# Determination of fluoride concentration in drinking water and its relation with DMFT: A case study in Hormozgan, Iran

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## Abstract

**Introduction:** Over twenty developed and developing countries have regions with endemic floursis, on the other hand tooth decay as an infectious disease in human societies is reported to occur due to the shortage of fluoride in water. Since decayed, missing, and filled teeth DMFT is considered a 52 -character indicator in health equity, the present research aims at studying the relationship between the concentration of fluoride and other variables such as location, parents' employments, visiting dentist, tooth brushing, and using mouth washes with DMFT index in Haji Abad, Hormozgan.

**Materials and methods:** This is a descriptive-analytical study. Where the population included 12-14 year old students from Haji Abad, Iran. The sample size of 336 subjects obtained using the calculation method of descriptive samples in the finite population situation and considering the coefficient interval of 95%.They were measured using SPADNS method The samples were conducted in triplicates and the average values were considered.Then the measured samples were coded using SPSS16 software and finally the coefficient correlation test as well as regression analysis was carried out.

**Results:** DMFT index was the average of 1.4±0.53 and the concentration of fluoride was the average of 0.82±0.29 In the present study, the coefficient value between fluoride concentration and DMFT was equal to 0.929 (Pierson correlation coefficient $P<0.001$).The study showed that the variables such as location, parents' employments, visiting dentist, tooth brushing, and using mouth washes has a significant relation with DMFT index.

**Conclusion:** The study showed that there was a direct relationship between concentration of Fluoride and DMFT; meaning that with the increase of fluoride DMFT increases. It occurs due to underlying variables such as location, parents' employments, visiting dentist, tooth brushing, and using mouth washes which have a significant relation with DMFT and caused the water role faded in this region.

**Keywords:** Fluoride, Water treatment, Haji Abad, Hormozgan province, DMFT index



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## Introduction

Today high concentration of fluoride in water sources is considered a problem in many countries such as Iran, Iraq, India, Mexico and etc. (1). Ion enters underground water sources through gradual dissolution of stones and other fluoride enriched minerals in water (1-2). Small concentration of fluoride is required for natural mineralization of bones and formation of tooth enamel. However, excessive concentrations may be hazardous which result in dental and skeletal fluorosis (3).The main origin of fluorosis is frequently hydrogeological. Evidences show that low concentration of calcium and high concentration of bicarbonate in water are a contributing condition which cause fluoride concentration to increase. Water contains high fluoride which is usually light with high PH and Silica. Effective factors in concentration of fluoride include geological and chemical characteristics of underground water table, porosity and acidity constituents of the whole dissolved solids, the degree of alkalinity, temperature and depth of well (4). Fluoride concentration in underground water is 1-35 mg/L due to the presence of many variables (5). Drinking water and food stuff is the main entering gate of fluoride to body (6). On the other hand tooth decay, as one of infectious disease factor in human societies, has been reported due to the shortage of fluoride level in water. Safe concentration of fluoride in drinking water equals 1 mg/L and the optimal concentration range is 0.7-1.2 mg/L (7). However, the amount of water as well as fluoride intake through that way depends upon the temperature of the region (8-9).

Although much of fluoride intake occurs through drinking water, under similar conditions the obtained results are shown differently in DMFT index. In a study by Hsiu-Yueh et al. in Taiwan on two groups of students as case and control, the case group received water with the concentration of 1 mg/L from NAF and for the second group no fluoride added to water. After two years DMFT indicator in the group which took fluoride showed .63and in control that value was 1.25 (10). Wang et al. (2004) concluded that drinking water was the most leading source of fluoride. The study showed that was a significant relation between fluoride and tooth health SD=0.988 and $r^2$=0.96). However, the study conducted by China Oral Health Committee on the association between DMFT index and fluoride concentration of drinking water showed an inverse relation and in only four villages with drinking water supply and high fluoride concentration showed that high levels of fluoride was effective in dental health (11).This study also showed that other factors such as economic situation, climate conditions, life style, local dishes may play major roles in DMFT index.

The results of a study by Basir et al. showed that there was a poor relation between the concentration of drinking water fluoride and DMFT index in some regions of Khoozestan province, Iran (12). Shidfar et al. (2001) reported that increase in concentration of drinking water fluoride (up to 1 mg/L) led to the reduction rate of tooth decay in the industrial town of Ilam, Iran (13).

Therefore, considering the fact that at the present the most economic way of preventing tooth decay is to add fluoride to drinking water in the region with poor fluoride where DMFT index is one of the fifty two branch-indices of equity in health for which the Ministry of Health, Treatment, and Medical education has undertaken to study and determine it, the present research was done to study the concentration of drinking water fluoride and DMFT index as well as its relation with fluoride concentration, parents employment and education, periodical visit to dentist, tooth brushing and using mouth washes in the city of Haji Abad.





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## Materials and methods

The present study was carried out to determine the concentration of drinking water fluoride and DMFT index in 12-14 years old students in Haji Abad city, Iran. The total numbers of the students were 2566. The required sample for this study obtained 336 people with the methods of calculating the numbers of descriptive samples as finite population, with consideration of 95% confidence interval, taking the equation of calculation and sample size, it was obtained based on Morgan Sample Set Table.

$$n = \frac{Nz^2Pq}{d^2(N-1) + z^2Pq}$$

In this equation, d=0.5, N=2566, q=0.5, P=0.5, and Z=1.96.

In sample selection, first the ratio of urban to rural population as well as the ratio of boys to girls, the numbers of the samples of each segment were obtained and then those samples were determined by the table of random numbers. The frequency distribution of the sample students in this study included 173(51.5%) boys and 163(48.5%) girls. The frequency percent distribution of the sample is given in Figure 1. The students were examined by dental technicians.

This research also studied the relations between parents' jobs, education, numbers of visit to the dentist, numbers of tooth brushing per day, how to use mouth washes and DMFT index in villages and cities. For the collection of data about concentration of drinking water supplies fluoride, the sample was taken from the drinking water supplies of 10 villages including Ganj, Baghat, Jaeen, Farghan, Sargaz, Sirmand, Gahkom, Madanooyeh, Tezerj, and Baraftab. The samples were collected in a 1litre plastic container and sent to lab.

The concentration of fluoride was measured in lab based on SPADANS of standard methods book for the test of water and sewage. In order to increase the precision of the test, the experiments were conducted in triplicates and the average value recorded, then the measured concentrations were compared to the guide value and collected data were coded. Correlation and regression tests were carried out by SPSS-16.

## Results

The participants to this study included 51.1% and 48.9% girls and boys respectively. The results showed that the employment status of the students' fathers in this study included farmers (35%), worker (23.3%), employee (11.7%), unemployed (10.6%) and other jobs (19.4%). About fathers' jobs in urban regions it included worker (33.3%), employee (16%), farmer (4.5%), unemployed (12.2%), and others (34%). The employment status of mothers in rural regions included housewife (69.4%), employee (6.1%), and other jobs (24.4%). In urban regions it included housewife (62.2%), employee (7.1%), and other jobs (30.8%).

Table 1 shows the frequency distribution of DMFT index in research sample in this study. The results of Table 1 show that DMFT index among rural and urban students was 1.58 and .86 respectively. The difference was statistically significant in two groups of rural and urban population (P<0.001). Based on obtained results, the average of fluoride concentration in rural and urban regions was 0.64 mg/L and 1.5 mg/L respectively, the difference was significant between rural and urban societies (P<0.001).



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**Table 1.** DMFT index for the sample of the study by place of residence.

| Living place | D* | M** | F*** | Total number | Fluoride concentration (mg/L) | DMFT |
|---|---|---|---|---|---|---|
| Urban area (Haji Abad) | 125 | 4 | 5 | 156 | 0.64 | 0.86 |
| Farghan | 30 | 1 | 1 | 25 | 0.69 | 1.28 |
| Sargaz | 33 | 3 | 1 | 26 | 0.96 | 1.42 |
| Sarchahan | 40 | 1 | 1 | 26 | 1.02 | 1.62 |
| Shamil | 27 | 0 | 2 | 25 | 0.81 | 1.16 |
| Tashgoye | 38 | 2 | 1 | 22 | 1.35 | 1.86 |
| Ashkara | 21 | 0 | 2 | 17 | 0.70 | 1.35 |
| Dehestan | 25 | 1 | 1 | 14 | 0.84 | 1.93 |
| Baghat | 6 | 0 | 1 | 10 | 0.54 | 0.70 |
| Madaniye | 22 | 1 | 2 | 8 | 1.74 | 3.13 |
| Tazraj | 19 | 0 | 2 | 7 | 1.81 | 3.00 |
| Whole rural regions | 261 | 9 | 14 | 180 | - | 1.58 |
| Total | 386 | 13 | 19 | 336 | 0.82±0.29 | 1.24±0.53 |

*D= decade, **M= missing, ***F= filling

In terms of the educational status of the students' fathers in rural regions, it included illiterate (15%), elementary education (50%), high school diploma (27.2%), associate degree (7.2%), bachelor and higher (6%).

In terms of mothers' education in rural regions it included illiterate (9.4%), elementary education (43.3%), high school diploma (38.3%), technician (6.7%), Bachelor and higher (2.2%).

That status in urban regions included illiterate (5.1%), elementary education (32.7%), high school diploma (48.1%), associate degree (9%), Bachelor and higher (5.1%). Table 2 shows the average of DMFT index among the students in the study based on their fathers' jobs.

Table 3 shows the average of DMFT index in parent's education separately.

In terms of father jobs the average of DMFT index and SD included employee 1.15±0.46, Worker 1.18±0.46, Farmer 1.57±0.59, Unemployed 1.26±0.56, and other jobs 1.11±0.46 respectively. The same values for mothers comprised housewife 1.29±0.58, employee 1.17±0.45 and other jobs 1.17±0.45.

The average and SD of DMFT index of parent's education included illiterate1.40±0.61, elementary) 1.33±0.58, high school diploma 1.13±0.46, associate degree 1.07±0.32, Bachelor and higher0.99±0.31. The same values for mothers included illiterate 1.37±0.59, elementary 1.38±0.64, high school diploma 1.12±0.39, associate degree 1.22±0.54, Bachelor and higher 1.06±0.34.

Figure 2 shows the frequency distribution bar chart of the students tooth brushing and Table 4 indicates the average of DMFT index in the study sample. Figure 3 shows the bar chart of the students' awareness about the benefits of using fluoride mouth washes. The results of the statistical analysis shows the students' awareness rate about the fluoride mouth washes. That the average index of DMFT among the students who were aware of the benefits of using fluoride mouth washes (1.15±0.39) was lower than those unaware of using that agent (1.32±0.6). The difference was statistically significant ($P<0.05$).



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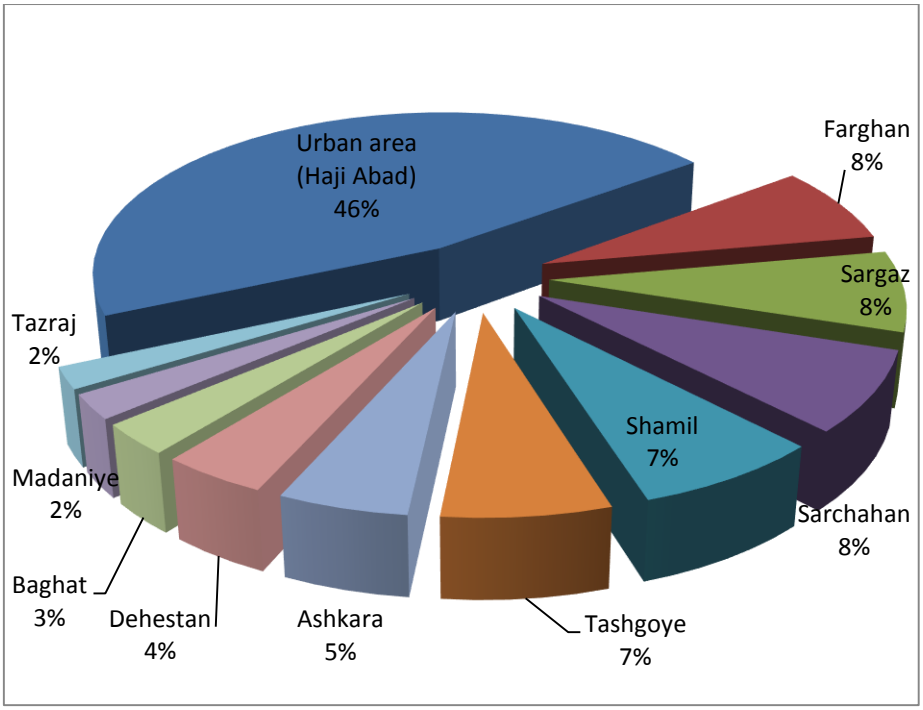


**Figure 1**. Frequency percent distribution of samples is given in rural and urban areas.

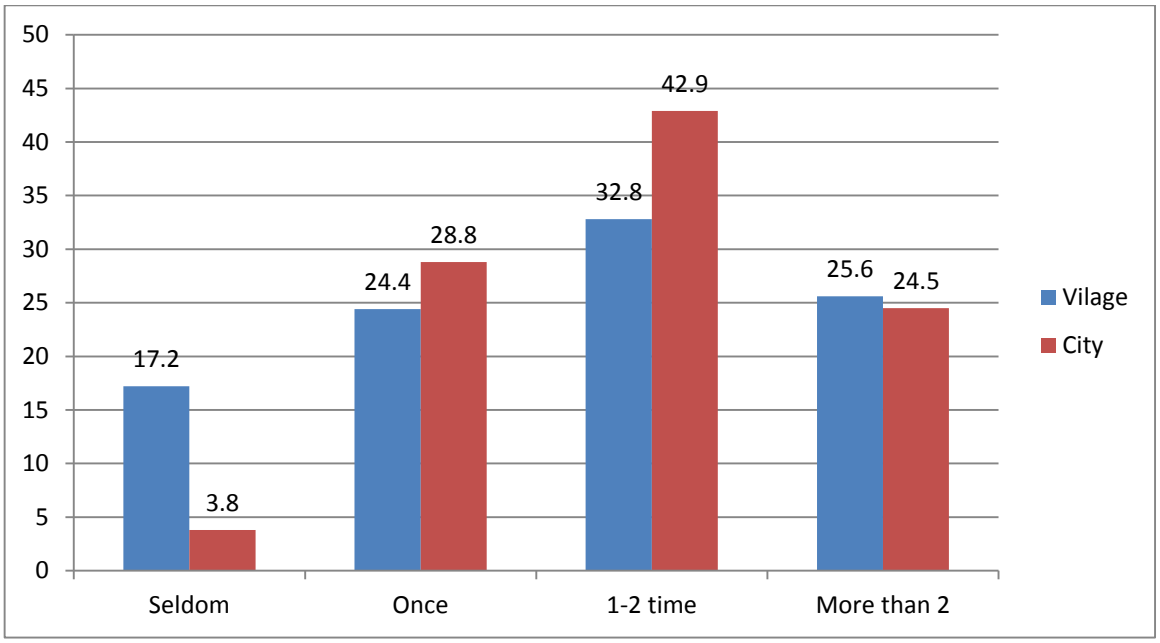


**Figure 2.** The bar chart of frequency percentage on students tooth brushing in separate living place per week.



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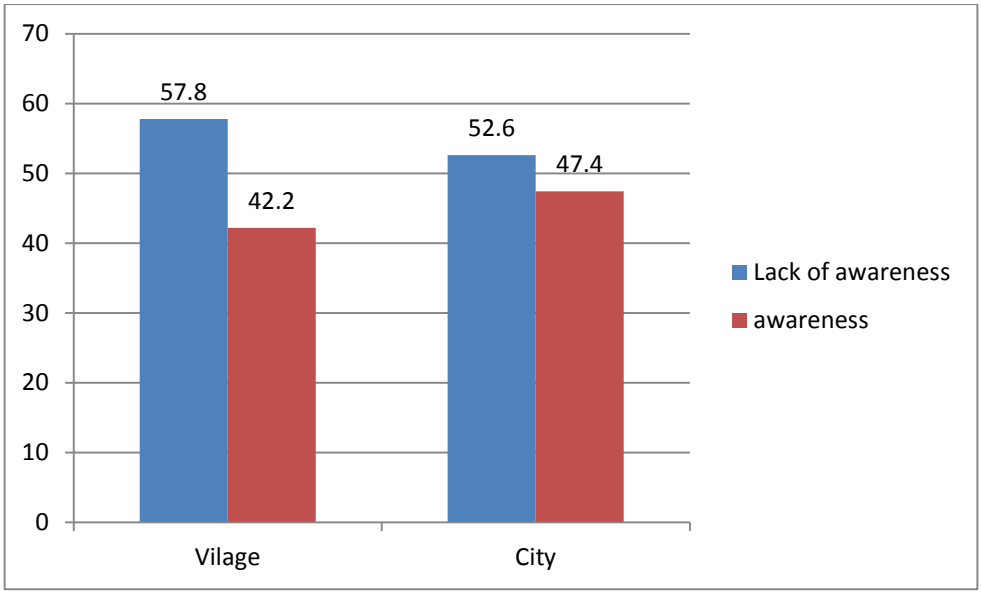


**Figure 3.** The bar chart of frequency percentage on students' awareness about mouth wash.

**Table 2.** DMFT index for the individual of the study separately by the numbers of brushing.

| | Once a day | More than once a day | Several times a week | Seldom | P value |
|---|---|---|---|---|---|
| The numbers of brushing | 1.17±0.41 | 1.11±0.38 | 1.33±0.63 | 1.68±0.73 | <0.001 |

## Discussion

In the study DMFT index met an average of 1.4 ± 0.53 and according to WHO that DMFT less than1.2 is considered very low, 1.2 to 2.6 low, 2.7 to 4.4 average and from 4.4 is considered high) the division in this ranking level is low (1.2-2.6). However, 20% of the area plucesin very low and 20% in medium rank. In this study the average of drinking water fluoride concentration and DMFT index is 0.82 ±0.29 mg/L. The correlation coefficient between the average of fluoride concentration and DMFT index is 0.992. Hence, there is a strong linear relationship between these two variables. (P<0.001). Those results are contrasted with the study of Hsiu-Hueh Liu et al. (2013) in Taiwan (10).The results of this study showed that DMFT index was 0.63 and 1.25 in the group which took fluoride and the group did not take it respectively. Wang Binbin et al. (2004) reported that there was significant relation between drinking water fluoride and dental health in some of large cities of China ( $r^2$= 0.96 SD=0.98) (11).

The results, however, showed that the residents of the only four villages that supplied drinking water with high concentration of fluoride had quite healthy teeth. The results of this study also showed that other factors such as economic status, climate conditions, life style, and types of local cuisines could be effective in DMFT index; it is consistent with the results of the present study. The results of Basir et al. studies showed that there was a poor relation between the concentration of drinking water fluoride and DMFT index in some regions of Khoozestan province it showed that there were other factors which may have a role in this relation. The results of that study showed that DMFT index in urban and rural regions was 0.86 and 1.58 respectively. Those values show that this index is very low in urban and low in rural areas. The difference in both rural and urban societies was statistically significant





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(P<0.001). The reasons of the difference seem to be lack of following health recommendations, level of education, parents' employment and other variables.

The relationship between DMFT and the concentration of fluoride in some studies are as follow (10-16):

**Table 3.** The relationship between DMFT and the concentration of fluoride in some studies.

| Researcher | The relationship between DMFT and Fluoride |
|---|---|
| The present study | Direct |
| Hsiu-Hueh | Reversed |
| Wang Bin Bin | Reversed |
| Chinese health committee | Direct |
| Basir Leila | Weak |
| Dobaradaran Sina | Direct |
| Shidfar | Reversed |
| Jones | Direct |

According to the table 3 it seems that DMFT index other factors may be involved except water.

Also, based on table 2 the average of DMFT indices the students whose fathers were farmers (1.47) hold the lowest value. That difference is statistically significant (P<0.001) among the students whose fathers were employee or had other jobs (1.11 and 1.15 respectively), it was statistically significant (P<0.001). In terms of occupation, the relation between mothers' jobs and DMFT index the highest average belongs to the students whose mothers were house wives (1.29) and the lowest to those whose mothers are employee (1.11). The difference was not statistically significant though (P<0.05). The awareness of parents about mouth and tooth health, the amount of time spent on giving advices and teaching children, the economic status of the family and etc. could be the reasons for those differences.

The average of DMFT index among the students whose fathers are illiterate the highest and lowest value belong to those whose fathers have bachelor degree or higher (99%). That difference is statistically significant (P<0.05). According to the results of that table the difference also exists among the mothers of the students in a way that the average of DMFT index among those students whose mothers are illiterate has the highest value (1.37) and those whose mothers have bachelor degree or higher (1.6) place in the lowest rank (P-value <0.05). Low awareness and ignoring health issues, poor economic status of the families are possibly the reasons of those differences. According to the figure (2), urban and rural students in this study brush their teeth more than once a day. Also 3.8% and 17.2% of urban and rural students seldom brush their teeth. Those results also verify the index difference of DFMT in two groups of urban and rural study population.

The results of table 2 show that the lowest value of DFMT index belongs to the students that brushed their teeth more than once a day. The highest value of that index also belongs to the students that seldom brushed their teeth (1.68) (P <0.001). According to figure 3 the level of the student's knowledge about the benefits of using fluoride mouth washes in urban and rural areas was 47.4 and 42.2 respectively. Statistical analysis also showed that DMFT index among those students more aware about using mouth wash was more (1.5±0.39) than those students who were not aware of its benefits (1.32 ±0.6) (P<0.05). Ashrafizade S et al. (2002) reported no significant differences the use of toothbrush and dental decay with parent literacy but there was a significant association DMFT score and number of children in the family (17). Also Lida Tomarian et al. (2005) reported significant differences between the use of toothbrush and DMFT index (18).





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The results of the present study and others showed that although water fluoride plays important role in DMFT index underlying variables such as location, parents' employments, visiting dentist, tooth brushing, and using mouth washes, it diminishes water role.

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