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PREVALENCE AND SEVERITY OF DENTAL CARIES IN 12-YEAR-OLD TURKISH CHILDREN AND RELATED FACTORS

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SUMMARY: The aim of this cross-sectional study was to determine the prevalence, severity, and some factors related to dental caries in 12-year-old children in Turkey.

A representative study population (covered 250 clusters) was chosen by the Turkish Statistical Institute using the proportional stratified cluster sampling method. The sample consisted of 1611 subjects. Data were collected via clinical examination and a questionnaire. Twenty-seven calibrated examiners recorded caries according to WHO criteria (1997) during home visits. The significance of the differences was tested by Chi-square, ANOVA, and logistic regression analysis.

The prevalence of caries was 61.1%. Children living in urban areas had significantly higher prevalence of filled teeth. The mean of Decayed, Missing, and Filled Teeth (DMFT) was 1.9 ± 2.2 and no difference by sex and residence was observed. The decayed component of the DMFT was the major contributor. The Significant Caries Index (SiC) was 4.33. Half of the children claimed to brush their teeth once or more per day. Girls brushed their teeth more frequently. The percentage of "never visited dentist" was 41.4%. Frequency of tooth brushing was the only significant independent variable determining caries occurrence.

In conclusion, the only meaningful significant independent variable was tooth brushing, which was found to be associated with caries frequency among Turkish 12-year-olds.

Key words: Dental caries, DMFT index, SiC, 12-year-olds

INTRODUCTION

The most prevalent oral disease of public health concern is dental caries. Although there exist great international and geographical differences, the severity and prevalence of dental caries have declined in developed countries over the past 20–25 years (1-2). According to the recommendations of the World Health Organization (3), 12-year-olds were chosen for evaluating the level of dental caries among children with permanent teeth and for international comparison. By the end of the 20th century, caries prevalence in some European countries declined dramatically among 12-year-olds (4-5). Similar declines were reported in other parts of the world (6-7). However, in Kuwait, an increase in caries level in 12-year-old children was reported (8). The first National Oral Health Survey was conducted in 1988 in Turkey, (9). The only information regarding dental caries in 12-year-old children was obtained from the data of this study. In

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2004, a survey entitled "Oral Health Profile of Turkey—2004" was conducted by Hacettepe University Medical and Dental Faculties in collaboration with the Turkish Ministry of Health (10). This present study is a part of the aforementioned national survey. The objectives of this study were to determine the coronal caries status among urban and rural children aged 12 years in Turkey. The objective was also to assess the association between some sociodemographic factors, oral hygiene practice, dental visit habits, and dental caries.

MATERIALS AND METHODS

The study design and completion conformed to the ethical guidelines of Hacettepe University for conducting studies, and informed verbal consents were obtained from the parents of the children who participated in the study on a voluntary basis. This institutionally approved cross-sectional survey covered the whole country to observe the oral health conditions in urban and rural locations. Turkey encompasses 783,577 km^2 area, and according to the 2000 census results, its population is 67,803,927. Of the total population, 29.8% peope are less than 15 years of age, and one-third of its citizens reside in rural areas (11).

The sample size calculation was based on an equation of sample size formula: n = [(Nt2pq)/d2 (N-1) + (pq)] × DE, where N = population under risk = 1,503,322, t = t-value at ∝ = 0.05 level (1.96), p = caries-free percentage (16%), q = 1–p, d = maximum deviation from prevalence accepted (4%), DE = design effect = 1. The calculated sample size was 323. When the surface area and population size of Turkey were taken into account, it was decided to reach almost fivefolds of the estimated sample size, i.e., to include 1500 subjects, to ensure that all regions were covered.

To obtain a national sample, Turkish Statistical Institute chose the representative study population of rural and urban citizens and covered 250 clusters at 68 provinces out of 81 total provinces identified. All settlements of the total 81 provinces in Turkey were covered in the sample selection. Settlements that had a population less than 200 were not covered in the survey as they did not allow reaching a sufficient cluster size. Using a proportional stratified cluster sampling procedure, the sample was selected based on the urban/rural proportion of the Turkish population;. At the first stage, clusters of households were combined to form the primary sampling units (PSUs). The PSUs were formed with 100 addresses in each. These PSUs were treated as clusters. Then 250 clusters were selected randomly based on the urban/rural proportion of the Turkish population. At the end, clusters from 68 provinces had been selected. From each cluster, households were visited and from each household one 12-year-old child was included in the study to complete the

sample size—each sample comprising six children. If there was a request for examination from another household after completing six examinations, they were also involved in the study for ethical reasons. This caused an increase in the number of the sample, making the final study population size 1611. The non-response rate was below 1%.

Calibration was done for all coding criteria. During the examination, dentition status and treatment need for each tooth were coded as recommended in WHO 1997 Guideline for Oral Health Surveys (3). In June 2004, a total of 27 fourth- or fifth-year dental students were trained and calibrated for 4 weeks according to the criteria used in the survey against four experienced dentists (one periodontist, one pedodontist, and two conservative dentistry specialists). These experts served as gold standards. Prior to initiation of the calibration process of the examiners, these experts were calibrated between themselves for each criterion. Each examiner examined five 12-year-old children who were also examined by the experts for the purpose of "expert–examiner" calibration. Calibration exercises were conducted in another ten 12-year-old subjects with different oral health situations like no caries, untreated caries, fillings, and recurrent caries and fillings for the interexaminer calibration process. WHO 1997 Guideline for Oral Health Surveys recommends to calculate overall reliability for field surveys rather than to calculate consistency for each diagnosis category (3). Thus, one overall Kappa statistic was calculated for each examiner. The Kappa statistics were reviewed and except two examiners (0.76 for one examiner and 0.79 for the other), all Kappa values were higher than 0.79. The examiners checked interexaminer consistency but did not check intraexaminer reliability. A refreshment retraining procedure was carried out 1 week prior to the initiation of the survey in September 2004.

The study was carried out from September 2004 through February 2005. The structured questionnaire contained 26 questions designed for this survey and was pre-tested (12). Interviews with the respondents were performed face to face during home visits. Collected variables covered the following: (1) some sociodemographic characteristics and health security, (2) dietary habits, (3) some oral health behaviors, and (4) dental attendance pattern.

Clinical data were collected on oral health status according to the methods and the criteria described by WHO in 1997 (3). The clinical examinations were performed to record coronal caries under natural daylight at outdoor setting of the houses of the subjects 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. The mirrors and periodontal sonds were wiped with sponges impregnated with a disinfection

solution (hexanios) after a single use and collected in a separate bag. On the evenings of each field study day, the used mirrors and probes were washed with tap water and placed in the baskets of the disinfection boxes filled with glutaraldehyde. After at least 1-hour waiting time, the mirrors and probes were washed with tap water again and kept for drying. The dried mirrors and probes were then placed in pairs in presterilized paper bags—one pair in each bag. As it is recommended in WHO 1997, coronal caries was recorded only when the lesion had an unmistakable cavity, a detectably softened floor, undermined enamel, or a softened wall to probing with the CPI probes. For each filled tooth, the examiner was required to indicate the status of restoration as filled and sound, or filled with recurrent caries. No radiographs were used. Decayed, Missing, and Filled Teeth (DMFT) scores were computed from the data obtained. The Significant Caries (SiC) Index was also calculated since it refers to the one-third of the population more severely affected by dental caries (13). The term "prevalence of children with no decay" was used to define the children with no untreated caries in their mouth, and "DMFT = 0" means no decay, no filling, and no missing teeth as a total.

The data from the clinical examinations of each subject were collected and checked for logical errors and then analyzed at the Hacettepe University, Ankara, Turkey. The data were described by frequency distributions and contingency tables. Statistical analysis included Chi-square analysis and ANOVA to test the significance of the differences in bivariate analysis which $\alpha=0.05$. Backward stepwise unconditional logistic regression was performed to evaluate the association between the independent and dependent factors. In the logistic regression analysis, the following variables were included simultaneously in the model: sex (male/female), place of residence (urban/rural), having health security (yes/no), frequency of tooth brushing per day (none/less than once/once/twice or more), ever visiting a dentist (yes/no), eating between main meals (yes/no), and consumption of sweet foods/drinks (yes/no). Consumption of sweet food/drink was recorded if someone consumed foods/drinks like biscuits, cake, sandwich, cola and tea with sugar.

RESULTS

Among the 1611 children, 52.6% were male, 66.7% lived in urban areas, and one-fourth had no health security. In Turkey, "health insurance" is obtained only by the private insurance companies, and "health security" is obtained related to the occupational status and also covers the health insurance. If one is not working and has no health insurance from a private company, he/she has no security related to health problems.

Males and rural residents were found to consume sweet foods/drinks more frequently. More than 9% of children had no toothbrush, and this percentage was significantly higher in rural areas (p = 0.001). Half of the children brushed their teeth at least once a day, and this habit was found at a significantly higher rate in females (p < 0.001) and urban residents (p = 0.002) compared to males and rural residents. Of the children, 41.4% had never visited a dentist, and this percentage increased in rural areas to 50.7%. In 61.3% of all study subjects who had ever visited a dentist, the last visit had occurred within the last year (Table 1).

More than half of the children had their first dental visit between the ages of 7 and 10 years; no significant difference was found with respect to sex.

The prevalence of children with no decay was 38.9%. The frequency of filled (6.5%) and missing teeth (7.9%) was low. The frequency of filled teeth showed a significant difference among groups, being higher in urban versus rural residents (p < 0.001) (Table 2).

The prevalence of DMFT = 0 (caries free) subjects was 33.9%.

The mean DMFT was 1.9 ± 2.2. There was no significant difference by sex for decayed, missing, filled teeth, and DMFT. The mean number of filled teeth was higher in urban areas and among children with health security (p < 0.001). The mean numbers of missing and filled teeth, and DMFT were lower in children who never visited a dentist. Children who did not consume sweet foods/drinks had more missing and filled teeth. The mean numbers of all dental health indicators and DMFT gradually decreased with the increasing number of daily tooth brushing, but the difference was found statistically significant for only the mean number of filled teeth (p < 0.001) and decayed teeth (p = 0.004) (Table 3).

The distribution of DMFT values is shown in Figure 1. Despite a mean DMFT of 1.9, the SiC Index was 4.33.

In the logistic regression analysis, the following independent variables were included in the model: sex, place of residence, health security status, frequency of tooth brushing, consumption of sweet foods/drinks, ever visiting a dentist, and eating between main meals. In the end, only no tooth brushing (OR = 1.7) and ever visiting a dentist (OR = 0.8) were shown to be significant independent variables associated with caries occurrence (Table 4).

Table 1: Percent distribution of some nutritional- and oral hygiene–related characteristics of 12-year-olds by sex and place of residence (Turkey, 2004).

Nutritional and oral hygiene characteristics	Total (1611)	Sex			Place of Residence		
		Male (n=848)	Female (n=763)	P	Urban (n=1074)	Rural (n=537)	P
Eating between meals							
Yes	87.4	86.6	88.3	0.316	86.9	88.4	0.40
No	12.6	13.4	11.7		13.1	11.6	
Consumption of sweet foods/drinks							
Yes	75.0	77.0	72.7	0.048	73.5	78.0	0.05
No	25.0	23.0	27.3		26.5	22.0	
Having a tooth brush							
Yes, own	89.4	83.3	90.4	0.088*	91.2	85.5	0.001*
Yes, shared	1.2	1.1	1.4		1.0	1.7	
No	9.4	10.6	8.1		7.7	12.9	
Frequency of tooth brushing/day							
None	15.9	18.3	13.2		14.0	19.7	
Less than once	34.0	36.8	30.8	0.000	32.8	36.3	0.002
Once	20.0	19.8	20.3		21.4	17.3	
Twice or more	30.1	25.1	35.6		31.8	26.6	
Dental visit							
Ever	58.5	59.1	58.2	0.718	63.3	49.3	< 0.001
Never	41.4	40.9	41.8		36.7	50.7	
*Time of last visit**							
Within last year	61.3	59.0	63.9	0.076	62.7	57.6	0.007
Before last year	35.5	38.8	32.5		33.6	41.7	
Don't remember	3.3	2.2	3.6		3.7	0.8	

* For statistical analysis, 'own' and 'shared' groups were joined.

** Among those who ever visited a dentist.

DISCUSSION

The present survey reports such information related to 12-year-old children, with emphasis given to determining the associated effects of some sociodemographic and behavioral risk factors on dental caries experience.

According to the results of this study, there was a considerable improvement among 12-year-olds; the prevalence of dental caries was considerably lower (61.1%) than the first national study (80.8 %) (9). However, although this is an improvement, the present level is higher than levels reported in England (33.4%) in 2008/2009 (14), and Germany (39.3%) (15), Northern Ireland (46%) (16), and Portugal (52.9%) in 1999 (17).

Furthermore, a less encouraging finding is that less than 8% of children had teeth missing due to decay, while this percentage was only 2% in England in 2003 (18).

The WHO's global goal of a DMFT of no more than 3 for 12-year-old children in the year 2000 (19) was achieved in Turkey in 1988 (2.7 DMFT), whereas the present study revealed a DMFT of 1.9, which is lower than the WHO European goal for 2020 of no more than 2 DMFT (20).

In European countries like Germany (15), Ireland (16), Portugal (17), and Italy (21), the mean DMFT values ranged from 0.98 to 1.5, and these figures denoted low caries experience. Therefore, new oral health goals for Europe have been formulated for the year 2020 by WHO (20). According to this new goal, by 2020, a DMFT of no more than 1.5 on average should be observed in children aged 12 years. Such goals can only be achieved in Turkey if oral disease prevention interventions are implemented in school-based oral health programs. However, the D-component was considerably high even in some European countries

Table 2: Percentage distribution of caries-free children, children with no decayed teeth, children with no missing teeth, and children with no filled teeth by gender and place of residence (Turkey, 2004).

		Sex			Place of Residence		
Indices	Total (1611)	Male (n=848)	Female (n=763)	P	Urban (n=1074)	Rural (n=537)	P
DMFT							
% of caries-free	33.9	33.4	34.5	0.642	34.9	33.1	0.66
Decayed crown							
% of none	38.9	39.4	38.4	0.685	39.6	37.6	0.45
Missing teeth							
% of none	92.1	91.3	92.9	0.222	92.8	90.5	0.10
Filled							
% of none	93.5	93.6	93.4	0.880	91.4	97.8	<0.001

Table 3: The mean caries experience of 12-year-olds by some characteristics (Turkey, 2004).

Characteristics	Decayed Teeth X ± SD	Missing Teeth X ± SD	Filled Teeth X ± SD	DMFT X ± SD
Sex				
Male (n=848)	1.7 ± 2.1	0.1 ± 0.5	0.1 ± 0.5	1.9 ± 2.2
Female (n=763)	1.7 ± 2.1	0.09 ± 0.4	0.1 ± 0.6	1.9 ± 2.2
p	0.1	0.08	0.51	0.86
Place of residence				
Urban (n=1074)	1.6 ± 2.0	0.02 ± 0.4	0.2 ± 0.6	1.9 ± 2.1
Rural (n=537)	1.8 ± 2.2	0.1 ± 0.5	0.02 ± 0.3	2.0 ± 2.2
p	0.11	0.17	<0.001	0.45
Health security				
Yes (n=1215)	1.6 ± 2.0	0.1 ± 0.4	0.1 ± 0.6	1.9 ± 2.1
No (n=393)	1.9 ± 2.2	0.1 ± 0.4	0.04 ± 0.2	2.0 ± 2.3
p	0.05	0.83	<0.001	0.33
Dental visits				
Ever (n=943)	1.7 ± 2.1	0.2 ± 0.6	0.2 ± 0.7	2.1 ± 2.2
Never (n=668)	1.6 ± 2.1	0.03 ± 0.2	0.003 ± 0.05	1.7 ± 2.1
p	0.36	<0.001	<0.001	<0.001
Tooth brushing frequency/day				
None (n=256)	2.1 ± 2.3	0.1 ± 0.4	0.0 ± 0.3	2.2 ± 2.4
Less than once (547)	1.7 ± 2.0	0.1 ± 0.4	0.1 ± 0.4	1.8 ± 2.2
Once (n=323)	1.7 ± 2.1	0.2 ± 0.5	0.2 ± 0.7	2.0 ± 2.2
Twice or more (n=485)	1.5 ± 2.0	0.2 ± 0.5	0.2 ± 0.6	1.8 ± 2.2
p	0.004	0.22	<0.001	0.07
Consumption of sweet foods/drinks				
Yes (n=1208)	1.7 ± 2.1	0.1 ± 0.4	0.1 ± 0.4	1.8 ± 2.0
No (n=403)	1.6 ± 2.0	0.1 ± 0.5	0.1 ± 0.6	2.0 ± 2.2
p	0.16	0.002	0.001	0.14
Total	1.7 ± 2.1	0.1 ± 0.4	0.1 ± 0.5	1.9 ± 2.2

(20), indicating that the caries experience was not yet under control. The D-component of the DMFT of Turkish children was the major contributor and indicates the need for dental care. The mean D, M, and DMFT of Turkish children were not found related to place of residence or sex. In contrast to some European countries, the mean number of filled teeth was too low in both urban and rural Turkish children, with rural children having a significantly lower number ($p < 0.001$). One of the reasons for the high proportion of un-restored teeth in Turkish children could be the lack of easy access to dental services. Furthermore,
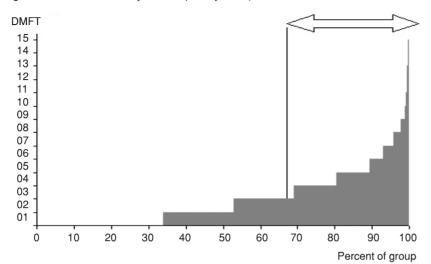
Figure 1: Caries data for 12-year-olds (Turkey, 2004).

Note: Arrow and vertical line indicate the subjects that are include in the calculation of the index.

lack of dental knowledge among parents and the low priority given to oral health care could be responsible for the failure to restore teeth. There is a clear need for establishing a national oral health program in schools to reach those children who are not yet receiving systematic preventive and curative services.

The mean DMFT could mask important information regarding the nature of decay among those children with high caries experience. The SiC Index is a new and efficient measurement in high caries risk populations, and this can be used for establishing global oral health goals. A recommended global oral health goal for the year 2015 is that the SiC Index should be less than 3 DMFT among 12-year-olds (13). In Israel (22), the SiC Index was determined as 4.3, which was similar to the present study, but in Sweden (23), the SiC Index was determined as less than 3 DMFT. The present study indicated that many children suffered from dental caries despite a low mean DMFT. It is evident that considerable effort should be made to reduce the SiC Index from 4.33 to at least 3 in Turkey.

Before the dental examination, a questionnaire comprising information on some sociodemographic characteristics, consumption of sweets, frequency of tooth brushing, and dental visit behaviors was administered via face-to-face interview. Nevertheless,

Table 4: The final regression results that show the independent associated factors with caries among 12-year-olds (Turkey, 2004).

Associated Factor	Odds Ratio	95% CI		p
		Lower	Upper	
Frequency of tooth brushing/day				
None	1.7	1.3	2.4	0.001
Less than once	1.3	1.0	1.6	0.07
Once	1.1	0.8	1.5	0.51
Twice or more	Reference			
Dental visits				
Never	0.8	0.6	1.0	0.022
Ever	Reference			
Health security				
No	1.2	1.0	1.6	0.1
Yes	Reference			

it is likely that, in this age group, the respondents were eager to reflect their knowledge rather than accurately report their dental care habits.

In the present study, regular consumption of between-meal snacks was very frequent (87.4%) among 12-year-olds, and the consumption of various sweet foods and drinks was also high (75.0%). This pattern is consistent with findings from Kuwait (24) and Poland (25). In the present study, no relationship was found between the consumption of sweet snacks and sex and place of residence. Paradoxically, DT and DMFT showed no correlation with the consumption of sweet food and drinks, whereas missing and filled teeth were significantly correlated. It is probable that these children were more likely to visit the dentist since both of the determinants were related to the monthly family income. The results obtained from the present study which show the high consumption of sweet foods and drinks among 12 year of age indicate that the programs related to gain healthy oral health behaviour should give emphasis to healthy food products. Access to sweet foods and drinks in the school environment should also be controlled.

Tooth brushing is the most important determinant of oral hygiene routines. The unfortunate situation of not having a toothbrush (9.4% in this study) is a significant problem in Turkey. This situation was not comparable to any of the European countries. In this study, although tooth brushing was simply valued in terms of number of times brushed per day, rather than as effective or not, it was found that frequency of tooth brushing was the only positively significant variable determining caries occurrence. Of the children, 30.1% claimed to brush their teeth at least twice a day. Girls (p < 0.001) and urban residents (p = 0.004) brushed their teeth more frequently. It is seen that the prevalence of brushing teeth at least twice a day is two times greater in Polish 12-year-old children, which parallels the improving oral disease patterns. Furthermore, Polish urban children brushed their teeth more frequently than Turkish children (25). Supervised tooth brushing interventions should be implemented in preschools and primary schools in Turkey. In addition, tooth brushes and fluoride toothpastes must be distributed free of charge in schools until the DMFT index at 12 years of age is 1. Moreover, widespread public health training on the significance of tooth brushing should be started as a continuous education program for adults, especially for the parents of minors.

In the present study, 41.4% of the children had never visited the dentist compared with 11% in Jordan (26). In Turkey, symptoms or problems with teeth were the main reasons for dental visits for all age groups; "check-up" visits accounted for only a small portion. This behavior was shown to be common for dental visits in Turkey (10).

In the present study, the number of missing and filled teeth and DMFT were higher in children who had visited a dentist than those who had not. There was an agreement with the other authors in the literature, which reported that children first have problems with their teeth, and then seek dental service (24).

The high F-component was found among the children who had health security in the present study. This result may be explained by the probability of better accessibility to dental services.

According to the logistic regression results, brushing teeth was one of the significant determinants of caries, as also shown in Portuguese and Indian children (17,27). The other determinant of caries that associated negatively among 12-year-olds was ever visiting dentist. In Turkey, the general behavioral pattern related to visiting dentist is as "visit when a problem occurs" and this situation is similar for 12-year-olds (10). In this case, children usually were not taken to a dentist by their parents unless decay occurred.The result obtained from regression analysis as the "opposite association between caries and ever visiting dentist" could be due to this behavioral pattern.

In conclusion, this study demonstrated that tooth brushing, which was the only meaningful significant independent variable, associated with caries frequency among 12-year-old Turkish children. In a long-term perspective, an effective strategy for promoting tooth brushing is dependent on oral health education in schools and at home. It is therefore important that the procedure is continually reviewed and monitored by the oral health educators such as parents, teachers, and health workers.

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