DRINKING WATER FLUORIDE AND CHILD DENTAL CARIES IN DASHTESTAN, IRAN

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SUMMARY: The aim of this study was to determine whether a relationship exists between the groundwater fluoride (F) concentration and dental caries in children living in the Dashtestan area of the Bushehr Province in Iran. Except for some very small villages, 14 villages in Dashtestan with only a groundwater source and essentially the same socio-economic living standards and nutritional conditions were surveyed. All of the children in each village in the ages 6–11 were sampled for a total of 2340 in all villages. F levels in the village drinking water measured by the SPADNS method ranged from 0.99 to 2.50 mg/L, while the number of decayed permanent (D_t) teeth per child ranged between 0.015 and 1.08 and the number of decayed deciduous (d_t) teeth ranged between 0.02 and 1.18. Over this narrow concentration range there appeared to be no significant association between the F level in the drinking water and D_t and d_t. However, when the village with the highest water F level and the lowest caries scores is omitted, linear regression analyses show weak increases of the D_t and d_t scores with increasing water F levels, regardless of age, for both boys and girls in the remaining 13 villages.

Keywords: Bushehr Province; Dashtestan, Iran; Dental caries and F water; Iran.

INTRODUCTION

Besides damaging bones and teeth, excessive intake of fluoride (F) is known to cause a wide range of adverse health effects.[1-5] Since drinking water is usually the main source of F intake, determination of water F concentration has been an important undertaking in many countries to investigate its potential effects on health, especially in relation to the occurrence of dental caries and dental fluorosis.[6-10] In this study we examined the relationship between dental caries in children and the F content of groundwater used for drinking and cooking in 14 villages of the Dashtestan area of Bushehr Province in Iran.

MATERIALS AND METHODS

This study was conducted between March and September 2007 in the 6366-km^2 Dashtestan area of Bushehr Province in southwestern Iran (Figure 1). The climate is hot and dry in summer and mild in winter. Except for some very small villages (population under 150), the 14 villages in Dashtestan that were selected for study rely for their drinking water on local groundwater sources with varying concentrations of F. The selection of these villages was done in such way that all of them have essentially the same socioeconomic standards and nutritional conditions. Most of villages have the similar public health and dental care. All the children aged 6–11 in each village were examined. Included in the total of 2340 children were 1110 boys and 1230 girls. For the F analyses, the standard SPADNS method was used with a DR/2000s Spectrophotometer (HACH Company, USA). The dmft and DMFT of the children in each village were determined according to

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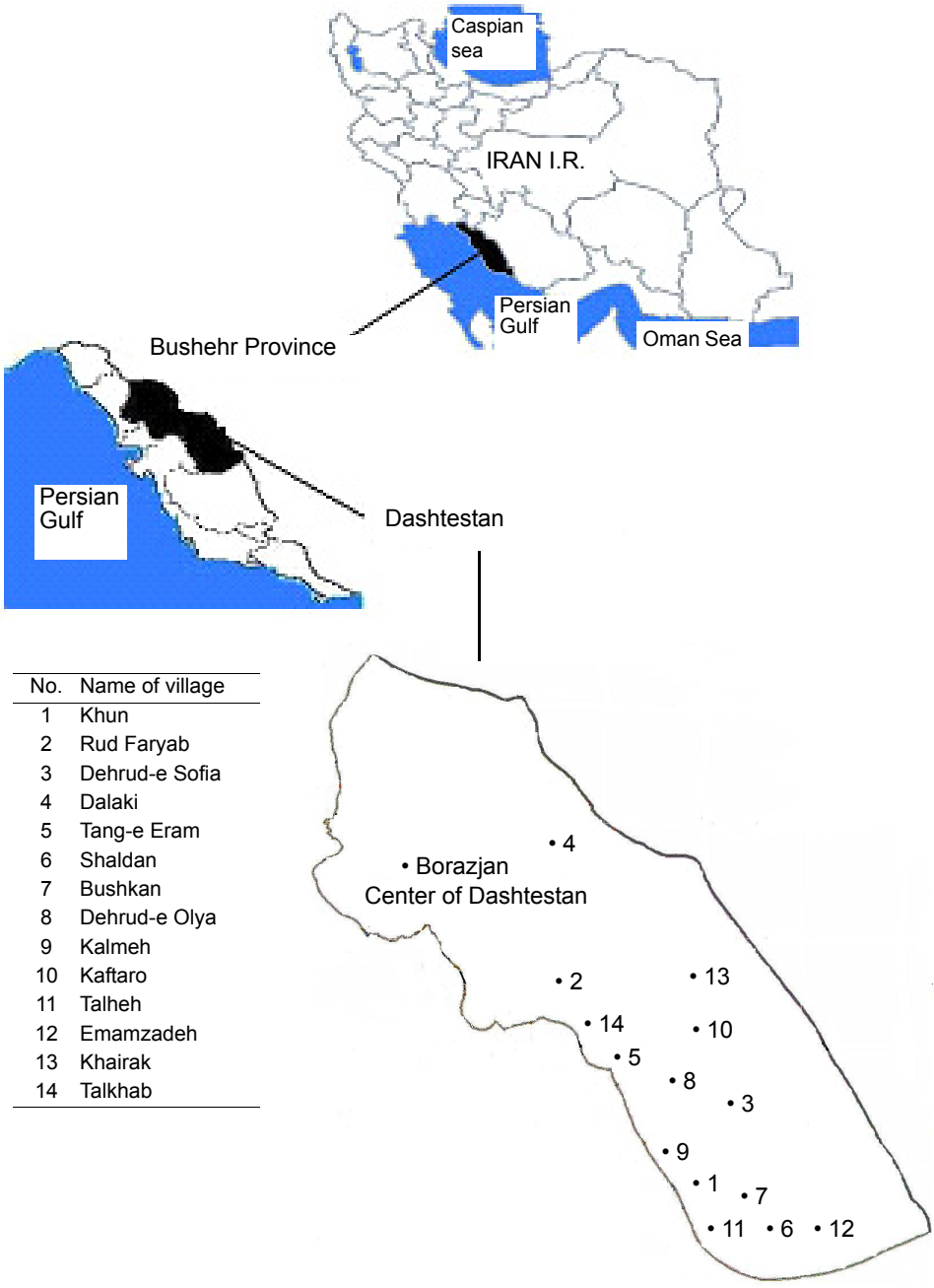
the WHO standard[11] by two dentists from Borazjan (center of Dashtestan) using a sharp dental probe and mouth mirror under good natural light.



No.	Name of village
1	Khun
2	Rud Faryab
3	Dehrud-e Sofia
4	Dalaki
5	Tang-e Eram
6	Shaldan
7	Bushkan
8	Dehrud-e Olya
9	Kalmeh
10	Kaftaro
11	Talheh
12	Emamzadeh
13	Khairak
14	Talkhab

Figure 1. Location of Dashtestan and its villages.

Data were computerized and analyzed using the statistical package for the social sciences (SPSS version 11.5). Linear regression analysis was used to examine the

relationship between the F concentration in the drinking water with caries in permanent (D_t) and deciduous (d_t) teeth.

RESULTS AND DISCUSSION

The population and the number of children examined in each village are shown in Table 1.

Table 1. Dashtestan village populations and subject sample information

Name of village	Population	Children examined	Number of boys	Number of girls	Girls/ boys	Boys mean age	Girls mean age	Children mean age	Elevation (m) above sea level
Khun	706	53	30	23	0.77	8.53	7.48	8.07	500
Rud Faryab	1785	234	105	129	1.23	8.54	8.11	8.30	660
Dehrud-e Sofla	1818	224	107	117	1.09	8.07	7.98	8.03	753
Dalaki	7068	720	368	352	0.96	8.49	8.17	8.34	90
Tang-e Eram	3334	331	151	180	1.19	7.99	8.39	8.21	884
Shaldan	410	63	31	32	1.03	7.45	7.34	7.40	572
Bushkan	1961	187	87	100	1.15	8.05	8.11	8.08	588
Dehrud-e Olya	988	124	65	59	0.91	8.06	7.59	7.84	785
Kalmeh	1981	227	120	107	0.89	8.41	8.50	8.45	395
Kaftaro	158	12	6	6	1.00	8.33	7.50	7.91	955
Talheh	2558	244	125	119	0.95	8.64	8.16	8.41	449
Emamzadeh	264	21	8	13	1.62	7.12	7.31	7.23	524
Khairak	444	26	12	14	1.16	7.17	7.50	7.35	1110
Talkhab	390	26	13	13	1.00	7.54	7.31	7.42	736

As seen in Table 2, the concentration of F in the village water was found to vary widely from 0.99 to 2.50 mg/L. In other studies in Iran the F level in the groundwater ranged from 0.12 to 0.39 mg/L in one area[10] and 0.12 to 2.17 mg/L in another.[12]

In Table 2, the D_t in the 14 villages is seen to range between 0.015 and 1.08 and the d_t between 0.02 and 1.18. Linear regression analysis indicates there is no significant correlation between the F content of the water with D_t and d_t in these 14 villages.

However, when the first village, Khun, with 2.50 mg F/L in its drinking water and a mean D_t of 0.015 and d_t = 0.02 for its 53 children is dropped, there is then a direct but weak linear correlation between increasing the F content of the water and increasing D_t and d_t for both boys and girls of different ages in the remaining 13 villages, as seen in Figure 2. In this connection, it is worth mentioning that Khun has better access to primary medical and dental care centers, which might be a reason for its low dental caries rates.

Table 2. Fluoride concentration and dental caries in 14 villages in Dashtestan, Iran

Name of village	Mean F (mg/L)	Girls		Boys		Mean D_t	Mean d_t
		D_t	d_t	D_t	d_t		
Khun	2.50	0.005	0.009	0.023	0.03	0.015	0.02
Rud Faryab	2.12	1.094	1.187	1.064	1.172	1.08	1.18
Dehrud-e Sofla	2.11	1.025	1.087	1.035	1.052	1.03	1.07
Dalaki	2.07	0.303	0.344	0.318	0.356	0.31	0.35
Tang-e Eram	2.00	0.885	0.619	0.787	0.621	0.84	0.62
Shaldan	1.87	0.959	0.897	1.083	0.801	1.02	0.85
Bushkan	1.87	0.64	0.769	0.747	0.685	0.69	0.73
Dehrud-e Olya	1.80	0.748	0.854	0.713	0.712	0.73	0.78
Kalmeh	1.67	0.125	0.170	0.154	0.170	0.14	0.17
Kaftaro	1.66	0.353	0.308	0.388	0.273	0.37	0.29
Talheh	1.65	0.736	0.756	0.687	0.627	0.71	0.69
Emamzadeh	1.29	0.247	0.259	0.36	0.34	0.28	0.29
Khairak	1.10	0.236	0.317	0.202	0.302	0.22	0.31
Talkhab	0.99	0.679	0.598	0.701	0.701	0.68	0.65

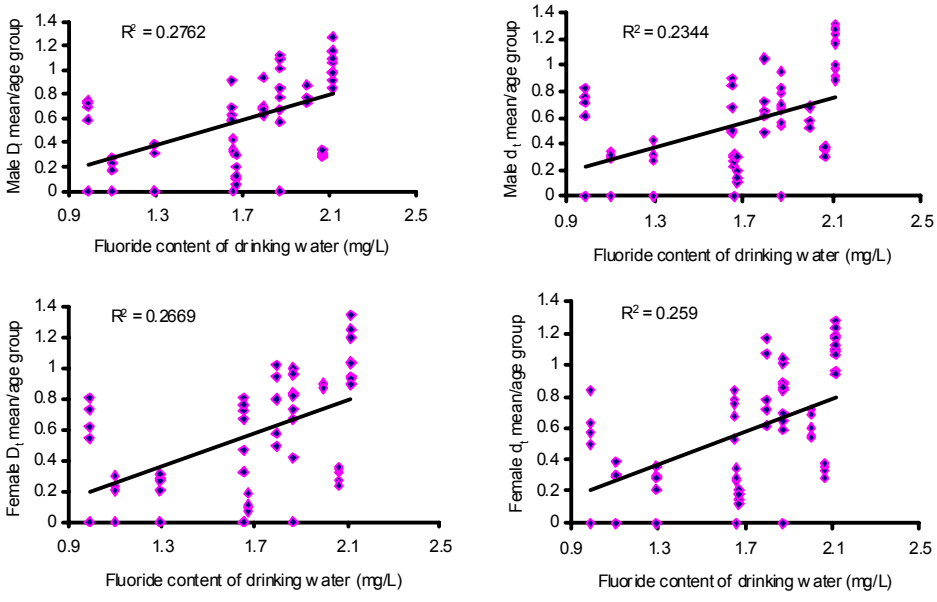


Figure 2. Relationship between fluoride content and mean D_t and d_t of each group of children in the 13 villages of Dashtestan (without Khun).

As seen in Figure 3, the same correlation pattern persists when the F concentrations are plotted against the mean overall tooth decay data for the 13 villages regardless of age and gender. Thus, over the fairly narrow F concentration range in this study, it appears there is a weak but direct linear correlation between the F content of drinking water and dental caries in both the permanent and deciduous teeth. It is not without interest that a recent study in Saudi Arabia, while indicating higher caries rates at low F concentrations, also found increased caries rates in children at concentrations above 1 mg F/L.[7]

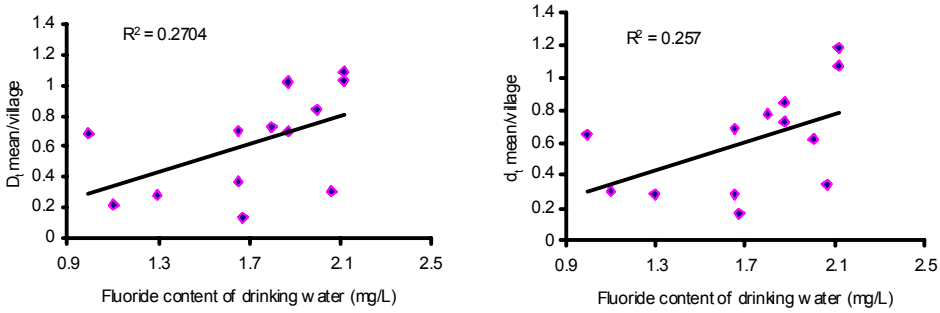


Figure 3. Relationship between fluoride content with mean D_t and d_t in each village (without Khun).

Another study in Iran indicated that consumption of drinking water with 1.3 mg F/L had a negligible effect in preventing caries, and the authors concluded that the child caries prevalence was quite low compared to other countries in the Middle East.[13]

As shown in Figure 4, when the village elevation above sea level versus the mean overall tooth decay rate in each village is plotted, there was no linear correlation between elevation and tooth decay.

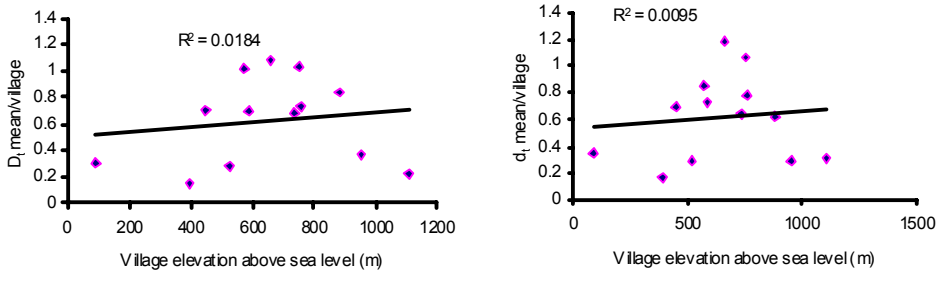


Figure 4. Relationship between village elevation above sea level with mean D_t and d_t in each village (without Khun).

Further analysis of the data also showed there was a direct correlation between percentage of children ages 6-11 in the population of each village with the mean D_t and d_t (Figure 5). The reasons for this are not clear, but they might reflect less dental care in villages with higher percentages of children in this age bracket.

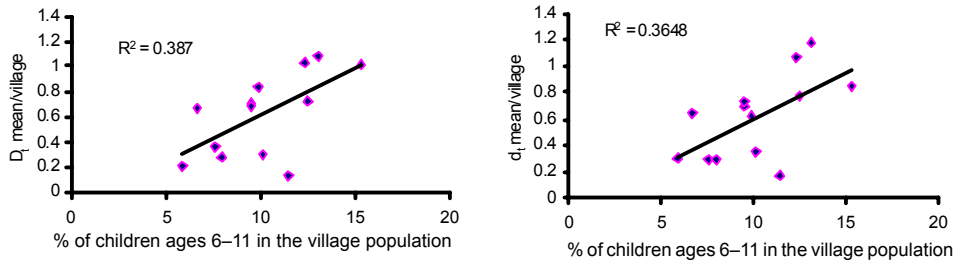


Figure 5. Relationship between percentage of children ages 6–11 in the population of each village with mean D_t and d_t in each village (without Khun).

Figure 6 illustrates disfiguring dental fluorosis that is fairly common in some of the villages of the Dashtestan area. In view of the relatively warm summer climate in Dashtestan and the elevated level of F in much of the available drinking water, along with extensive consumption of tea with a mostly modest F content,[14,15] it is probably advisable to recommend the use low-F bottled drinking water in this part of Iran.[16]

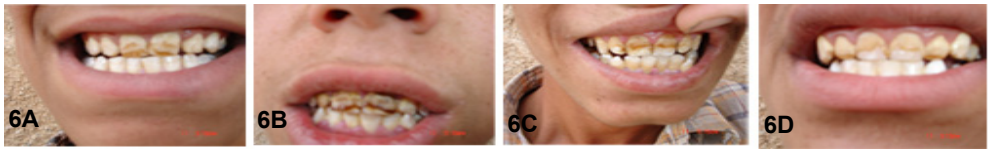


Figure 6. Examples of dental fluorosis in three villages of the Dashtestan area with 1.87 to 2.07 mg F/L in the drinking water. 6A: age: 8, sex: male, village: Dalaki; 6B: age: 9, sex: female, village: Dalaki; 6C: age 10, sex: male, village: Tang-e Eram; 6 D: age: 11, sex: female, village: Bushkan.

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