

Original Research Article

Dental Fluorosis Prevalence of Children and Drinking Water Fluoride Level in Bahar City of Iran

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Abstract: Attention to health and prevention of disease occurrence has priority to treatment. High fluoride intake through drinking water is one of the important factors of dental fluorosis. The present study investigated the prevalence of dental fluorosis in children between 6 to 12 years old in Bahar city and fluoride levels in drinking water. This work was a cross-sectional study. 288 students between 6 to 12 years old (144 females and 144 males) were entered in study. Dean index of dental fluorosis was used to determine the fluorosis intensity of teeth. Exclusion criteria included: lack of central tooth in the mouth, use of fluoride supplements, students who were not born or spend their childhood in Bahar city. Also, a water sample of the Bahar city reservoir was taken to measure the fluoride level in the Health faculty lab of Hamadan University of Medical Sciences. Fluoride level was measured using SPANDS method. The data were analyzed using SPSS v.16 software and by student t test, Chi-square and one sample t test. The fluoride level in drinking water was 0.66 PPM. Total community fluorosis index (FCI) was 0.5503 ± 0.4920 which was significantly higher in upper jaw ($p=0.001$). Fluorosis were 9.7% (11.8% of boys and 7.6% girls) in all students which was not statistically significant regarding sex ($p=0.233$). No mandibular and maxillary molars were affected by fluorosis. There were no significant difference between fluorosis intensity and gender of students ($P>0.05$). Fluorosis intensity in school children of Bahar city was reduced than previous years. However regular and periodical examinations in health homes, oral health education to parents and students to prevent the complications of fluorosis, as well as regular follow up by dental professionals for early diagnosis of fluorosis is strongly recommended.

Keywords: Fluorosis, fluoride, Drinking water, prevalence, children.

INTRODUCTION

Dental caries is the most common disease in permanent and primary teeth which is still considered as a problematic chronic disease in public health [1].

Regarding tooth decay, fluoride is a substance which no doubt plays a vital role in preventing dental caries among children and adults if properly used [2]. Lab studies prove that fluoride causes an anti-decay effect on ongoing tooth caries [3].

Fluoride exists in nutrients (as tea and fish), mouth rinse, toothpastes and drinking water. It also can enter drinking water system through natural recourses. For example it could enter under ground water through stones, soil and stone- washing and even through industrial sewage it could penetrate into drinking water. On the other hand, fluoride can cause poisoning if it enters drinking and under ground water because it can exist in toxic doses [4].

Fluoride effects are categorized in two parts: local and systemic. Systemic effects are caused through having foods containing fluoride and also water with natural amounts of fluoride or added fluoride- water. Also its local effects can be caused through using fluoride- added toothpastes.

Fluoride can cause bad side – effects if it is not used properly [5]. Fluoride poisoning is either chronic or acute. Nausea, vomiting, stomach acid, diarrhea, abdominal cramp and coma are symptoms of acute poisoning [6]. If little amounts of fluoride are repeatedly swallowed then chronic poisoning is possible. Too much exposure to fluoride can cause a state called dental fluorosis [6]. Based on the amounts of fluoride taken in and gradual and developmental phase of the teeth, the effects of fluoride can vary from a minor color change on the surface of the tooth to severe dyeability, loosing tooth enamel and formation of cavities.

Fluorosis can also effect skeleton and increase bone density and toughness or hardness of joints and causes pain in joints [6].

The adding fluoride to drinking water is a criterion for health progress which is considered by world Health Organization (WHO) and on the other hand inappropriate adding of fluoride to drinking water increases the prevalence and intensity of fluorosis [4].

In 1986, Environmental protection Agency (EPA) announced that the highest accepted (legal) concentration of fluoride in drinking water should be 4 mg [5]. Gopalakrishnan *et al.* reported that fluorosis community index or FCI among students in an area in India is about 169. This epidemiologic index states the intensity and distribution pattern of fluorosis among different populations and communities and if it exceeds over 0.6, it would be the symptom of a health problem [7].

Mortazavi *et al.* have reported that fluorosis prevalence is equal between boys and girls and there no meaningful statistical differences [8]. Eskandarloo has also confirmed the equality of prevalence between boys and girls [9].

Based on the fact that fluoride causes a change in the structure and color of the teeth especially maxillary centrals and accordingly effects on the appearance of the people and their social role and self-confidence and also because of the importance of epidemiologic studies in evaluation the situation of the diseases and planning how to control and cure them, this study focuses on the prevalence rate of dental fluorosis among 6-12 years old students living in Bahar town and the amount of fluoride in Bahar driking water.

Later we compare the study with one conducted by doctor Eskandarloo to determine the possible changes regarding the amount of fluoride in the drinking water of Bahar and consequently dental fluorosis rate among the same age child in this town.

METHODOLOGY

In this study, 150 CC water sample was taken from Bahar water resources, kept in PVC vessels and was sent to the health faculty laboratory of Hamedan university of medical science to measure the amount of fluoride in it. Measuring fluoride performed using SPANDS method [9, 10]. Necessary information about under study students gathered through referring to Hamedan ministry of education headquarter including the number of female and male elementary students and schools. This work was performed using a cross-sectional study and cluster – random sampling method 288 students between 6-12 years old were chosen. Exclusion criteria included:

Lack of central teeth in the mouth, students who were not born or spent their childhood in Bahar or those who use fluoride supplements [9].

To determine dental fluorosis and its intensity, dental clinical checkups done in proper light using mirror to retraction of lips, chicks and tongue also using cotton role for cleaning and drying teeth, and using explorer for touching of dental caries and damages

In order to differentiate between dental caries damages, we used the method of touching the damage in the dentine using a probe and the method of watching white spots in enamel before shaping cavities.

Dean index of dental fluorosis was used to determine the state and fluorosis intensity of teeth. Based this index, each tooth is given a "degree or number" and the highest degree or number for the affected person is among these six numbers and such a person should have at least two damaged teeth. On the other hand the records should consist at least two fluorosis teeth and if only one tooth is observed and other teeth are safe, we consider the teeth natural and safe.

The degrees of this index are:

- 0) Natural: smooth, glassy enamel with pale creamy- white translucent surface.
- 1) Questionable: A few white flocks or white spots are observed.
- 2) Very mild: Small opaque, paper white areas regularly covering less than 25% of the tooth surface.
- 3) Mild: Opaque white areas are wider but covering just less that 50% of the tooth surface.

- 4) Moderate: All tooth surfaces are affected and marked wear on surface also have brown stains.
- 5) Severe: All tooth surfaces are affected also discrete or confluent pitting with brown stains is present.

For measuring middle class FCI index, each kid is given a degree and each degree receives a mean number as the following:

- a) Degree 0, natural index, score=0
- b) Degree 1, questionable index, score= 0.5
- c) Degree 2, Very mild index, score=1
- d) Degree 3, mild index, score=2
- e) Degree 4, moderate index, score=3
- f) Degree 5, severe index, score=4

After that the total number of these who own the same degree are multiplied by the mean score of the same degree, later by dividing the total statistical product of the degrees on the total number of the visited (tested) childs we reach the numerical value of FCI [9]. (As the following formula shows):

$$FCI = \frac{\sum(\text{statistical product of degrees})}{\text{Total number of the studied kids}}$$

Statistical product=means score * number of studied kids

Through SPSS V.16.0 and mean descriptive statistics method (mean, deviation and ratio) and student t-test, chi-square, one sample t-test, gathered information analysed. Constantly $P < 0.05$ was considered as a meaningful level.

RESULTS

Fluoride rate in Bahar drinking water was 0.66 PPM and fluorosis community index or (FCI) was totally 0.5503 ± 0.4920 in a way that for upper jaw it was 0.3282 ± 0.27035 and for lower jaw it was 0.2124 ± 0.27035 which shows a meaningful statistical difference ($P=0.001$), it means that FCI level was meaningfully, in upper jaw than lower one. In this study, 9.7% of the students (11.8% boys and 7.6% girls) had dental fluorosis. No meaningful differences were observed between male and female students regarding dental fluorosis ($p=0.233$).

In the study, most of the students (90.3%) regarding fluorosis based on Dean index, were normal. Also no meaningful differences were noticed between the degree (level) of fluorosis and the sex of the students ($P=0.152$) (see table 1). Fluorosis prevalence in different upper and lower jaws teeth regarding student's sex is shown in table 2. It's necessary to know that none of the mandibular and maxillary molars were affected by fluorosis.

Table 1: Dental fuorosis prevalence in school students based on Dean index

P value	Total	Severe (5)	Moderate (4)	Mild (3)	Very mild (2)	Questional (1)	Natural (0)	Fluorosis	
								Number (%)	Sex
0.152	(100)144	(0)0	(0)0	(3.5)5	(4.2)6	(4.2)6	(88.2)127		boy
	(100)144	(0)0	(0)0	(1.4)2	(0.7)1	(5.6)8	(92.4)133	(%)	girl
	(100)288	(0)0	(0)0	(2.4)7	(2.4)7	(4.9)14	(90.3)260	(%)	total

Table 2: Dental fluorosis prevalence among school students regarding their sex

P value	Total (%)	No (%)	Yes (%)	Fluorosis			Sex
				Number (%)	Male	Female	
0.143	(100)144	(88.9)128	(11.1)16				Central
	(100)144	(93.8)135	(6.2)9	(%)	Male		
	(100)288	(91.3)263	(8.7)25	(%)	Female	total	
0.314	(100)144	(99.3)143	(0.7)1	(%)	Male		Lateral
	(100)144	(97.9)141	(2.1)3	(%)	Female		
	(100)288	(98.6)284	(1.4)4	(%)	total		
-	(100)144	(100)144	(0)0	(%)	Male		Molar
	(100)144	(100)144	(0)0	(%)	Female		
	(100)288	(100)288	(0)0	(%)	total		
0.562	(100)144	(98.6)142	(1.4)2	(%)	Male		Central
	(100)144	(99.3)143	(0.7)1	(%)	Female		
	(100)288	(99.0)285	(1.0)3	(%)	total		
0.082	(100)144	(97.9)141	(2.1)3	(%)	Male		Lateral
	(100)144	(100)144	(0)0	(%)	Female		
	(100)288	(99.0)285	(1.0)3	(%)	total		
-	(100)144	(100)144	(0)0	(%)	Male		Molar
	(100)144	(100)144	(0)0	(%)	Female		
	(100)288	(100)288	(0)0	(%)	total		

Fluorosis prevalence of different upper and lower jaws teeth in students based on Dean index and regarding their sex is in table 3. No meaningful

statistical differences were observed between the degree or level of fluorosis and the sex of the students. ($P > 0.05$).

Table 3: Dental fluorosis prevalence in school students based on Dean index regarding student's sex

P value	Total	Severe (5)	Moderat (4)	Mild (3)	Very wild (2)	Questional (1)	Normal (0)	Fluorosis		
								Number (%)	Sex	
0.055	(100)144	(0)0	(0)0	(3.5)5	(4.9)7	(2.8)4	(88.9)128	Central	Maxillary	Male
	(100)144	(0)0	(0)0	(0.7)1	(0.7)1	(3.5)5	(95.1)137			Female
	(100)288	(0)0	(0)0	(2.1)6	(2.8)8	(3.1)9	(92.0)265			total
0.510	(100)144	(0)0	(0)0	(0)0	(0)0	(0.7)1	(99.3)143	Lateral	Maxillary	Male
	(100)144	(0)0	(0)0	(0.7)1	(0)0	(1.4)2	(97.9)141			Female
	(100)288	(0)0	(0)0	(0.3)1	(0)0	(1.0)3	(98.6)284			total
-	(100)144	(0)0	(0)0	(0)0	(0)0	(0)0	(50)144	Molar	Maxillary	Male
	(100)144	(0)0	(0)0	(0)0	(0)0	(0)0	(50)144			Female
	(100)288	(0)0	(0)0	(0)0	(0)0	(0)0	(100)288			total
0.223	(100)144	(0)0	(0)0	(1.4)2	(0)0	(0)0	(98.6)142	Central	Mandibular	Male
	(100)144	(0)0	(0)0	(0)0	(0)0	(0.7)1	(99.3)143			Female
	(100)288	(0)0	(0)0	(0.7)2	(0)0	(0.3)1	(99.0)285			total
0.220	(100)144	(0)0	(0)0	(0.7)1	(1.4)2	(0)0	(97.9)141	Lateral	Mandibular	Male
	(100)144	(0)0	(0)0	(0)0	(0)0	(0)0	(100)144			Female
	(100)288	(0)0	(0)0	(0.3)1	(0.7)2	(0)0	(99.0)285			total
-	(100)144	(0)0	(0)0	(0)0	(0)0	(0)0	(50)144	Molar	Mandibular	Male
	(100)144	(0)0	(0)0	(0)0	(0)0	(0)0	(50)144			Female
	(100)288	(0)0	(0)0	(0)0	(0)0	(0)0	(100)288			total

DISCUSSION

Fluorosis is a dental defect which is the result of harmful effect of fluor ion on the building structure of teeth, in the formation phase and calcification phase and it is mostly known mottled enamel.

Based on the level of fluoride and gradual development of the teeth, fluorosis effects vary from minor color change on the surface of the tooth to severe dyeability, losing enamel, forming different cavities and changing the structure and color of the teeth, especially centrals of the upper jaw which accordingly effects on the appearance of the people and their social role and self- confidence (1 and 6).

In this study, fluoride level in Bahar drinking water was 0.06 PPM which is lower than optimal level [9]. Moreover, this level of fluoride was less than the level of fluoride in Bahar drinking water study performed by Eskandarloo (0.72PPM) [9].

Fluorosis community Index (FCI) was totally 0.55, in a way that it was around 0.32 for upper jaw and 0.21 for the lower one, so the difference between upper and lower jaws as statistically meaningful. Thus, according to Dean index, fluorosis is not considered as a social health problem in studied population living in Bahar; Hamedan.

Gopalakrishnan *et al.* in 1999, reported that fluorosis community Index (FCI) among students was 0.69 [7]. Beltran- valladares *et al.* in 2005 reported that

in school kids (elementary level) in Campeche (Mexico) was 0.7 [11]. The results of the mentioned studies don't match up with the result of the present study. In this work, 9.7% of the students (11.8% boys and 7.6% girls) had dental fluorosis.

There was no meaningful difference between fluorosis prevalence and the sex of the school students ($P > 0.05$). Based on Dean index most of the students teeth regarding fluorosis infection, were normal and no meaningful differences noticed between the level (rate) of fluorosis and the sex of the students ($P > 0.05$). None of the students had moderate or severe fluorosis (based on Dean index).

Mortazavi *et al.* and Eskandarloo reported that fluorosis prevalence is the same and equal in both boys and girls [8, 9]. Although in the present study the level of fluoride was 0.66 PPM in Bahar drinking water, 9.7% of the studied school children had dental fluorosis. Even in Eskandarloo's study, unlike this fact that mean fluoride is 0.72 PPM, the intensity of fluorosis is 24.5%. The reason for that could be much more drinking water intake or excessive consumption of none- water fluoride resources [9].

In the present study, 7.8% of central maxillaries, 1.4% of lateral maxillaries and 1% of central mandibulars were fluorosis infected, although none of the maxillary and mandibular molars were fluorosis infected. No meaningful statistical differences were noticed between the fluorosis level in central

maxillary and mandibular teeth and the sex of the school students ($P>0.05$). Burger *et al.*, Aminabadi *et al.* and Medina-solis *et al.* reported that fluorosis frequency in upper jaw teeth is more than lower ones [12-14]. Hong *et al.* and Wondwossen *et al.* have already stated that fluorosis frequency in central teeth of upper jaw is more than other teeth [15, 16].

The result of the mentioned studies don't match up with the result of the present study. In the study conducted by Eskandarloo on junior high school students living in the same town, it was reported that 24.05% of central maxillary teeth, 11.3% of lateral maxillary teeth and 8.75% of maxillary molars were fluorosis infected but the results were less in the present study [9].

Regarding lower jaw teeth, the result of the findings in this study is less than the same conducted past studies. Generally speaking, fluorosis prevalence in this study was less than the result of the findings conducted by doctor Eskandarloo in the same town. This difference could be because of the following factors:

The difference between the studied age populations, the decrease of fluoride level in the drinking water of the area, water consumption pattern changes, changes in the prescription and consumption of fluoride complements and also change in the consumption pattern of fluoride – added nutrients.

Final result

Reduction in fluorosis prevalence among 6-12 years old students in Bahar probably indicates a better management of drinking water in the area, informing the parents, the students and their health care trainers about prevention, causes, and effects of fluorosis. However, regular and periodical examinations in health centers, oral health education to parents and school students to prevent the complications of fluorosis, as well as regular follow up by dental professionals for early diagnosis of fluorosis is strongly recommended.

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