Fluorosis in Relation to Nutrition, Fluoride in Drinking Water and Socio Economic Background in Agastheeswaram Union, India

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Abstract - A cross-sectional survey of 12,485 people of both sexes living in 25 villages of Agastheeswaram Union, India was conducted to correlate the prevalence of fluorosis with nutritional status, socioeconomic and academic background and occupation. The highest incidence of dental fluorosis was observed among the daily wagers (21.9%) followed by farmers (20.5%), house wives (19.9%), students (17.3%), private sector employees (8.5%) and government employees (5.4%). Fluoride (F) levels were determined in 51 randomly sampled water sources in 25 villages of 10 fluorotic areas of Agastheeswaram Union using a fluoride ion selective electrode. Nearly all the samples had elevated fluoride concentrations ranging from 1.3 to 2.7 mg/*l* which were capable of causing health risk to the community. These data pertaining to the relationship of dental and skeletal fluorosis with nutritional status, socio-economic background, fluoride content of drinking water source and occupation were statistically analysed and found to exhibit high positive correlations. A level of 2.5 mg/*l* of fluoride was found to be a critical threshold manifestation of crippling skeletal fluorosis. However defluoridation along with improved nutrition rich in calcium should be recommended for the people of these villages.

Keywords: Fluoride, Fluorotic area, Dental and skeletal fluorosis, Endemic.

I. INTRODUCTION

According to Government estimates, approximately 66 million people in India are at risk of fluorosis, which is more than 5 percent of the total population (1). Besides damaging bone and teeth, excessive intake of fluoride is known to cause a wide range of adverse health (2).

Although the primary factor for causing fluorosis is undoubtedly consumption of water containing large amount of fluoride, over several years reported evidences suggest that even certain factors such as socio economic background, consumption of tea and tobacco also can add on to the body burden fluoride. Hence the present investigation was undertaken to know the effect of the above said factors on the prevalence of fluorosis in Agastheeswaram Union of Kanyakumari district and also to determine the fluoride levels in domestic water sources of the same area to evaluate the potential risk of fluorosis to the people using these waters.

II. MATERIALS AND METHODS

A door to door survey was conducted using a pretested questionnaire to record the data regarding age, sex, academic qualification, occupation, food habits, source of water and dental complaints inorder to determine the presence or absence of dental fluorosis to normal, questionable, very mild, mild, moderate, moderately severe and severe using Dean's index (3).

A total of 51 water samples were collected from different water sources selected randomly in the study region. Water samples were analysed for fluoride within 24 hours of collection. A fluoride ion selective electrode (Orion 9609 BNWP) was used with TISAB-II solution in a 1:1 volume ratio with the samples. For calibration standard solutions containing 0.1, 1.0, 10.0, 100.0 ppm fluoride prepared by serial dilution of a 1000 ppm fluoride stock solution with de-ionised water were employed (4).

III. RESULTS AND DISCUSSION

The overall prevalence of dental fluorosis in the study area was 50.02%. The prevalence of dental fluorosis cases was higher in female (52.45%) when compared to male (47.54%) (Table 1). Further it was clear that a great majority of affected people (41.2%) were showing a very mild type of fluorosis.

The percentage distribution of the dental fluorosis cases noticed in people with different professions are daily wagers (21.9%) followed by farmers (20.5%), house wives (19.9%), students (17.3%), private employees (8.5%) and (5.4%) of Government employees (Table 1.2).

Of the 51 drinking water sources in the 10 affected areas of Agastheeswaram Union (Figure.1) that were analysed the fluoride concentration was higher in all of them than the desirable limit of 1.0 mg/l for safe drinking water. The highest fluoride concentration of more than 2.5 mg/l was detected in 16 water sources in Azhagappapuram and Anjugramam. Areas around Mylady, South Thamaraikulam and Marungoor have water with more than 2 mg/l. Areas around Theroor, Mahadhanapuram, Theraikal- pudur, Kottaram and Nallur were within the range of 1.3 to 2 mg/l. (Table 1.3)
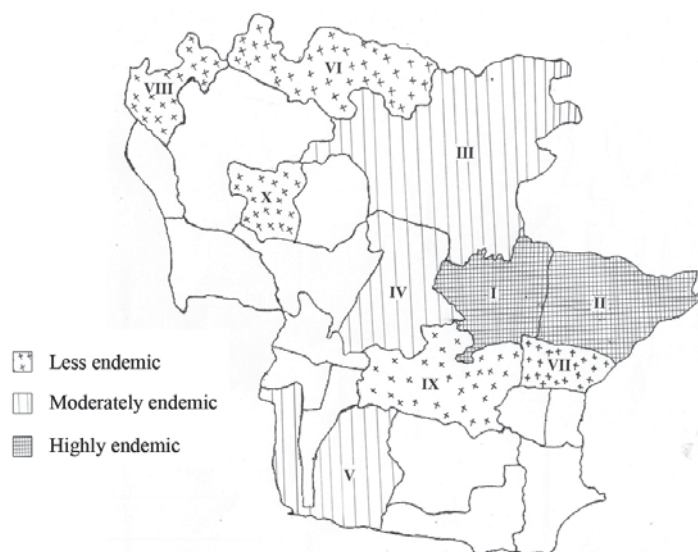

FIGURE 1: LOCATIONS OF TEN FLUOROTIC AREAS IN AGASTHEESWARAM UNION
I. Azhagappapuram, II. Anjugramam, III. Marungoor, IV. Mylady, V. South Thamaraikulam,
VI. Theroor, VII. Mahadhanapuram, VIII. Theraikalpudur, IX. Kottaram, X. Nallur.

Table 1.1: Severity of dental fluorosis on the basis of Dean's Index

Sl.No	Deans Index	Male dental flourosis cases	Female dental fluorosis cases
1	Questionable	272	434
2	Very mild	1216	1357
3	Mild	946	985
4	Moderate	368	342
5	Moderately severe	100	97
6	Severe	67	61
	Total	2969	3276

Table 1.2: Prevalence of dental fluorosis on the basis of occupation

S.No	Occupation	Dental fluorosis cases
1	Daily wagers	1369(21.9%)
2	Farmers	1284(20.5%)
3	Private sectors	534(8.5%)
4	Retired persons	390(6.2%)
5	Government employees	340(5.4%)
6	House wives	1246(19.9%)
7	Students	1082(17.3%)

Table 1.3: Levels of fluoride in ground water samples of Agastheeswaram Union

S.No	Fluorotic areas	Minimum (ppm)	Maximum (ppm)
I	Azhagappapuram	1.5	2.7

II	Anjugramam	2.0	2.6
III	Marungoor	1.6	2.1
IV	Malady	1.6	2.2
V	South Thamaraikulam	1.5	2.0
VI	Theroor	1.6	2.1
VII	Mahadhanapuram	1.9	2.0
VIII	Theraikalpudur	1.5	1.7
IX	Kottaram	1.4	2.0
X	Nallur	1.3	1.9

From the data collected it is clear that dental and skeletal fluorosis occur in fluorotic areas I and II where the water contains fluoride more than 2.5 mg/*l*. Severe dental fluorosis and mild skeletal fluorosis occur in fluorotic areas III, IV & V where the flouride content of water ranges between 1.5 to 2.2 mg/*l*. Moderate and mild fluorosis occur in fluorotic areas VI, VII, VIII, IX and X where the fluoride content ranges between 1.3 to 1.9 mg/*l*.

According to Teotia SPS (5) "Over 90% of the people affected with severe fluorosis belongs to the low socio economic status and they had generalized nutritional deficiencies". In this survey also among 6245 affected people 21.9% are daily wagers and 20.5% are farmers who belong to low socio economic status. Many of these working adults of low socio economic group and house wives of this survey area consume an average of 5 litres of water per day. This elevates the fluoride content in people as the fluoride content of the water they consume is greater than the permissible limit.

Secondly the daily wagers and farmers also ingest locally made tea and tobacco. These substances also contain elevated levels of fluoride which would enhance the body burden fluoride in already affected people (6 & 7). People belonging to the other occupational groups also drink tea and other beverages, but the nutrient value of their diet and socio economic status greatly vary. Its a known fact that milk, curd, fruits and vegetables are rich in Calcium and vitamin C. But farmers and other labourers who have poor nutrition would suffer from increased fluoride intoxication / absorption (8).

IV. CONCLUSION

The present survey reveals the impact of fluoride intoxication in people through water usage. The information available from this study will undoubtedly help to mitigate adverse health effects of fluoride in these areas. Active steps must be taken to partially defluoridate the water before usage and also proper awareness and better knowledge must be given by the administration about fluoride toxicity to the people of Agastheeswaram Union to minimise this endemic disease.

REFERENCES

[1] D.R. Reddy, "Neurology of endemic skeletal fluorosis", Neurol India, vol.57, pp.7-12, 2009.
[2] Y.M. Shivarajashankara, A.R. Shivashankara and P.G. Roash Bhat, "Oxidative stress in children with endemic skeletal fluorosis", Fluoride, vol.34, pp.103-7, 2001.
[3] H.T. Dean, "The investigation of physiological effects by the epidemiological method", In fluorine and dental health edited by Moulton, F.R. American Association advancement science publication no. 19, Washington, D.C, pp.23-31, 1942.
[4] Enos W. Wambu, G.K. Muthakia and Nairobi, "High fluoride water in the Gilgil area of Nakuru country", Kenya, Research report fluouride, vol.44(1), pp.37-41, 2011.
[5] S.P.S. Teotia, "Environmental fluoride and metabolic bone disease, an epidemiological study (fluoride and nutrient interactions)", Fluoride, vol.17, pp.14-33, 1984.
[6] M.K. Malde, R. Greiner–Simonsen, K. Julshamn and K. Bjorvatn, "Tea leaves may release or absorb fluoride depending on the fluoride content of water", Science of the total environment, vol.366, pp.915-917, 2006.
[7] Annapoorna Kubakkadi, Pushpa Bharati and B. Kasturiba, "Effect of fluoride rich adjuncts and prevalence of fluorosis", J.Hum. Ecolo, vol.17, pp.43-45, 2005.
[8] Oster, "Dental fluorosis in relation to nutritional status, living habits and occupation in rural tribal areas of Rajasthan, India", Research report fluoride, vol.42(3), pp.210-215, 2009.