EVALUATION OF DENTAL CARIES AND NURSING CARIES PREVALENCE IN PRE-SCHOOL CHILDREN LIVING IN A HIGH FLUORIDE AREA OF TURKEY

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SUMMARY: Children in nursery schools from each neighbourhood of Isparta city, a high fluoride area of Turkey which has drinking water fluoride ranging from 0.14 to 3.40 mg/L, were randomly selected and screened for this study. Out of 566 children between 2.5 and 6 years of age who were screened, 520 (91.9%) met the inclusion criteria (240 girls and 280 boys). An inverse correlation was found between dental fluorosis and nursing caries at a significance level of *P*<0.001. Subjects with fluorosis experienced less caries than those with no fluorosis. Although the difference between fluorosis and caries experience was not statistically significant (*P*>0.05), there was an inverse correlation between fluorosis and the number of carious teeth (*P*<0.001). Caries prevalence and mean dmft were 70% and 2.90±2.14 for the former group with fluorosis and 77% and 4.53±3.27 for the latter group with no fluorosis. This study shows that dental caries and nursing caries experience among children exposed to fluoride was lower than for those living in localities with less fluoride in the drinking water.

Keywords**:** Caries prevalence; Dental fluorosis; Nursing bottle; Nursing caries; Primary teeth.

INTRODUCTION

Early childhood caries (ECC), nursing bottle caries, baby bottle tooth decay, baby bottle caries, and bottle mouth caries are terms used to describe rampant caries in infants and babies attributed to prolonged bottle feeding containing fermentable carbohydrate liquids, beyond the usual time when the child is weaned from the bottle and introduced to solid food.[1] "Early childhood caries" was a term adopted in 1994 which acknowledged the multifactorial causes of the disease.[2] In addition, it has been described as endemic in some populations.[3]

The clinical appearance of the teeth in nursing caries in a child is typical and follows a definite pattern. There is early carious involvement of the maxillary primary incisors, the maxillary and mandibular first primary molars and the mandibular primary canines, within months after their eruption. Extensive and rapid destruction of the primary dentition occurs as a result. Early implantation of *mutans streptococci*, bottle feeding with sugary liquids, and prolonged breastfeeding, especially at night, are important predisposing factors.[1] This severe form of dental decay, which is rapid in onset, compromises a young child's smile and is difficult to treat. Indeed, the usual clinical solution is to extract many of the primary teeth under general anaesthetic, a psychologically traumatic event that may cause children to develop dental phobias.

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Fluoride in drinking water may help prevent dental caries, but excessive ingestion during the period of pre-eruptive tooth formation may also cause dental fluorosis.[4,5] The classical studies of Dean *et al*[6] are widely cited (but not universally accepted—see Discussion) in support of the view that optimal dental caries protection and minimal dental fluorosis are associated with a drinking water fluoride level of about 1 mg/L.

Various studies have been conducted on infant feeding practices, oral microflora and their effects on nursing caries, and the caries protective mechanisms of fluoride on permanent tooth enamel, but the effect of dental fluorosis on the formation of nursing caries in primary dentition is not well known. The aim of this study was to evaluate the relationship between dental fluorosis and nursing caries, and to determine caries and nursing caries experiences of the children residing in a high fluoride area of Turkey (Isparta city), which has a fluoride content in drinking water of different neighbourhoods ranging from 0.14 to 3.4 mg/L.[7] In addition, the relationships between the educational levels of the mothers, the period of bottle use, contents of the bottle, frequency of tooth brushing, and nursing caries were investigated.

MATERIALS AND METHODS

Isparta is a city of Turkey which has a yearly average temperature of 12.2 ºC. Heavy clay soils, groundwater, and lake water in the vicinity of volcanic areas can take up high levels of fluoride from these rocks.[8] Isparta city is localized on such a volcanic area, and Gölcük Crater Lake is one of the water sources of the city. The other two water sources are Eğirdir Lake and Andık River. The fluoride levels of these sources increase especially in spring and summer due to increases in temperature. Annual minimum and maximum fluoride levels of Gölcük Crater Lake, Eğirdir Lake, and Andık River are 0.79 and 1.55 mg/L (mean±SD: 1.12±0.29), 0.14 and 0.35 mg/L (mean±SD: 0.22±0.077), and 2.55 and 3.40 mg/L (mean±SD: 2.96±0.31), respectively.[7] Prior to the study, neighbourhoods of Isparta city were classified according to these three fluoride concentrations in the drinking water. Nursery schools from each neighbourhood were randomly selected and screened for this study.

A questionnaire was designed to determine medical history, type of nutrition, and general health condition of each child, problems during pregnancy and just after birth, mother's type of nutrition during pregnancy, child's primary caregiver, period of using a bottle or pacifier, contents of the bottle, weaning age, dietary habits, snacking and tooth brushing frequency, additional fluoride use, educational level of mother, and number of visits to dentists. The mothers of the children were requested to fill out these questionnaire forms in order to obtain information about the children, and assistance was provided to mothers during completion of the forms.

Among the 566 participants who were screened, 520 (91.9%) children met the inclusion criteria of the study and were included in the study. The children's mothers read and signed a letter of informed consent enclosed with the forms.

The study population was composed of 240 girls and 280 boys, who were 2.5 to 6 years of age at their time of entry into the study. These were children: (i) who were healthy and free from physical or mental handicaps and had primary dentition, (ii) whose mothers had read and signed the letter of informed consent and filled the forms completely and correctly, (iii) who were cooperative and had never received any additional fluoride treatment, and (iv) who had continuously resided in the same neighbourhood since birth.

Children with primary molars with white spot lesions, cavitations restorations or profound caries, especially on buccal surfaces, and children with excessive loss of anterior and posterior tooth structure, were excluded from the study for the probability of interference with the diagnosis of fluorosis and nursing caries. For the children who were excluded from the study, dental examinations were performed, indicated treatments were determined, and the parents were informed. Oral examinations were performed visually by two independent examiners visually using a No. 4 mirror and a WHO-CPI probe (a ball-ended periodontal probe) during daylight with a battery-operated light (Oral probe kit, Osada, Japan). Where this was not possible, younger children were examined using the lap-to-lap technique. Teeth were cleaned using gauze if debris obscured visualization of the tooth surface, but they were not dried during oral examination.

It was observed that none of the fluorotic primary teeth showed mottling or loss of enamel. Because of the difficulties in adequate identification, grading and evaluation of primary-tooth fluorosis compared to fluorosis in permanent teeth in epidemiological studies, as well as the absence of the severe forms of fluorosis in primary dentition, Dean's criteria[9] for dental fluorosis were modified as follows:

0	Normal (includes 'Normal' score of Dean's classification)
1	Mild fluorosis (includes 'Questionable' and 'Very mild' scores of Dean's classification)
2	Moderate fluorosis (includes 'Mild' score of Dean's classification)
3	Severe fluorosis (includes 'Moderate' and 'Severe' scores of Dean's classification)

Primary molars were the teeth considered for scoring of fluorosis. Score 0 showed healthy enamel surface, while score 1 showed loss of transparency and the presence of small white spots. Teeth with white, opaque spots on one quarter of the tooth surface, and teeth with large spots on the half and more of the tooth surface, were given scores of 2 and 3, respectively.

Nursing caries was diagnosed according to the following criteria: (i) one or more maxillary incisors showing a ring-like pattern of decay, (ii) one or more maxillary incisors showing decay to the gum-line, (iii) sound mandibular inci-

sors, and (iv) use of a nursing bottle at naptime and/or bedtime which contained fermentable carbohydrate liquids. Caries was diagnosed using WHO recommendations for oral health surveys.[10] The dmft (decayed, missing, and filled primary teeth) scores for each child were calculated with teeth lost to trauma or exfoliation excluded from the calculation. This information was obtained from parents and questionnaires. Lesions were recorded as present when a carious cavity was apparent on visual inspection. If doubt existed, the surface was investigated with the WHO-CPI probe. Unless the point entered the lesion, the surface was recorded as sound. The catching of the probe in a pit or fissure was not enough to warrant the diagnosis of caries unless there was additional visual evidence. Use of a nursing bottle at naptime and/or bedtime which contained fermentable carbohydrate liquids and the presence of caries in anterior maxillary incisors were the criteria used to distinguish patients with nursing caries from patients with more common childhood caries.

The examination scores were reproducible. Inter- and intra-examiner calibrations were conducted for the caries and fluorosis indices on dental patients prior to the study. Kappa scores were 0.87 and 0.71 for dental caries and fluorosis scores, respectively, for both inter- and intra-examiner calibration exercises. Statistical analysis was performed using the Statistical Package for Social Science (SPSS, version 10.0). The data were analysed by chi-square, Kruskal-Wallis, and Mann-Whitney-U tests. Statistical significance was set at $P< 0.05$.

RESULTS

Dental fluorosis was clinically detected in the primary dentition of 264 (50.8%) children who had lived continuously in their neighbourhoods with intermediate and high fluoride levels and had been drinking tap water since birth, but none of them exhibited severe form of fluorosis with mottling or loss of enamel. The remaining 256 (49.2%) children had no fluorosis and had been residing in neighbourhoods with low fluoride levels.

Nursing bottle caries was diagnosed in 95 (18.3%) children, while the remaining 425 (81.7%) children did not have nursing caries. There was an inverse correlation between dental fluorosis and nursing caries at a significance level of $P<0.001$. Kruskal-Wallis and Mann-Whitney-U tests were performed in order to determine the relationship between fluorosis scores and nursing caries. Significant differences were found between fluorosis scores of 0 and 1 and 0 and 2 at significance levels of $P<0.001$ and $P=0.001$, respectively, while there was no significant difference between the scores of 0 and 3 ($P>0.05$). Among the children with fluorosis, 13 girls (5.4%) and 15 boys (5.4%) were observed to have nursing caries, whereas among the children with no fluorosis, 35 girls (14.6%) and 32 boys (11.4%) were found to have nursing caries (Table 1).

The children were classified into five groups according to their nursing bottle contents: (i) ones who drink milk; (ii) ones who drink milk with sugar; (iii) ones who get formula; (iv) ones who drink cola, fruit juice, or tea with sugar; and (v) ones who get two or more of the contents determined above. The period of using

a bottle was classified as: (i) 0–12 months; (ii) 0–24 months; (iii) 0–36 months or longer. A highly significant difference between bottle contents and nursing caries, and between bottle contents and period of using a bottle was found at significance level of $P<0.001$. The majority of the participants (47.1%) were observed to drink milk sweetened with sugar, and 36.7% did not use a bottle. The children who used a bottle for longer periods and who drank milk with sugar from a bottle experienced more nursing caries than others.

Table 1. Distribution of nursing caries according to gender

Fluorosis scores	Nursing caries				Total
	No. without caries		No. with caries		n (%)
	Girls n (%)	Boys n (%)	Girls n (%)	Boys n (%)	
0	91 (37.9)	98 (35)	35 (14.6)	32 (11.4)	256 (49.2)
1	58 (24.2)	83 (29.6)	10 (4.2)	9 (3.2)	160 (30.8)
2	31 (12.9)	40 (14.3)	1 (0.4)	5 (1.8)	77 (14.8)
3	12 (5)	12 (4.3)	2 (0.8)	1 (0.4)	27 (5.2)
Total	192 (80)	233 (83.2)	48 (20)	47 (16.8)	520 (100)

It was observed that 34.8% of 264 children with fluorotic teeth were caries free and 20.5% had five or more caries. In the nonfluorosis group, the percentages of children with no caries and with five or more caries were 27.0% and 37.9%, respectively (Table 2). It was observed that children with fluorosis experienced less caries than children with no fluorosis, and the teeth with fluorosis were observed to have smaller and shallower caries cavities than nonfluorotic teeth. Although the difference between fluorosis and patient's caries experience was not statistically significant ($P>0.05$), there was an inverse correlation between fluorosis and number of carious teeth ($P<0.001$). Caries prevalence was 70% and the mean dmft was 2.90±2.14 for the former group with fluorosis and 77% and 4.53±3.27, respectively, for the latter (Figure 1, Table 3). The mean mt (missing primary teeth) figure was included, because it was very low.

There were 34 patients (6.5%) with 10 or more carious teeth who had small Class I and II cavities with sound buccal surfaces.

Figure 2 reveals the distribution of the number of children and caries according to gender in both fluorosis and nonfluorosis groups.

The percentage of mothers with a high educational level was 60% and with a low educational level was 21.3%. The inverse relationship between the educational level of the mothers and their children's caries experience was highly sig-

nificant (P<0.001), while no significant relationship was found between mothers' educational level and their children's nursing caries experience (P>0.05) (Table 4).

Table 2. Number of caries in fluorosis and nonfluorosis groups

Number of carious teeth	Fluorosis scores				Total n (%)
	0 n (%)	1 n (%)	2 n (%)	3 n (%)	
0	69 (13.3)	48 (9.2)	33 (6.3)	11 (2.1)	161 (31)
1	18 (3.5)	13 (2.5)	8 (1.5)	2 (0.4)	41 (7.9)
2	26 (5)	21 (4)	10 (1.9)	5 (1)	62 (11.9)
3	17 (3.3)	16 (3.1)	6 (1.2)	1 (0.2)	40 (7.7)
4	29 (5.6)	21 (4)	10 (1.9)	5 (1)	65 (12.5)
5	22 (4.2)	12 (2.3)	5 (1)	1 (0.2)	40 (7.7)
6	14 (2.7)	11 (2.1)	3 (0.6)	1 (0.2)	29 (5.6)
7	11 (2.1)	5 (1)	1 (0.2)	-	17 (3.3)
8	18 (3.5)	3 (0.6)	1 (0.2)	1 (0.2)	23 (4.4)
9	5 (1)	3 (0.6)	-	-	8 (1.5)
10	7 (1.3)	3 (0.6)	-	-	10 (1.9)
11	4 (0.8)	2 (0.4)	-	-	6 (1.2)
12	3 (0.6)	1 (0.2)	-	-	4 (0.8)
13	2 (0.4)	1 (0.2)	-	-	3 (0.6)
16	2 (0.4)	-	-	-	2 (0.4)
17	1 (0.2)	-	-	-	1 (0.2)
18	2 (0.4)	-	-	-	2 (0.4)
19	1 (0.2)	-	-	-	1 (0.2)
20	5 (1)	-	-	-	5 (1)
Total	256 (49.2)	160 (30.8)	77 (14.8)	27 (5.2)	520 (100)

The majority of the participants (69.4%) did not brush their teeth or brushed them only once a day or irregularly. Low-fluoride toothpaste was used by 30.6%

of the children. The frequency of tooth brushing showed no significant relationship with either caries or nursing caries ($P>0.05$).

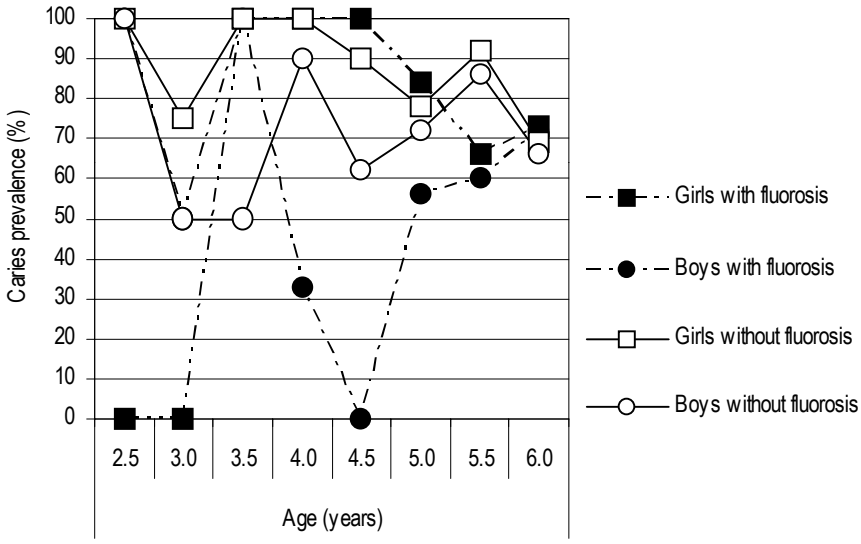


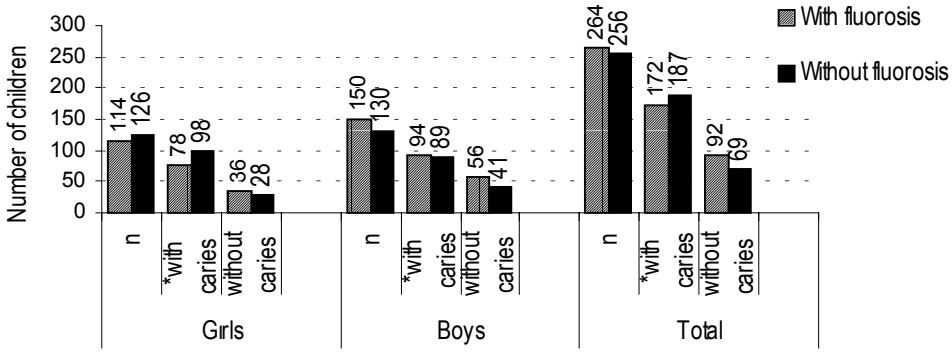
Figure 1. Caries prevalence in fluorosis and nonfluorosis groups.

Table 3. Caries prevalence and mean number of decayed, missing, and filled primary teeth in fluorosis and nonfluorosis groups

	Prevalence (%)	dt ± SD	mt ± SD	ft ± SD
With fluorosis	70	2.78±2.90	0.037±0.33	0.083±0.46
Without fluorosis	77	4.23±4.47	0.19±0.90	0.097±0.41

Table 4. Educational level of mothers in relation to mean decay number of their children with nursing caries

Educational level of mothers	dt ± SD	Number of children with nursing caries N (%)
Primary school	4.75±3.98	24 (21.2)
High school	4.28±3.85	16 (14.2)
University	2.80±3.60	73 (64.6)
Total	3.49±3.82	113 (100.0)



* Including the number of children with nursing caries.

Figure 2. Distribution of the number of children and caries according to gender in both fluorosis and nonfluorosis groups.

DISCUSSION

In recent years, there has been growing evidence that the prevalence of dental fluorosis is increasing in both optimally and negligibly fluoridated communities.[11-15] Dental fluorosis is a dose-response condition, so that a higher intake during the critical period of tooth development will result in more severe fluorosis.[16,17] It is believed that the early maturation stage of enamel formation is the most critical stage for both primary and permanent tooth fluorosis,[18,19] but that the highest risk for fluorosis occurs when there is fluoride exposure during both the secretory and maturation stages.[20] Fluorosis in the primary dentition has generally been reported to be less prevalent and less severe than fluorosis in the permanent dentition.[13,21] Primary molar teeth, particularly the primary second molars, which form at later stages of development, have been reported to be the most commonly affected teeth.[22,23] For this reason, in the present study primary molars were the teeth considered for scoring fluorosis.

Several studies indicate that primary-tooth fluorosis can be prevalent in areas with very high fluoride water concentrations.[24,25] In these areas, primary-tooth fluorosis is likely the result of both pre- and postnatal exposures. Studies have documented that primary-tooth fluorosis does occur in areas with optimal or suboptimal water fluoride concentrations, and that, in these settings, primary-tooth fluorosis is most likely caused by postnatal exposures.[26,27] In primary teeth, the maturation phase occurs *in utero* while the placenta acts as a barrier to the transfer of fluoride and so a partial protection is provided by the maternal exclusion of fluoride to the fetus.[19] The development of primary teeth in a shorter time than permanent teeth develop provides less fluoride exposure for primary teeth.[28,29]

Moreover, the much thinner enamel layer of primary teeth may also explain the lower degree of dental fluorosis in primary teeth.[25] It is more difficult to make adequate identification and grading of primary-tooth fluorosis than fluorosis in permanent teeth. Because of these difficulties in evaluating primary-tooth fluorosis and the absence of severe forms of fluorosis with mottling or loss of enamel in primary dentition, the fluorosis scoring of Dean[9] was modified for use in this study.

Children who lived in the same neighbourhood since birth were diagnosed as having similar levels of fluorosis in their primary teeth. Children with severe dental fluorosis (score 3) lived in neighbourhoods with high fluoride levels (2.55–3.40 mg/L). It was also noted that nutrition types of the children were similar in both the high and low fluoride areas. Isparta is a secluded city, and for this reason nutritional and traditional habits of the families remain relatively unchanged and may be a possible reason for similar nutrition types of the children in this city.

Although the classical studies of Dean *et al*[6] reporting an inverse water fluoride-dental caries relationship are widely cited, they are not universally accepted. One critique noted that Dean *et al* only presented data from the selected communities while not taking into account factors other than fluoride, *e.g.*, socio-economic and dietary differences and variations in the composition of the drinking water.[30] Teotia and Teotia[31] reported that increased calcium intake without fluoride was effective in reducing dental caries in children and that dental caries was actually caused by high fluoride and low dietary calcium intakes, separately, and through their interactions. These factors may help explain differences in the results of various studies on the relationship between caries incidence and fluoride.

On the other hand, various levels of fluoride exposure have been reported to delay or reverse the caries process by remineralizing the tooth enamel.[5,32,33] In our study, we found that the percentage of caries-free children in the fluorosis group was higher than the percentage of caries-free children in the nonfluorosis group. In this respect, our findings are consistent with those of many other studies demonstrating lower dental caries experience among children exposed to fluoridated water.[5,28,35-39] However, there are also studies indicating a positive association between high fluoride levels in drinking water and dental caries.[40-43] In contrast to our study, permanent teeth of children were evaluated and an increasing decay rate in permanent dentition with increasing fluorosis severity was observed in those studies.[40-43] Moreover, in the research of Yiamouyianis[44] and more recently of Armfield *et al*[45], lower tooth decay rates were found only in primary dentition with exposure to fluoridated drinking water, while no difference was found in caries rates for the permanent teeth of the children in these studies.

A difference between decay rates of primary and permanent teeth with fluorosis may be explained by the findings of Yoshida *et al*,[46] who reported that the fluoride content on the outer 10 µm of permanent teeth varied from 2000 to 3000 ppm depending on the original fluoride level of the drinking water. On the other hand, the concentration of fluoride in the outermost layer of primary teeth was

much lower (1000 ppm in an area with 1 ppm fluoride). It is fluoride concentration in this outer enamel layer which these authors consider critical for caries prevention. Mottled enamel, which is generally seen with permanent teeth, has a much higher fluoride concentration than normal enamel or the enamel formed in the presence of optimal fluoride level.

In developing countries the prevalence of nursing caries has been reported to be as high as 70% in pre-school populations.[47] In the present study, the percentage of children with nursing caries was 18.3%. Although Turkey is a developing country, nursing caries experience may be reduced by high fluoride levels in drinking water in Isparta. This percentage has been reported to vary from 14% to 27.3% in previous reports.[48-50] Mean dmft values reported by Kırzıoğlu *et al*[49] for Erzurum (eastern Turkey) and Bursa (western Turkey) cities (2.49 and 2.77, respectively) were lower than the mean dmft (4.53) in the nonfluorosis group in Isparta. The prevalence of caries and nursing caries may be affected by the differences between periods of using a nursing bottle, the time of eruption of the primary teeth, and dietary habits of the children residing in different geographic regions. In one study, the age of complete eruption of primary teeth of the children in Isparta was reported as 30 months.[51]

Our finding that there was a highly significant association between contents of the bottle and nursing caries is generally supported by other studies reporting that nursing bottles containing fermentable carbohydrate liquids play an important role in the formation of nursing caries.[52,53] This is in contrast to some studies showing no relationship between contents of the bottle and nursing caries.[54,55] Dietary habits play an important role in caries formation. Prolonged use of a nursing bottle containing fruit juice and sweetened liquids both at night and during the day significantly promotes caries formation. Schwartz *et al*[54] reported that 62% of the children with nursing caries had the habit of sleeping with a nursing bottle in their mouth.

A mother's higher education level has been shown to be a good predictor for low-caries experience,[48,56] as it was in this study. This may be because educated mothers have more knowledge about dental health issues. There is also an association between higher education and higher income that relates to the ability to afford better dental care for their children. In contrast to this finding, it was observed that children of mothers with high education level were more likely to have nursing caries experience than other children from families with lower educational background, but the difference was not statistically significant. This may be an indicator of lack of knowledge about predisposing factors of nursing caries in our society even among educated mothers. In Turkey, maternity leave of women is only 40 days, and at the end of this period mothers are obliged to return to work. This may be another possible reason for the early use of nursing bottle for babies of educated mothers rather than breast feeding.

In conclusion, in this study dental caries and nursing caries experience among children exposed to fluoride was lower than for those living in localities with less fluoride in drinking water. The results of the study indicated that there is an

urgent need for disseminating appropriate and accurate information about oral health care for infants and caregivers, especially regarding the inappropriate use of a nursing bottle at night and giving non-dairy products in a bottle. It is necessary to promote dental awareness among young mothers to facilitate early dental check-ups for young children. In addition, fluoride, in recommended doses, continues, in our view, to be a primary therapeutic agent for the prevention of dental caries in adults and children. With the downward adjustment in the fluoride supplements, especially in endemic fluorosis areas, continued monitoring of the prevalence of dental fluorosis in young children is needed to determine if any additional steps are necessary to restrict fluoride intake during the years that enamel formation is occurring.

REFERENCES

1 McDonald RE, Avery DR, Stookey GK. Dental caries in the child and adolescent. In: McDonald RE, Avery DR, editors. Dentistry for the child and adolescent. 7th ed. St. Louis: Mosby Year Book; 2000. p. 209-46.

2 Reisine S, Douglass JM. Psychosocial and behavioral issues in early childhood caries. Commun Dent Oral Epidemiol 1998;26(1 Suppl):32-44.

3 Ismail A. Prevention of early childhood caries. Commun Dent Oral Epidemiol 1998;26(1 Suppl):49-61.

4 World Health Organization (WHO). Technical Report Series 846: Fluoride and Oral Health. Report of a WHO Expert Committee on Oral Health Status and Fluoride Use. Geneva: World Health Organization; 1994.

5 Slade GD, Davies MJ, Spencer AJ, Stewart JF. Association between exposure to fluoride drinking water and dental experience among children in two Australian states. J Public Health Dent 1995 Fall;55(4):218-228.

6 Dean HT, Jay P, Arnold FA, Elvolve E. Domestic water and dental caries. II A study of 2,832 white children aged 12-14 years, of eight suburban Chicago communities, including *L. acidophilus* studies of 1,761 children. Public Health Reports 1941;56:761-92.

7 Kır E. Isparta ili içme suyu kaynaklarında nitrat, fosfat ve florür dağılımının araştırılması (Yüksek Lisans Tezi). Süleyman Demirel Üniversitesi, Fen Bilimleri Enstitüsü, Kimya Anabilim Dalı 1996. [The determination and evaluation of nitrate, phosphate and fluoride levels in the sources of drinking water in Isparta city (Postgraduate thesis). Süleyman Demirel University, Institute of Science, Department of Chemistry, 1996.]

8 World Health Organization (WHO). Fluorine and fluorides. Environmental Health Criteria No.36. Geneva: World Health Organization; 1984.

9 Mellberg JR, Ripa LW, Leske GS. Water fluoridation. In: Mellberg JR, Ripa LW, Leske G, editors. Fluoride in preventive dentistry. Chicago: Quintessence; 1983. p. 103-22.

10 World Health Organization (WHO). Oral Health Survey. Basic Methods, 4th ed. Geneva: World Health Organization; 1997.

11 Pendrys D. Risk of fluorosis in a population. Implications for the dentist and hygienist. J Am Dent Assoc 1995 Dec;126(12):1617-24.

12 Jackson RD, Kelly SA, Katz B, Brizendine E and Stookey GK. Dental fluorosis in children residing in communities with different water fluoride levels: 33-month follow-up. Pediatr Dent 1999 Jul-Aug;21(4):248-54.

13 Warren JJ, Kanellis MJ, Levy SM. Fluorosis of the primary dentition: What does it mean for the permanent teeth? J Am Dent Assoc 1999 Mar;130(3):347-56.

14 Clarkson J, Hardwick K, Barmes D, Richardson LM. International collaborative research on fluoride. J Dent Res 2000 Apr;79(4):893-904.

15 Paiva SM, Lima YBO, Cury JA. Fluoride intake by Brazilian children from two communities with fluoridated water. Commun Dent Oral Epidemiol 2003 Jun;31(3):184-91.
16 Osuji OO, Leake JL, Chipman ML, Nikiforuk G, Locker D, Levine. Risk factors for dental fluorosis in a fluoridated community. J Dent Res 1988 Dec;67(12):1488-92.
17 Burt BA. The changing patterns of systemic fluoride intake. J Dent Res 1992 May;71(5):1228-37.
18 Angmar-Mansson B, Whitford GM. Enamel fluorosis related to plasma F levels in the rat. Caries Res 1984;18(1):25-32.
19 Gedalia I, Saphira L. Effect of prenatal and postnatal fluoride on the human deciduous dentition. A literature review. Adv Dent Res 1989 Sep;3(2):168-76.
20 DenBesten PK. Biological mechanisms of dental fluorosis relevant to the use of fluoride supplements. Commun Dent Oral Epidemiol 1999 Feb;27(1):41-7.
21 Ng'ang'a PM, Valderhaug J. Prevalence and severity of dental fluorosis in primary schoolchildren in Nairobi, Kenya. Commun Dent Oral Epidemiol 1993 Feb;21(1):15-8.
22 Milsom KM, Woodward M, Harran D, Lennon MA. Enamel defects in the deciduous dentition as a potential predictor of defects in the permanent dentition of 8- and 9-year-old children in fluoridated Cheshire, UK. J Dent Res 1996 Apr;75(4):1015-8.
23 Warren JJ, Levy SM, Kanellis MJ. Prevalence of dental fluorosis in the primary dentition. J Public Health Dent 2001 Spring;61(2):87-91.
24 Forsman B. Dental fluorosis and caries in high-fluoride districts in Sweden. Commun Dent Oral Epidemiol 1974;2(3):132-48.
25 Thylstrup A. Distribution of dental fluorosis in the primary dentition. Commun Dent Oral Epidemiol 1978 Nov;6(6):329-37.
26 Booth JM, Mitropoulos CM, Worthington HV. A comparison between the dental health of 3-year-old children living in fluoridated Huddersfield and non-fluoridated Dewsbury in 1989. Commun Dent Oral Epidemiol 1992 June;9(2):151-7.
27 Leverett DH, Adair SM, Vaughan BW, Proskin HM, Moss ME. Randomized clinical trial of the effect of prenatal fluoride supplements in preventing dental caries. Caries Res 1997;31(3):174-9.
28 Haikel Y, Cohen PM, Turlot JC, Frank RM. Dental caries and fluorosis in children from high and low fluoride areas of Morocco. ASDC J Dent Child 1989 Sep-Oct;56(5):378-81.
29 Ten Cate AR. Development of the tooth and its supporting tissues. In: Ten Cate AR, editor. Oral histology development, structure and function. 4th ed. St Louis: Mosby Year Book; 1994. p. 58-80.
30 Colquhoun J. Is there a dental benefit from water fluoride? Fluoride 1994;27(1):13-22.
31 Teotia SPS, Teotia M. Dental caries: a disorder of high fluoride and low dietary calcium interactions (30 years of personal research). Fluoride 1994;27(2):59-66.
32 Featherstone JD. The science and practice of caries prevention. J Am Dent Assoc 2000 Jul;131(7):887-99.
33 Featherstone JD. Prevention and reversal of dental caries: role of low level fluoride. Commun Dent Oral Epidemiol 1999 Feb;27(1):31-40.
34 McInnes PM, Richardson BD, Cleaton-Jones PE. Comparison of dental fluorosis and caries in primary teeth of preschool-children living in arid high and low fluoride villages. Commun Dent Oral Epidemiol 1982 Aug;10(4):182-6.
35 Ibrahim YE, Affan AA, Bjorvatn K. Prevalence of dental fluorosis in Sudanese children from two villages with 0.25 and 2.56 ppm fluoride in the drinking water. Int J Pediatr Dent 1995 Dec;5(4):223-9.
36 Ibrahim YE, Bjorvatn K, Birkeland JM. Caries and dental fluorosis in a 0.25 and 2.5 ppm fluoride area in the Sudan. Int J Pediatr Dent 1997 Sep;7(3):161-6.
37 Künzel W, Fischer T. Caries prevalence after cessation of water fluoridation in La Salud, Cuba. Caries Res 2000 Jan-Feb;34(1):20-5.
38 Budipramana ES, Hapsoro A, Irmawati ES, Kuntal S. Dental fluorosis and caries prevalence in the fluorosis endemic area of Asembagus, Indonesia. Int J Pediatr Dent 2002 Nov;12(6):415-22.
39 Stephen KW, Macpherson LM, Gilmour WH, Stuart RA, Merrett MC. A blind caries and fluorosis prevalence study of school-children in naturally fluoridated and nonfluoridated townships of Morayshire, Scotland. Commun Dent Oral Epidemiol 2002 Feb;30(1):70-9.

40 Mann J, Mahmoud W, Ernest M, Sgan-Cohen H, Shoshan N, Gedalia I. Fluorosis and dental caries in 6-8-year-old children in a 5 ppm fluoride area. Commun Dent Oral Epidemiol 1990 Apr;18(2):77-9.
41 Grobler SR, Louw AJ, Kotze TJ. Dental fluorosis and caries experience in relation to three different drinking water fluoride levels in South Africa. Int J Pediatr Dent 2001 Sep;11(5):372-9.
42 Rwenyonyi CM, Birkeland JM, Haugejorden O, Bjorvatn K. Dental caries among 10- to 14-year-old children in Ugandan rural areas with 0.5 and 2.5 mg fluoride per liter in drinking water. Clin Oral Invest 2001 Mar;5(1): 45-50.
43 Ermiş RB, Koray F, Akdeniz BG. Dental caries and fluorosis in low- and high-fluoride areas in Turkey. Qintessence Int 2003 May;34(5):354-60.[abstract and comment in Fluoride 2003;36(4):292-3].
44 Yiamouyiannis JA. Water fluoridation and tooth decay: results from the 1986-1987 national survey of U.S. schoolchildren. Fluoride 1990;23(2): 55-67.
45 Armfield JM, Spencer AJ. Consumption of nonpublic water: implications for children's caries experience. Commun Dent Oral Epidemiol 2004;32(4):283-96.
46 Yoshida S, Sobue, S, Nakata M, Nishino M, editors. Better dental care for children toward the 21st century. Proceedings of the 13th Congress of the International Association of Dentistry for Children; 1991 Sep 27-30; Kyoto, Japan.
47 Milnes AR. Description and epidemiology of nursing caries. J Public Health Dent 1996;56(1):38-50.
48 Wyne A, Darwish S, Adenubi J, Battata S, Khan N. Prevalence and pattern of nursing caries in Saudi pre-school children. Int J Pediatr Dent 2001 Sep;11(5):361-4.
49 Kırzıoğlu Z, Şimşek S, Gürbüz T, Yağdıran A, Karatoprak O. Erzurum ve Bursa illerinde 2-5 yaş grubu çocuklarda çürük sıklığı ve bazı risk faktörlerinin değerlendirilmesi. Atatürk Üniversitesi Dişhekimliği Fakültesi Dergisi 2002;12(2):6-13. [The evaluation of caries prevalence and some risk factors in 2-5 years of age children in Erzurum and Bursa cities in Turkey].
50 Jones SG, Nunn JH. The dental health of 3-year-old children in east Cumbria 1993. Commun Dent Health 1995 Sep;12(3):161-6.
51 Mercan Ö. Isparta il merkezinde ilk süt dişlerinin sürme zamanlarının çeşitli faktörlerle ilişkisinin incelenmesi (Mezuniyet tezi). Süleyman Demirel Üniversitesi, Diş Hekimliği Fakültesi, Pedodonti Anabilim Dalı, 2001. [An evaluation of the eruption time of primary teeth and affecting factors in Isparta city (Undergraduate thesis)]. Süleyman Demirel University, Faculty of Dentistry, Department of Pedodontics, 2001.
52 Newbrun E. Frequent sugar intake then and now: interpretation of the main results. Scand J Dent Res 1989 Aug;97(2):103-9.
53 Johnston T, Messer LB. Nursing caries: literature review and report of a case managed under local anesthesia. Aust Dent J 1994 Dec;39(6):373-81.
54 Schwartz SS, Rosivack GR, Michelotti P. A child's sleeping habit as a cause of nursing caries. ASDC J Dent Child 1993 Jan-Feb;60(1):22-5.
55 Ayhan H. Influencing factors of nursing caries. J Clin Pediatr Dent 1996 Summer;20(40):313-16.
56 Mariri BP, Levy SM, Warren JJ, Bergus GR, Marshal TA, Broffitt B. Medically administered antibiotics, dietary habits, fluoride intake and dental caries experience in the primary dentition. Commun Dent Oral Epidemiol 2003 Feb;31(1):40-51.