EVALUATION OF DENTAL FLUOROSIS IN RELATION TO DMFT RATES IN A FLUOROTIC RURAL AREA OF TURKEY

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SUMMARY: The purpose of this study was to determine the fluoride concentration of drinking water and any correlations between the severity, and discoloration level of dental fluorosis and decayed/missing/filled permanent teeth (DMFT) values in the rural fluorotic village of Deregümü, Isparta, Turkey. Intraoral examination of 293 individuals (150 women, 143 men) aged between 12 and 80 years was performed. Female and male individuals were divided into four age groups. DMFT and Thylstrup-Fejerskov Index (TFI) scores and discoloration levels were recorded for each tooth. Water samples were taken from the drinking water tank of the village and from the groundwater source. Statistical analysis was performed using the Kruskal-Wallis, Mann-Whitney, Bonferroni-Dunn, and Spearman rank correlation tests. The prevalence of dental fluorosis in this population was 94.1%, with TFI scores between 1 and 8. The level of fluoride in the drinking water was 1.83 mg/L. The mean TFI score was 3.58 and the overall mean DMFT value was 6.45. Men had significantly higher DMFT values (8.13) than women (4.75) ($p<0.05$). Discoloration was severe (score of 3) in 25.08% of the individuals, moderate (score of 2) in 20.14%, and mild (score of 1) in 20.5%, whereas 34.28% had no discoloration (score of 0). DMFT, TFI and discoloration scores were positively correlated with age in both genders and were positively correlated with gender in some age groups ($p<0.05$). A very high prevalence and relatively severe dental fluorosis exists in the population of Deregümü, Isparta, Turkey, which continues to be a high-fluoride area.

Keywords: Dental fluorosis; DMFT and dental fluorosis; Enamel discoloration; Fluorotic area of Turkey; Thylstrup-Fejerskov Index.

INTRODUCTION

The chemical element fluorine exists only as compounds of solid fluoride (F) salts or solutions or HF gases in nature. The primary factor affecting the fluoride content of groundwater and surface waters is the interaction of water and volcanic rock.[1,2] The level of F in drinking water is important for humans, because, although F is not essential for the development of healthy teeth and bones, it accumulates in both the hard and the soft tissues of the body and may cause a variety of adverse health effects. Water fluoridation is widely considered to be an effective method for the prevention of caries at a concentration of <1 mg/L of F, but the excessive consumption of water, especially when containing >1.5 mg F/L, can result in the development of fluorosis in bones and teeth. According to the World Health Organization,[3] more than 200 million people in 25 nations worldwide are affected by fluorosis.[4,5]

Twelve volcanic rock area regions in Turkey are endemic for fluorosis with 1.4 to 13.7 mg F/L in the groundwater. Isparta was the first such area to be reported

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with its high prevalence of fluorosis being recognized about 55 years ago.[6] Extremely high concentrations of fluoride (1.4–4.6 mg/L) have been reported in the public water systems in this area, including samples obtained from Andik spring, Gölcük Crater Lake, and Egirdir Lake.[7] The fluoride content of the water was less in some districts of the city because of a change of source (Egirdir Lake, Gölcük Crater Lake) in 2003, with the F concentration reported to be between 0.17 and 2.3 mg/L.[7] However, dental fluorosis is still a health problem for residents of Isparta, even in young individuals. Residents of villages like Deregümü¸ near Isparta also continue to experience dental fluorosis because public water is obtained from Gölcük Crater Lake or underground water sources with high levels of F. Moreover, high DMFT scores are a significant dental public health problem in Turkey, which is often observed in populations with low socioeconomic status.[8,9] Some studies have reported there is a correlation between the F concentration in drinking water and DMFT scores.[10,11]

The purpose of this study was to determine the F of the drinking water and any correlations between the severity and discoloration level of dental fluorosis and decayed/missing/filled (permanent) teeth (DMFT) scores in relation to age and gender in Deregümü, Isparta, Turkey.

MATERIALS AND METHODS

Background: This observational, cross-sectional, analytical study was conducted among native-born individuals of the high F Deregümü village area with 1840 (926 male, 914 female) inhabitants in Isparta, Turkey.[12] The community has a relatively low socioeconomic status, and the primary means of income is agriculture. The village has one public school providing eight years of classroom education and one public health clinic; dental care is not available. Until 1991, drinking water containing high levels of F was obtained from Gölcük Crater Lake, but since then the water source was changed to a new borehole with a 160-m depth near the village.

Study protocol: The study was conducted over a period of three months between February and April in 2011. Data were collected from the patients of the Deregümü clinic and students of the school who consumed water from the groundwater source for the first 10 years of their lives. Informed consent was obtained from the individuals and from the parents of the children (<18 years), as well as from local authorities. Female (F) (n=150) and male (M) (n=143) individuals were assigned to one of 4 age groups as follows: F1, 12–19 years; F2, 20–39 years; F3, 40–59 years; F4, ≥60 years; M1, 12–19 years; M2, 20–39 years; M3, 40–59 years; and M4, ≥60 years. Ages of the participants, levels of education, and occupations were recorded. Oral examination was performed in daylight using plane mirrors and dental probes by four calibrated dental examiners who had clinical experience with dental fluorosis to determine DMFT levels, fluorosis scores, and discoloration levels.

Procedures: For assessment of dental fluorosis, examiners were calibrated until a kappa value of >0.80 was obtained. After one month, intra-examiner kappa values were 0.80, 0.82, 0.85, and 0.90, respectively. The teeth were dried, and the facial/buccal surfaces were evaluated using the Thylstrup-Fejerskov Index (TFI), with scores of 0–9.[13] Discoloration was examined with three-score index developed by the authors. It was scored for the upper and lower 6 incisors as follows: 0 = no discoloration: opacity is present, but no staining; 1 = mild discoloration: yellow stains; 2 = moderate discoloration: yellow to brown stains; 3 = severe discoloration: brown to dark brown stains.

Water samples were collected to determine the chemical properties of drinking water from the tank and the borehole of the village in March 2011. Samples were stored in two polyethylene bottles (100 mL) for analysis of anions and cations. The sample used for the analysis of cations was acidified by adding concentrated HCl for storage until chemical analysis. Analyses of samples to measure the anion and cation levels were performed at the Ministry of Agriculture and Rural Affairs, Fisheries Research Institute Egirdir, in Isparta. The Scott-Sanchis colorimetric assay was used to determine the F concentrations of the samples.

Data analysis: Data were analyzed with nonparametric tests, since the parametric conditions were not fulfilled following the Levene's (homogeneity of variance) and Kolmogorov–Smirnov Normality tests. The Kruskal-Wallis test was used to compare the groups by age and the Mann-Whitney *U*-test, to compare the groups by gender ($p<0.05$). Differences between the mean rank values of the groups were tested using the Bonferroni-Dunn test ($p<0.05$). DMFT data were transformed using $\sqrt{xi + 3/8}$. Correlations among the level of fluorosis, DMFT, and discoloration values were tested for each age and gender subgroups using the Spearman rank correlation test ($p< 0.05$).

RESULTS

A total of 293 individuals were assessed. The distribution of the groups according to age, gender and educational status is shown in Table 1.

Table 1. Distribution of gender, age, and educational status of the individuals

Educational status	Groups and age in years								Total n
	Female (F)				Male (M)				
	F1 12–19	F2 20–39	F3 40–59	F4 ≥60	M1 12–19	M2 20–39	M3 40–59	M4 ≥60	
Elementary school	38	9	36	20	18	7	43	25	186
High school	19	27	0	0	28	11	6	2	93
University	1	0	0	0	0	2	0	1	4
Postgraduate	0	0	0	0	0	0	0	0	0
Total n	58	36	36	20	46	20	49	28	293

According to the chemical analysis of the samples collected from the groundwater source and the water tank of the village, the drinking water was found to be of Ca-HCO_3 type and had a high concentration of SO_4 (70–85 mg/L) and F (1.80–1.83 mg/L).

A total of 6605 teeth were evaluated using the TFI, and 3903 (59.09%) of them were fluorosed. Dental fluorosis was detected in 94.19% (n = 276) of the individuals (female, n = 141 [48.12%]; male, n = 135 [46.07%]), and more severe fluorosis was found on the maxillary teeth (n = 160) than on the mandibular teeth (n = 122). TFI scores ranged from 1 to 8, with a mean score of 3.58 (3.46 in female individuals and 3.71 in male individuals). One hundred and sixty five (56.31%) of the individuals (female, n = 82 [27.98%]; male, n = 83 [28.32%]) were affected severely by dental fluorosis (TFI score = 5). The distribution of TFI scores according to age, gender, and location on the jaw is shown in Tables 2, 3, and 4.

Table 2. Distribution of mean and range of TFI values of the premolars according to the evaluated groups. Values are mean and (range)

Dentition	Groups							
	Female (F)				Male (M)			
Upper premolars	F1	F2	F3	F4	M1	M2	M3	M4
14	2.48 (0–6)	4.05 (0–7)	4.5 (0–6)	4.42 (4–5)	3.07 (0–6)	4.36 (0–7)	4.62 (0–6)	4.19 (2–7)
15	2.56 (0–6)	4 (0–7)	4.62 (0–6)	4.42 (4–5)	3.15 (0–6)	4.3 (0–7)	4.60 (0–6)	4.27 (3–7)
24	2.56 (0–6)	4.05 (0–7)	4.29 (0–6)	4.57 (4–5)	3.09 (0–6)	4.42 (0–7)	4.24 (0–6)	4.28 (3–7)
25	2.56 (0–6)	3.96 (0–7)	4.46 (0–6)	4.62 (4–5)	2.97 (0–6)	4.36 (0–7)	4.38 (0–6)	4.28 (3–7)
Subtotal	2.54 (0–6)	4.01 (0–7)	4.46 (0–6)	4.5 (4–5)	3.07 (0–6)	4.36 (0–7)	4.46 (0–6)	4.26 (3–7)
Lower premolars	F1	F2	F3	F4	M1	M2	M3	M4
36	2.53 (0–7)	3.88 (0–6)	4.36 (0–6)	4.5 (4–5)	2.97 (0–6)	4.05 (0–6)	4.15 (0–5)	4.2 (3–7)
37	2.65 (0–7)	3.88 (0–6)	4.27 (2–6)	4.57 (4–5)	3.33 (0–7)	4.17 (0–7)	4.38 (0–6)	4.04 (3–7)
46	2.47 (0–7)	3.90 (0–7)	4.27 (2–6)	4.57 (4–5)	3.1 (0–6)	3.66 (0–6)	4.21 (0–5)	4.47 (3–7)
47	2.52 (0–7)	3.81 (0–7)	4.4 (2–6)	4.57 (4–5)	3.2 (0–7)	3.81 (0–7)	4.32 (0–6)	4.15 (3–7)
Subtotal	2.54 (0–7)	3.87 (0–7)	4.33 (2–6)	4.55 (4–5)	3.15 (0–7)	3.92 (0–7)	4.27 (0–6)	4.22 (3–7)
Total	2.54	3.94	4.4	4.53	3.11	4.14	4.36	4.24

Table 3. Distribution of mean and range of TFI values of the incisors according to the evaluated groups. Values are mean and (range)

Dentition	Groups							
	Female (F)				Male (M)			
Upper incisors	F1	F2	F3	F4	M1	M2	M3	M4
11	2.96 (0–7)	4.05 (0–7)	4.6 (0–7)	4.37 (4–5)	3.5 (0–7)	4.63 (0–7)	4.56 (0–6)	4.17 (2–7)
12	2.61 (0–6)	3.85 0–7)	4.39 (0–6)	4.42 (4–5)	3.13 (0–7)	4.61 (0–7)	4.42 (0–6)	4.04 (2–7)
13	2.65 (0–6)	4.11 0–7)	4.48 (3–6)	4.5 (4–5)	2.97 (0–6)	4.47 (0–8)	4.55 (0–6)	4.12 (2–7)
21	2.96 (0–7)	4.05 (0–7)	4.58 (0–7)	4.37 (4–5)	3.5 (0–7)	4.63 (0–7)	4.46 (0–6)	4.2 (2–7)
22	2.62 (0–6)	3.85 (0–7)	4.33 (0–6)	4.42 (4–5)	3.11 (0–7)	4.61 (0–7)	4.4 (0–7)	4.12 (2–7)
23	2.58 (0–6)	4.05 (0–7)	4.36 (0–6)	4.57 (4–5)	3.04 (0–6)	4.44 (0–8)	4.44 (0–6)	4.19 (2–7)
Subtotal	2.73 (0–7)	3.99 (0–7)	4.45 (3–7)	4.44 (4–5)	3.2 (0–7)	4.56 (0-8)	4.47 (0–7)	4.14 (2–7)
Lower incisors	F1	F2	F3	F4	M1	M2	M3	M4
31	2.17 (0–6)	3.57 (0–7)	4.18 (0–6)	4 (1–5)	2.67 (0–5)	4.05 (0–6)	4.14 (0–6)	4.08 (2–7)
32	2.28 (0–7)	3.57 (0–7)	4.18 (0–6)	4 (1–5)	2.68 (0–5)	4.1 (0–6)	4.16 (0–6)	4.08 (2–7)
33	2.47 (0–7)	3.85 (0–7)	4.2 (0–6)	4.1 (1–5)	2.7 (0–6)	4.25 (0–7)	4.17 (0–7)	4.17 (3–7)
41	2.19 (0–6)	3.57 (0–7)	4.18 (0–6)	4 (1–5)	2.71 (0–5)	4.05 (0–6)	4.13 (0–6)	4.08 (2–7)
42	2.26 (0–6)	3.57 (0–7)	4.17 (0–6)	4 (1–5)	2.65 (0–5)	4.1 (0–6)	4.16 (0–6)	4.11 (2–7)
43	2.46 (0–6)	3.74 (0–6)	4.16 (0–6)	4.11 (1–5)	2.62 (0–6)	4.35 (0–7)	4.18 (0–7)	4.19 (3–7)
Subtotal	2.3 (0–7)	3.64 (0–7)	4.17 (0–6)	4.03 (1–5)	2.67 (0–6)	4.15 (0–7)	4.15 (0–7)	4.11 (2–7)
Total	2.52	3.81	4.32	4.24	2.94	4.36	4.31	4.13

Table 4. Distribution of mean and range of TFI values of the molars according to the evaluated groups. Values are mean and (range)

Dentition	Groups							
	Female (F)				Male (M)			
Upper molars	F1	F2	F3	F4	M1	M2	M3	M4
16	2.40 (0–6)	4.06 (0–6)	4.95 (3–6)	4.42 (4–5)	3.12 (0–6)	4.44 (0–6)	4.42 (0–6)	4.30 (3–7)
17	2.72 (0–7)	3.88 (0–6)	4.68 (3–6)	4.5 (4–5)	2.69 (0–5)	4.27 (0–6)	4.53 (0–6)	4.35 (3–7)
26	2.43 (0–6)	4.27 (0–7)	4.72 (4–6)	4.66 (4–5)	3.23 (0–6)	4.2 (0–6)	4.4 (0–7)	4.47 (3–7)
27	2.84 (0–7)	4 (0–6)	4.62 (2–6)	4.57 (4–5)	2.83 (0–6)	4.22 (0–6)	4.30 (0–6)	4.26 (3–7)
Subtotal	2.6 (0–7	4.05 (0–7)	4.74 (2–6)	4.54 (4–5)	2.97 (0–6)	4.28 (0–6)	4.41 (0–7)	4.35 (3–7)
Lower molars	F1	F2	F3	F4	M1	M2	M3	M4
34	2.62 (0–7)	3.91 (0–7)	4.27 (2–6)	4.1 (1–5)	2.89 (0–6)	4.2 (0–6)	4.24 (0–6)	4.24 (3–7)
35	2.58 (0–7)	3.72 (0–6)	4.03 (0–6)	4.55 (4–5)	2.91 (0–6)	4.2 (0–6)	4.22 (0–6)	4.29 (3–7)
44	2.36 (0–6)	3.83 (0–7)	4.08 (0–6)	4.11 (1–5)	2.87 (0–6)	4.26 (0–6)	4.10 (0–6)	4.28 (3–7)
45	2.42 (0–6)	3.71 (0–6)	4 (0–6)	4.5 (4–5)	2.97 (0–6)	4.26 (0–6)	4.09 (0–5)	4.4 (3–7)
Subtotal	2.5 (0–7)	3.79 (0–7)	4.1 (0–6)	4.32 (1–5)	2.91 (0–6)	4.23 (0–6)	4.16 (0–6)	4.3 (3–7)
Total	2.55	3.92	4.42	4.43	2.94	4.26	4.29	4.32

The mean DMFT value was 6.45 for this population (4.75 for female individuals and 8.13 for male individuals). Forty-six individuals had no caries, and only 45 individuals (female, n = 25; male, n = 20) had a DMFT value of 0. The distribution of mean DMFT values according to age and gender is shown in Table 5. The DMFT value was significantly higher (6.59) in individuals with dental fluorosis than in those without dental fluorosis (3.18).

Discoloration related to fluorosis was observed mostly in the maxillary central incisors (65.72%), whereas the least discoloration was seen in the mandibular incisors (52.65%). In total, 34.28% had no discoloration, 25.08% had severe discoloration (score of 3), 20.14% had moderate discoloration (score of 2), and 20.5% had mild discoloration (score of 1).

Table 5. The mean values of the evaluated parameters

Dentition	Groups							
	Female (F)				Male (M)			
Incisors	F1	F2	F3	F4	M1	M2	M3	M4
DMFT (overall)	0.20	0.75	1.11	5.00	0.15	0.55	2.48	6.42
DMFT (with fluorosis)(n=266)	0.19	0.76	1.11	5.00	0.17	0.57	2.54	6.42
DMFT (without fluorosis)	0.33	0.50	1.00	0.00	0.00	0.00	0.00	0.00
TFI	2.52	3.82	4.3	4.24	2.94	4.35	4.31	4.13
Discoloration	0.44	1.07	1.41	1.33	0.33	1.75	2.04	1.92
Premolars	F1	F2	F3	F4	M1	M2	M3	M4
DMFT (overall)	0.22	1.19	1.25	3.10	0.13	0.95	2.93	4.39
DMFT (with fluorosis)(n=266)	0.19	1.17	1.25	3.10	0.12	1.00	2.95	4.39
DMFT (without fluorosis)	0.50	1.50	1.00	0.00	1.66	0.00	2.00	0.00
TFI	2.51	3.90	4.28	4.41	2.99	4.29	4.31	4.28
Discoloration	0.25	0.67	1.15	1.21	0.1	1.27	1.90	1.86
Molars	F1	F2	F3	F4	M1	M2	M3	M4
DMFT (overall)	2.17	3.94	4.38	4.10	2.13	4.10	5.12	5.78
DMFT (with fluorosis)(n=266)	2.25	4.05	4.28	4.10	2.17	3.94	5.18	5.78
DMFT (without fluorosis)	1.50	2.00	8.00	0.00	1.83	7.00	2.00	0.00
TFI	2.57	3.96	4.53	4.54	3.02	4.10	4.10	4.28
Discoloration	0.28	0.70	1.15	1.37	0.17	1.27	1.90	1.83

There was a significant difference between the M2 and F2 groups in terms of fluorosis (p = 0.043) and discoloration levels (p = 0.03), with individuals in the M2 group demonstrating significantly higher mean TFI and discoloration scores than those in the F2 group. In addition, a significant difference was found between the M3 and F3 groups with regard to the DMFT values (p = 0.002), with individuals in the M3 group demonstrating significantly higher DMFT values than those in the F3 group. Finally, there was also a significant difference between the M4 and F4 groups in terms of the DMFT values (p = 0.014) and discoloration scores (p = 0.008), with individuals in the M4 group demonstrating significantly higher DMFT values and discoloration scores than those in the F4 group.

Age was a significant factor for both genders for the DMFT values, TFI scores, and discoloration levels (p = 0.000) (Table 6).

Table 6. Distribution of the mean rank values of DMFT, TFI, and discoloration according to age and gender

Factor	Group (age in yr)	Female		Male	
		n	Mean rank	n	Mean rank
DMFT	1 (12–19)	58	53.19†	46	34.83**
	2 (20–39)	36	90.50*	20	64.45¶
	3 (40–59)	36	88.14*	49	90.20‖
	4 (≥60)	20	90.45*	28	106.61§
	Total	150		143	
TFI	1 (12–19)	58	49.71†	46	50.46¶
	2 (20–39)	36	82.35*	20	90.98§
	3 (40–59)	36	98.43*	49	86.10§,‖
	4 (≥60)	20	96.70*	28	69.16‖,¶
	Total	150		143	
Discoloration	1 (12–19)	58	55.34‡	46	37.08‖
	2 (20–39)	36	85.99*,†	20	90.70§
	3 (40–59)	36	99.54*	49	89.35§
	4 (≥60)	20	71.80†,‡	28	85.66§
	Total	150		143	

Values in the same column with the same superscript symbols indicate no significant difference. Otherwise p = 0.000.

According to the Spearman rank correlation test, there was a positive correlation between TFI scores and discoloration levels in the F1, F2, and F3 groups with correlation coefficients of 0.733, 0.371, and 0.461, respectively. A positive correlation between the DMFT value and discoloration score was found only in the F2 group (correlation coefficient = 0.350). Additionally, according to the Spearman rank correlation test, there was a positive correlation between the TFI score and the discoloration level in the M1 and M2 groups with correlation coefficients of 0.475 and 0.769, respectively. A positive correlation between DMFT and TFI values was found only in the M1 group (correlation coefficient = 0.359)

DISCUSSION

Dental fluorosis due to consumption of groundwater enriched by water-rock interaction in recent or active volcanic areas has been assessed in many parts of the world such as in limited areas like Elementatia Lake, Kenya;[14] Mount Aso volcano, Japan;[15] Island of Tenerife, Spain;[16] Furnas volcano, São Miguel, Azores, Portugal;[17] and Tendürek Volcano, Ağrı, Turkey.[6] Gölcük Crater Lake in Isparta, Turkey, is another example of such an area experiencing this phenomenon, and the village of Deregümü, which is located near this lake, was chosen as the sample for the present study because we noticed intense fluorosis in this population, even during general dental surveys in the health clinics of the city center.

It is known that the mineralization of all permanent teeth except the third molars is complete by the age of 10 years.[10,18] Thus, one of the inclusion criteria in this study was consumption of water from the groundwater source in the first 10 years of life. Dental fluorosis is related to the dose and duration of fluoride intake, with mechanisms such as direct or indirect effects of fluoride on ameloblasts affecting the matrix formation and calcium homeostasis.[19,20]

The TFI, which is superior to other scoring systems, was used to determine the severity of dental fluorosis because TFI is based on histological features of fluorosis, thereby reducing subjectivity in scoring and providing a better diagnosis in uncertain cases.[13,21]

The severity of the fluorotic enamel is linearly related to the dose and duration of fluoride exposure.[22] The fluoride level of the investigated area in the present study was 1.8 mg/L, which is moderate compared with the levels in endemic areas in other countries. However, climatic conditions can increase or decrease these concentrations of fluoride. The concentration of fluoride is diluted during rainy periods; therefore, a higher level of fluorosis may be expected during the summer.[23]

The association between the level of fluoride (1.80–1.83 mg/L) and the prevalence of dental fluorosis (94.1%) in the present study is comparable to that in previous reports from endemic areas in other countries (76%–100%).[11,24-27] In the Hail region of Saudi Arabia, which has a fluoride level of 0.5–2.8 mg/L in the water, the prevalence of dental fluorosis is 90%. In a rural area of Kenya with a fluoride level of 2 mg/L in the water, the prevalence of dental fluorosis is 100%.[25] Additional examples include the Rift Valley of Ethiopia, which has a fluoride level of 0.3–2.2 mg/L in the water and a prevalence of dental fluorosis of 91.8%,[11] and Andhra Pradesh in India, which has a fluoride level of 0.7–4 mg/L in the water and a prevalence of dental fluorosis of 100%.[27] The high prevalence of fluorosis in areas with a fluoride level of <2 mg/L has been explained by increased water intake due to climatic factors, consumption of food with high levels of fluoride, and even inspiration of the air in these endemic areas.[27,28] Altitude has also been considered a contributing factor for a high prevalence of fluorosis.[29] The village of Deregümü in Isparta does not have a tropical climate but is at a high altitude (1035 m).[30]

Severe fluorosis (score = 5) has been reported in 24% of the population in an area with fluoride levels between 0.5 and 0.79 mg/L[32] and in 29% in an area with fluoride levels between 0.3 and 2.2 mg/L.[11] The prevalence of severe fluorosis (score = 5) was 56% in the present study. The difference in these findings can be explained by a higher level of fluoride found in the present study than in the report by Akpata et al.[31] and the narrower range of fluoride levels (1.80–1.83 mg/L) in the present study than by Wondwosssen et al.[11] In another study, Manji et al. found a prevalence for severe fluorosis, with a TFI score > 4, of 92% in an area with a fluoride level of 2.17 mg/L.[25]

Different predisposing factors can be related to the severity of fluorosis. In the present study, there was no correlation between gender and severe fluorosis, which is similar to the findings of other studies.[24,27,28,32] In addition, in the present study, the prevalence of severe dental fluorosis in the maxillary teeth was found to be greater than that in the mandibular teeth, which is also similar to the findings of previous studies.[31-33]

Dental fluorosis is a developmental process, and the teeth that mineralize last are most affected.[27,28] Second molars, second premolars, canines, first premolars, incisors, and first molars were affected, in descending order, in the present study. These findings are similar to those of the studies by Wondwossen et al.,[11] and Sudhir et al.[27] This finding is consistent with the mineralization time, in which the ameloblasts are negatively affected and pitting occurs, and the extent of posteruptive exposure of the tooth surface to masticatory forces.[27]

The development of caries is multifactorial, depending on many interacting variables such as the presence of bacteria, a substrate for the bacteria (food/ sugars), the host's oral environment, the time, socioeconomic status and dental attendance of the individuals. For assessing caries prevalence in epidemiological and clinical studies, DMFT and DMFS scores are the most common methods as well as dental treatment needs among populations. As expected, mean DMFT values increased with increasing age. This result was in accordance with the findings of Okullo et al.[34] and Wondwossen et al.[11] The present study showed that the male population had gradually increasing DMFT scores with age, whereas the

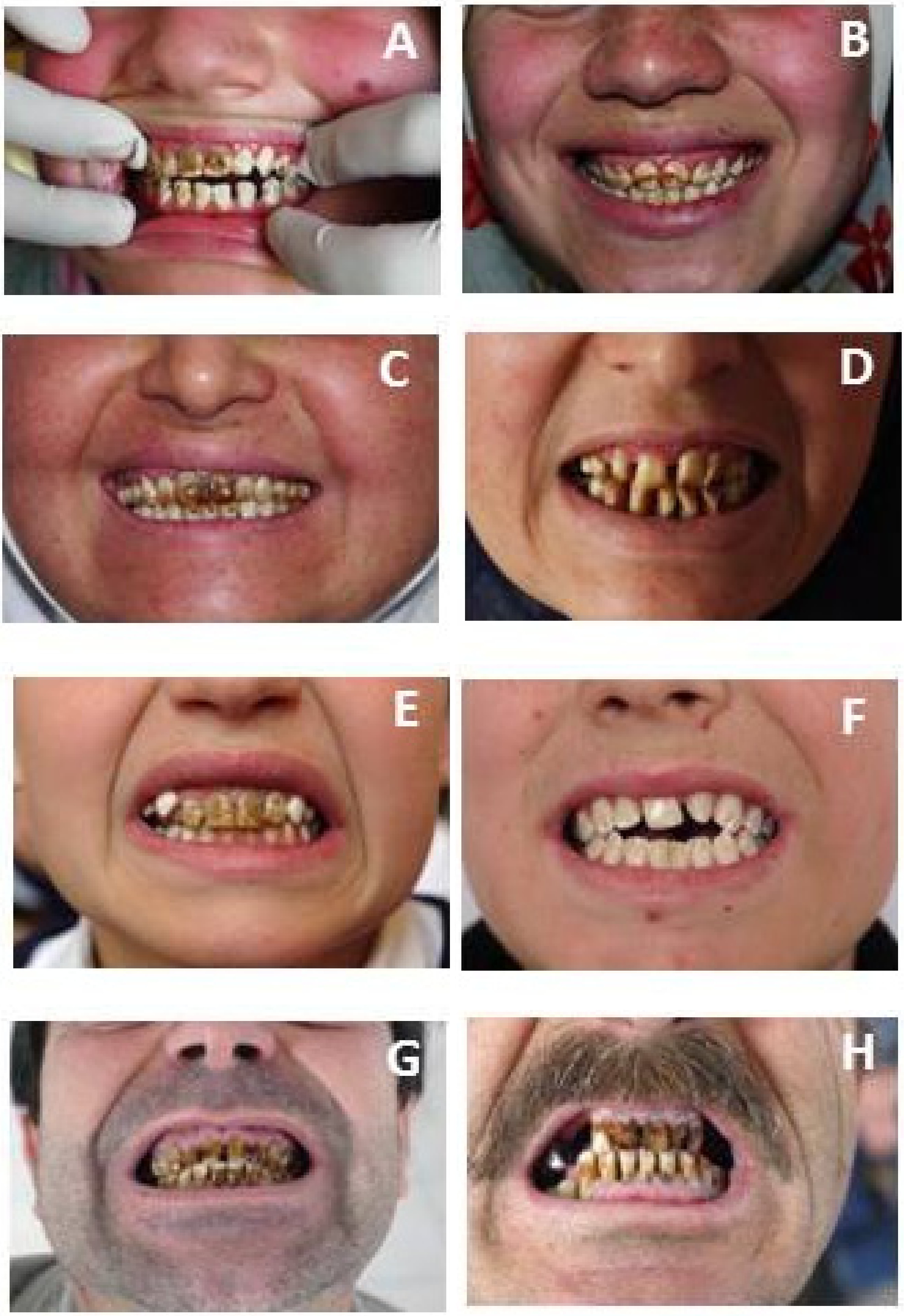
DMFT values in the female population were relatively high in all age groups, even in youths. This difference was not expected, because it is known that women are generally more attentive to their oral hygiene and aesthetics than men. This can be explained by the low socioeconomic status and hard work done by women, both at home and in the field, and the lack of dental care services in the village.

In the present study, TFI scores increased with age in both genders except in the oldest group of male individuals. This was related to the high frequency of missing and prosthetically restored teeth, which was not assessed by the TFI. The recorded age-related increase in severity was caused by progressive wear and tear of fluorosed enamel.[11] Several studies have reported that since 1954, water from Gölcük Crater Lake and surrounding groundwater in Isparta have a fluoride content of 1.4–5.3 mg/L.[7] Post-1991, a new borehole in Milas road with a lower level of fluoride (1.4–2.65 mg/L) was used, and the last fluoride levels measured in this study were still in this range.[35] The increasing severity of fluorosis with age can be attributed to the use of high fluoride lake water until 1991. It must be noted that the 20–39 age group was a mixture of individuals, who obtained their drinking water from both the lake and the new borehole.

In general, there was a positive correlation between DMFT values and TFI scores similar to the findings of Wondwossen et al.,[11] who indicated that this was true for both moderate (0.3–2.2 mg/L) and high (8.9–14.1 mg/L) fluoride levels.

Discoloration was evaluated to determine any possible relation to DMFT and/or TFI levels. These parameters showed a significant positive correlation in some groups as mentioned above. High levels of discoloration due to dental fluorosis seemed to result in the lack of attention to aesthetic appearance and oral hygiene in the village population. Discoloration was mostly observed in the maxillary central incisors, as reported by other studies[28] (Figures 1A-1H). The maxillary central incisors are dry more often than the other teeth because they interact with the environment, and dried surfaces absorb stains more easily and rapidly. Further studies are planned to assess the perception and satisfaction of personal dental appearance due to dental fluorosis in this population

The large majority of the village population has aesthetic and functional problems caused by dental fluorosis next generation from dental fluorosis and caries. Increasing the awareness of the government and the residents in terms of the causes and damages of dental fluorosis is of great importance. Besides the motivation for oral hygiene, solving the aesthetic problems might improve the oral health status of this population.



Figures 1A-1H. 1A, 1B, 1C, 1D, and 1E: moderate fluorosis, severe discoloration, and poor oral hygiene; 1F: mild fluorosis with noticeable opacities; 1G: mild fluorosis with severe discoloration and poor oral hygiene; 1H; moderate fluorosis with severe discoloration and poor oral hygiene.

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