectively, and two-thirds (65.6%) had no periodontitis; and 10.5% and 21.8% of persons have extensive and limited gingivitis, respectively.[19,20] By comparison, in this study group a relatively high overall prevalence of periodontitis (43.4%) was detected and 4.6%, 7.6%, and 31.2% of the subjects had advanced, moderate, and mild periodontitis, respectively. The group also had, however, a relatively low prevalence of gingival bleeding with 5.3% of subjects having extensive gingivitis, and 12.5% had limited gingivitis.

Community-based research shows that stopping tobacco consumption has considerable health benefits. Quitting cigarette smoking reduces the risk of stroke and other diseases and may also result in increased life expectancy.[28-30] Recent data also show that stopping smokeless tobacco use for 6 weeks may resolve potentially precancerous oral leukoplakic lesions.[31]

In this study we investigated the effect of cigarette smoking cessation on periodontal health and tooth loss. Current cigarette smokers had the highest prevalence of moderate and severe periodontitis (25.7%), followed by the former cigarette smokers (20.2%), and non-smokers (13.1%) suggesting an oral health benefit from cessation. A similar pattern was seen in other periodontal indices including the percentage of teeth with ≥5 mm attachment loss and probing depth, ≥3 mm gingival recession, and dental calculus. In addition, there was a positive correlation with the number of missing teeth with the current, former, and non-smokers having 5.1, 3.9, and 2.8 missing teeth, respectively.

One of the limitations of this study is that it comprised a relatively small number of cigar/pipe smokers and only a few of these were current users. Also, smoking cessation was measured retrospectively based on smoking history, and assessment of the periodontal status of the study group used cross-sectional measurement of periodontal indices. Hence, the findings may suggest associations and no causal relationship can be inferred about the effectiveness of tobacco use cessation.

Few studies have investigated the effects of smoking cessation on periodontal disease. In a group of 349 edentulous individuals who were followed radiographically over 10 years, it was found that the rate of alveolar bone loss correlated with cigarette smoking status, and that subjects who had quit smoking during that period showed significantly less bone loss than subjects who continued to smoke and showed higher rate of bone loss than non-smokers.[32] Results of another study showed that current smokers have more tooth loss than former smokers.[8] Our results showing that current smokers of cigarettes, cigars, or pipes have a higher prevalence of moderate and severe periodontitis than former smokers and that current cigarette smokers had higher prevalence of moderate/severe periodontitis compared to former cigarette smokers are in agreement with these two cited studies.

The present results suggest that cigar and pipe smoking may have similar adverse effects on periodontal health and tooth loss to those of cigarette smoking. Smoking cessation counseling has been proposed to be an integral part of periodontal prevention and therapy.[1] This study suggests the importance of tobacco use cessation efforts as a means of improving periodontal health and reducing tooth loss in heavy smokers of cigarettes, cigars and pipes with periodontal disease.

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