Clinical Cancer Investigation Journal-ISSN: 2278-0513

Examining the Prevalence of Fluorosis in 6-12-Year-Old Children in Saveh Schools

Abstract

Fluorosis is specific damage to the tooth structure that is seen on the enamel. In this study, we investigated the prevalence of this problem in children aged 6 and 12 in Saveh, Iran. In a 2-stage cluster study, 428 students were selected. Demographic and geographical information was recorded. The students' teeth were examined. The amount of fluorosis was determined according to the Dean's index. Dental fluorosis status was divided into two categories: "does not have fluorosis", nd "has fluorosis", including cases with degrees of dental fluorosis. dmft / DMFT/dmft index was also measured. Study data were analyzed by Sample complex analysis and General Liner model methods. A significance level of less than 0.05 was considered. More than 80% of students had natural enamel. Fluorosis was seen in 13.8% of students. There was no significant relationship between dental fluorosis and the age of samples in the first and sixth grades, but the chance of seeing dental fluorosis at 12 years was 2 times that of 6 years (p-value = 0.12). There was not a significant relationship between dmft and DMFT and dental fluorosis (p-value = 0.11 and p-value = 0.10, respectively). Among the 376 students who used fluoridated toothpaste, 15.2% had fluorosis. The highest fluoride content in drinking water was 1ppm. Variables such as sex, age, and use of fluoride toothpaste had no significant effect on the prevalence of fluorosis. Drinking water with fluoride levels up to 1ppm cannot cause severe fluorosis.

Keywords: *Tooth structure, Fluorosis, Caries prevention, Dean's index*

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Introduction

Fluorosis is a type of specific damage to the tooth structure that happens because of excessive consumption of fluoride during teeth formation. Based on the reports, the prevalence of fluorosis has increased in the last 50 years (1). Fluoride is found everywhere in nature, even in the air. However, the value of fluoride in the air of urban areas is higher and it contains up to 10 times higher concentration of fluoride (2).

Fluoride is found in food and potable water is the main source of fluorine. If the water contains one part per million (1 ppm), fluorine, one to two milligrams of this element is provided in the body daily (3).Fluorine absorption in the digestive system starts from the stomach and after absorption, it is excreted through urine. About 90% of fluorine from food is absorbed, the part required is used by teeth and bones, and the rest is excreted through urine (4).

Fluoride increases tooth resistance. Different assumptions have been madein this case (5). Systemic fluoride has a role in reducing caries through several mechanisms. Fluoride could convert hydroxyapatite to fluorapatite so that the solubility of tooth enamel in acid decreases. Moreover, it reduces the acid produced by plaque organisms. Fluoride remineralizes tooth enamel that has been demineralized by acid produced by caries-causing bacteria. Moreover, by affecting the development of the dental papilla cells responsible for creating the final shape of the tooth, it creates teeth with shallow and wide grooves and smooth surfaces, with less tendency to decay. Fluoride affects the composition of enamel, cement, or dentin during or after mineralization, and the presence of a sufficient value of fluoride causes an increase in the amount of fluorapatite compared to hydroxyapatite during tooth mineralization, leading to larger and more perfect apatite crystals resistant to acid. They are more resistant, they reduce decay. After teeth are exposed to liquids containing fluoride, foods and saliva absorb fluoride on the enamel surface and fluoride replaces the hydroxyl ions in apatite and creates fluorapatite which is resistant to decay. Continuous control during fluoride exposure, especially its topical types, including toothpaste, is critical to creatinga balance between the maximum benefit of reducing caries and the minimum risk of developing fluorosis (6). Fluoride supplements are another method of receiving systemic fluoride, used in the form of liquid and tablets containing fluoride. After measuring fluoride in drinking water in areas where the value is less than the desired value, these products could be used after six months until the second permanent molar grows (5).

Another way to receive fluoride is local fluoride therapy. It is recommended to use fluoride toothpaste depending on the age and weight of the person (7). Fluoride gel is available in forms that can be used in dental offices and at home. Using fluoridated mouthwash at home or school is only recommended for a group of children whose swallowing

reflexes are completely controllable and the child could reliably spit out the mouthwash after gargling (8). The use of fluoridated mouthwash in children under 6 years of age is not recommended because of the risk of swallowing it unless the dentist has performed the necessary evaluation.

Nowadays, some dental materials such as glass ionomer, composite, and fissure sealants contain fluoride, and their use in dental services and tooth restoration could increase the strength of the tissue around the filling (9, 10). Fluoride has been added tosome composites too. These composites, with fluoride nanoparticles, are mostly used in the installation of orthodontic brackets. However, glass ionomer cementisbetter for this purpose (11, 12).

Like any other substance, fluoride causes poisoning if consumed excessively. Three types of complications have been stated as a result of increased fluoride consumption in humans: 1) acute poisoning, 2) chronic fluorosis and 3) dental fluorosis (13).The deformed appearance of the teeth and the destruction of the tooth structure, which is called fluorosis are among the disadvantages of improper use of fluoride. For instance, onecould see in people whose fluoride consumption is more than 2 ppm in drinking water, a result of which changes such as dull and white spots or yellow and brown spots and bands appear on the teeth. Nevertheless. The intensity and weakness of these dental changes depend on how much fluorine, in what condition the tooth changes are, depends on how much fluorine has reached the body, for how long, and at what age. Usually, the accumulation of stains is more on the maxillary central teeth (14). Dental fluorosis is a condition that causes teeth to come into contact with high amounts of ingested fluoride during enamel formation. Fluorosis does not occur once the tooth enamel is completely formed and the tooth erupts. Hence, there is no risk of developing dental fluorosis in older children and adults. Moreover, dental fluorosis takes place when children receive high values of fluoride (15, 16).

The degree of fluorosis relies on the total dose of fluoride, as well as the time and duration of contact with it. As previously argued, fluorosis of the suspected, very mild, and mild type in young children is the result of swallowing toothpaste with high fluoride content or fluoride supplement products inappropriately prescribed (17).Among the indices for measuring dental fluorosis is the Dean's index, which according to the significance of the points stated, the study was carried on to examine the prevalence of fluorosis based on the Dean's index in 6- and 12-year-old children of Saveh schools and to examine the relationship of this index with dmft/DMFT.

Materials and Methods:

A cross-sectional study was designed for first and sixth-grade children in Saveh schools. Firstly, the plan was approved by the Research Council of the Faculty of Dentistry of Tehran University of Medical Sciences. Then the necessary coordination was made with the Vice-Chancellor of Saveh Medical Sciences Faculty. Saveh Faculty of Medical Sciences requested cooperation by sending Saveh letter to Education, and the list of schools was obtained from Education. Two-stage cluster sampling method was used in the study. Thus, each school was considered a cluster. Saveh was divided into three regions of north, south, and center. The areas of Saveh were divided into three groups based on water fluoride based on the World Health Organization (WHO) water quality guidelines - low (less than 0.5ppm), medium (between 0.5 and 1ppm), and high water-fluoride group (more than 1.1ppm) (18). In each region, the desired samples were selected according to the number of students. The studied population was first and sixth-grade children of Saveh schools. Selecting 15 schools from among Saveh schools was random. A Sum of 428 students wasselected, of whom 231 were girls and 197 boys.

Necessary arrangements were made with school officials. Moreover, performing the activity and its goals were explained. After obtaining permission from the parents, considering the need to reach 10 students in each class, 13 first-grade and 13 sixth-grade students were randomly selected from each school. The class attendance book was used to randomly select the students of each class, and then these students were subjected to oral and dental examinations. Firstly, some demographic indices like first and last name, gender, age, and student number were recorded in the class list for each student. The students sat on a chair under natural light, and masks, examination gloves, trays, freezer bags, abseiling tubes, disposable mirrors, disposable catheters, gauze, latex gloves, paper towels, and sheet covers were prepared for these examinations. The examination results were given to the mothers and they were referred to the health-treatment center or the private sector in case needed. Regarding the latter case, only the school health care worker or a similar responsible person had the right to decidebecause of the knowledge of the students and their family's circumstances.

WHO criteria and Dean's index were used todetermine the level of fluorosis of dental surfaces. According to this index, the tooth surfaces in terms of the presence of fluorosis include the following states, which were identified in the questionnaire with codes from zero to five (19):

Zero: normal (translucent enamel with smooth and shiny surface and creamy white color)

1: Suspicious (white spots or moles like snow cover, and enamel lack normal translucency)

2: very mild (white areas of opaque paper or a linear condition similar to a vein that covers less than 25% of the tooth surface)

3: mild (white areas of the opaque that occupy less than 50% of the tooth surface)

4: Moderate (significantly covers the occlusal and incisal surfaces and may have brown pigments)

5: severe (staining and hypoplastic brown pigments that cover the entire surface of the tooth and may be accompanied by wear)

Moreover, according to the intensity of fluorosis, dental fluorosis is divided into two classes: 1) "no fluorosis", including normal or suspicious cases (code 0 and 1 in the Dean's index), and 2) "has fluorosis", such as cases with degrees of dental fluorosis (code 2 to 5 in Dean's index) were divided into general categories, and to examine the relationship between fluorosis and dmft/DMFT index, this index was measured too. This measurement was carried out by two final-year dental students and two dentists. The examinees were calibrated with themselves and with each other before starting the examinations.

The data of the study were analyzed in SPSS-22 and with a sample complex analysis. The mean was used with a confidence limit of 95% to describe the quantitative variables. Moreover,raw and relative abundances were reported to describe qualitative variables. Toexamine the relationship between risk factors (education level, gender, and water fluoride level of the area) associated with the outcome variable fluorosis, it was included in the logistic regression model in two states (normal or suspected fluorosis versus fluorosis of any degree). The General Linear Model (GLM) method was used to examine the possible effects of fluorosis on dmft/DMFT value as a quantitative variable. The statistical significance limit was less than 0.05 and between 0.05 and 0.1 was almost significant.

Results

The results indicated that more than 80% of the students had no dental fluorosis. The value of various intensities of dental fluorosis is given in Table 1. The studied population was divided into two groups based on the presence or absence of fluorosis, having or not having fluorosis, with 369 people not having dental fluorosis and 59 having dental fluorosis according to this division. Those with normal or suspicious status (codes 0 and 1) were the ones with no dental fluorosis. Moreover, 59 of the rest of the students had degrees of dental fluorosis (codes 2 to 5) (Table 1).

Table 1.The conditions of dental fluorosis of the samples participating in the study of primary school students of Saveh according to Dean's index

Detailed status of dental fluorosis	Samples	Mean percentage of samples	Clinical status of fluorosis	Mean percentage of samples
Normal	344	80.4%	Does not have	86.2%
Suspicious	25	5.8%		
Very mild	27	6.3%	Has	13.8%
Mild	23	5.4%		
Medium	8	1.9%		
Intense	1	0.2%		
All samples	428	100%		

The areas of Saveh were divided into two groups of moderate water fluoride (between 0.5 and 1 ppm) and low water fluoride (0.25 ppm and less) based on water fluoride. In areas with higher water fluoride, 51 out of 371 students had fluorosis, which is about 13.7% of the samples. Moreover, in areas with less water fluoride, 8 out of 58 students had fluorosis, which is about 14% of the samples. Table 2 gives more details.

Table 2.The samples according to the water concentration of Saveh region in the samples participating in the study of Saveh students according to the Dean's index

A fluoride concentration of water in the area	Total number of the samples	The number of samples with fluorosis	Percentage of samples with fluorosis
Medium (between 0.5 and 1 ppm)	370	51	13.7%
Low (less than 0.5ppm)	58	8	14%

From the samples participating in the study, 376 used toothpaste containing fluoride to clean their teeth, of which 57 had fluorosis, which is 15.2%. Moreover, from the number of samples participating in the study, 21 did not use a toothpaste containing fluoride to clean their teeth, of which 1 person had fluorosis, which is 4.8%. Moreover, the relationship between dmft/DMFT and dental fluorosis was extracted. The results are given in Table 3.

Table 3.The correlation between dental fluorosis and dmft/DMFT based onGLM and sample complex analysis in samples participating in the study of first and sixth-grade students in Saveh in 2014 based on Dean's index

Parameter	Group with fluorosis	The group not affected by fluorosis or suspected	p-Value
DMFT	0.95	0.62	0.11
dmft	2.20	3.11	0.10

The relationship between the classified dental fluorosis and the age of the samples in the first and sixth grades was examined and based on the results obtained from the Logistic Regression analysis, there were no significant relationships between the two. However, the chance of seeing dental fluorosis in 12-year-olds was 2 times that of 6-year-olds. Value-p = 0.12 to examine the relationship between classified dental fluorosis and fluoride concentration in different areas of Saveh (areas with high ppm of fluoride and areas with low ppm of fluoride) with logistic regression indicated no significant relationships between dental fluorosis classified with fluoride concentration in various areas of Saveh (areas with high ppm fluoride and areas with low ppm fluoride) (p-value=0.96). Moreover, in the relationship between classified fluorosis and the number of times using fluoride toothpaste, based on the results obtained from regression logistics, there are no significant relationships between classified fluorosis and the number of times using fluoride toothpaste (p-value=0.18). The relationship between dental fluorosis and the gender of the students (girl-boy) was examined and based on the results obtained from logistic regression, there were no significant relationships between the two (p-value=0.98). In the relationship between fluorosis and dmft (milk teeth), there is no significant relationship between these two parameters (p-value=0.10) based on the results obtained from the CSGLM test. Moreover,according to the

results of the CSGLM test between these two parameters (p-value=0.11),there were no significant relationships between fluorosis and DMFT (permanent tooth).

Discussion

According to the study findings, it was seen that the value of fluorosis in 12-year-olds was higher than in 6-year-olds, although no significant relationship between fluorosis and age was considered in the logistic regression analysis. Several studies have been carried out in the same field in the study conducted by Sukhabogi in Nalgonda, India, where there were no significant differences between the ages of 15-12 years with fluorosis (20).Saravanan et al. (2007) in a cross-sectional study examined the prevalence of dental fluorosis in 525 children (270 girls and 255 boys) aged 5-12 years in the Indian region. Clinical information was obtained through oral examinations and was measured using the Dean's index of fluorosis. With the help of the Chi-Square test, the prevalence of dental fluorosis was 31.4%, and its prevalence increased with age. The differenceswere insignificant (21).Furthermore, in another study in India, Bhalla divided students into various age groups, including 5 age groups: A, B, C, D, and E (22). Age group A was 7-9 years old, B 11-9, C 13-11, D 15-13, and D 17-15 years old. The result of the study showed that age groups E and D had less fluorosis, and age groups A, B, and C had more. Moreover, age group C, with 13-11-year-old people, had a higher percentage of mild fluorosis. In another study by Ravikumar, the highest rate of dental fluorosis was seen in students aged 9 to 12 years (23).The prevalence of dental fluorosis was significantly higher with increasing age in Saravanan's study in India (21). In Perez's study in Brazil, the highest rate of fluorosis was seen atthe ages of 9 and 13. These studies'resultsshowed that there is a chance of getting dental fluorosis because of the effect of the factors that cause fluorosis, especially in areas with more than optimal fluoride levels even at the age when the enamel is completely formed and developed (24). In a 2007 study, Saravanan et al. examined the prevalence of dental fluorosis in 525 children (270 girls and 255 boys) aged 12-5 years in a cross-sectional study in India. Clinical information was obtained through oral examinations and was measured using the Dean Fluorosis index. With the help of the Chi-Square test, the prevalence of dental fluorosis was 31.4% and its prevalence increased with an increase in age. Their results showed that there is a chance of getting dental fluorosis because of the effect of the factors that cause fluorosis, especially in areas with more than optimal fluoride levels even at ages when the enamel is fully formed and developed (21). In our study in Saveh, there were no significant relationships between the dmft index and fluorosis. We know that this relationship is usually reported and proved to be significant in international studies. The relationship between the dmft/DMFT index and the value of fluorine and fluorosis cannot be accurate, as it was impossible to examine and research where the mother lived from pregnancy to the birth and development of the child, and regarding the change of place of residence. Moving families tovariousregions, and not remembering the length of time in each place was one of the reasons. Nevertheless, there were no significant relationships between dmft/DMFT and fluorosis in many past studies. As in our study, there were no statistically significant differences between the DMFT/dmftindexesconcerning the prevalence of fluorosis. In Jordao's study in Brazil, there were no statistically significant differences between the dmft/DMFT indexesconcerning the prevalence of fluorosis, which probably had the case of moving the place of residence. Moreover, there was no statistically significant difference between the dmft/DMFT indexesconcerning the prevalence of fluorosis in a study in Brazil (25).In contrast to our study in Saveh, in the study by Sukhabogi in Nalgonda, India, the meandmft/DMFT index in an area with medium fluoride content is the lowest and a significant statistical difference was seen in the prevalence of fluorosis with dmft/DMFT. An inverse relationship was seen between the value of fluoride in the area water and the meandmft/DMFT, and there was a direct relationship between the values of fluoride in the area water, in which people with more fluorosis had less DMFT (20).Moreover,Mortazaviet al. in Bushehr found that the relationship between fluorosis and DMFT reduction was statistically significant (26).

Ajami et al. indicated that 95.33% of the students have fluorosis in Titkanlu village. Titkanlu has a high concentration of fluoride in the drinking water of that area (1.7 ppm). Moreover, their 15-year-old teenagers had low DMFT (1.95) (27).

There were no significant relationships between fluorosis and the gender of students in Saveh in our study. There are similar studies in this regard too. In the study of the prevalence of dental fluorosis in students aged 12 to 15, Bakhshi et al. no significant relationship between the prevalence of fluorosis and gender (P=0.202), but a significant one with age (P=0.005) (28).

In a study conducted by Sukhabogi in Nalgonda, India, there were no significant relationships between the prevalence of fluorosis and gender (20).Saravanan et al. (2007) examined the prevalence of dental fluorosis in 525 children (270 girls and 255 boys) in a cross-sectional study in the Indian region. While the gender difference did not show a significant difference, in the villages of ZhaperambieKe and Senjichery in India, the prevalence of fluorosis was higher in boys than in girls, although the difference was not statistically significant (21). In a study by Miomaz in Brazil, there were no significant relationships between fluorosis and the student's gender (29). In Saravanan's study in India, according to the relationship between the prevalence of fluorosis and gender, the rate of

fluorosis was higher in boys than in girls (21). In Bhalla's study in Kanpur, India, boys had more fluorosis than girls (22). In Perez's study, the prevalence of fluorosis was higher in boys than in girls according to the prevalence of fluorosis and its relationship with gender (24).Saravanan et al. (2007) examined the prevalence of dental fluorosis in 525 children (270 girls and 255 boys) aged 12-5 years in a cross-sectional study in India. Clinical information was obtained through oral examinations and was measured using the Dean's index of fluorosis. With the help of the Chi-Square test, the prevalence of dental fluorosis was 31.4%, and its prevalence increased with age. As a result of these studies, we found out that even at the age when the enamel is completely formed and developed, there is a chance of getting dental fluorosis because of the effect of the factors that cause fluorosis, especially in areas with more than optimal fluoride levels (21). In our study in Saveh, there are no significant relationships between classified fluorosis and the number of times using fluoridated toothpaste according to the results obtained from logistic regression. In Brazil, the Jordao study showed no significant relationships between the prevalence of classified fluorosis and the frequency of using fluoride toothpaste similar to our study (25).Tabari et al.(1998) studied the fluorosis of incisor and maxilla teeth concerning the value of fluoride in water and toothpaste and social factors in 9-8-year-old children, showing that the consumption of children's toothpaste with a lower concentration of fluoride could increase the risk of fluorosis in areas with further reduce the fluoride in the water (30). In our study in Saveh, the relationship between water fluoride in variousregions of Saveh and the prevalence of dental fluorosis was not statistically significant. In Miomaz's study in Brazil, there were no significant differences between the water fluoride level in the area and fluorosis between the areas with more than the optimal fluoride level and the areas with the optimal fluoride level in the local water and mild and very mild fluorosis (29). In the study by Jordao in Brazil in the Goiania region, the relationship between water fluoride in different regions and the prevalence of fluorosis was not significant like our study (25). In a study in India in 2015, Ravikumar et al. studied the prevalence of dental fluorosis in primary school children in Namakkal state, India. A fluoride concentration of underground water and various sources of fluoride received by 251 schoolchildren in various villages of the region (75 samples) were examined. Clinical information was obtained through oral examinations and a questionnaire was prepared to examine children's fluoride history. The fluoride concentration of underground water in these areas was higher than normal, fluorosis was directly associated with the value of fluoride water in various areas (23). In a study in Brazil by Perez, fluorosis was seen in areas with water fluoride levels of 1.5 ppm and more. The study indicated that no personal or organizational studieshave focused on the water fluoride levels in the areas up to now (24).

The study strengths were the large volume of samples, the prevalence in the entire city, and the presence of trained and calibrated examiners. However, unfortunately, it was impossible to follow the trend of people living in the areas where they were children. This meansa student was in an average fluoride zone at the time of the study but had spent the preceding growth period in an intermediate fluoride zone. Doing this is very difficult.

Conclusion

Fluorosis in values up to 1.1 ppm cannot be severe. It is possible to make the urban water balanced in this sense by networking it in the cities with different water sources with various concentrations of fluoride.

Acknowledgment

The writers state their utmost gratitude for the sincere cooperation of the health center and the oral health unit of that center, especially Ms. Ghafari and the education of Saveh. Additionally, we appreciate the efforts of our honorable colleagues who helped us in conducting the project - Dr. Mehbobeh Zangoui, Betoul Pirouzhashmi, Mehbobeh Fallah, Prasto Gayini and Professor Jalil Koohpayezadeh.

Conflict of interest: There was no funding source for this study and it was done by authors**.**

Financial support: There was no financial support.

Ethics statement: Ethical issues approved by the Ethics Committee of the Tehran University of Medical Sciences. Although the forms were anonymous, informed consent was taken from participants. There was no compulsion to participate in the study. Attending or not attending had no effect on their related items.

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