

# Root caries in 35-44 and 65-74 year-olds in Turkey

S. Gökalp<sup>1</sup> and B. Güçüz Doğan<sup>2</sup>

<sup>1</sup>Hacettepe University, Faculty of Dentistry, Ankara, Turkey; <sup>2</sup>Hacettepe University, Faculty of Medicine, Ankara, Turkey

**Objective:** To assess the prevalence and related factors of root caries in Turkish 35-44 and 65-74 year-olds. **Basic research design:** In this cross-sectional study, using a proportional stratified cluster sampling, 1,631 subjects aged 35-44 years and 1,545 aged 65-74 years were examined. Data were collected via a structured, pre-tested face-to-face administered questionnaire and oral examination following WHO 1997 guidance. Statistical significance was evaluated with  $\chi^2$  test and binary logistic regression analyses to determine the significance of explanatory variables. **Results:** The prevalence of root caries was 20.1% in dentate 35-44 year-olds, 28.4% in 65-74 year-olds. Mean decayed root increased significantly with the increasing number of retained natural teeth ( $p=0.010$  for 35-44 and  $p<0.001$  for 65-74 year-olds). First molars were the most affected by root caries in both age groups. For adults, being male (OR=1.37), rural residence (OR=1.50), being unschooled (OR= 3.07), no tooth brushing (OR=1.83) and never visiting dentist (OR=2.03) were the predictors of the presence of root caries. For elderly, rural residence (OR=1.54), no tooth brushing (OR=1.89), and never visiting dentist (OR=2.38) were the determinants of root caries. **Conclusion:** There is a need for the increased implementation of oral health measures with increasing age in Turkey.

**Key words:** Root caries, 35-44 year-olds, 65-74 year-olds, adult, elderly, cross-sectional study, Turkey

## Introduction

The world's population is aging resulting in an increasing number of retained natural teeth in one's old age. Increased retention of teeth means that more adults are at risk for root caries but estimation of the prevalence of root caries is complicated because of continuous tooth loss with increasing age (Ritter *et al.*, 2010). It is difficult to draw comparisons between available data originating in different populations with different prevalence of tooth loss (Fejerskov *et al.*, 1993) and also with different diagnoses of root caries (Katz, 1982). Therefore, the World Health Organization (WHO) has developed methods for scoring root caries in index age groups for epidemiological investigations and recommends using simple prevalence which is the percentage of individuals with at least one untreated root caries for comparison (WHO, 1997).

Concerns about root caries increased after the early 1980s since when many studies have been carried out including Nicolau *et al.* (2000) with 60-74 year-olds and Splieth *et al.* (2004) with subjects aged 20-79. In these studies, the prevalence of root caries differs considerably, ranging 18-36%. The incidence of root caries also varies from 12% to 77% (Ritter *et al.*, 2010). Some of the cited studies have reported mandibular molars as the teeth more frequently affected by root caries in any age group (Kularante and Ekanayake, 2007; Watanabe, 2003). On the other hand, Imazato *et al.* (2006) have reported root caries on premolars and canine teeth in the elderly.

Among the indicators and predictors of root caries, root caries prevalence at baseline, number of teeth and plaque index are the most frequently reported measures (Ritter *et al.*, 2010). While all the possible factors associated with root caries prevalence have not been clearly

identified, several studies have demonstrated some of the strongest, such as oral hygiene, regular dental attendance, socioeconomic status, salivary rate, and salivary bacteria level (Brennan *et al.*, 2007; Ringelberg *et al.*, 1996; Ritter *et al.*, 2010).

There were no data on the prevalence and intra-oral distribution of root caries and related factors in Turkey before the 2004 National Oral Health Study. Since the use of dental health services is low in Turkey, describing the level of root caries at the population level is important for planning future preventive measures. The aim of this present study was to determine the prevalence and intra-oral distribution of root caries in 35-44 and 65-74 year-olds in Turkey as a part of the 2004 National Oral-Health Study and to identify some socio-demographic factors and oral health behaviors related to root caries.

## Method

This study used data from a nationwide cross-sectional survey conducted to evaluate the oral health status of the Turkish population (Gökalp *et al.*, 2010). This survey was reviewed and approved by the Committee on the Ethics of Human Experimentation at the University of Hacettepe. Informed verbal consent for the interview and examination was obtained from all participants after an explanation of the procedure. The Turkish Statistical Institute chose the representative study population of rural and urban citizens. Proportional stratified cluster sampling procedure was used though settlements with populations under 200 were not included on account of being too small. At the first stage, clusters of households were combined to form the sampling clusters each with 100 addresses. Then 250 of these clusters were selected

randomly to match the urban/rural proportion of Turkish population: these encompassed 68 of the 81 Turkish provinces. For each age group, 6 persons were selected per cluster giving 1500 persons per age group. Finally, from each cluster, households were visited. At every household, firstly the age and gender of those living in the household were asked, recorded on the "Household Record Form", and the eligible persons for each age group determined, interviewed and examined. If there was more than one eligible subject for a specific age in a household, one was randomly selected for the study. Requests for examination of others from the same household were also accepted but they were not included in the study. If there was a request for examination from another household after completing 6 examinations for a cluster, ethically, they were also involved in the study. This caused an increase in the sample size and the final study population reached was 7833. Among them, 1631 subjects aged 35-44 years and 1545 subjects aged 65-74 years were evaluated for the purposes of this study.

The calculated sample size using the formula  $t^2pq/d^2$ , where  $t=1.96$  for  $\alpha=0.05$ ;  $p$ , caries-free fraction=0.16;  $q=1-p$  and  $d$ , maximum acceptable deviation from prevalence=4%, is 323. However to give confidence when comparing subgroups and when ensuring a geographical spread across Turkey, the sample size was increased to 1500 individuals.

During June 2004, for four weeks, 27 4<sup>th</sup>/5<sup>th</sup> grade dental students were trained as examiners by 4 experienced dentists. Before beginning the training, these experts were calibrated among themselves for each diagnosis category. Each examiner evaluated 5 persons who had also been examined by an expert. Calibration exercises were then conducted on 10 subjects from each age group with different oral health situations. The calculated inter-examiner Kappa value was  $>0.80$  with all 27 examiners showing inter-examiner consistency though intra-examiner reliability was not checked. Refresher training was carried out a week before the survey started.

The study was conducted from September 2004 through February 2005. The 26 structured questions were designed and pre-tested for this survey and the interview was performed face-to-face during home visits. The content included socio-demographic characteristics, dietary habits, oral health behaviour and dental attendance but behavioural factors such as correct tooth brushing or smoking status were not evaluated in this study. In Turkey, "health insurance" is only available via private insurance companies but is not compulsory and take up is low given the high premiums. On the other hand, "health security" is related to occupational status and includes health insurance with premiums paid by employers. For the unemployed without private health insurance there is no health security. For this reason "health security" was chosen as an explanatory variable.

Collection of clinical data followed WHO guidance (1997) and recorded root caries observed under natural outdoor lighting at subjects' houses using mirrors and ball-ended WHO/CPI periodontal probes (WHO 973/80-Martin, Solingen, Germany). An asepsis protocol was developed and strict procedures for infection control were followed. During the clinical examinations, all teeth with root caries were examined with CPI probe, includ-

ing third molars, and root caries was recorded when a lesion softened or was leathery. Only dentate persons were included in the analyses and the non-response rate was below 1% for each age group. Since "restored and decayed roots" were noted in very low frequency, these were grouped as root caries. There were 12 roots with restored root decay in the group aged 35-44 and 7 among the 65-74 year-olds. When various other treatments/situations prohibited examining the root, those roots were not included in the analysis. Further, while the Root Caries Index is a popular index for measuring root caries (Katz, 1982) the WHO recommend reporting in terms of simple prevalence and this study followed their guidance so comparisons are not made with Root Caries Index studies.

Data were analyzed using  $\chi^2$  to test the significance of the differences in bivariate analyses and binary logistic regression analysis was used to determine the significance of the explanatory variables age, gender, residence, educational level, health security status, frequency of tooth brushing, time since last dental visit and consumption of sweet food/drink between meals. The level of statistical significance was set at 0.05.

## Results

Of the 35-44 year-old adults: 69.2% were female; 15.5% were unschooled, 54.4% had primary education; 33.6% were rural residents; only 30.7% were employed; and only 23.8% had health security. Among the 65-74 year-old elderly: nearly half were male (46.8%); 60.1% were unschooled; 35.1% were rural residents; most were not employed and one-fifth had no health security. The mean number of teeth present was 23.6 (sd 6.6) for adults and 7.0 (sd 9.1) for the elderly. The prevalence of edentulousness was 2.6% in adults and 48.0% in the elderly. The number of roots was 38,039 among adults and 10,616 among the elderly. Of the natural roots in adults, the percentage of decayed roots was 2.2% and 5.9% among the elderly.

Decayed roots per person decreased with the increasing number of retained natural teeth ( $p=0.010$  for 35-44,  $p<0.001$  for 65-74 years). However, no association was found between root caries prevalence and the number of retained teeth (Table 1). Among 35-44 year-old adults, 20.1% and of 65-74 year-old elders 28.4% had some root caries. Root caries prevalence was similar in males and females ( $p=0.110$ ) but significantly higher in adult rural residents ( $p=0.006$ ). This situation was similar with the elderly. Health security status, tooth brushing and dental visits were the other characteristics related with root caries in both age groups ( $p<0.001$ ); educational level showed a significant association only in the adult group ( $p<0.001$ ) Consumption of sweet food/drink was not a significant determinant for root caries in either age group (Table 2).

First molars were the teeth most frequently affected by root caries in both age groups followed by the adults' third molars and elderly's first pre-molars. Anterior roots were affected at rather low levels in adults. In contrast, in the elderly, the roots of maxillary canines were affected at almost the same level as in first molars and pre-molars (Table 3).

**Table 1.** Percentage and mean number of decayed roots among Turkish 35-44 and 65-74 year-olds (2004)

Number of retained teeth	35-44 years				65-74 years					
	Number of subjects	Mean number of decayed roots (X, SE)	p	Percentage of decayed roots* (%)	p	Number of subjects	Mean number of decayed roots (X, SE)	p	Percentage of decayed roots* (%)	
1-9	28	0.047, 0.019		14.3		336	0.18, 0.022		25.0	
10-19	234	0.027, 0.003	<b>0.010</b>	18.8	0.631	249	0.15, 0.014	<b>&lt;0.001</b>	32.9	0.109
20 +	1327	0.021, 0.001		20.4		219	0.08, 0.009		28.3	
Overall**	1589	0.021, 0.001		20.1		804	0.12, 0.008		28.4	

\* Percentages of all subjects.

\*\* Edentates are excluded.

**Table 2.** Distribution of root caries by some characteristics among Turkish 35-44 and 65-74 year-olds (2004)

Some oral health-related characteristics	35-44 year-olds			65-74 year-olds		
	n	% of root caries	p	n	% of root caries	p
Gender						
Male	494	22.5	0.110	391	29.9	0.338
Female	1095	19.0		413	26.9	
Age						
35-39 (65-69)	807	20.7	0.532	443	26.4	0.146
40-44 (70-74)	782	19.4		337	31.2	
Residence						
Urban	1059	18.1	<b>0.006</b>	512	26.0	<b>0.047</b>
Rural	530	24.0		292	32.5	
Education						
Unschoolled	241	30.7	<b>&lt;0.001</b>	465	32.0	0.075
Primary/secondary school	1023	20.8		276	23.6	
Lycée, +	325	9.8		63	22.2	
Health security						
Yes	1212	17.2	<b>&lt;0.001</b>	658	25.7	<b>&lt;0.001</b>
No	377	29.2		146	40.4	
Tooth brushing						
None	920	25.5	<b>&lt;0.001</b>	581	32.9	<b>&lt;0.001</b>
Once a day	388	13.7		119	15.1	
Twice or more a day	281	11.0		104	18.3	
Months since last dental visit						
≤12	652	14.7	<b>&lt;0.001</b>	208	24.0	<b>&lt;0.001</b>
>12	757	21.4		501	26.5	
Never	180	33.9		95	47.4	
Consumption of sweet food/drink between meals						
Yes	927	19.0	0.199	379	28.8	0.793
No	662	21.6		425	28.0	
Overall*	1589	20.1		804	28.4	

\* Edentates are excluded.

**Table 3.** Intra-oral prevalence (%) of root caries by some characteristics of Turkish 35-44 and 65-74 year-olds (2004)

Age group	Characteristics	Central incisor	Lateral incisor	Canine	1 <sup>st</sup> premolar	2 <sup>nd</sup> premolar	1 <sup>st</sup> molar	2 <sup>nd</sup> molar	3 <sup>rd</sup> molar	All teeth
35-44 (n=1539*)	Maxilla									
	Roots, n	2897	2844	2904	2466	2266	1798	2284	1164	18623
	Male	1.4	1.8	1.6	5.0	3.6	5.9	1.9	3.9	2.9
	Female	0.6	1.3	0.9	4.1	4.0	4.8	2.9	5.5	2.6
	Urban	0.4	0.9	1.0	4.1	3.2	4.6	2.4	5.1	2.3
	Rural	1.9	2.6	1.4	5.1	5.4	6.5	2.9	4.8	3.5
	Overall	0.9	1.4	1.1	4.4	3.9	5.2	2.6	5.0	2.7
	Mandible									
	Roots, n	2976	3026	3053	2810	2515	1501	2191	1344	19416
	Male	1.2	1.0	0.4	3.0	2.9	4.7	2.3	3.0	2.1
	Female	0.7	0.4	0.7	1.3	1.5	4.7	2.3	3.4	1.5
	Urban	0.6	0.3	0.5	1.2	1.6	3.9	1.9	2.8	1.3
	Rural	1.3	1.1	0.9	3.0	2.7	6.2	3.1	4.1	2.4
	Overall	0.8	0.6	0.6	1.8	1.9	4.7	2.3	3.3	1.7
65-74 (n=804*)	Maxilla									
	Roots, n	869	817	904	639	569	428	473	212	4911
	Male	4.6	6.3	8.4	6.6	5.2	7.6	7.6	2.3	6.4
	Female	6.0	5.7	6.4	8.1	5.7	7.3	5.2	4.8	6.2
	Urban	4.2	5.1	7.0	6.4	5.2	6.6	4.3	2.2	5.4
	Rural	7.6	7.8	8.4	9.3	6.1	9.4	10.9	5.2	8.2
	Overall	5.3	6.0	7.4	7.4	5.4	7.5	6.3	3.3	6.3
	Mandible									
	Roots, n	929	1024	1180	918	647	330	436	235	5699
	Male	4.4	5.8	4.6	6.6	6.2	10.2	5.7	4.1	5.7
	Female	3.8	4.8	5.2	7.3	5.8	6.3	5.3	7.9	5.4
	Urban	3.9	4.6	5.2	5.9	5.0	7.1	4.4	2.0	4.9
	Rural	4.4	6.5	4.5	9.2	8.0	11.4	7.9	12.0	6.9
	Overall	4.1	5.3	4.9	7.0	6.0	8.5	5.5	5.5	5.6

\* Edentates are excluded.

**Table 4.** The remaining independent risk factors at the end of the logistic regression analysis for Turkish 35-44 year-olds and 65-74 year-olds (2004).

Independent variables	35-44 year-olds					65-74 year-olds				
	$\beta$	SE	p	Odds ratio	95% CI	$\beta$	SE	p	Odds ratio	95% CI
Gender										
Male	0.314	0.147	<b>0.032</b>	1.37	1.03-1.82					
Female (reference)										
Residence										
Urban (reference)										
Rural	0.408	0.143	<b>0.004</b>	1.50	1.14-2.00	0.432	0.203	<b>0.033</b>	1.54	1.04-2.29
Education										
Unschooling	1.120	0.260	<b>&lt;0.001</b>	3.07	1.84-5.10					
Primary/secondary school	0.673	0.212	<b>0.002</b>	1.96	1.29-2.97					
Lycée or higher (reference)										
Tooth brushing										
None	0.605	0.215	<b>0.005</b>	1.83	1.20-2.79	0.637	0.274	<b>0.020</b>	1.89	1.10-3.24
Once a day	0.143	0.245	0.560	1.15	0.71-1.86	-0.175	0.363	0.629	0.84	0.41-1.71
Twice or more a day (reference)										
Last visit to dentist (months ago)										
≤12 (reference)										
>12	0.339	0.145	<b>0.019</b>	1.40	1.06-1.86	0.039	0.197	0.841	1.0	0.71-1.53
Never	0.709	0.210	<b>0.001</b>	2.03	1.35-3.06	0.866	0.277	<b>0.002</b>	2.38	1.38-4.09

The results of the logistic regression analysis are presented in Table 4. The independent variables rural residence, tooth brushing and dental visits were significant risk factors determining root caries occurrence in both age groups. In addition, male gender and poor education were also factors for 35-44 age adults. Age, health security status and consumption of sweet food/drink between meals were not significant factors.

## Discussion

Several studies of root caries indicate that it is becoming an important problem in aging adults e.g. affecting 68% of Scandinavian 65 year-olds (Fejerskov *et al.*, 1993) and 44% of older US adults (Ritter *et al.*, 2010). Therefore, the prevalence and incidence of root caries have been studied among adult and elderly groups in many recent national oral health surveys. Whelton (1993) found the prevalence of root caries to be greatest in older age groups among an Irish population. In China, it was 10% among 35-44 year-olds in urban and 39% in rural regions; these figures were 39% and 38% respectively for 65-74 year-olds (Lin *et al.*, 2001) whereas the prevalence was 19% among 65-74 year-olds and 34% among 35-44 year-olds in a German population (Splieth *et al.*, 2004).

The first Turkish national oral health survey determined the prevalence of edentulousness as 2.7% and 75.0% for subjects aged 35-44 and 65-74 years, respectively (Saydam *et al.*, 1990). The 2004 survey showed that there has been a small decline to 2.6% among 35-44 year-olds and a considerable decrease to 48.0% among 65-74 year-olds (Gökalp *et al.*, 2010).

The literature includes some reports of root caries in the elderly, a few in the middle-aged (Du *et al.*, 2009) but none for this latter age group in Turkey. The findings that root caries prevalence increased in the elderly agree with some studies (Lin *et al.*, 2001; Splieth *et al.*, 2004). In Turkey, the elderly showed considerably lower prevalence of root caries (28.4%) than in the Chinese (Lin *et al.*, 2001) possibly explained by the low number of retained natural teeth and limited access to preventive care and restorative treatment in the Turkish group. A cross-sectional study of institutionalised Turkish aged 70 and over showed that root caries prevalence was lower (18.1%) than determined in the present study (Ünlüer *et al.*, 2007). This might be explained by that group's greater age. The Turkish middle aged group showed considerably higher prevalence of root caries (20.1%) than the Chinese (Lin *et al.*, 2001). Again, limited access to preventive care and treatment could be contributing factors.

Most of the studies showed that root caries was more prominent in males than in females (Splieth *et al.*, 2004; Whelton *et al.*, 1993). The present study agreed with a German study of 50-60 year-olds in finding no significant differences in the prevalence by gender (Hahn *et al.*, 1999). The finding that root caries was more common in rural areas is consistent with other studies (Lin *et al.*, 2001; Ringelberg *et al.* 1996).

In this study, although all subjects retained fewer natural molars than anterior teeth, thus reducing the number of molar teeth that could decay, molars are still prone to root caries. In both age groups, the first molars were the teeth most frequently affected by root caries.

In the Turkish elderly, with the exception of maxillary third molars, root caries prevalence is highest in the first molars and premolars of both jaws, and in the maxillary canines; lower incisors and canines show the least caries involvement. These results are consistent with a German study (Heinrich *et al.*, 1990). Slade and Spencer reported that the roots of maxillary canines had the greatest likelihood of being filled and decayed while in the mandible it was the first molar (Slade and Spencer, 1997). In the Turkish 35-44 age group, the upper first molars were the most affected teeth followed by upper third molars and lower first molars; the least affected teeth in this age group in both jaws were anterior teeth. The present study showed that root caries prevalence for different tooth types ranged from 0.6 to 8.5%, indicating a wide variation in attack rates.

Decayed root lesions per person for Turks aged 35-44 and 65-74 years decreased with the increasing number of teeth ( $p=0.010$  and  $<0.001$ ), and the percentages of decayed roots were 20.4% and 28.3% respectively among those with 20 or more teeth. This finding was in line with other studies (Nicolau *et al.*, 2000; Ritter *et al.*, 2010; Splieth *et al.*, 2004). It was found that the level of education had a positive influence concerning root lesions only in the 35-44 year olds. This finding was also supported by the results of regression analysis (OR=3.07 for unschooled). In contrast, educational status was associated with root caries among the Thai elderly (Nicolau *et al.*, 2000).

Although health security status seemed to be related with root caries in both age groups in bivariate analysis, the results of logistic regression analysis showed no impact on root caries in 35-44 or 65-74 year-olds.

Based on the results of logistic regression analysis, one of the determinants of untreated root caries that emerged was no tooth brushing (OR=1.83 in adults and 1.89 in the elderly). Most of the studies demonstrated a significant association of tooth brushing habits with prevalence of root caries (Imazato *et al.*, 2006; Joshi *et al.*, 1994). Inadequate oral hygiene performance revealed that self-care was neglected among these age groups. The prevalence of root caries was significantly higher among those who had never visited a dentist or not visited in the previous year. Regular dental attendance also reduced root caries prevalence among 50-60 year-old Germans (Hahn *et al.*, 1999).

In this study, consumption of sweet food and/or drink between meals was not found to be a determinant of root caries and this result contradicted the finding of a previous study reporting that low-sugar nutrition was positively associated with the prevalence of root caries among German elderly (Hahn *et al.*, 1999). These contradictory results suggest the need for further detailed clinical and experimental studies to understand the correlation between consumption of sugar laden food or drink and root caries prevalence.

Root caries prevalence was high in both age groups in this study and appeared to reflect a lack of access to dental services and/or neglect of oral health. These findings indicate an increasing need for caries prevention, restorative measures and improved oral care behaviours for this population.

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