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Survey of Fluoride Concentration in Drinking Water Sources and Prevalence of DMFT in the 12 Years Old Students in Behshar City

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The aim of this study was to determine DMFT index (Decayed, Missing and Filled Teeth) in the 12 years old students in Behshar city and to determine the fluoride concentration in drinking water Sources. The survey was performed using the cross-sectional method on 300 students' selected using multi-stage sampling . The DMFT index of permanent teeth was determined, using its standard methods recommended by world Health organization. The water fluoride level was estimated in water supplies, using SPANDS method. The Annual Mean Maximum Temperature (AAMT) recorded during the last two yeas were Collected from the meteorological Center. A total number of 300 students (50% boys and 50% girls) aged 12 years and 120 water samples were assessed. The results showed that mean fluoride concentration of drinking water during one year was 0.25 ppm, which Less than normal level. The average AMMT of behshar city is 22±4°C at which the optimal fluoride in drinking water of Behshar using Galagan and Vermillion equation was calculated to be 0.8 ppm. The mean DMFT value was 1.48±0.13 and was higher in girls in comparison with boys. Results indicate that the availability of other sources of fluoride must also be considered and taken into account in the planning of programs in public health dentistry.

Key words: Fluoride, DMFT, drinking water, dental caries

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INTRODUCTION

The presence of fluoride in drinking water has been related to dental caries and fluorosis since the early studies carried out by Eager (1901), as highlighted by Dean, until now (Peres *et al*., 2003). Small amounts, in order of 1 mg L^{-1} in ingested water, are generally conceded to have a beneficial effect on the rate of occurrence of dental caries, particularly among children. On the other hand, excessive fluoride results in pathological changes in teeth and bones, such as mottling of teeth or dental fluorosis and skeletal fluorosis (Czarnowski *et al*., 1996; Hatami *et al*., 2004). It also affects human intelligence, especially in children, who are most susceptible to early toxicity (Li *et al*., 1995; Hoque *et al*., 2003). Chronic fluoride intoxication (fluorosis) occurs not only in human but also in animals, such as Cattle, buffaloes, sheep and goats (Hoque *et al*., 2003). Although fluoride has an established role in the prevention of dental caries, if its concentration is high in water and other sources, may also cause diseases. In bones, fluoride is incorporated into hydroxyl apatite to form the less soluble fluoroapatite. In higher concentrations fluoride stimulates osteoblast activity leading to an increase in cancellous bone mass. The dental caries was registered with the use of the DMFT (Decayed, Missing and Filled Teeth) index (Hatami *et al*., 2004; Allolio and Lehmanm, 1999).

There is only a narrow margin between the desired and harmful doses of fluoride (WHO, 1997). The fluoride intake in the general population derives chiefly from drinking water and dietary sources. It is now generally agreed that the optimal fluoride level in drinking water is in the range 0.7-1.2 mg L^{-1} for temperatures between 50 and 90°F (Peres *et al*., 2003; WHO, 1994). In many communities where the level is low, a controlled addition of fluoride to drinking water supplies is conducted. On the Contrary, localities where the water fluoride is excessive measures and taken to reduce its Concentration to the recommended level (Allolio and Lahmanm, 1999).

The aim of this study was to determine the fluoride level in water supplies of Behshar city in Mazandaran province in the north of Iran. And also to determine the dental caries Prevalence with using of the DMFT index in the 12 years old students were chosen because they represented those children receiving the benefits of systemic fluoride during tooth formation (Hatami *et al*., 2004). The Annual Mean Maximum Temperature (AMMT) recorded during the last two years were collected from the meteorological centre of Behshar city.

MATERIALS AND METHODS

The survey was performed using cross-sectional design. A total number of 300 students based on sample estimation formula (50% boys and 50% girls) aged 12 years were examined. People were selected by visiting all the guidance schools, the share of each school was determined according to students' registration. Respecting the number of students of different classes, the shares of each school were determined using systematic random sampling. The examination was performed by a dentist, using mirror and in sunlight. The aim was to assess the permanent teeth status respecting DMFT index and fluorosis rate. The DMFT index was determined using its standard form suggested by WHO (1994).

The fluoride concentration in water was measured by collecting water samples from 10 water supplies. Samples were in 1 L plastic bottles and were analyzed according to SPANDS method (APHA, 1998). One hundred and twenty water samples were collected from water supplies. The optimal level of fluoride content in drinking water has traditionally been calculated on the basis of Annual Mean Maximum Temperature (AAMT) and varied from 0.7 to 1.2 ppm depending on the temperature and climate of the region. These standards were based on the Galagan and Vermillion (Galagon *et al*., 1956), which estimated the daily water intake under different temperature conditions. The original metric units employed by Galagan and Vermillion can be converted to SI units. The equation to calculate the optimal level of fluoride in drinking water (mg L^{-1}) is:

$$\text{Optimal fluoride concentration (mg L}^{-1}\text{)} = \frac{0.022}{0.0104+0.000724\times AMMT}$$

Where AMMT is the Annual Mean Maximum Temperature in centigrade. The present data were registered in an informative format. The informative format data were classified, extracted and analyzed with using of ANOVA. The prevalence of DMFT was determined in the samples and its real rate (confidence interval) with 95% probability was estimated in the population and the role of sex on DMFT occurrence was assessed. This research has been conducted in North of I.R. of Iran in 2005.

RESULTS

The results showed that fluoride concentration in 120 water samples from different sources ranged from 0.12 to 0.39 mg L^{-1} with a mean 0.25±0.06 mg L^{-1}. The fluoride

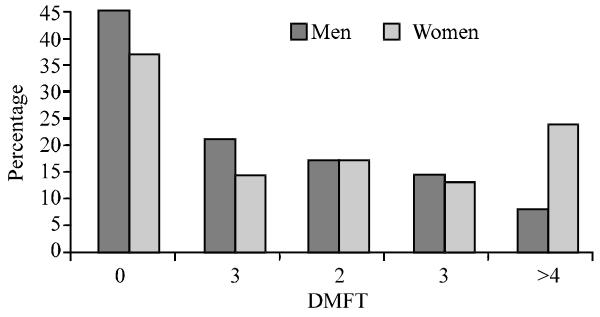

Fig. 1: Distribution of school children girls and boys at 12 years old according to the DMFT index in Behshar city

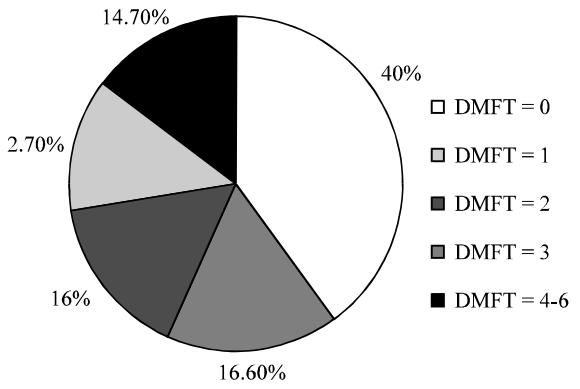

Fig. 2: Distribution of school children girls and boys at 12 years old according to the DMFT index in Behshar city

Table 1: DMFT indexes in the 12 years old students in Behshar city

Index* Sex	DT (Decayed Teeth)	MT (Missed Teeth)	FT (Filled Teeth)	DMFT**
Boy	1.11±0.15	0.00+0.00	0.11±0.08	1.21±0.16
Girl	1.6±0.18	0.013±0.013	0.13±0.06	1.75±0.19
Total	1.35±0.12	0.07±0.07	0.12±0.05	1.48±0.13
p-value	<0.04	NS***	NS***	<0.033

* Mean, **DMFT = Decayed, Missing, Filled Teeth, ***NS = statistically non-Significant difference

level was less than the standard limit (0.7-1.2 ppm) in all the drinking water supplies. In order to calculate the optimal level of fluoride in drinking water of Behshar city by Galagan and Vermillion equation, AMMT records during the last two years (2003-2004) were collected from meteorological centre of Behshar and it was 22±4°C. According to Galagan formula, the recommended optimal fluoride in drinking water in Behshar should be 0.84 ppm.

The survey was performed on 300 students of which 150 were girls and 150 were boys (Table 1). The mean DMFT was 1.21±0.16, 1.75±0.19 in boys and girls, respectively and totally was 1.48±0.13. Fig. 2 shows that the mean DMFT values in boys has been varied significantly in comparison with girls ($p<0.05$). Also, the mean DT values in boys and girls was significantly different but the mean MT and FT values in boys and girls had not significant difference.

Figure 1 and 2 show that the percentage of school children at 12 years old according to the DMFT index. The results of the questionnaire showed that 54% students had consulted and visited dentist. Also, 38.67% students brushed their teeth twice or more than a day, 41.33% once a day, 7.33% once two days, 1.67% once a week and 2% didn't use tooth-brush at all. There was no significant difference between DMFT value and dentists consult number.

DISCUSSION

The survey showed that mean DMFT value was 1.21±0.16 in boys and 1.75±0.19 in girls, totally was 1.48±0.13. The mean DMFT value of the girls was more than of boys. Mahyaee (2000) had reported the DMFT prevalence to be 2.98±1.95 in the 12 years old students of Baboul town and also the DMFT value was more in girls than in boys. Other researcher had reported the DMFT prevalence to be 1.8±1.73 in the students aged 13±3 years. They had reported that the DMFT value was 1.65±1.76 in boys and 1.98±1.67 in girls. The mean DMFT value of the girls was more than that of boys (Ramezani *et al*., 2004). In other survey in Mashad, the DMFT has been reported to be 2.42±2.28, 2.32±2.34 in boys and 2.52±2.12 in girls (Yousefi, 1995).

In this survey, similar to the above mentioned studies, DMFT was more in girls than in boys. One of the WHO goals for the years 2000 to 2010 is DMFT at 12 years old children equal or less than which should be 3 and 1, respectively. Therefore, the percentage of school children at 12 years old who did not meet the WHO goals for the year 2000 to 2010 is 14.7 and 43.4%, respectively. DMFT average in this study is less than WHO goals for the year 2000 but it is more than WHO goals for the year 2010. This survey has shown that there is no fluorosis.

Majidi (1995) reported 8.3% moderate fluorosis and 91.7% sever fluorosis in 12 years old girls. In the same age-group boys showed 9.8% moderate fluorosis and 90.20% severe fluorosi.

Eflekhare and Mazloum (1999) had reported fluorosis rate to be 76% in Larestan town and its suburb in 1996-1997, the related prevalence was 72% in boys and 62% in girls. In all of the above mentioned surveys, a direct relation between water fluoride content and DMFT and fluorosis prevalence has been observed. In regions such as Dayer and Larestan water fluoride level is higher than permitted limit and weather is warmer. The daily

water consumption is high and fluorosis prevalence is high. Due to high water fluoride concentration, systemic complications such as hyperparathyroidism and bone problems like spontaneous fracture of the bones may occur. Dental fluorosis is the most common effect of high water fluoride concentration (Ramezani *et al*., 2004).

This survey showed that the fluoride level in drinking water was 0.25 ppm in Behshar city, which was less than the permitted limit according WHO guidelines. Ramezani *et al*. (2004) had reported mean fluoride concentration of drinking water 2.43±0.23 ppm which was higher than permitted limit. Eftekhari and Mazloum (1999) had reported drinking water fluoride concentration to be 1.2±0.68 in Larestan and its suburb in 1996-1997.

As statistically significant difference was found for DMFT between boys and girls. As fluoride absorbed from different sources such as milk, tea and food, therefore, it is important that each country calculates its own optimal level of fluoride in drinking water in accordance to the dose-response relationship of fluoride in drinking water with the levels of caries and fluorosis. Climatic conditions, dietary habits of the population, fluoride exposures also need to be considered in formulating these recommendations.

The number of visits to dentist did not increase the DMFT. Present results indicate that availability of other sources of fluoride must also be considered and taken in to account in the planning of programs in public health dentistry.

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