

SHORT COMMUNICATION

Prevalence of dental fluorosis among school children in Thirunagar, Madurai

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Abstract

Questionnaire prepared from children studying in Ananth Matriculation School and Middle School located in Thirunagar revealed symptoms of hydro-fluorosis. Water samples of the residential areas of the school children namely, Thirunagar were collected and analyzed for pH, fluoride, chloride ion, total hardness, total dissolved solids, and trace metals. From the results, it has been understood that the increase in fluoride content of water than the allowable limit resulted in dental fluorosis among school children. The pH of the water samples was found to be weak basic and the trace amounts of dissolved solids were also observed. A simple deionization process was proposed for village people to minimize the fluoride ion concentration in drinking water.

Keywords: Hydro-fluorosis, pH, fluoride, chloride, total hardness, total dissolved solids, deionization.

Introduction

Growth of industries creates opportunity for millions of people to perceive jobs and most public requirements are fulfilled to lead a comfortable and luxurious life. But on the other hand, more toxic substances are given off as industrial effluents, by these industries, in the form of dusts, fumes, vapour and water (Grobler *et al.*, 2009; Demos *et al.*, 2001). In recent years, many studies were conducted to determine the prevalence of dental fluorosis (Heller *et al.*, 1997). The occurrence of fluorosis depends on the exposure to fluoride from various sources such as water, dietary supplements, etc. (Burt, 1992; Whitford, 1996). Although there are several sources of fluoride intake, it is estimated that 60% is through drinking water (Rao and Mahajan, 1998).

The fluoridated water was generally regarded as a safe, simple and cost-effective measure to prevent dental caries (Burt, 1992). However, a too high fluoride concentration in drinking water will lead to dental fluorosis. The relation between dental fluorosis and fluoride concentration in drinking water has been explored (Grobler *et al.*, 2009). Generally, surface water is not contaminated with fluoride; whereas ground water may be contaminated with fluoride because of the fluoride in fluoride rich rocks. When water percolates through rocks it leaches out the fluoride from these rocks such as fluorspar, cryolite, fluorapatite, etc. (RGNDWM, 1993). Children of 0 to 12 years are most prone to fluorosis as their body tissues are in formative/ growth stage during this period.

A national survey of school children showed that 13.5% to 41.4% of the school children were affected by Dental fluorosis, depending on the fluoride level in water (Jayanth and Philip, 1998). Against these backdrops, this study was aimed to analyze the relationship between the dental fluorosis among school children and the fluoride concentrations in the drinking water. A simple deionization process was also proposed for village people to minimize the fluoride ion concentration in drinking water.

Materials and methods

Survey among school children: A systematic survey was undertaken among school children belonging to Ananth Matriculation School and Middle School located in Thirunagar, Madurai. A questionnaire was prepared and provided to children having symptoms of dental fluorosis. It revealed their residence, parent's occupation, income, food habits and the type of water they use for drinking purpose since water forms the main source of fluoride ion.

Water analysis: Eight water samples used by the people including school children for drinking as well as cooking purposes were collected for analysis. All the eight samples were subjected to systematic analysis such as fluoride ion content, chloride ion content, pH, total dissolved solids, total hardness and trace metals.

Fluoride ion content: Fluoride ion content was determined by the zirconium-alizarin colorimetric method

according to Villena *et al.* (1996). To 100 mL of the sample, 5 mL of zirconium-alizarin reagent was added and mixed well and placed for 1 h. It was then compared with the colour of the standard solution (0.221 g of dry sodium fluoride dissolved in distilled water).

Chloride ion content: The chloride ion content of all water samples were determined by Mohr's method as followed by Ranganna (1977).

pH: pH values of the water samples were determined using analog pH meter (systronic make) (Ranganna, 1977).

Total Dissolved Solids: Total dissolved solids (TDS) of each water sample were determined by evaporating a definite weight of water sample and weighing the residue obtained (Ranganna, 1977). 50 mL of each water sample was evaporated in a china dish on a water bath after filtering. The residue was dried up in air-oven at 110°C for about half an hour, cooled in a dessicator and weighed.

Total hardness: Total hardness of all water samples were determined by EDTA method of Ranganna (1977).

Deionization process: A specially designed earthen pot having a hole at the centre of the bottom is required. The pot was filled with a layer of Charcoal. A layer of coarse sand is laid above that. When water with high fluoride content is filled in the pot, the water with reduced fluoride trickles down the hole at the bottom (Agarwal, 1997).

Results and discussion

Fluorosis continues to be an endemic problem in India. More and more areas are being discovered regularly affected by fluorosis in different parts of the country (Gupta, 1999). The present study aimed at a survey for analyzing the dental fluorosis in school children near Thirunagar area, Madurai. In Ananth Matriculation School (Std. 1 to 5), out of the 234 students 71 students were found to be affected by fluorosis (32.3%).

Fig. 1. A child with dental fluorosis in Ananth Matriculation School.

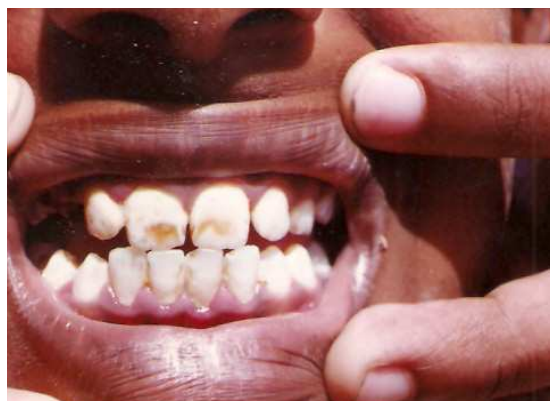


Fig. 2. A child with dental fluorosis in Middle School.



Thirty eight boys and 33 girls were affected respectively. The percentage of boys affected by fluorosis (17.2%) was high compared to girls (15%) (Table 1). In middle school (Std. 1 to 4), out of the 318 students, 70 students were affected by fluorosis (Table 2). Photographs of a few cases of dental fluorosis in these schools are depicted in figure 1 and 2. Jayanth and Philip (1998) have reported that the children were most prone to fluorosis when compared to the adults.

Table 1. Survey data on dental fluorosis in Ananth Matriculation School, Thirunagar.

Standard & Age	No. of student surveyed	No. of student affected	Percentage affected	No. of Boys	Percentage affected	No. of Girls	Percentage affected
I (5 years)	37	8	21.6	4	10.8	4	10.8
II (6 years)	36	12	33.0	7	19.4	5	13.8
III (7 years)	52	15	28.8	6	11.5	9	17.3
IV (8 years)	62	19	30.6	13	20.9	6	9.6
V (9-10 years)	47	17	36.1	8	17.0	9	19.1

Table 2. Survey data on dental fluorosis in Middle School, Thirunagar.

Standard & Age	No. of students surveyed	No. of student affected	Percentage affected	No. of Boys	Percentage affected	No. of Girls	Percentage affected
I (5 years)	92	15	16.3	9	9.7	6	6.3
II (6 years)	71	19	26.7	12	16.9	7	9.8
III (7 years)	73	19	26.0	10	13.6	9	12.3
IV (8 years)	82	17	20.7	11	13.4	6	7.3

Table 3. Physico-chemical characterization of water samples.

Sample	pH	Fluoride ion content (ppm)	Chloride ion content (mg/L)	TDS (mg/L)	Total hardness (mg/L)
1	7.5	1.3	50	3294	256
2	7.2	0.9	430	2540	2520
3	7.5	1.4	162	868	776
4	7.2	0.5	220	1126	1000
5	7.9	1.3	630	2218	700
6	7.5	0.8	98	622	644
7	7.1	1.4	226	1052	1000
8	7.3	0.9	480	2496	1800

Children indicated the existence of dental fluorosis from the detailed survey among the two schools. So the potable water contaminated with fluoride was suspected to be the cause of fluorosis prevailing in this area since Rao and Mahajan (1998) has evidenced the drinking water is considered to be the major source for fluoride intake. The systematic analysis of drinking water samples collected from Thirunagar and surrounding area was analyzed for fluoride ion, chloride ion, trace metals and hardness. The various levels of pH, fluoride ion content, total dissolved solids, total hardness and chloride content are presented in Table 3. The fluoride ion content of water samples ranged from 0.5 ppm to 1.4 ppm (Table 3). The fluoride ion content should be within 0.5 to 1.0 ppm as suggested by WHO (1984). It has been observed that the fluoride concentration is founded to be increased than the normal levels. Hence, it is proven to be one of the major carriers of fluorosis. The results found in accordance with Grobler *et al.* (2009). Among the 8 samples analyzed, maximum amount of fluoride ion content was found in sample 3 and 7. The minimum amount was found in the sample 4. The samples 3 and 7 were founded as bore water. Previously RGNDWM (1993) hypothesized that the underground water were contaminated with fluoride while they are leached through fluoride rich rocks.

As the school children are affected from dental fluorosis they can be advised to include in their daily diet, a protein rich food (with calcium, vitamin C, wheat, jaggery, Bengal gram, ragi etc.) (Cerklewski, 1997). Fluorides cannot be reduced by boiling the water or simple chemical process. Several projects like Nalgonda process, activated alumina process, electro dialysis, Krass process, etc., exist to remove fluoride from drinking water (Nawlakhe *et al.*, 1975; Rubel and Woosely, 1979; Gupta *et al.*, 1999). But they need costly treatment plants. It was not affordable for ordinary people. So, a very simple 'Deionization process' was tried by us. This is possible because of deionizing capacity of charcoal. This method was found to yield a reduction of about 20% of the fluoride in the drinking water available in Thirunagar (data not shown). This method is the cheapest deionization method proposed by Agarwal (1997).

Conclusion

Survey among school children studying in Ananth Matriculation School and Middle School located in Thirunagar revealed symptoms of hydro-fluorosis. The water samples were collected and analyzed for pH, fluoride, chloride ion, total hardness, total dissolved solids, and trace metals. The results revealed the prevalence of dental fluorosis among school children. The pH of the water samples was found to be weak basic and the trace amounts of dissolved solids were also observed. A cheap deionization process was proposed for village people to minimize the fluoride ion concentration in drinking water.

References

1. Agarwal, K.C. 1997. Study of Dental fluorosis in Rampura village and new low cost Defluoridation Technology. Master of Engineering dissertation submitted to MREC, Hyderabad.
2. Burt, B.A. 1992. The changing patterns of systemic fluoride intake in children. *J. Dent. Res.* 71: 1228-1237.
3. Demos, L.L., Kazda, H., Cicuttini, F.M., Sinclair, M.I. and Fairley, C.K. 2001. Water fluoridation, osteoporosis, fractures: recent developments. *Aust. Dent. J.* 46: 80-87.
4. Grobler, S.R., Louw, A.J., Chikte, U.M.E., Rossouw, R.J. and Kotze, T.J.W. 2009. The Relationships between Two Different Drinking Water Fluoride Levels, Dental Fluorosis and Bone Mineral Density of Children. *Open Dentistry J.* 3: 48-54.
5. Gupta, S.K. 1999. Environmental Health Perspective of Fluorosis in Children. Ph.D Thesis submitted to University of Rajasthan, Rajasthan.
6. Gupta, S.K., Gupta, A.B., Dhindsa, S.S., Seth, A.K., Agrawal, K.C. and Gupta, R.C. 1999. Performance of a Domestic filter based on KRASS defluoridation process. *J. IWWA.* 3(31): 193-200.
7. Heller, K.E., Eklund, S.A. and Burt, B.A. 1997. Dental caries and dental fluorosis at varying water fluoride concentrations. *J. Public. Health Dent.* 57: 136-143.
8. Jayanth, V.K. and Philip, A.S. 1999. Fluoride exposure and dental fluorosis in Newburgh and Kingston, New York: policy implications. *Commun. Dent. Oral Epidemiol.* 27: 171-180.
9. Nawlakhe, W.G., Kulkarni, D.N., Pathak, B.N. and Bulusu, K.R. 1975. Defluoridation of Water by Nalgonda Technique, *Ind. J. Environ. Health.* 17: 26.
10. Ranganna, S., 1977. Manual of Analysis of fruit and vegetable products. Tata Mc Graw-Hill publishing company Ltd, New Delhi, pp. 331-380.
11. Rao, V.K. and Mahajan, C.L. 1990. Fluoride content of some common South Indian foods and their contribution to fluorosis. *J. Sei. Food. Agric.* 51(2): 275-279.
12. RGNDWM. 1993. Prevention & Control of fluorosis in India. Water Quality and Defluoridation Techniques, Volume II, Published by Rajiv Gandhi National Drinking Water Mission, Ministry of Rural Development, New Delhi, 1993.
13. Rubel and Woosely, R.D. 1979. The Removal of Excessive Fluoride from Drinking Water by Activated Alumina. *J. AWWA.* 71(1): 45-49.
14. Villena, R.S., Borges, D.G. and Cury, J.A. 1996. Evaluation of fluoride content of bottled drinking waters in Brazil]. *Rev-Saude-Publica.* 30(6): 512-518
15. Whitford, G.M. 1996. The metabolism and toxicity of fluoride. New York, Karger.
16. WHO. 1984. Guidelines for Drinking Water Equality, World Health Organisation, Geneva. 2: 249.