

The relation between brewed tea and drinking water with urinary fluoride concentration among youths

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Summary. *Background:* Fluoride is an element that enters the body from different dietary and non-dietary sources. Water and brewed tea are the main dietary sources of this element. Therefore, we are going to assess the student's urinary fluoride concentration and evaluated whether there is a relation between the amount of drinking water and tea with urine. *Methods:* In a cross-sectional study, we enrolled 100 males and female students of Qom University of Medical Sciences. Daily intake of water and brewed tea were assessed in three days before obtaining urine samples. Urinary fluoride concentration tested in samples by using of spectrophotometer model DR-4000 and in the method of SPADNS. *Results:* Fluoride levels in the urine of male and female students were almost similar and it was about 1.45 mg/lit. There was a significant relation between urinary fluoride concentration and the number of consumed cups of tea ($P < 0.01$). There was no difference between male and female students. *Conclusion:* Based on the findings of this study, it seems that the tea-drinking habit was correlated with higher urinary fluoride concentration. In community-based nutrition education, perhaps we should consider more tea-drinking-related factors when we suggest tea consumption.

Key words: fluoride, black tea, students, urinary fluoride

Introduction

Fluoride is an element that does not exist as a free form and it is found in compounding form (1). This element spread in the nature, widely. It received by human through a variety of sources such as water, food and some health products or drugs (2). Fluoride involved in the hard and calcium based tissues such as teeth and bones. This element absorbed from gastrointestinal tract and after 30 minutes from swallowing reach to maximum concentration in the blood (3). Kidney is the most important organ for the metabolism of this element and about half of fluoride intake is excreted through kidney (4). Due to the beneficial effects of this element on the prevention of tooth decay, since 1940s,

United States of America enriched drinking water with fluoride and then many countries have attempted to do this action (4). However, in some countries such as Germany, Finland, Japan, Sweden and Switzerland, according to published evidence that explained the potential side effects of addition of fluoride to the water, was not continued (4). Based on the systematic review, McDonough reviewed 214 published researches on the effects of adding fluoride to the water, their results revealed that addition of fluoride to the water reduced tooth decay, but dental fluorosis is an important side effect in the prescribed dose of 1 ppm in about 12% of population (5). Accordingly, the researcher proposes that the beneficial effects of fluoride on teeth should be reviewed in joint with its side effects such as fluorosis

(5). In this regard, Akapta in the survey of 2355 rural children in Saudi Arabia found that consumption of fluorinated water have limited impact on the reducing of dental decay but some cases of dental fluorosis occurs with the consumption of this type of water. Therefore, the researcher suggests that added fluoride should be removed from water or the concentration of added fluorine to the water should be reduced (6). However further studies are needed to assess the possible side effects of intake excessive amount of fluoride (5).

In another aspect, it does not seem that only by removal of fluoride added to drinking water, a problem receiving too much fluoride can be resolved. But oral intake of this element is very important especially in the areas with low level of fluoride in the soil (7). Between the foods, beverages such as tea, known for years as a rich source of fluoride (8). Several studies indicated high concentrations of fluoride in brewed black tea in various countries such as Turkey (9), China (10) and Iran (11, 12). Fluoride content in tea has led to consider the excess tea consumption as a risk factor for excessive intake of fluoride (13) and Fung recommends that maximum daily consumption black tea should be 4.8 liter (10). Amanloo shows that consumption of four cups of brewed black tea that made from tea packaging can supply half of the daily requirement of fluoride of an adult person (12). Joshi et al. in a clinical case report have reported a significant relationship between tissues, serum or urine fluoride concentration with the amount of consumption of tea and toothpaste in a 53 years old woman (14).

However, no previously published studies have compared the relationship between tea or water consumption and urinary fluoride concentration. So, in this study we intended to survey the relationship between the amount of brewed tea and water with excreted fluoride in the urine of students of Qom University of medical sciences.

Materials and Methods

This study was an analytical cross-sectional study that was performed in 2013 on the concentration of fluoride in the urine of male and female students of Qom University of medical sciences. We enrolled one

hundred male and female students that were selected, randomly. At the first, a questionnaire was designed to collect some data includes personal information such as age, height, weight and medical history especially kidney disease and hormonal disorder. In addition, a questionnaire was made for collecting data related to the amount of water, brewed tea and other beverages consumption. In order to achieve more accurate results and elimination of interference of received fluoride from toothpaste, in this study fluoride-free toothpaste provided from Pakshoo Company (one of the valid companies in the production of toothpaste in Iran) and it were asked from the participants to use from this toothpaste from one week before to the end of the study. And also same tea from the same type and brand provided for the participants during the course of study to amount of fluoride intake of participants were the same. To determine the correlation between urinary fluoride levels with water and tea consumption, in the first, the level of fluoride concentration in brewed tea was measured. The results showed that the amount of fluoride per liter of brewed tea and in the water were 1.29 and 0.44 mg, respectively.

We monitored the subjects for a week and visited them every night to ensure proper completion of the questionnaires and use of toothpaste. In the morning of eighth day, urine samples were collected by use of especial container for each of subjects. The samples were transferred to the laboratory, immediately. For evaluating of fluoride concentration in the samples, we used DR-4000 spectrophotometer (HACH) at a wavelength of 580 nm and the procedure of SPADNS (15).

Statistical analyses

Data were analyzed by SPSS (Statistical Package for Social Sciences Inc., Chicago, IL, United States) for Windows ver. 16. One-way analysis of variance (ANOVA) was used. The Independent T-test used for comparison of urinary fluoride concentrations between male and female. Finally, to determine the correlation between urinary fluoride of students with amount of water and brewed tea intake, we used Pearson correlation coefficient test. Results were evaluated with significance level of $p < 0.05$.

Results

From the total of participants, 52% and 48% were males and females respectively. The participants were divided into three groups based on the number of cups of water that was consumed. The first, second and third groups were the subjects who consumed under eight, 8-16 and more than 16 cups of water, respectively. In table 1, fluoride concentration in the urine samples was mentioned according to the amount of consumed water.

Individuals based on the consumed cups of tea per day were divided into five groups. The first, second, third, fourth and fifth groups were consumed 0 cups of tea, 1-5 cups of tea, 5-10 cups of tea, 10-15 cups of tea and more than 15 cups of tea over the day, respectively. In table 2, the relationship between urinary fluorides concentrations according to the amount of consumed

Table 1. The relationship between urinary fluoride concentrations and consumed water among the students of Qom University of Medical Sciences

The number of glass of water	The number of peoples	The mean and standard deviation urinary fluoride (mg/l)	P-value*
0-8	43	1.45±0.36	0.617
8-16	44	1.45±0.26	
16<	13	1.39±0.25	

*ANOVA test

Table 2. The relationship between urinary fluoride concentrations and the amount of consumed tea by the students of Qom University of Medical Sciences

The number of tea cup	The number of subjects	The mean and standard deviation of urinary fluoride (mg/l)	P-value*
0	6	1.28±0.49	0.013**
1-5	50	1.53±0.31	
5-10	31	1.36±0.23	
10-15	8	1.46±0.36	
15<	5	1.17±0.29	

*ANOVA post hoc tests

tea are mentioned. As shown in this table, there was a significant difference between urinary fluoride concentration and the number of consumed cups of tea. However, the trend of urinary fluoride is not as same as drinking tea.

According to the table 3 and figure, the level of urinary fluoride in the female students and the male students were the same.

The correlation between urinary fluoride results (Table 4) showed that there was significant relationship between the levels of consumed tea with urinary fluoride level in the students. (P=0.023, r=0.227).

Discussion

According to the results, urinary fluoride levels had correlation with the amount of consumable tea. Although the level of excreted urinary fluoride in female was more than male, this difference was not statistically significant. The mean fluoride concentration in the subjects urine was 1.45 mg/l. (Female students were 1.49 mg/l and male students were 1.41 mg/l).

The results of the present study were similar to the Yadav findings in India in 2003 that reported the mean urinary fluoride concentration in the ranging from 1.48 to 1.58(16). Also, urinary fluoride concentration in this research was similar to the findings of Mansfield (17) and Bhargava (18).

Table 3. Comparison of urinary fluoride concentrations between male and female students of Qom University of Medical Sciences

Sex	Urinary Fluoride* (mg/l)	P-value**
Male	1.41±0.31	0.165
Female	1.49±0.29	

*Mean±SD; **Independent T-test

Table 4. Correlation between urinary fluoride and consumed tea and water

Urinary Fluoride	r	Consumed Tea	Consumed water
		0.227	-0.034
	P	0.023	0.734

Urinary fluoride concentration in this study was more than Chen study (19) in 2013 in china but in the Chen study, 120 children in the ages of 6-12 years old were studied and these children after giving water with insufficient fluoride were evaluated, that this insufficient amount of fluoride intake can lead to the reducing of excreted urinary fluoride.

The lack of difference between urinary fluoride concentrations between male and female subjects showed no relationship between sex and urinary fluoride concentration. This is similar to the Torra (2) findings. Torra and colleagues examined the 250 subjects in the state of Catalonia in Spain, found that urinary fluoride concentrations were not correlated with gender (2).

According to the present study, there was relationship between consumed tea and excreted urinary fluoride. This Finding was similar to the findings of Izura in 2011 (8) and Li in 2001(20) results.

In a cross-sectional study the level of fluoride in consumed water and tea was assessed in three zones of north china. The researchers evaluated the effects of tea and water intake on the urinary fluoride levels. In this study, 117 residents of three regions (61 females and 56 males) were enrolled in the study. The results showed that in the region that had higher level of fluoride concentration, it was observed higher excreted level of fluoride than two other regions (20). In addition, the researcher reported that consumption of brewed black tea with high fluoride level was a factor for increasing of urinary fluoride in the samples of Mongolia region (21).

Also, Izura in a case report mentioned that 48 years old woman that high amount of tea consuming (1-2 gallons of tea equal to 3.9-7.5 liter of brewed tea per day) was associated with an increase in urinary fluoride. It should be noted that urinary fluoride level in this study with consumption of too much brewed tea increased about of 3.5 mg/lit and were associated with fluorosis and bone pain. However, six months after cessation of drinking tea in the patient's, symptoms of bone pain disappeared (8). Also, Joshi in the report of a clinical case in the 53 years old woman found that fluoride concentration in 24 hours urine sample in this woman was about 16.9 mg. It should be noted that this subject stated that in the recent 10 years drunk 6 cups

of brewed tea in the day (14). Also, as shown in table 2, the trend of urinary fluoride concentrations of subjects was not increase regularly, and based on tea consumption. Unfortunately, we cannot describe this, and we need more research on the metabolism and turnover of fluoride in the human body.

It seems that the reason of this result should be related to fluoride metabolism in the body. Existent evidence indicated that fluoride metabolism is determined by two major mechanisms including uptake by bone mass and renal excretion (2). By increase in the age, the ability of kidneys in excretion of urinary fluoride decreased and this change lead to decrease in urinary fluoride concentration and increase of serum fluoride concentration by increasing in the age. This has been confirmed in previous studies (2). Also, according to Simpson (2001) study, fluoride intake through brewed tea may have a greater impact in the oral cavity and have localized effects. It may also have an influence on the absorption of fluoride (22).

However, it seems that other factors except of the amount of fluoride intake be important in the appearance of fluorosis symptoms. According to the Lakshmi study in 2013, it is appeared that the appearances of fluorosis symptoms between the children who followed better dietary programs and have more nutrients intake, reduced significantly in compare with the children who had inappropriate dietary intake (7). This finding indicates the influences of other nutritional factors in the metabolism of fluoride. There is no human study in this issue. But Lohakare in 2013 in the survey of 30 breed calves found that consumption of low level of protein in the daily regimes of these animals is associated with increasing of fluoride urinary excretion level (23).

A large amount of fluoride intake has been linked with the onset of related signs and symptoms of fluorosis. According to the Li study on the 8266 subjects from China, long term intake of water with the content of more than 4.3 mg fluoride per liter is associated with significant increase in the incidence of bone fractures (20).

Recently, Bhardwaj in a study on the 705 patients who received water with high doses of fluoride (5.9 to 24.5 mg per liter) had been found that the concentration of total protein, albumin and globulin in serum of

patients were lower than control group, significantly. And they concluded that high concentrations of fluoride intake can lead to disturbances in protein metabolism (24). Also Ding in the survey of 331 children in the age of 7-14 years old found that increase in urinary fluoride concentration was associated with lower IQ. According to the findings of this study each milligram increase in urinary fluoride was associated with 0.59 decreases in IQ (25). And also Hu after addition of 100 mg/lit fluoride to the drinking water of rats, found that after consumed this water, insulin concentration in these rats increased significantly and glucagon concentration decreased, significantly in compare with control group (26). Moreover, Sun in 2012 reported chromatin changes in the rats that consumed 30, 70 and 150 mg of sodium fluoride for 49 days (27).

According to the above-mentioned, it seems that more research is needed about the amount of fluoride excretion, its metabolism and side effects of receive high amount of it.

Conclusion

The results of this study showed that fluoride concentration in Iranian students was similar to the other areas and there were no difference between the males and females in the amount of fluoride excretion. And also, the amount of fluoride excreted in the urine was related to the amount of consumed brewed tea.

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