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RESEARCH ARTICLE

Dental Caries and Caries Associated Factors of Six and Seven Year-Old Children Living in a High Fluoride Area

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ABSTRACT

Objectives: The aims of this study were to examine the prevalence of dental caries and fluorosis in six and seven year-old children living in a high-fluoride area and to evaluate the associations between the caries experience and sociodemographic factors, oral hygiene habits, dental attendance and diet in this population.

Materials and Methods: A total of 2000 children, ranging in age from six to seven years of age in the first grade of elementary school in Isparta, Turkey were included in this study. The questionnaires, including questions about sociodemographic factors, oral hygiene habits, dental attendance and diet, were answered by the parents of these children. Three experienced examiners performed the clinical examinations. The data were analyzed using the linear regression model to determine factors independently associated with the caries experience. The one-way ANOVA and post-hoc tests were used to analyze the differences in the caries experience scores. Chi-square test was used to analyze the differences in the caries experience scores depending on age and gender (a = 0.05).

Results: While 30% of the children have no carious primary teeth, 96% have no carious permanent teeth. Thirty percent had no carious teeth. The mean caries experience (dmf+DMFT) was 3.60 (±3.63). Various degrees of fluorosis were present in 2% of the children's primary dentition and 28% of the children's permanent dentition. The father's and mother's education, the paternal and maternal ages of the parents, when the child's first dental visit occurred, the frequency of toothbrushing and ingesting sugar-containing soft drinks were all associated with the caries experience.

Conclusions: The prevalence of dental caries and fluorosis was high among the examined child population in the high-fluoride area. Sociodemographic factors, oral hygiene habits, dental attendance and diet are risk indicators for caries in this population.

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INTRODUCTION

Dental caries is one of the most common infectious diseases found throughout the world, but its prevalence varies from county to country. In developed countries, a substantial reduction in the prevalence of dental caries has been reported, probably as a result of successful prevention programs. However, children from developing countries generally experience high levels of dental caries.[1] In Turkey, the population of children under the age of 18 accounted for 31.1% of the general population, and the country's public dental health care services offer comprehensive dental care free of charge to children from birth.[1] However, the proportion of five year-old caries-free children was 30% and the mean caries experience was 3.7 (±3.9).[2] These statistics for Turkey are based on the most recent national survey of oral health status of children. The results of this national survey have recommended instituting community-based oral disease prevention programs to promote oral health.[2]

Preventive and oral health programs should be planned and targeted towards those who are at the greatest risk for dental caries to prevent its potential increase. Targeting caries prevention in children requires identifying those children who are at the greatest risk for acquiring caries. A number of factors have been identified as risk indicators for dental caries, including sugar consumption, oral hygiene habits, the amount and type of bacteria present in the oral cavity, salivary factors, exposure to fluoride and some sociodemographic factors.[3]

Isparta, where the current study was performed, is an urban area of Turkey with a high concentration of fluoride in the drinking water. It has been known that fluoride intake led to delay or reverse in caries process by remineralizing tooth enamel.[4,5] For this reason, the prevalence of dental caries and the effects of caries-related factors on the caries experience may be different in high-fluoride areas compared to low- or non-fluoride areas. As a result, preventive programs in high-fluoride areas are more effective in promoting different strategies compared to programs conducted in non-fluoride areas.

The aims of this study were to examine the prevalence of dental caries and fluorosis in six and seven year-old children living in a high-fluoride area and to evaluate the associations between the caries experience and sociodemographic factors, oral hygiene habits, dental attendance and diet in this population.

MATERIALS AND METHODS

The prevalence of dental caries and fluorosis in six and seven year-old children living in a high-fluoride area was evaluated in this study. Also, the associations between the caries experience and sociodemographic factors (annual family income, the father's and mother's education, the occupation of both parents, the maternal age and the paternal age and the number of siblings in the family), oral hygiene habits (frequency of tooth brushing), dental attendance (child's first dental visit, how often the child went to the dentist), and diet (the frequency of ingesting sugar-containing soft drinks and sweet food consumption and the frequency of snacks) in this population were examined.

The required permissions for beginning the study protocol were obtained from the local health authority and local education authority. The nature of the study had been explained orally to the students and teachers and a written consent was taken from the children's parents.

Subject Selection

A total of 2000 children, ranging in age from six to seven years of age, were included in this study. The sample size for the study was determined considering a power of 80% and a type I error of 5%. All the children were in the first grade of elementary school and all were born in the City Center of Isparta, Turkey a region with high fluoride drinking water. The fluoride level of the toothpastes used by the children was 1100 ppm. The parents were informed by a form explaining the purpose of the study. They were requested to give consent to their child's participation and were asked some questions about caries-related factors in a questionnaire.

Questionnaires

The questionnaire focused on querying the parents' sociodemographic factors (annual family income, the father's and mother's education, the occupation of both parents, the maternal age and the paternal age and the number of siblings in the family), oral hygiene habits (frequency of tooth brushing), dental attendance (child's first dental visit, how often the child went to the dentist) and diet (the frequency of ingesting sugar-containing soft drinks and sweet food consumption and the frequency of snacks).

Clinical Examination

Three experienced examiners performed the clinical examinations. The examiners were trained and calibrated by an associate professor in the Department of Restorative Dentistry. The calibration included 50 children not selected for the main study. Ten percent of the subjects were randomly selected for re-examination for intra-examiner reliability, with the second examination performed two weeks after the initial examination. Kappa statistics of inter-examiner for the presence or absence of caries are 0.88, 0.86, 0.81 and of intra-examiner 0.87, 0.87, 0.93.

The children were examined under natural light while being seated in a chair. A plain mirror and periodontal probe were used. The diagnostic criteria were based on visual evidence of a lesion. The periodontal probe was used only to remove dental plaque. Caries was defined in accordance with the World Health Organization (WHO) criteria.[6] A tooth was recorded as decayed when there was visible evidence of cavitation, including dentin or a secondary caries occurrence. A tooth was considered missing if it was believed to have been lost through caries. Dental fluorosis was assessed using the TFI (Thylstrup and Fejerskov) index.[7]

The statistical analysis was processed with the SPSS 13.0 software system (SPSS Inc, Chicago, IL, USA). Differences in the caries experience scores across the categories of different variables were compared using the one-way ANOVA and post-hoc tests. Differences in the caries experience scores between the categories of age and gender were analyzed using the Chi-square test.

Multivariate analyses using the linear regression model, including significant independent variables from the bivariate analyses, were used to determine factors independently associated with the caries experience. The confidence level was set at 95% ($p<0.05$).

RESULTS

The final sample consisted of 2,000 children: 1,037 (52%) boys and 963 (48%) girls. In this study 30,302 primary and

14,155 permanent teeth were examined. Thirty percent of the children had no carious primary teeth; this ratio was 96% for permanent teeth. Thirty percent had no carious teeth. The prevalence of zero dmf was 24%, with zero DMFT being 95% for these children. The mean caries prevalence (dmf+DMFT) was 3.60 (±3.63). Various degrees of fluorosis were present in 2% of the children's primary dentition and 28% of the children's permanent dentition.

The mean caries prevalence did not vary significantly with age, gender, the father's occupation or the child's frequency of snacks. Children with a low annual family income, whose father did not attend high school and/or university, whose mother who were unemployed or did not attend university, had a higher mean caries experience than their counterparts in the opposite groups ($p<0.05$). The caries experience scores of children categorized according to the maternal age, the paternal age and the number of siblings were also significantly different ($p<0.05$) (Table 1). Children who never visited a dentist and brushed their teeth twice a day or more revealed a lower caries experience than those who did not ($p<0.05$). The caries experience scores of children categorized according to the frequency of ingesting sugar-containing soft drinks and sweet food consumption were also significantly different ($p<0.05$) (Table 1).

The significant risk indicators for caries included the father's and mother's education, the paternal age, when the child's first dental visit occurred, the frequency of tooth brushing and how often sugar-containing soft drinks were consumed (Table 2).

DISCUSSION

The family environment is one of the most important potential contributors to children's development, socialization and health-related attitudes. Previous studies demonstrated that biological factors acting on caries development are also firmly correlated with social variables.[8] To date, most studies have focused on education level, age, status of the family and immigrant background.[9,10] These studies reported that dental health from early childhood up to the mid-teens has been affected by the conditions in which the child has lived, including the important role of the parents. Children with families that have a low annual income, a father who did not attend high school and/or university, whose mother who did not attend a university and did not work, revealed a higher caries experience than their counterparts. The caries experience scores of children categorized according to the maternal age, the paternal age and number of siblings, were also significantly different.

The father's and the mother's education were also the significant risk indicators for the caries experience in the current study. This is because educated mothers and fathers may have better careers, fewer children and more knowledge about dental issues than parents with less formal education. In addition, generally, higher education is associated with higher income, which enables parents to afford better dental care for their children.

The paternal age was found to be one of the significant risk indicators. This was agreed with the same sociodemographic background factors found in the study of Mattila et al.[11] Young fathers may not be very experienced in child rearing or may not have enough knowledge about preventive oral health care.

Daily tooth brushing with a fluoride toothpaste is believed to be the main reason for the decline in caries relevance for many populations since the 1970s.[12] However, the

Table 1. Mean caries experience for each of the caries-related variables.

	Number of children (%)	Caries experience (mean (SD))
Age		
6 yr	533(27)	3.02(2.45)
7 yr	1467(73)	3.71(3.12)
		p=0.251
Gender		
Boy	1037(52)	3.47(3.24)
Girl	963(48)	3.65(2.97)
		p=0.391
Annual family income		
Low	994(49.7)	3.63(3.26)[a*]
Medium	558(27.9)	2.75(2.75)[b]
High	448(22.4)	1.38(1.90)[b]
		p=0.000
Father's education		
No schooling or primary school	730(36.5)	4.04(3.40)[a]
High school	744(37.2)	3.36(3.16)[b]
University	526(26.3)	3.10(3.05)[b]
		p=0.000
Mother's education		
No schooling or primary school	957(47.9)	3.86(3.34)[a]
High school	662(33.1)	3.49(3.20)[a]
University	381 (19)	2.54(2.73)[b]
		p=0.000
Father's occupation		
Non-working	62(3.1)	3.73(3.34)
Working	1702(85.1)	3.53(3.23)
Health worker	246(12.3)	2.91(3.13)
		p=0.389
Mother's occupation		
Non-working	1239(61.95)	3.73(3.32)[a]
Working	450(22.5)	2.73(2.76)[b]
Health worker	311(15.55)	2.74(2.78)[b]
		p=0.000
Maternal age		
Under 25-year-old	833 (41.65)	3.78 (3.38)[a]
Between 26-and 35-year-old	928 (46.4)	3.27 (3.04)[b]
After 36-year-old	239 (11.95)	3.42 (3.71)[a,b]
		p=0.009

Table 1. ***(continued)***.		
Number of siblings		
More than 3 siblings	263 (13.15)	3.98 (3.34)[a]
2 or 3 siblings	1334 (66.7)	3.57 (3.28)[a,b]
Only child	403 (20.15)	3.09 (2.94)[b]
		p=0.030
Child's first dental visit		
Never	541 (27.05)	2.71 (2.96)[a]
≥ 2 years	1104 (55.2)	3.51 (3.25)[b]
< 2 years	355 (17.75)	3.70 (3.05)[b]
		p=0.005
How often the child went to the dentist		
Never attended	541 (27.05)	2.71 (2.96)[a]
Not regular attender	943 (47.15)	4.02 (3.30)[b]
At least once in 1 year	516 (25.8)	3.51 (3.21)[b]
		p=0.000
Frequency of tooth brushing		
Irregular		
Once a day	864 (43.2)	3.95 (3.38)[a]
Twice a day or more	685 (34.25)	3.36 (3.11)[b]
	451 (22.55)	2.75 (2.91)[c]
		p=0.000
Frequency of ingesting sugar-containing soft drinks		
≥ 3 times each day	587 (29.35)	3.93 (3.36)[a]
Otherwise	740 (37)	3.52 (3.20)[a,b]
< 2 times per week	673 (33.65)	3.07 (3.07)[b]
		p=0.000
Frequency of sweet food consumption		
≥ 3 times each day	529 (26.45)	4.04 (3.35)[a]
Otherwise	936 (46.8)	3.18 (3.07)[b]
< 2 times per week	535 (26.75)	3.70 (3.36)[a]
		p=0.000
Frequency of snacks		
5+ times	1089 (54.45)	3.46 (3.26)
3-4 times	703 (35.15)	3.6 (3.20)
1-2 times	208 (10.4)	3.23 (3.47)
		p=0.425

* Different letters in the same column indicate significant differences among the different categories of each variable.

Table 2. Linear regression modelling of caries experience.

Model	Unstandardized Coefficients		Standardized Coefficients	p value	95% Confidental Interval for B		Model's p value	Nagelkerke R square
	B	Std. Error	Beta		Lower Bound	Upper Bound		
Caries experience								
(Constant)	6.739	0.818	-	0.000	5.135	8.343		
Annual family income	-0.137	0.265	-0.015	0.609	-0.662	0.388		
Father's education	-0.305	0.135	-0.072	0.023	-0.569	-0.041		
Mother's education	-0.350	0.160	-0.079	0.028	-0.663	-0.037		
Mother's occupation	-0.248	0.192	-0.041	0.196	-0.625	0.129		
Paternal age	-0.265	0.169	-0.051	0.016	-0.596	0.066		
Maternal age								
Number of siblings	-0.124	0.171	-0.023	0.467	-0.459	0.211	0.000	
Child's first dental visit								
How often the child went	-0.313	0.177	-0.046	0.077	-0.659	0.034		
to the dentist	1.181	0.142	0.221	0.000	0.902	1.460		0.09
Frequency of tooth brushing	0.195	0.286	0.017	0.495	0.765	0.966		
Frequency of ingesting sugar	-0.595	0.103	-0.143	0.000	-0.797	-0.394		
containing soft drinks								
Frequency of sweet food	-0.331	0.111	-0.081	0.003	-0.548	-0.115		
consumption								
	-0.090	0.127	-0.020	0.470	-0.337	0.155		

role of tooth brushing in caries prevention has been questioned. Similar to some previous clinical trials[13,14] the authors of the current study found that children who brushed their teeth more than once a day revealed a lower caries experience than those who brushed less frequently. However, a number of studies have not been able to confirm such a correlation.[15,16] There may be two explanations for these controversial results. One reason is that tooth brushing per se does not say anything about the quality of the oral hygiene procedures. Although it is commonly believed that the dentition becomes perfectly free from debris after tooth brushing, that is rarely achieved by patients. In addition, it is not clear whether the effects of tooth cleaning are essentially a result of using fluoridated toothpaste or plaque removal.

Contrary to previous studies,[17,18] the current investigation shows that children who have never visited the dentist had a lower caries experience than those who visited the dental office. This indicates that children who participated in this study usually made a dental visit for a dental problem rather than for preventive advice or early treatment interventions.

To date, the relationship between the child's diet and dental caries was evaluated in a wide range of epidemiological and experimental studies.[19,20] The association between higher caries-experience scores and a higher frequency of sugar-containing soft-drink consumption is consistent with findings from other studies.[19,20] In the current study, children who consumed soft drinks three times or more per day had a higher caries experience than those who consumed them less than twice per week. A high intake frequency increases the overall length of time that the teeth are exposed to sugar-containing foods. Sugars can ferment by cariogenic microorganisms and contribute to the fermentation of acidic products that reduce the pH of the oral cavity. However, there are also a number of studies that did not attain this association or merely found a weak relationship between the frequency of consumption of sweet foods, beverage consumption and dental caries.[20,21]

Water fluoride intake was found to be inversely associated with a severe caries experience.[22,23] On the other hand, some authors reported that the caries levels of children living in areas with different levels of fluoride in their drinking water were not different.[24,25] In addition, weak and inconsistent evidence that the use of fluoride supplements prevents dental caries in primary teeth was reported in a previous systematic review.[26] In the current study, living in a high fluoride area did not reduce the mean caries experience of this population when compared with a national survey of the oral health status of children in Turkey as reported by Gökalp and others.[2] In addition, the global goal of the WHO for the year 2000 was that "50 per cent of 5-6-year-olds will be caries free" was not achieved in this population.[27] The global goal of the WHO for the year 2020 is to increase the proportion of caries free 6-year-olds by X%. The national global goal of Turkey for the year 2020 is 80% caries free 6-year-olds and has not been achieved in our population yet.[28]

CONCLUSION

The prevalence of dental caries in six to seven year-old children living in a high-fluoride area in Turkey was similar to the national score at this age but higher than the global goal of the WHO for the year 2000. The proportion of caries free children at this age was also lower than the national global goal for the year 2020. Living in a high

fluoride area did not reduce the prevalence of dental caries in this population, although it increased the risk of having fluorosed teeth. Sociodemographic factors, oral hygiene habits, dental attendance and diet are risk indicators for caries in this population. Preventive programs may encourage children to brush their teeth twice a day or more, reduce their frequency of ingesting sugar-containing soft drinks and visit a dentist for ways to prevent dental caries in this population.

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