

Percentage and severity of periodontal diseases in Turkish adults aged 35+ years, 2009-10

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Introduction

Turkey is a large and pivotal country linking the Middle East, Asia, and Europe. With a large and increasing population of adults, cost of dental care and changing prevalence of periodontal diseases could have significant economic, social, and development implications (1,2). Although Turkey has experienced phenomenal economic development over the last two decades, it still does not have a comprehensive plan for the promotion of oral health and provision of dental care to its population (3).

Abstract

Objective: This article presents data on the burden of periodontal diseases in Turkish adults aged 35 years or older.

Methods: Within each region of Turkey, a rural and an urban area or city were selected in 2009-10 using a probability proportional to size method. In the selected towns, local officials who were familiar with their communities assisted in recruiting subjects. Loss of Attachment (LOA) was measured at six sites around each tooth present in the mouth, excluding third molars. Additionally, the Community Periodontal Index was used to assess the severity of periodontal diseases around 12 index teeth. Self-reported data on key risk factors were also collected. Weights were computed using a raking ratio adjustment procedure and used in all analyses.

Results: Almost all examined adults had some loss of periodontal attachment. The proportion of those with more than 3 mm LOA ranged from 43 percent in 35-44 year olds to 91 percent in those aged 65+ years. Among females, older age, low education status, smoking 11-40+ cigarettes a day, being employed, and presence of high number of missing tooth surfaces were associated with LOA > 3 mm. Among males LOA > 3 mm was associated with older age, use of alcohol, and unemployment. The CPI data did not yield the same associations with periodontal diseases and risk factors.

Conclusions: Periodontal diseases in Turkish adults are highly prevalent. A tailored common risk factor health promotion program is recommended to reduce the burden of periodontal infection in Turkey.

Periodontal diseases have significant impact on the quality of life and can cause severe pain and discomfort (4). Severe periodontal disease is the sixth most prevalent disease in the world (4) and is one of the main causes of partial or full loss of teeth (5).

In 2004-05, a survey was carried out of periodontal diseases in adults aged 35-44 and 65-74 (6). That survey measured periodontal diseases [calculus, gingivitis, and periodontal pockets, and loss of attachment (LOA)] around 12 index

teeth. The examination in the 2004-05 survey was conducted by dental students or residents (6). The 2004-05 survey found that the percentage of Turkish adults with loss of periodontal attachment (LOA) more than 3 mm in the age groups 35-44 and 65-74 years, was 32.1 percent and 61.7 percent, respectively. Among those with LOA more than 3 mm, the majority had LOA of 4-5 mm (22.9 percent and 34.4 percent among those aged 35-44 or 65-74 years, respectively). That survey also found a high percentage of older adults with LOA more than 6 mm (26.3 percent) (6).

The high burden of periodontal diseases and the relatively high use of tobacco products, specifically cigarettes, raise concerns about the overall impact of periodontal infections in Turkey. Based on a 2015 World Health Organization report, 53.2 percent of men aged 25-39 years smoked cigarettes (7). The Tobacco Atlas published by The American Cancer Society and the World Lung Foundation ranked Turkey in the second tier in terms of smoking of cigarettes. In 2015, 30.8 percent of deaths among males was caused by use of tobacco products while only 12 percent of deaths in women were attributed to exposure to tobacco (8).

Another common chronic disease associated with periodontal infections and is prevalent in Turkey is diabetes. There has been increasing evidence that the two diseases are highly linked and treatment of periodontal diseases may have impact on managing diabetes (9,10).

The objective of this survey, which expands on the previous survey, was to estimate the severity of periodontal diseases in Turkish adults aged 35 years or older by measuring loss of attachment and pocket depth around all teeth rather than just index teeth and identify the major risk factors associated with periodontal infections.

Methods

Turkey is divided into seven regions: 1 = Mediterranean (Akdeniz), 2 = East Anatolia (Dogu Anadolu), 3 = Aegean (Ege), 4 = South East Anatolia (Guney Dogu Anadolu), 5 = Middle Anatolia (Ic Anadolu), 6 = Black Sea (Karadeniz), and 7 = Marmara (Marmara). The regions vary socio-economically, culturally, and in availability of natural resources (2,11). Hence, residence in a region may indicate differences in several important risk factors that may be associated with health and oral health. After the sample size was estimated to detect a prevalence of 30 percent with 9 percent confidence for each region, the research team, with the assistance of the Biostatistics Department of Istanbul University Cerrahpasa Faculty of Medicine, selected an urban and a rural site using probabilities proportional size to represent the population characteristics in each region. In each region, a representative city was chosen, except for the Marmara Region where Istanbul, which is the largest city in Turkey, as well as the cities of Tekirdag and Bursa were included with certainty

because of their large population sizes. In each selected city, adult volunteers were recruited from one rural and one urban area in each region.

In each site, the research team established an examination clinic at a local hospital, public dental clinic, and in some rural areas, administrative office of a local official such as the mayor or local directors responsible for civil affairs in the area. These individuals were networked with local members of their community. Each local contact was provided with a target number of adults to recruit for examination at the local clinical examination site. To evaluate the level of error between the raw data and data entry, hypothesizing that there could be as much as a 20 percent entry error, the forms of 342 individuals were selected for an independent review. The incorrect entry rate in the data entry sample was 0.6 percent, a rate that would not significantly change results for the total sample.

The protocol for the survey was approved by Yeditepe University Human Subjects Research Review Committee (No: 016/075). Individuals who agreed to participate signed an informed consent form that was approved by the IRB committee.

The periodontal examiner used Q-optics radiant head light (91,500 Lux Power) and either a portable dental chair or a regular chair when the examinations were conducted in local areas. Prior to the start of the examination, the dental examiner of the oral mucosal lesions section administered the questionnaire recommended by the European Global Oral Health Indicators Development (EGOHID) to gather information on demographic and medical conditions, cigarette smoking, and oral health behaviours (12,13). The periodontal examiner used a plane mouth mirror, Williams Probe (marking at 1-3-7-9 mm), to estimate pocket depth and loss of periodontal attachment in millimetres. The Community Periodontal Index (CPI) probe was used to determine the CPI score for 12 index teeth following the protocol developed by the World Health Organization. All data were recorded on the EGOHID survey form by an assistant who worked with the periodontal examiner.

To estimate the LOA, six sites per tooth (28 teeth excluding third molars) were assessed, and for the CPI, 12 teeth were examined in six sextants. The recording of LOA was conducted by measuring the distance between the free gingival margin to the cemento-enamel junction (FG-CEJ) and from free gingival margin to the bottom of the crevice or pocket (FG-C or P). The examiner computed LOA by subtracting the distance between the FG-C or P and FG-CEJ if there was no gingival recession. If there was a recession the two distances were added to reflect the degree of LOA. The examiner ran the CPI probe in the sulcus or depth of pocket and scored each tooth as follows: 0 = healthy, 1 = gingival bleeding only, 2 = calculus and gingival bleeding, 3 = pockets of 4-5 mm, and 4 = pockets ≥ 6 mm.

Periodontal outcomes included percent of tooth sites with LOA 1-3 mm, percent of tooth sites with LOA > 3 mm, and percent of sextants with varying level of periodontal pockets (0, 1-3 mm, 4-6 mm, >6 mm). Along with dental outcomes, the study collected data on participants' socio-demographic information (age, gender, employment, education, and region of residence), oral health-related characteristics (frequency of tooth brushing, dental visits), alcohol consumption, smoking, and diabetes.

The research team that performed the examination for periodontal diseases included a calibrated periodontist and a dental recorder. Local dentists in the area helped with sterilization of dental instruments. The periodontist who conducted all examinations was trained by an experienced periodontal faculty from Istanbul University to measure loss of periodontal attachment and pocket depth following a standard clinical protocol. The training included about 20 adults who attended and were examined by both the periodontal examiner and the trainer. A month after the baseline examination, the same adults were re-examined by both examiners. In total, 2,862 measurements (six sites per each tooth) from 20 adults were evaluated for inter-examiner reliability. The interexaminer kappa coefficient between the periodontal examiner and the expert faculty was 0.73. The same group of patients was examined again for the intraexaminer reliability after 3 weeks. The intraclass correlation coefficient was 0.81 for the calibrated periodontal examiner. After the baseline calibration, and because of difficulty in the field of recalling patients to be re-examined, no further reliability assessments were conducted.

Of 930 individuals who consented to be examined, 132 fully edentulous individuals were excluded from the analysis. Additionally, 55 individuals with missing LOA were excluded, which resulted in a final sample of 743 individuals. Socio-demographic and oral health-related characteristics were not significantly different between this final sample ($n = 743$) and the sample with missing LOA ($n = 798$).

The study relied on data collected from convenience samples of adults in each site. The distribution of the sample by age, by sex, and by region was compared to the population distributions from the 2010 Turkish Census of Population (data are available from the lead author upon request). The volunteers were younger and more evenly distributed across regions than the Census. These differences were corrected through the development of weights assigned to each of the sampled individuals such that the weighted sample distribution matched the Census distribution by age, sex, and region. The weighting procedure employed a raking ratio estimation procedure (14). The resulting "poststratification" weights were evaluated in terms of their impact on estimates and variance, and extremely large values trimmed to reduce the variance of the weights. The raking procedure successfully adjusted the

convenience sample distributions to match the Turkish population at least in terms of three population characteristics. It is expected that weighted estimates of oral health and other findings will be closer to the underlying true population values than would the unweighted estimates. This expectation is based on the degree to which age, sex, and region are correlated with other variables in analysis, and thereby corrects for discrepancies between the sample and the unknown population distributions.

Summary weighted measures were calculated to describe socio-demographic and oral health-related characteristics among study participants. Then associations between these characteristics and periodontal outcomes were assessed via multivariate regression analysis to account for potential confounders. Because outcomes were highly skewed toward larger values and always greater than zero (e.g., 0 percent to 100 percent), negative binomial regression models were used. All statistical analyses were performed using STATA version 12 software, except for the raking procedure that was performed using survey package in the R statistical software system. All estimates were computed using the raking ratio poststratification weights. Statistical significance was determined at the two-sided critical value of 0.05.

Results

The percentage of adults with at least one tooth and who smoked at least one cigarette per day was 36 percent (Table 1). Educational attainment was relatively low with only 12 percent reported that they had graduated from a university or a 4-year college. Around 37 percent of the examined adults were employed. Only 6 percent of the examined adults reported being diagnosed with diabetes. Around 16 percent of the adults reported that they drink alcohol. Of the examined adults, 70 percent reported that they brushed their teeth two times a day. The percentage of adults who reported visiting a dentist within the last year was 36 percent.

Almost all examined adults had some loss of periodontal attachment (Table 2). The proportion of adults with LOA > 3 ranged from 43 percent in 35-44 year olds to 91 percent in adults aged 65+ years. The mean number of tooth sites per adults with LOA > 3 mm ranged between 6 percent in youngest age group to 49 percent in the oldest age group. The mean LOA per individual ranged from 2.2 mm in those aged 35-44 to 4.1 mm in those 65 years or older.

The percentage of sextants with gingivitis or calculus only based on CPI examination was 77.7 percent in the youngest age group and decreased to 46.6 percent in the oldest age group (Table 3). The percentage of sextants with pockets equal or deeper than 4 mm ranged from 11.7 percent in the youngest age group to 40.8 percent in the oldest age group.

Table 1 Characteristics of Adults Examined and Have at Least One Tooth Site with Loss of Periodontal Attachment (Weighted Percentage), 2009-10

Age groups		35-44 year old	45-54 year old	55-64 year old	65+ years old	Total	
No of subjects		N = 396	N = 206	N = 88	N = 53	N = 743	
Average age in years (SE)		39 (0.2)	48 (0.3)	59 (0.5)	73 (1.1)	45 (0.5)	
Gender	Male	63%	51%	57%	51%	59%	
	Female	37%	49%	43%	49%	41%	
Smoking	1-5 cigarettes per day	13%	16%	5%	1%	12%	
	6-10 cigarettes per day	6%	9%	2%	1%	6%	
	11-20 cigarettes per day	19%	9%	10%	6%	15%	
	21-40 cigarettes per day	3%	5%	6%	0%	3%	
	Never smoked	60%	61%	77%	92%	64%	
Educational level	Never attended school	5%	7%	9%	12%	7%	
	Elementary school	38%	50%	24%	28%	37%	
	Grades 9-11 attended high school	10%	11%	16%	29%	14%	
	Grades 12 graduated at high school	24%	19%	30%	16%	22%	
	College for 1 to 3 years	11%	5%	4%	7%	8%	
Employment status	University-college 4 or more years	13%	8%	17%	8%	12%	
	Employed with wages	59%	37%	12%	0%	37%	
	Unemployed	9%	5%	1%	2%	6%	
	Student	3%	0%	0%	0%	1%	
	Unable to work	0%	0%	0%	0%	0%	
	Self employed	1%	3%	15%	5%	4%	
	Home-maker	26%	38%	26%	49%	32%	
	Retired	2%	15%	46%	44%	18%	
Diabetes	Not recorded	0%	2%	0%	0%	2%	
	Yes	0%	4%	13%	21%	6%	
Alcohol consumption	No	100%	96%	87%	79%	94%	
	Everyday	0%	0%	1%	1%	0%	
	Sometimes	21%	17%	9%	7%	16%	
Daily toothbrushing	Never	79%	83%	90%	92%	84%	
	Yes	72%	77%	66%	57%	70%	
	No	24%	18%	32%	28%	25%	
Last dental visit	Not reported	4%	5%	2%	15%	5%	
	Less than 1 year	46%	38%	31%	12%	36%	
	More than 1 year but less than 2 years	21%	17%	15%	8%	17%	
	More than 2 years but less than 5 years	9%	13%	35%	18%	15%	
	More than 5 years	23%	30%	18%	57%	30%	
Missing tooth surfaces	Never previously examined	1%	0%	1%	2%	1%	
	Mean count of missing surfaces (SE)	36 (2.3)	45 (3.8)	57 (4.3)	73 (8.9)	42 (1.8)	
	Region	0%	2%	0%	3%	1%	
		Akdeniz	14%	10%	7%	19%	13%
		Dogu Anadolu	3%	5%	8%	3%	4%
		Ege	4%	7%	7%	13%	6%
		Guney Dogu	3%	4%	2%	1%	3%
		Ic Anadolu	2%	3%	2%	3%	3%
Karadeniz		2%	10%	6%	5%	5%	
Marmara	72%	61%	68%	56%	66%		

Of 930 individuals, we include 743 because they had at least one tooth site examined for LOA. Those who were excluded ($n = 187$) included those with full edentulism ($n = 132$), those with partial edentulism and missing loss of periodontal attachment (LOA) ($n = 54$), and one dentate individual with missing LOA.

About 23 percent of the sextants in the oldest age group had pockets equal to or deeper than 6 mm.

Table 4 presents the findings from the negative binomial regression model for proportion of sites in females with LOA deeper than 3 mm. Older age, heavy smoking, region,

and number of missing tooth surfaces were significantly associated with higher probability of LOA > 3 mm. Among females, attending college, being self-employed, unemployed, home maker or retired were associated with lower risk of developing LOA > 3 mm. Among males

Table 2 Weighted Percentages or Averages of Percentage of Adults with Periodontitis Assessed by Loss of Attachment (LOA) in at Least One Tooth Site in Turkish Adults, 2009–10

Age groups	35-44 year old	45-54 year old	55-64 year old	65+ years old
Mean proportion of sites/mouth LOA = 0 (SE)	0% (0%)	0% (0%)	0% (0%)	1% (1%)
Mean proportion of sites/mouth LOA between 1 and 3 mm (SE)	94% (1%)	84% (3%)	67% (6%)	50% (7%)
Mean proportion of sites/mouth LOA >3 mm (SE)	6% (1%)	16% (3%)	33% (6%)	49% (7%)
Proportion of individuals with LOA = 0 on all tooth sites	0%	0%	0%	0%
Proportion of individuals with LOA between 1 and 3 mm	100%	98%	93%	82%
Proportion of individuals LOA >3 mm	43%	57%	82%	91%
Mean LOA (mm) (SE)	2.2 (0.1)	2.7 (0.1)	3.6 (0.3)	4.1 (0.3)

(Table 5), older age, drinking alcohol, being self-employed, were associated with LOA > 3 mm. There were regional differences in LOA > 3 mm only among females. When the analysis was repeated with advanced periodontal pockets (CPI 3 or 4; Tables available upon request from the first author) among females and males, we did not find the same risk factors. Females and males, who were 55-64 year old had significantly higher probability of being classified with advanced periodontal pockets.

Discussion

The 2009-10 oral health survey found that Turkish adults had significantly high burden of periodontal diseases. While this present survey relied on convenience samples of volunteers, it is the only relatively detailed examination of periodontal diseases for adults at least 35 years old. Compared with the findings reported from the 2004-05 survey, the burden of periodontal disease is significantly higher in this study. For example, the percentage of adults aged 35-44 years with CPI scores 3 and 4 reported here was about 2-3 times higher than the findings from the 2004-05 survey. The difference was even higher in the oldest age group. In the previous survey 27 dental students were trained to assess the CPI scores, while in this study a calibrated practising periodontist conducted the examination. Another difference between the two surveys is the measurement of pocket depth and loss of periodontal attachment from all teeth present in the mouth (excluding third molars) in the recent survey compared with the measurement of depth of periodontal pockets and LOA around 12 index teeth, in the previous survey.

Based on the data collected by the World Health Organization (15), the percentage of adults with CPI 4 severity level found in the survey for the age group 35-44 was lower than the burden reported for adjacent countries, but it was close to that reported for Greek adults. For adults aged 65+, the burden of deep periodontal pockets was similar to that reported for Denmark and Lebanon. All these comparisons are limited because most of the other surveys relied on small convenience samples, and no adjustment to population distributions through weighting was employed. Overall the use of the CPI assessment of periodontal diseases did not find any significant association with the same risk factors identified in the analysis of loss of periodontal attachment.

An important finding of this study was the high exposure to tobacco, now considered one of the main etiological factors of periodontal diseases. It is interesting to find that smoking cigarettes was associated with periodontal diseases in Turkish females (Table 4) but not in males (Table 5). While the use of alcohol by men in Turkey is common (16) data are limited because of religious teachings which forbid the drinking of alcohol. We expect that the use of alcohol by men to be highly underreported. The majority of Turkish females do not drink alcohol neither in private nor public for reasons related to religious and cultural norms. This finding of the different manifestation of cigarette smoking and alcohol use among males and females is important because any future oral health marketing or educational campaigns targeting the smoking of cigarettes and drinking alcohol on oral health should be tailored based on gender.

National data on oral health are necessary for developing national oral health policy. Turkey has embarked on significant expansion of the number of dental schools and the

Table 3 Weighted Percentages of Sextants by CPI (Community Periodontal Index) Scores (SE) and Age Groups in Turkish Adults

Age groups	35-44 year old	45-54 year old	55-64 year old	65+ years old
CPI 0 (healthy)	10.6 (1.1)	6.9 (1.6)	7.3 (4.3)	12.7 (11.5)
CPI 1 (bleeding on probing)	30.5 (2.1)	22.5 (2.5)	7.7 (2.6)	0.8 (1.5)
CPI 2 (calculus present)	47.2 (2.6)	48.4 (4.0)	39.2 (6.4)	45.8 (11.8)
CPI 3 (PPD ≥4 and <6mm)	8.8 (1.4)	14.5 (2.8)	27.1 (5.4)	17.3 (5.5)
CPI 4 (PPD ≥6mm)	2.9 (0.9)	7.6 (2.4)	18.7 (5.9)	23.5 (11.5)

Table 4 Regression Coefficients of Risk Factors Associated with Advanced Periodontitis Measured Using Proportion of Teeth with Loss of Attachment More Than 3 mm among Turkish Females

		Proportion of sites/mouth LOA >3 mm
Demographic data		Beta coefficient (SE)
Age groups	35-44 year old	REF
	45-54 year old	0.68 (0.24)***
	55-64 year old	1.03 (0.36)***
	65+ years old	1.35 (0.39)****
Smoking	Never smoke	REF
	1-10 cigarettes per day	0.43 (0.27)
	11-40+ cigarettes per day	0.58 (0.30)*
Alcohol consumption	Never	REF
	Sometimes or everyday	0.41 (0.36)
Education	Never attended school	REF
	Elementary school	-0.15 (0.25)
	Grades 9-11 attended high school	-0.01 (0.36)
	Grades 12 graduated at high school	-0.50 (0.35)
	College for 1 to 3 years	-1.27 (0.43)***
Employment	University-college 4 or more years	-0.30 (0.49)
	Employed with wages	REF
	Unemployed	-0.63 (0.37)*
	Unable to work	1.15 (0.77)
	Self employed	-1.60 (0.76)**
	Home-maker	-0.55 (0.29)*
	Retired	0.64 (0.36)*
Diabetes	Not recorded or student	-0.03 (0.78)
	No	REF
Region	Yes	0.02 (0.46)
	Akdeniz	REF
	Dogu Anadolu	1.23 (0.40)***
	Ege	1.90 (0.66)***
	Guney Dogu	1.08 (0.38)***
	Ic Anadolu	0.88 (0.39)**
	Karadeniz	0.32 (0.39)
	Marmara	0.37 (0.33)
Daily toothbrushing	No	REF
	Yes	0.16 (0.21)
Last dental visit	Less than 1 year	REF
	More than 1 year but less than 2 years	0.37 (0.23)
	More than 2 years but less than 5 years	0.004 (0.39)
	More than 5 years	0.33 (0.29)
	Never previously examined	0.92 (0.48)
Count of missing surfaces	<20	REF
	20 - <40	-0.08 (0.34)
	40 - <98	0.57 (0.31)
	98*	1.24 (0.33)****

To address skewness, we used a quasi-Poisson regression model.

* $0.05 \leq P\text{-value} < 0.10$; ** $0.01 \leq P\text{-value} < 0.05$; *** $0.001 \leq P\text{-value} < 0.01$; ****: $0 \leq P\text{-value} < 0.001$.

education of dentists to provide restorative or reparative care. Planning for oral health care as well as the promotion of oral health in Turkey requires an understanding of the burden of oral diseases by social, economic, geographic, and demographic factors. Periodontal diseases, which have not been included in the national strategic goals developed by the Ministry of Health (17), should be added with specific

targets set for promoting periodontal health. Based on the high burden of periodontal diseases in Turkey, a dental team model should be considered to provide integrated and comprehensive care to all the Turkish population.

Turkey is a complex country with expansive geography and diverse ethnic and racial minorities. For financial and logistical reasons, this survey relied on local civic leaders to recruit adults

Table 5 Regression Coefficients of Risk Factors Associated with Advanced Periodontitis Measured Using Proportion of Teeth with Loss of Attachment More Than 3 mm among Turkish Males

		Proportion of sites/mouth LOA >3 mm
Demographic data		Beta coefficient (SE)
Age groups	35-44 year old	REF
	45-54 year old	0.68 (0.24)***
	55-64 year old	1.03 (0.36)***
	65+ years old	1.35 (0.39)****
Smoking	Never smoke	REF
	1-10 cigarettes per day	0.43 (0.27)
	11-40+ cigarettes per day	0.58 (0.30)*
Alcohol consumption	Never	REF
	Sometimes or everyday	0.41 (0.36)
Education	Never attended school	REF
	Elementary school	-0.15 (0.25)
	Grades 9-11 attended high school	-0.01 (0.36)
	Grades 12 graduated at high school	-0.50 (0.35)
	College for 1 to 3 years	-1.27 (0.43)***
Employment	University-college 4 or more years	-0.30 (0.49)
	Employed with wages	REF
	Unemployed	-0.63 (0.37)*
	Unable to work	1.15 (0.77)
	Self employed	-1.60 (0.76)**
	Home-maker	-0.55 (0.29)*
	Retired	0.64 (0.36)*
Diabetes	Not recorded or student	-0.03 (0.78)
	No	REF
Region	Yes	0.02 (0.46)
	Akdeniz	REF
	Dogu Anadolu	1.23 (0.40)***
	Ege	1.90 (0.66)***
	Guney Dogu	1.08 (0.38)***
	Ic Anadolu	0.88 (0.39)**
	Karadeniz	0.32 (0.39)
	Marmara	0.37 (0.33)
Daily toothbrushing	No	REF
	Yes	0.16 (0.21)
Last dental visit	Less than 1 year	REF
	More than 1 year but less than 2 years	0.37 (0.23)
	More than 2 years but less than 5 years	0.004 (0.39)
	More than 5 years	0.33 (0.29)
	Never previously examined	0.92 (0.48)
Count of missing surfaces	<20	REF
	20 - <40	-0.08 (0.34)
	40 - <98	0.57 (0.31)
	98*	1.24 (0.33)****

To address skewness, we used a quasi-Poisson regression model.

* $0.05 \leq P\text{-value} < 0.10$; ** $0.01 \leq P\text{-value} < 0.05$; *** $0.001 \leq P\text{-value} < 0.01$; **** $0 \leq P\text{-value} < 0.001$.

to be examined by a calibrated periodontist who is a full-time private practitioner in Istanbul. To address this potential sampling bias, this study used a survey weighting procedure, the raking ratio adjustment, to obtain weighted sample distributions by age, gender, and regions that matched those from the 2010 Turkish Census. This approach may be effective in reducing sampling bias for characteristics of oral health and risk factors associated with age, gender, and region of residence. But

differences in other demographic and behavioural characteristics may persist between the sample and the Turkish population. In the future, investment must be made to select a nationally representative sample using probability sampling methods throughout, rather than only at the site level.

This study had other limitations. First, data were missing on pocket depths from the same six sites where LOA was assessed, because an examiner did not separately record

pocket depth and LOA. Instead the CPI was used to assess pocket depth around 12 index teeth. This approach did not enable applying the recent case definition of moderate and severe periodontitis as defined by the US CDC Working Group. Second, because of logistical barriers, recalling examinees for a subsequent visit for reliability assessment in the field was not possible.

Despite these limitations, there were strengths in the study. The survey conducted assessment of LOA following proposed standards recommended by the Joint EU/USA Periodontal Epidemiology Working Group (18) and the US Centers for Disease Control and Prevention (19) based upon the analysis of Kingman et al. in 2008 (20). The standard recommends full mouth measurement at six sites around each tooth, excluding third molars, because this standard yields more complete information on the severity of periodontal disease. Recent studies and consensus reports have indicated that partial mouth measurement of LOA and pocket depth underestimates the severity and prevalence of periodontal diseases (20-23). The survey reported in this article is the first to examine LOA at six sites per tooth around all teeth present at the time of the examination in adults 35 years or older. The 2004-05 survey recorded LOA at four sites around 12 index teeth (6).

This cross-sectional survey, which collected self-reported data on diabetes did not find an association between diabetes and periodontal diseases. Diabetes was not highly prevalent in Turkish adults before the age of 65 years. The overall prevalence reported in the adults who participated in the survey was 6 percent. This reported prevalence is less than the 16.5 percent reported in a recent study of diabetes in Turkey which collected data from over 25,000 adults and relied on fasting glucose and biochemical parameters to diagnose diabetes (16).

In summary, periodontal diseases in Turkish adult is highly prevalent. The percentage of LOA of more than 3 mm ranged from 43 percent of 35-44 year olds to 91 percent of adults aged 65+ years. There were differences in the association of alcohol and cigarette smoking between males and females which places gender as an important determinant of health in developing countries.

The findings from the 2009-10 survey point to the need for developing a focused approach to reduce the burden of oral diseases in Turkey. The findings of the survey indicate that there is a need for a long-term preventive strategy with an emphasis on promoting primary care to control and treat periodontal diseases. The burden of periodontal diseases cannot be reduced without marketing of periodontal health as a norm for all the population and the promotion of methods to improve oral hygiene, reduce tobacco use, and manage related medical conditions. Government should promote the oral hygiene practices as it is done heavily for tobacco cessation. Dentists must take the charge and focus on preventive

and nonsurgical management modalities. Their proficiency level in this area must exceed and dental schools in Turkey must focus on educating dentists who understand the pathology, etiology, diagnosis, and evidence-based strategies for controlling periodontal diseases.

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