

## Prevalence of Dental Fluorosis in a Non-Endemic District of Tamil Nadu, India

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Despite the fact that Kanchipuram district in Tamilnadu is not considered a fluorosis endemic district, this study was under taken as few fluorosis cases reported in our institution. The objectives of the study are: 1.To describe the prevalence of dental fluorosis among children aged 7-15 years. 2. To assess fluoride levels in drinking water supply in the study villages. 3. To assess knowledge and attitude regarding fluorosis among children affected with fluorosis. A cross sectional study was conducted where 348 children of age 7-15 years were examined for fluorosis by a qualified dentist who graded the severity of fluorosis using the Dean's Fluorosis Index. Information on knowledge and attitude regarding fluorosis was collected from children through an interview schedule. Water samples were collected from various drinking water sources and were analyzed for its fluoride levels. The prevalence of dental fluorosis was 19.2%(CI- 15.1,23.3). The analysis of drinking water sources showed fluoride levels up to 2.2mg/l of water. Significant correlation between high fluoride levels and occurrence of fluorosis ( $p < 0.0001$ ) found. Positive correlation found between age and severity of fluorosis ( $r = 0.6690$ ,  $p < 0.0001$ ). Dental caries occurrence was found less in children with fluorosis ( $p < 0.0001$ ). Only five children with fluorosis knew that the discolouration of their teeth was due to water they consume. It was observed that water was not subjected for quality standards periodically. Few rural pockets of this district have ground water levels high in fluoride. Steps should be taken to find alternate source of water supply and most importantly potable water should be analysed periodically for its quality.

**Key words:** Prevalence; Fluorosis; Water.

The key to man's health is largely in his environment<sup>1</sup>. Water is considered to be one of the most essential forms of our physical environment and access to safe drinking water is our right and necessity. 780 million people around the world are still without access to safe drinking water though the millennium development goal of providing safe drinking water has been met<sup>2</sup>. In India, around 37.7 million Indians are affected by water borne

diseases annually<sup>3</sup>, and per the eleventh five year plan document of India, there are about 2.17 lakh habitations in the country affected with water quality problems with more than half affected with excess iron, followed by fluoride<sup>4</sup>.

Unsafe, contaminated or polluted water is known to produce many water related morbid conditions and one among them, that has its own morbidity and mortality, is the presence of high levels of inorganic chemical named fluoride. Fluoride, is an essential element which is good for mineralisation of bones, formation of teeth enamel and helps to prevent dental caries<sup>5</sup>. The desirable concentration of fluoride in drinking water is 1.0 mg/l according to the Bureau of Indian Standard and World Health Organisation. However, it is suggested that the maximum permissible limit can

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be extended up to 1.5 mg/l<sup>6,7</sup>. If levels exceed the standard it is known to cause dental, skeletal and non-skeletal problems<sup>8</sup>.

Fluorosis in India is endemic and as many as 19 states and 230 districts are affected<sup>9</sup>. Andhra Pradesh, Tamil Nadu, Uttar Pradesh, Gujarat, Rajasthan are states where about 50-100% districts are affected<sup>10</sup>. It is reported that 17 districts in Tamil Nadu are endemic for fluorosis<sup>11</sup>. Despite the fact that Kanchipuram district is not considered one among them this study was under taken with following objectives, as few cases of fluorosis reported in our institution.

1. To describe the prevalence of dental fluorosis among children aged 7-15 years in a developmental block of Kanchipuram district.
2. To assess the levels of fluoride in drinking water supply in the study villages.
3. To assess the knowledge and attitude of fluorosis among children with fluorosis.

#### Methodology

Walajahbad block was identified by simple random procedure out of the total 13 blocks in Kanchipuram district. From the sampling frame of 140 villages in Walajahbad block, five study villages (Oliyur-Mottur, Vaiyavoor, Gowriammanpettai, Nallur, Mottur) were identified by the table of random numbers. All the children in the age group of 7-15 years who attended the schools in these five villages on the day of screening were included in the study (n=348). Most children of these five villages attended the government primary and secondary schools in their locality and rarely did they go to a private school that is far off, due to transport and socioeconomic restraints. Hence by selecting the students of the local schools the sample was representative of the population studied.

Informed consent was obtained from the head of the schools in the five villages studied. A pre-structured questionnaire was used to collect data from the students and this was followed by dental examination by a trained dentist. Dental caries was measured using the DMF Index and fluorosis was measured using the Dean's Fluorosis Index<sup>12</sup> where the severity of the fluorosis is categorised into Questionable (Grade 1), Very Mild (Grade 2), Mild (Grade 3), Moderate (Grade 4) and severe (Grade 5) cases.

The people of these villages depend

on ground water for drinking purposes. Water samples were collected from the different sources (overhead tanks and bore wells) with the help of a local person in each village who was responsible for water supply. 1 litre of water was collected from each source in a plastic container, given a dummy number (to take care of bias) and subjected for chemical analysis.

#### RESULTS

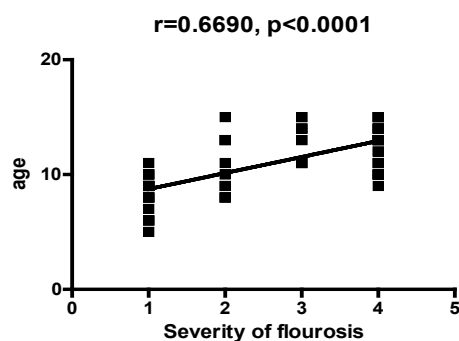
A total of 348 children in the age group of 7 – 15 years were screened of which 184 (52.9%) were males and 164 (47.1%) were females. The prevalence of fluorosis in this population was 67/348 (19.2%, CI-15.1, 23.3) of which 36 were males and 31 were females. t – Test for significance showed that there is no statistically significant difference between males and females in the occurrence of fluorosis ( $p > .05$ , CR=1.22).

According to Dean's Fluorosis Index around 20 children (29.8 %) were in grade I (questionable mottling), 10 children (14.9%) in grade II (very mild mottling), 11 children (16.4%) in grade III (mild mottling), and 26 children (38.8%) in grade IV (moderate mottling) and none in grade V (severe mottling).

With respect to age and the occurrence of fluorosis, there was a positive correlation between age and severity of fluorosis ( $r=0.6690$ ,  $p<0.0001$ ). As age of the children increased the severity grade of fluorosis also increased (Graph 1 showing correlation between age and severity of fluorosis). The percentage of children who were in grade IV (moderate mottling) in each age group is as follows: none in 7-8 years of age, 21% in 8-10 years, 30% in 10-12 years, and 49% in 12-15 years.

The prevalence of dental caries in this total population was 37.6% (CI-32.5, 42.7). Dental caries was present in only 18 children (26.8%) of fluorosis affected cases. t-test for significance showed a high significant difference between fluorosis positive and negative cases in occurrence of caries. Dental caries occurrence was found less in children affected with fluorosis ( $p < .0001$ , CR=7.575).

On assessment of the children's knowledge and attitude regarding fluorosis, it was seen that out of 67 children who were affected with fluorosis only ten children knew they had a problem related



**Graph 1.** Showing correlation between age and severity of fluorosis

to their teeth. Only five children consulted dentist for the discolouration. Results showed that out of these ten only five knew that this problem was due to water, two said that it is due to eating brinjal, two said that it was due to eating some fruit when they were young and one said it was due to vitamin deficiency. The five children, who knew that the discolouration was due to water, continued drinking the same water as that was the only available source.

On enquiry, it was found that physical, chemical and bacteriological analysis of the water was not done periodically.

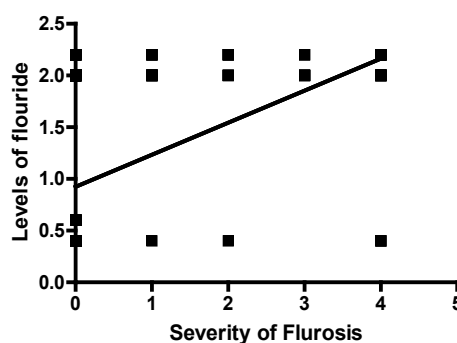
#### Water analysis

**Table 1.** Levels of fluoride in each village and number of children affected with fluorosis

Name of the village	Fluorosis positive	Fluorosis negative	Total number( n)	Mean Fluoride levels mg/l	
Gowriammanpettai	22	18	40	2.1	high
Oliyur mottur	40	61	100	2.0	high
Nallur	0	22	22	0.4	Low
Oliyur	0	43	44	0.6	Low
Vaiyavur	5	137	142	0.4	Low
Total	67	281	348	-	-

Analysis of water samples collected from different water source showed that water samples collected from Oliyur Mottur village and Gowriammanpettai village had high levels of fluoride in water ranging from 1.4-2.2mg/l. Samples collected from Oliyur, Vaiyavur and Nallur villages showed fluoride levels between 0.2 -0.8mg/l. It was seen that cases of fluorosis occurred in villages where fluoride levels were above 1.5mg/l(Table 1).

Karl- Pearson coefficient for correlation was used to evaluate the association between levels of fluoride in water and the occurrence of fluorosis in that particular village. There was a significant correlation ( $r=0.457$ ) ( $p$  value  $<0.0001$ ) between high fluoride levels in water and high prevalence of fluorosis(Graph 2 showing the positive trend as the level of fluoride increases the severity of fluorosis increases.). There was an increase in the occurrence of dental fluorosis with corresponding increase in water fluoride content i.e. 3.5% at 0.0m/l of fluoride to 55% at 2.2mg/l of fluoride was found.



**Graph 2:** Shows the positive trend as the level of fluoride increases the severity of fluorosis increases

#### DISCUSSION

This cross sectional study in a developmental block was done to find the prevalence of fluorosis and the levels of fluoride in water. The prevalence of dental fluorosis in this study population was 19.2%. Study done by Harikumar *et al.*,<sup>13</sup> in north western districts of Tamilnadu has shown an overall prevalence of around 30%

in all age groups and a prevalence of above 40% in the age group of 5-14 years. The districts covered in this study were Vellore, Dharmapuri, Krishnagiri, Salem, and Erode which are known fluorosis endemic areas of Tamilnadu. In our study there were water samples that had fluoride levels around 0.2mg/l. Optimal levels of fluoride (BIS 0.6-1.2) is necessary for bone calcification and teeth formation and so water samples that contain fluoride less than 0.6 and above 1.5mg/l is not fit for consumption. Balakrishnan *et al.*, (2008) in his study in the same Kanchipuram district but in different blocks, has shown that fluoride levels in the water samples were within normal limits<sup>14</sup>.

This study showed that there is a positive correlation between age and severity of fluorosis. As age increased the severity of fluorosis increased. The children who were affected with fluorosis gave history of stay in high fluoride level village from birth. As the duration of exposure increases the severity of the problem increases is well proven where the highest percentage of children (57.1%) were in age group 12-15 years with grade IV (moderate mottling of teeth) when compared to the other age groups.

Out of 140 children who were residing in high fluoride area only 62(44.28%) children were affected with fluorosis. Also five children were from low fluoride levels. The reason for the other children not affected though residing in the same village, may be due to reasons of migration or other dietary habits- food rich in calcium is known to have a protective effect. Dietary habits and variations in intake of foods like Jowar, Ragi and milk (rich in calcium) are known to alter the clinical manifestations of fluorosis. Vitamin C ingestion also safeguard against the risk of fluorosis<sup>15, 16</sup>.

It was seen that the occurrence of dental caries was found to be less among children affected with fluorosis. Fluoride helps in calcification of bones and teeth and dental caries being lower in children affected with fluorosis is suggestive of its protective effect. The hypocalcified areas of the mottled enamel are less soluble in acids<sup>17</sup>. Similar findings were found in other studies done by Kotecha *et al.*,<sup>18</sup> and Mascarenhas *et al.*,<sup>19</sup>.

Positive correlation was found in the occurrence of fluorosis and the level of fluoride in water. This study has proven that fluoride in high levels than the normal specification is a known

cause for the development of fluorosis as proven by other studies done in Rajasthan<sup>[20]</sup>, Kerala<sup>[21]</sup> and in other countries too!!

Regarding the children's attitude and knowledge about fluorosis it was seen that most children were not aware of their problem and the very few who knew about it were not aware that the reason is water except for five children. Fluorosis causes internal staining of teeth, whereas other causes like Brinjal eating, Banana biting, Palm leaf biting, Coconut leaf chewing cause external staining of teeth and may be mistaken for dental fluorosis<sup>[22]</sup>. This finding stresses the need for education of the people and children on fluorosis – its effects and complications.

It has been noted from the study that though chlorination was done at regular intervals, periodic bacteriological, physical and chemical examination of water that is used for consumption was not carried out by the local water supply board.

### Conclusion and Recommendations

This study shows that fluorosis is present in Kanchipuram district too. This study covered only five villages of the district. More studies are required to know the actual extent of the problem in this district. It is important to create awareness about fluorosis and most importantly educate the people about the sources of the fluoride and how dietary habits can minimize the problem. The village heads were advised to look out for alternate water source. Most importantly it is recommended that water that is consumed should be analysed periodically on its quality before it is distributed to the public for consumption.

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