ORIGINAL ARTICLE

CONCENTRATION OF FLUORIDE IN DRINKING WATER OF CERTAIN AREAS OF LAHORE AND ITS RELATIONSHIP TO THE SEVERITY OF FLUOROSIS

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ABSTRACT

Fluoride contaminated drinking water is a global problem affecting more than 25 nations and over 200 million people globally. The present study was aimed to determine the fluoride concentration in the drinking water of certain areas of Lahore (Manga Mandi, Ali Razaabad, Nawab town, Patoki, Multan road, Judicial colony, Dubai town, Mustafa town) and its relationship to dental fluorosis. A total of 300 patients with dental fluorosis were seen and dental fluorosis was observed using Dean's index. Forty eight samples of drinking water from the patients presenting clinical dental fluorosis were collected randomly. Fluoride concentration in the drinking water was determined through the courtesy of Pakistan Council of Research in Water Resources (PCRWR) using SPADNS method and fluorosis was determined by using Dean's index. The results show that all the patients with dental fluorosis were living in areas where fluoride concentration in drinking water ranged from 0.27 ppm to 7.4 ppm. It was concluded that dental fluorosis seen in patients was directly proportional to the fluoride concentration in their drinking water. This indicates that dental fluorosis is the result of high fluoride in the body and it can affect teeth, bones as well as other tissues resulting in serious illness. It should be taken seriously by the concerned authorities to save humanity from the detrimental effects of fluoride. Serious measures are needed for providing clean drinking water to inhabitants of the area.

Key words: *Dean's index, Dental fluorosis, inhabitants, PCRWR, SPADNS method*

INTRODUCTION

Fluorine, a naturally occurring element, exists in combination with other elements as a fluoride compound and is found as a constituent of minerals in rocks and soil.[1] Fluoride occurs in most springs, wells, sea water, and plants. Fluoride is present in traces in all surface and underground waters. Fluoride contained in drinking water is commonly the largest single contributor to the daily fluoride intake.[2] Fluoride is also found in various concentrations in different foods like Sea food, Rock salt, Tea, Leafy vegetables like cabbage and lettuce.[3] Air borne Fluoride emissions are heaviest in the vicinity of industries involved in the production of aluminum, from cryolite or phosphate fertilizers. Fluoride content in soft drinks and mineral water reflects the same levels of water from which they are produced. Human breast milk has low fluoride 0.002 mg/l, in human plasma it is 0.017mg/l, in cow's milk 0.12ppm and in formula milk it ranges between 1.95ppm and 7.45ppm. Some pharmaceutical products (NaFl tablets, vitamin pills), fluoride dentifrices, fluoride gels and solutions widely used for caries prevention also contain fluoride.

Over the past 50 years, the prevalence of dental fluorosis has increased quite dramatically and with this increase, esthetic concern pertaining to fluorosis has to be taken into consideration.[4, 5, 6] More than 50 percent of infants are currently formula fed by 1 month of age, and these infants are likely to be continuously exposed to high intakes of fluoride for 9 to10 months - a circumstance quite rare in the 1960s and 1970s.[7, 8.]

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The Optimum fluoride levels for water in temperate climate is 1ppm and for Pakistan about 0.39 ppm approximately.[10] For warmer and colder climates, the amount can be adjusted from approximately 0.7ppm to 1.2ppm adapted according to the amount of water consumed (WHO).[11] Estimated daily intake of fluoride from food and water is 1.7-3.3mg, which varies among nations.[2] On one hand, fluoride is added to drinking water in small quantities to prevent dental caries while on the other hand, fluoride is a carcinogen, a bone seeker and is linked to dental fluorosis, hip fractures and brittle bones [(12).] Research of several investigators during the last 5–6 years has proved that life-long impact and accumulation of fluorides causes not only human skeletal and teeth damage, but also changes in the DNA-structure, paralysis of volition, cancer, etc.[13]

There is growing evidence which indicates that the prevalence and in some cases, the severity of dental fluorosis is increasing in both fluoridated and non-fluoridated regions. This trend is highly undesirable for several reasons. It increases the risk of esthetically objectionable enamel defects, in more severe cases; it increases the risk of harmful effects to dental function and jeopardizes the perception of the safety. [14]

Dental fluorosis occurs because of the excessive intake of fluoride either through fluoride in the water supply, naturally occurring or added to it, or through other sources. The damage in tooth development occurs between the ages of 3 months to 8 years from overexposure to fluoride. Excessive fluoride can cause white spots, and in severe cases, brown stains or pitting of enamel. Although it is usually the permanent teeth which are affected, occasionally the primary teeth may be involved.[15] Healthy as well as individuals who are immune-compromised (e.g., AIDS, transplant, and bone-marrow-replacement patients) could be at greater risk of the immunologic effects of fluoride. It is an evidence of fluoride's potency and ability to cause physiologic changes within the body, and raises concerns about similar damage that may be occurring in the bones and other tissues.

The Main objective of this study was to determine the concentration of fluoride in drinking water of the areas near The University of Lahore and to determine the relationship between fluoride concentration in drinking water and the severity of fluorosis of teeth and other physiological effects of fluoride.

METHODOLOGY

This study was carried out from March 2010 to April 2011 to find out concentration of fluoride in drinking water and its relationship to the severity and incidence of dental fluorosis among the patients visiting The University of Lahore Dental Hospital. Forty eight water samples were collected from areas surrounding The University of Lahore where patients were living namely (Manga Mandi, Ali Razaabad, Nawab town, Patoki, Multan road, Judicial colony, Dubai town and Mustafa town) (Fig 1). Samples were stored in thoroughly cleaned 500 ml plastic bottles at room temperature. Water samples were transferred to Pakistan Council of Research in Water Resources (PCRWR) same day to avoid any temperature changes.

Determination of fluoride concentration in drinking water by SPADNS Method

This method relies on the fact that when fluoride reacts with certain zirconium dyes, a colorless complex anion and a dye are formed. The complex, which is proportional to the fluoride concentration, tends to bleach the dye which therefore becomes progressively lighter as the fluoride concentration increases. In the case of the fluoride ion reaction with Zr-SPADNS (sodium 2-(para sulphophenylazo-)-1, 8-dihydroxy-3, 6-naphthalene disulphonate), the resulting colored complex is measured in a spectrophotometer at 580 nm. Fluoride concentration was determined in all water samples. Experiments were repeated thrice at the same time for all water samples and average fluoride concentration was calculated.

Determination of dental fluorosis using Dean's Index

The study population consisted of 300 patients presenting dental fluorosis and visiting the University of Lahore dental hospital for aesthetic concerns. These patients were separated and specified history forms filled. It included 125 (42 %) males and 175 (58 %) females. Oral examination was carried out for clinical dental fluorosis. Natural light was used for clinical examination. Teeth were examined wet and a clinical periodontal index for treatment need (CPITN) periodontal probe was used to remove food debris and exclusion of any carious lesion or cavitations.

Dean's index for fluorosis determination was used to indicate the level of fluorosis in the patients. The examiner stood in front of the patient to inspect the

teeth along a horizontal plane, noted the distribution pattern of any defects and decided if they were typical of fluorosis. Dean's index was scored on the condition of the two most severely affected teeth. In the present study, patients having questionable fluorosis were considered as having no fluorosis. Then the patients with very mild, mild, moderate and severe fluorosis were noted and tabulated. Detailed history was also taken to find out other risk factors in fluorosis. During examination, one more dentist was involved to confirm the clinical severity of dental fluorosis.

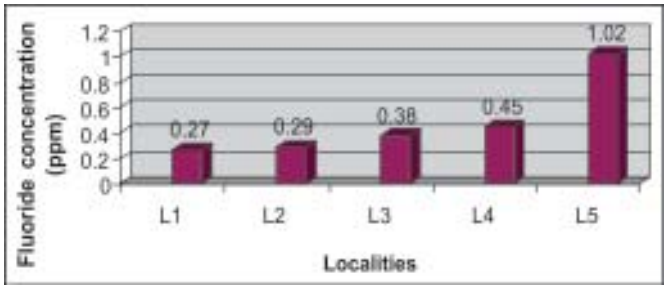

Fig 1: Variations of fluoride at different locations L1-L5

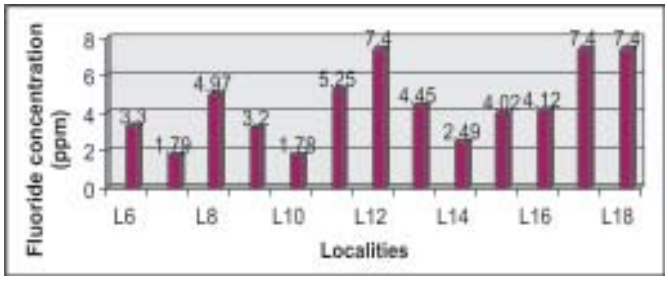

Fig 2: Graphic representation of fluoride concentrations in water samples from various localities L6-L18

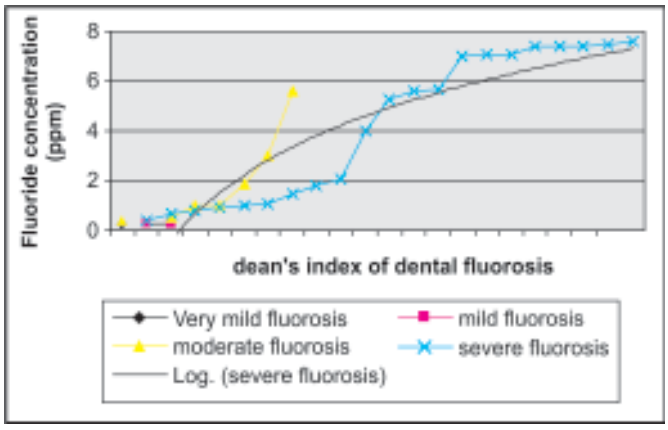

Fig 3: Proportion of the concentration of fluoride and dental fluorosis

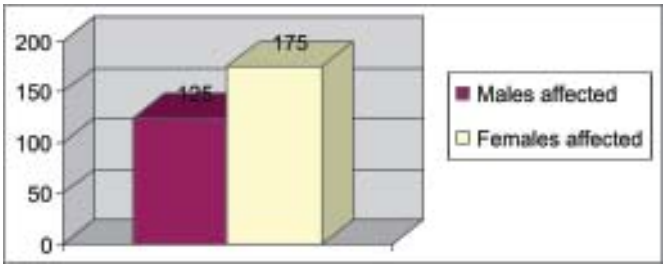

Fig 4: Prevalence of dental fluorosis in male and female patients

TABLE 1: CONCENTRATION OF FLUORIDE IN WATER AND THE SEVERITY OF FLUOROSIS IN THE PATIENTS SEEN.

Concentration of fluoride in water (ppm)	Severity of dental fluorosis
0.27	Very mild fluorosis
0.29	Mild fluorosis
0.29	Mild
0.38	Mild
0.51	Mild
0.98	Mild
1.0	Mild
1.9	Mild
2.98	Mild
5.6	Mild
0.4	Moderate
0.67	Moderate
0.81	Moderate
0.95	Moderate
1.02	Moderate
1.08	Moderate
1.5	Moderate
1.78	Severe fluorosis
2.1	Severe fluorosis
3.98	Severe fluorosis
5.25	Severe fluorosis
5.6	Severe fluorosis
5.65	Severe fluorosis
7.0	Severe fluorosis
7.05	Severe fluorosis
7.05	Severe fluorosis
7.4	Severe fluorosis
7.4	Severe fluorosis
7.45	Severe fluorosis
7.6	Severe fluorosis

RESULTS

Fig 1 shows the concentrations of fluoride in water samples from various locations ranging between 0.27ppm to 1.02 ppm.

SPADNS method to determine the concentration of fluoride in drinking water was carried out. From the results obtained it can be seen that the patients are living in area where drinking water has fluoride concentration within the WHO limits and are prone to fluorosis.

Fig 2 provides the concentrations of fluoride in water samples from various locations ranging between 1.78 ppm to 7.5 ppm. All samples were analyzed 3 times.

SPADNS method to determine the concentration of fluoride in drinking water was carried out. From the results obtained it can be seen that the patients are living in the areas where drinking water has high fluoride concentration which is far more than the WHO recommended limit, resulting in dental fluorosis.

From Fig 3 it can be seen that concentration of fluoride in water is directly proportional to the severity of dental fluorosis (Dean's Index) in the patients seen. Patients drinking high fluoride containing water have more severe form of fluorosis and Low fluoride concentration caused mild fluorosis.

Figure 4 gives prevalence of dental fluorosis among the patients seen in the OPD of the Dental Hospital. 300 patients were seen with dental fluorosis. Out of 300, female patients with dental fluorosis were 175, and male patients were 125. A comparison between male and female patients revealed that fluorosis incidence was higher in females than in males.

Table 1 shows the concentration of fluoride in the water samples and dental fluorosis seen in those patients. It clearly shows that on average, the fluorosis is severe in patients drinking highly fluoridated water than those drinking low fluoridated water with few exceptions.

DISCUSSION

The present study tried to find out the risk factors like fluoridated water, and the severity of fluorosis among the patients visiting the University of Lahore, Dental Hospital.

Recent studies have revealed that certain areas of Pakistan have high fluoride concentration in drinking water. This high concentration is affecting population living in these areas causing dental as well as skeletal fluorosis.[16, 17, 18, 10, 19] These elevated levels of fluoride are putting the population at a high risk of dental and skeletal fluorosis and other severe problems associated with fluoride. It still remains a serious problem in Pakistan like other developing countries and many developed countries of the world including Europe and USA.

Evidences using Dean's index are now available which indicate that the prevalence of enamel fluorosis has increased in both fluoridated and non-fluoridated areas.[20] Present study was carried out in order to highlight this problem which is directly related to human health and could cause devastating physiological and psychological impact on population living in certain areas and are affected by drinking water with high fluoride concentration.

In this study 48 water samples were collected from the patients presenting dental fluorosis and seeking treatment to improve their aesthetics. All the water samples were analyzed from the Pakistan Council of Research in Water Resources (PCRWR) for the determination of fluoride concentration using SPADNS method. Results showed the presence of high fluoride concentration in drinking water samples, ranges between 0.28 ppm to 7.4 ppm. In Water samples collected from localities L1-L5, the fluoride concentration ranges between 0.28 ppm to 1.02 ppm. These results show that the patients are living in an area where drinking water has fluoride concentrations within or slightly more than the limitations of fluoride for Pakistan (0.39 ppm) determined by O'Mullane D et al [10] but within the limits of WHO (0.7 ppm-1.2 ppm) thus resulting in dental fluorosis. Where as the water samples collected from localities L6-L18 (fig. 2) showed the presence of fluoride concentration ranging between 1.78 ppm to 7.4 ppm which is far above the recommended limits of WHO, confirming the role of fluoride in causing dental as well as other effects of fluorosis on body tissues.

Dean's index for dental fluorosis was used to indicate the level of fluorosis in the patients. It was scored

on the condition of the two most severely affected teeth. Data collected shows that high fluoride concentration caused severe dental fluorosis (fig 3 and table 1, Results) and even in many cases, patients complained of having body ache, back pain, and joint pain. Also it is seen that the harmful effects are directly proportional to the concentration of fluoride in the drinking water, more the concentration of fluoride in water, severe the form of dental fluorosis as well as more complaints of the skeletal tissue involvement.

A comparison between male and female patients revealed that fluorosis incidence was higher in females than in males. This may be due to the fact that females are more concerned about their aesthetics than males and they want some treatment to be done to improve aesthetics.

Endemicity of fluorosis in these areas also indicates that the drinking water here is contaminated due to industrial pollution (Chemicals, textiles, fertilizers). The Government and Higher Authorities of the area should take necessary measures to control or prevent fluorosis and its effects on the body tissues by controlling the risk factors.

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