Tooth mortality in smokers and nonsmokers in a selected population in Sana'a, Yemen

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Background and Objective: Tobacco smoking has been shown to be a major risk factor for tooth loss. The present study was designed to examine tooth mortality and the patterns of tooth loss in smokers and nonsmokers over a wide age range in a selected population from Sana'a, Yemen.

Material and Methods: A total of 2506 persons between the ages of 15 and 64 years were examined, and every permanent tooth was assessed. Missing teeth included both extracted and missing teeth. Individuals currently smoking one or more boxes of cigarettes (20 cigarettes) a day for 5 years were considered as smokers, whereas individuals with no smoking history were considered as nonsmokers.

Results: Smokers had a higher mean tooth loss than nonsmokers. The difference was statistically significant at p < 0.001. Mean tooth loss was significantly higher in smokers across all age groups, except for those in the 45–54 years age group. Smokers had a significantly higher mean upper tooth loss than nonsmokers. Tooth loss decreased from the incisors to the canines and then increased, with peak loss in the first molars.

Conclusion: Tooth loss among smokers is significantly higher than among nonsmokers. The central incisors, lateral incisors and first molars were the most commonly missing teeth in smokers, compared with nonsmokers. © 2007 The Authors. Journal compilation © 2007 Blackwell Munksgaard

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Tobacco smoking has long been known to be associated with chronic disease. Classical examples of diseases for which tobacco smoking is considered to be a substantial contributing risk are lung cancer and cardiovascular disease (1,2). Poor oral hygiene, tobacco smoking and high alcohol consumption are considered to be synergistic risk factors for precancerous lesions in the oral cavity. It is accepted that long-standing bacterial infection is a primary cause of periodontitis (3). In addition, there are a number of risk factors that may increase the probability of the occurrence of periodontal disease, and among these is smoking. Several studies have indicated a higher rate of alveolar bone loss among smokers (4–7). In some investigations, more gingivitis, higher plaque index, higher calculus index and poorer oral hygiene are observed among smokers, whereas other investigations provide no support for such claims, and even seem contradictory on some parameters (4–7). Most investigators do agree that the pattern of periodontal disease is affected by smoking, even when oral hygiene is good (4–8). At any rate, a connection between smoking and periodontal disease is known, and recently tobacco smoking was shown to be a major risk factor for tooth loss (4,5,9,10). Chen *et al.* reported that cigarette smoking was associated with a greater increase in attachment loss and tooth loss at a younger age (11). Federal *et al.* reported that smoking was a predictor for tooth loss (12). Owing to the lack of oral health education, Yemenis do not practice any oral hygiene procedure and, as a consequence, oral hygiene is poor. Smoking in Yemen is almost universal in the male population; it is the basis of a lifestyle and thus a regular habit (13). As tooth loss is the ultimate result of untreated dental disease, tooth mortality figures, such as the mean number of missing teeth, are recognized as a crude, yet useful, measure of the oral health status of a community. In Sana'a, Yemen, although a number of epidemiological studies have revealed oral disease patterns typical of many Third World countries, very little information is available on the patterns of tooth mortality in smokers and nonsmokers, despite the simplicity of the survey methods required to assess tooth loss. The present investigation was therefore designed to examine tooth mortality and the patterns of tooth loss in smokers and nonsmokers over a wide age range in a selected population in Sana'a, Yemen.

Material and methods

The investigation was carried out at the Department of Periodontology of the College of Dentistry in Sana'a University and University of Sciences & Technology over a period of 2 years. A total of 2506 persons, ranging in age from 15 to 64 years, was examined. The status of every permanent tooth was assessed; however, third molar teeth were not included in the study on account of their frequent impaction or agenesis. Missing teeth included both extracted teeth and missing teeth. A tooth was classified as requiring extraction because of dental caries if caries had so destroyed the crown that it could not be restored, if there were septic roots, or if there was carious exposure of the pulp - these being the criteria used in Yemen dental clinics for extraction. A tooth was regarded as requiring extraction because of periodontal disease if it tended to satisfy the score eight criteria of RussellsPI, namely the presence of considerable mobility or a nonfunctional tooth. Before the intra-oral examination, background information, such as name, age, gender and smoking habits, was recorded. Individuals who smoked one or more boxes of cigarettes (20 cigarettes) a day for 5 years were considered as smokers; individuals with no smoking history (never smoked) were considered as nonsmokers; and former smokers were excluded. The number of tooth loss per person was calculated and this mean value was used for all tests. The *t*-test was performed to compare means between groups. Normality assumptions were assessed using the Kolmogorov-Smirnov test, and homogeneity of variances was tested using Levene's test. All statistical tests were carried out using a significance level of 0.05.

Results

A total of 2506 patients was examined. Of these, 548 (21.9%) were smokers and 1958 (78.1%) were nonsmokers. Table 1 displays the breakdown by age group and smoking status. Overall, the majority of patients seen were nonsmokers of all age groups.

The mean total tooth loss, by age group and smoking status, is shown in Table 2. In both smokers and nonsmokers, mean tooth loss increased with age and was highest in the oldest age group. Overall, smokers had a higher mean tooth loss (3.5566) than nonsmokers (2.5332). This difference was statistically significant (mean difference, 1.0234; 95% confidence interval: 0.7580, 1.2888). Mean tooth loss was significantly higher in smokers across all age groups, except for the 45–54 years age group where the difference was not significant.

The mean upper tooth loss, by age group and smoking status, is shown in Table 3. Generally, smokers had significantly higher mean upper tooth loss than nonsmokers (mean difference, 0.5501; 95% confidence interval: 0.4304, 0.6968). However, this difference was not found for all age groups. In the 35–44 years and 45–54 years age groups, the difference was reversed and nonsmokers appeared to have significantly higher mean upper tooth loss than smokers.

The mean lower tooth loss, by age group and smoking status, is shown in Table 4. In the younger age groups (15–24 and 25–34 years age groups), there was no significant difference in mean tooth loss between smokers and nonsmokers. In the older age groups, there was a significant difference in mean tooth loss between smokers and

Table 1. Breakdown of patients by age group and smoking status

	Age group, in years						
	15–24	25–34	35–44	45–54	55–64	Total	
Smoker Nonsmoker	150 (18.1) 681 (81.9)	111 (19.8) 450 (80.2)	138 (28.6) 345 (71.4)	84 (25.0) 252 (75.0)	65 (22.0) 230 (78.0)	548 (21.9) 1958 (78.1)	
Total	831 (100.0)	561 (100.0)	483 (100.0)	336 (100.0)	295 (100.0)	2506 (100.0)	

Results are shown as number of subjects in each age group. The values in parenthesis represent the percentage of smokers, nonsmokers, or total smokers + nonsmokers in each age group.

Table 2. Total mean teeth loss by age group and smoking status

Age group (years)	Smokers	Nonsmokers	Mean difference	95% CI of difference (smokers – nonsmokers)	<i>p</i> -value
15-24	0.8200	0.4302	0.3898	(0.2849, 0.4946)	< 0.001
25-34	2.2793	1.5333	0.7460	(0.5214, 0.9705)	< 0.001
35-44	3.7174	3.2116	0.5058	(0.3998, 0.6118)	< 0.001
45–54	5.2143	5.0873	0.1270	(-0.2228, 0.4767)	0.715
55-64	9.5692	6.9000	2.6692	(2.0647, 3.2738)	< 0.001
All groups	3.5566	2.5332	1.0234	(0.7580, 1.2888)	< 0.001

CI, confidence interval.

Table 3.	Mean	upper	teeth	loss	by	age	group	and	smoking	status
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Age group (years)	Smokers	Nonsmokers	Mean difference	95% CI of difference (smokers – nonsmokers)	<i>p</i> -value
15-24	0.5600	0.1689	0.3911	(0.3396, 0.4426)	< 0.001
25-34	1.3604	0.7200	0.6404	(0.5545, 0.7262)	< 0.001
35-44	1.5870	1.6522	-0.0652	(-0.0982, -0.0322)	< 0.001
45-54	2.0357	2.6984	-0.6627	(-0.8437, -0.4817)	< 0.001
55-64	5.6923	3.4304	2.2619	(1.9049, 2.6189)	< 0.001
All groups	1.8157	1.2656	0.5501	(0.4034, 0.6968)	< 0.001

CI, confidence interval.

Table 4. Mean lower teeth loss by age group and smoking status

Smokers	Nonsmokers	Mean difference	95% CI of difference (smokers – nonsmokers)	<i>p</i> -value
0.2600	0.2614	-0.0014	(-0.0579, 0.0551)	0.962
0.9189	0.8133	0.1056	(-0.0485, 0.2597)	0.178
2.1304	1.5594	0.5710	(0.4876, 0.6544)	< 0.001
3.1786	2.3889	0.7897	(0.5778, 1.002)	< 0.001
3.8769	3.4696	0.4074	(0.1434, 0.6713)	< 0.001
1.7409	1.2676	0.4733	(0.3416, 0.6049)	< 0.001
	Smokers 0.2600 0.9189 2.1304 3.1786 3.8769 1.7409	Smokers Nonsmokers 0.2600 0.2614 0.9189 0.8133 2.1304 1.5594 3.1786 2.3889 3.8769 3.4696 1.7409 1.2676	Mean Smokers Nonsmokers difference 0.2600 0.2614 -0.0014 0.9189 0.8133 0.1056 2.1304 1.5594 0.5710 3.1786 2.3889 0.7897 3.8769 3.4696 0.4074 1.7409 1.2676 0.4733	Mean 95% C1 of difference Smokers Nonsmokers difference (smokers – nonsmokers) 0.2600 0.2614 -0.0014 (-0.0579, 0.0551) 0.9189 0.8133 0.1056 (-0.0485, 0.2597) 2.1304 1.5594 0.5710 (0.4876, 0.6544) 3.1786 2.3889 0.7897 (0.5778, 1.002) 3.8769 3.4696 0.4074 (0.1434, 0.6713) 1.7409 1.2676 0.4733 (0.3416, 0.6049)

CI, confidence interval.

Table 5. Tooth loss by smoking status

Age group	Smokers	Nonsmokers	Mean difference	95% CI of difference (smokers – nonsmokers)	<i>p</i> -value
Central incisors	0.4964	0.2773	0.2190	(0.1818, 0.2563)	< 0.001
Lateral incisors	0.4270	0.2074	0.2196	(0.1768, 0.2625)	< 0.001
Canines	0.1423	0.1221	0.0202	(0.0007, 0.0405)	0.049
First premolars	0.4215	0.2421	0.1794	(0.1459, 0.2130)	< 0.001
Second premolars	0.4635	0.3463	0.1172	(0.0781, 0.1564)	< 0.001
First molars	0.9161	0.7835	0.1326	(0.0646, 0.2006)	< 0.001
Second molars	0.6898	0.5546	0.1351	(0.0831, 0.1872)	< 0.001
All teeth	3.5566	2.5332	1.0234	(0.7580, 1.2888)	< 0.001

CI, confidence interval.

nonsmokers. This difference appeared to increase with age and was greatest in the oldest age group.

Table 5 shows the mean tooth loss for every tooth (upper and lower jaw combined), by smoking status. There were significant differences in mean tooth loss between smokers and nonsmokers for every tooth and for all teeth. Overall, smokers had significantly higher mean tooth loss than nonsmokers. Tooth loss decreased from the central incisors to canines, and thereafter increased again, and peak loss was of the first molars.

Data on mean upper tooth loss (every tooth) by smoking status are shown in Table 6. Overall, smokers had a significantly higher mean upper tooth loss than nonsmokers. In each upper jaw tooth, smokers had significantly higher mean tooth loss than nonsmokers, except for the canines, whereby the difference was not statistically significant. The pattern of tooth loss observed in the lower jaw was not repeated in the upper teeth, but the highest number for tooth loss was still for the first molars.

The data on mean lower tooth loss (every tooth) by smoking status is shown in Table 7. In the lower jaw, there were differences between smokers and nonsmokers. Overall, smokers had significantly higher mean tooth loss than nonsmokers. In all lower teeth, smokers had significantly higher mean tooth loss than nonsmokers, except for the canines and first molars. Generally speaking, the pattern for tooth loss followed the pattern seen for all teeth (upper and lower jaws combined) in that there was a decrease in the mean tooth loss from the central incisors to the canines, followed by an increase of molar tooth loss. Lower jaw tooth loss was highest for first molars.

Discussion

Smoking is a known risk factor for many diseases. The smoke from cigarettes contains materials toxic to humans, often in high concentrations; however, the effect is not immediate (14). An example of this is the time required to develop lung cancer from smoking. A similar problem arises when analyzing smoking habits as a cause for tooth loss (15). Age is universally accepted to be associated with increasing number of lost teeth and edentulous persons, and many studies have shown differences between younger and older age groups with respect to tooth loss, but those differences could also be attributed to the cumulative effects of dental diseases on

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Table 6	I nner 19	w teeth	lose by	r smoking	etatu
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Age group	Smokers	Nonsmokers	Mean difference	95% CI of difference (smokers – nonsmokers)	<i>p</i> -value
Central incisors	0.1898	0.1456	0.0442	(0.0218, 0.0666)	< 0.001
Lateral incisors	0.2354	0.1287	0.1067	(0.0825, 0.1309)	< 0.001
Canines	0.0766	0.0654	0.0112	(-0.0010, 0.0235)	0.071
First premolars	0.2573	0.1456	0.1117	(0.0929, 0.1306)	< 0.001
Second premolars	0.2773	0.1854	0.0919	(0.0693, 0.1146)	< 0.001
First molars	0.4288	0.3161	0.1127	(0.0761, 0.1493)	< 0.001
Second molars	0.3504	0.2789	0.0715	(0.0415, 0.1015)	< 0.001
All teeth	1.8157	1.2656	0.5501	(0.4221, 0.6781)	< 0.001

CI, confidence interval.

Table 7. Lower jaw tooth loss by smoking status

Age group	Smokers	Nonsmokers	Mean difference	95% CI of difference (smokers – nonsmokers)	<i>p</i> -value
Central incisors	0.3066	0.1318	0.1748	(0.1450, 0.2046)	< 0.001
Lateral incisors	0.1916	0.0787	0.1129	(0.0891, 0.1368)	< 0.001
Canines	0.0657	0.0567	0.0090	(-0.0006, 0.0186)	0.067
First premolars	0.1642	0.0965	0.0677	(0.0480, 0.0874)	< 0.001
Second premolars	0.1861	0.1609	0.0252	(0.0052, 0.0453)	0.014
First molars	0.4872	0.4673	0.0199	(-0.0173, 0.0571)	0.294
Second molars	0.3394	0.2758	0.0636	(0.0357, 0.915)	< 0.001
All teeth	1.7409	1.2676	0.4733	(0.3416, 0.6049)	< 0.001

CI, confidence interval.

oral health, oral hygiene status and the treatment philosophies of past days (16–19).

It was clearly demonstrated, from the results of the present study, that mean tooth loss in both smokers and nonsmokers increases with age and is highest in the older age groups. This finding is in accordance with what is universally accepted, in that the severity of tooth loss increases with advancing age (20–23).

The results of the present study illustrated that the severity of tooth loss among the total mean tooth loss was higher in smokers than in nonsmokers and that this difference was highly significant. This finding is in agreement with Ragnarsson et al. (24), who indicated a connection between smoking and the number of remaining teeth. In accordance with our discussion above, epidemiogical data have revealed that smokers have fewer teeth, a higher prevalence of edentulism and a greater incidence of tooth loss compared with nonsmokers (10,15,25,26).

Many studies exist confirming the relationship between smoking and the deterioration of dental status (8). In our study, smokers had a higher mean upper tooth loss than nonsmokers, and the difference was significant. Tobacco smoking can affect periodontal tissues directly, causing local irritation, and gingival pockets tend to be greater in the maxillary lingual sites (27). However, the difference was reversed in the 35-44- and 45-54-years age groups, whereby the nonsmokers appeared to have significantly higher mean upper tooth loss compared with smokers, a situation that may be ascribed to inferior oral hygiene status because oral care is given low priority, or even neglected altogether, by those within these age groups in Yemen (28).

The results for teeth in the lower jaw reflected no significant differences between smokers and nonsmokers in the younger age groups (15–24 and 25–34 years). This may be a result of better oral health and a conscious decision to keep their teeth for aesthetic purposes. Differences in the mean values were observed as age increased, and were highest in the oldest age group, possibly because of the effect of long-term exposure to tobacco.

As expected, the pattern of lost posterior teeth differed from that of the anterior teeth. Comparisons between smokers and nonsmokers for the total sample, according to the tooth, revealed that smokers had significantly higher mean tooth loss than nonsmokers, with the central and lateral incisors notably being the most commonly missing anterior teeth, and the first molars representing the most commonly missing posterior teeth (Table 5). Similarly, the results for the lower teeth (Table 6) and upper teeth (Table 7) showed the same picture, and these finding were in accordance with studies which reported that differences in the pattern of periodontal destruction and tooth loss among smokers and nonsmokers implied a localized effect of the smoking habit upon the upper anterior region, especially at the palatal sites (29-31).

In conclusion, there was a greater incidence of tooth loss among smokers compared with nonsmokers in Sana'a, Yemen, and the central incisors, lateral incisors and first molars were the most commonly missing teeth in smokers.

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