"Prevalence Of Dental Fluorosis In Permanent Teeth Among School Going Children – A Cross Sectional Study"

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Abstract

Dental fluorosis is a major endemic oral disease characterized by hypomineralization of enamel caused due to consumption of water containing high concentration of fluoride during developmental stages of teeth.

Aim:

To assess the prevalence of dental fluorosis in permanent teeth among 06-12 years old school children in endemic fluoride areas of Bhavnagar district.

Methodology:

A cross-sectional study was carried out in Bhavnagar district to assess the prevalence of dental fluorosis among 1500 school children in the age group of 6-12 years. Data collected included estimation of fluoride in the drinking water supply and measurement of dental fluorosis in school children.

Results:

Among total population of 1500 children, 746 were males and 754 were females. It shows the prevalence of Dental Fluorosis among total population of 1500 children, out of which 304 (40.75%) were males with fluorosis & 338 (44.82%) were females with fluorosis. Chi square test Pearson's correlation test were applied to obtain inferential data.

Conclusion:

Our findings showed that the risk of dental fluorosis was significantly higher in the areas showing more fluoride content in drinking water.

Keyword: permanent dentition, dental fluorosis, dean's index, ground water fluoride level.

Introduction

Fluoride, an element essential for human health, plays a critical role in the calcification of bones and teeth.[1] hoverer, it may be regarded as a 'double edged sword' as deficiency of fluoride intake predispose to dental caries, while excess consumption lead to dental and skeletal fluorosis.[2]

Dental fluorosis is a major endemic oral disease characterized by hypo mineralization of enamel caused due to consumption of water containing high concentration of fluoride during developmental stages of teeth. Fluorosis is one of the severe public health problems in India, as almost two-third states are fluoride endemic. In India, approximately 25 million people are presently affected by fluorosis and 66 million are at risk of developing fluorosis, including children of age 14 years. India is situated in the geographical fluoride belt and in areas where fluoride content is high in rocks or soil, leaching of fluoride occurs, causing excess fluoride level in groundwater. However, the level of fluoride in water also depends on the natural solubility, presence of other minerals, the acidity of the soil and amount of water present, which explains high fluoride content in the groundwater[3].

Endemic fluorosis resulting from high fluoride concentration in groundwater is a public health problem in India. The available data suggest that 15 States in India are endemic for fluorosis, five of these have category III (>50% of the districts affected) which includes Gujarat. Gujarat Water Supply and Sewerage Board (GWSSB) has surveyed all the villages in Gujarat and reported 15.8 per cent of the villages having fluoride level more than 1.5 mg/l (personal communication, GWSSB).[4]It is very difficult to isolate these factors and draw conclusions regarding the minimum level of fluoride concentration in drinking water which may prevent dental caries and will not cause dental fluorosis[5].

Ground water has been a significant source for domestic consumption, irrigation and industrial use in India. More than 85% of rural and 50% of urban domestic water requirements is met from ground water resources. As Bhavnagar district is a major endemic fluoride area where ground water fluoride concentration is high,Bhavnagar district is one among them, where people are affected with dental and skeletal fluorosis. This makes Bhavnagar district an ideal place for the present study. There is scarcity of data regarding prevalence of dental fluorosis and treatment needs. Hence, the present study was conducted.

Aim and Objective

Aim :-: To assess the prevalence of dental fluorosis in permanent teeth among 06-12 years old school children in endemic fluoride areas of Bhavnagar district.

Objective: -To assess the prevalence and severity of dental fluorosis and its relationship with fluoride levels in drinking water.

Materials and Methods:-

A cross-sectional study was carried out in Bhavnagar district to assess the prevalence of dental fluorosis among school children in the age group of 06–12 years. Data collected included estimation of fluoride in the drinking water supply and measurement of dental fluorosis in school children. A calibrated & trained examiner of the department of Public Health Dentistry examined all the children to determine the presence or absence of dental fluorosis and graded the degree of dental fluorosis using Dean's index.

- **Place and time period of study:**

The study conducted after obtaining ethical clearance from ethical committee of COLLEGE OF DENTAL SCIENCE & HOSPITAL, AMARGADH. All the necessary permission and consent were obtained from school authorities. The study was conducted among Government school children of Bhavnagar district from October 2022 and December 2022. Only Government school children were included for study as most of the area has only govt.school. Furthermore it maintains homogeneity among sample (sameage, social class, geographical area, climate, water supply).

Sample size:

The sample size was calculated based on the prevalence of dental fluorosis. Around 1500 students were included in the study.

All the participants were selected based on the following criteria:

1. **Inclusion criteria:-**

   A. Age group :- 06 to 12 years
   B. Boy and Girl both are included
   C. A common and stable public drinking water supply form bore well which should be continuously in use.
   D. School children who were lifelong residents in that region and who were using one source of drinking water from birth to at least 10 years of their life
   E. Similar socioeconomic status.

2. **Exclusion criteria:-**

   A. Age group :- above 12 years
   B. Migrated children
   C. Children with history of drinking water of more than one source.

Fluoride estimation in drinking water:-

Ground water data was obtained from the data available from GROUND WATER YEAR BOOK 2020-21, GUJARAT STATE.[6,7] For the area where data were not available, Water samples were collected in 500-ml plastic bottles, which were doubly rinsed with distilled water. They were labelled, coded and sent to laboratory Bhavnagar for fluoride estimation on the same day.

Data collection:

Data were collected from the Governmentprimaryschool. School, which were selected according to WHO survey guideline (applied it to the district area).

Questionnaire:

After obtaining the necessary permission and consent from school authority, the students were interviewed and examined to fill self-administered questionnaire, which included 3 parts:

- Demographic details.
- Questionnaire.
1. Are you aware of the term fluorosis? Yes/ No.
2. What is your source of drinking water? Bore well/ Municipality/Other.
3. Are you lifelong residents in that region & who were using one source of drinking water from birth to at least 10 years of their life? Yes/ No.
(Investigator and teachers helped to comprehend the questions to children)
- Examination:

Clinical examination:-

- Clinical assessment of dental fluorosis was achieved by using MODIFIED DEAN'S FLUOROSIS INDEX (1942).[8]

- Only permanent tooth were examined for fluorosis.

- If fluorosis is present, the individual will be scored based upon the two most affected teeth.

- Examination is made in good natural light with dental probe.

- A nonprobability convenience sampling method was used.

STATISTICAL ANALYSIS:

The data was summarised and analysed using Ms excel and SPSS 20. The mean scores of dean's index were compared with demographic and edentulous variables using Categorical analysis using the Chi-square test has been used to assess the relationship between the variables.Pearson correlation test were used to finding association. The level of statistical significance was set at 5%.

RESULT

1500 participants were included in study. The response rate was noted around 87.1% for the study. Descriptive and inferential statistic was calculated. Table 1 show that the age group of the population ranges from 6 to 12 years. Among total population of 1500 children, 746 were males and 754 were females. It study has found that the prevalence of Dental Fluorosis was 642(42.80%).Among the gender, 304 (40.75%) male diagnosed with with fluorosis & 338 (44.82%) female had fluorosis. Chi square test is applied to find association between genders. And it was found to be significance in some age group. (>0.05*)

Table 2 shows the severity and distribution of Dental Fluorosis according to Modified Dean's Index among the total population, out of which 858 were normal children & 642 were children with fluorosis.

Table. 3 shows Mean dental fluorosis score in high fluorosis area.Pearson's correlation test is applied to estimate association between them. This shows strong positive correlation(0.842), which means that high fluoride in water scores go with high deans score scores.

Table 4.Shows Mean dental fluorosis score in low or optimum fluorosis area. Pearson's correlation test is applied to estimate association between them. The results showmoderate positive correlation (0.742), which means there is a moderate tendency for fluoride water scores correlate with dean score scores.

Graph 1. shows, Results of the Pearson correlation, there is a significant large positive relationship between X - ground water fluoride level and Y- deans fluorosis score, $(r(20) = .953, p < .001)$.

Discussion

Endemic fluorosis is an important public health problem in certain parts of the Bhavnagar district of Gujarat. The present study was done to evaluate prevalence of fluorosis in permanent tooth of mixed dentition of 6-12 years old of Bhavnagar district Gujarat. The study sample was selected 6-12 years old govt.school children as they were easily available sample for the study. And it was feasible to maintain their specific homogeneity for the study(age, water supply, diet, socioeconomic status, geographic area, climateetc.). This study reports dental fluorosis of permanent teeth in the mixed dentition in primary school children.As Reporting fluorosis in mixed dentition is not very straight forward. Data about dental fluorosis on permanent dentition is more appropriate. [9]

The study showed Panvil, Ayodhyapuram, Khijdia and Bora areas of Bhavnagar district were most affected areas with dental fluorosis. (Table 4, 5) Geographical location of area nearest to the main land mass makes it rich in fluoride contains. The fluoride contain in water were also found to be higher in these areas. Most of the participants (456) effected with dental fluorosis belonged to these areas only.

In the present study it is estimated that around 42.80% participants have dental fluorosis. It is found that female participants had more prevalent (44.82%) with dental fluorosis than male participants (40.75%). And these findings were found to be significant. (Table 2). These finding were similar to study done by Anurag T et al [10] on 2000 participants ,and study done Hussain I and Hussain J on 9242 participants.[11]The study showed marked high prevalence of dental fluorosis in female participants.This finding was not in accordace with the other study as studies which shows more numbers of male are effected with dental fluorosis.

 The prevalence of dental fluorosis varied significantly with age (graph 1). Prevalence found to be increasing with the age. This was found to be in accordance with the study done by chaudhry M et al.[15] The reason of this can be longer duration of fluoridated water intake or presence of more permanent teeth presenting more fluorosis than younger participants.

Most of the participants were belong to the high fluoridated area. The dental fluorosis was found to be high in the area were water fluoride level was above 1.0 mg/l. Very low amount of dental fluorosis was found in participants with minimal fluoride area. These finding found to be significance. In this study, there was an increase in the percentage of children affected with dental fluorosis with an increase in fluoride level in drinking water. This was in accordance with other studies. These findings were supported by studies carried out by Chandrashekar and Anuradha and Budipramana et al.[2] A similar study done bySebastian ST, Soman RR, Sunitha S in Mysure district shows close agreement with this finding of the present study.[9]

Moreover,Pearson's correlation analysis shows strong positive correlation between ground water fluoride level and dean's fluorosis core, which means that high fluoride in water scores is significantly, associated with high deans dental fluorosis scores.(Table 4, 5) Most of the participants had drinking water through bore well or central water supply. Thirty percent of urban and 90% of rural population is dependent on untreated water source, of which 80% is ground water.By early 2004, the rural drinking water supply program in India was estimated to have 3.7 million hand pumps dependent on ground water.[9]Being in the high fluoridated belt it was expected to have high dental fluorosis score in the present study.When a graph plotted against high fluoride water contain and deans score it showed large positive relationship between x- ground fluoride water and y- dental fluorosis $(r (20) = .953, p < .001)$ (Graph 1).It is known that fluoride content in drinking water is the primary cause of fluorosis. It is suggested that other factors like altitude of residence, climate, dietary habits, tea

consumption, nutritional status of the child, duration of breast feeding, infant formulae, and use of fluoridated toothpaste have an influence on the prevalence and severity of dental fluorosis.[5]Morover it has been stated in literature that , the Fluorosis, a public health problem is caused by excess intake of fluoride through drinking water/food products/industrial pollutants over a long period. It results in major health disorders like dental fluorosis, skeletal fluorosis and non-skeletal fluorosis.[12]The study results were in accordance with these findings.

In the present study, it was it was noted very few participants has moderate to severe grade of dental fluorosis (1.55% and 1.4%). Most of the participants had questionable to milder form of dental fluorosis (38% to 48.59%). Fluoride level of 1 mg/l to 2 mg/l in ground water has direct dose –effect relationship with this finding.Positive covariance - changes go in the same direction, when one variable(fluoridated water ppm) increases usually also the second variable (deansscore)increases, and when one variable (fluoridated water ppm)decreases usually also the second variable (deansscore)decreases. (Graph 1). World Health Organization (WHO) has set the upper limit of fluoride concentration in drinking water at 1.5 mg/L.[13] However, in 1984 WHO suggested that in areas with a warm climate the optimal fluoride concentration in drinking water should remain below 1 mg/L while in cooler climates, it could go up to 1.2 mg/L.[14] Therefore, the Bureau of Indian Standards has laid down Indian standards as 1.0 mg/L as the maximum permissible limit of water fluoride concentration with further remarks as "lesser the better."[15]As Rajasthan and Gujarat in north India and Andhra Pradesh in south India are the worst affected states.[16]Furthermore, based on the previous study[5] it can be assumed that humid and high temperature of Bhavnagar district leads to more amount of water to be ingested. Thus it can be explained that 0.75-2 mg/l fluoridated water intake since years can lead to dental fluorosis in the area. The reason for the increase in the disease incidence and the sizeable number of locations being identified as endemic zones for fluorosis is due to overgrowth of population, necessitating more and more water, indiscriminate digging of tube wells, resorting to the use of hand pump water, unawareness regarding the importance of checking water quality, especially for fluoride and due to water shortage.[17]

In the present study majority of the school children at present used purified tap water for drinking purpose but consumed ground water with increased concentration of fluoride during their developmental stages and this may be the reason for occurrence of dental fluorosis. On other hand most of the children had knowledge about the 'tooth stain' caused by 'hard water" rather than dental fluorosis itself.

The other major findings of the study were Permanent maxillary Central incisors (71.1%) were most affected teeth followed by permanent mandibular molars (12.1%) and permanent maxillary molars (10.8%). This finding can be due to presence of these teeth in most of the participants. Because of the central importance of physical appearance to a young person's self-esteem, the disfiguring stains of severe fluorosis have significant psychological consequences to which the adolescent age group is highly vulnerable. Dental fluorosis is, however, not just confined to cosmetic concerns but has health implications as well.

Conclusion

Our findings showed that the risk of dental fluorosis was significantly higher in the areas showing more fluoride content in drinking water. When mild or more severe forms of dental fluorosis are found prevalent in a community, steps should be taken to reduce fluoride ingestion during the ages of tooth development. This study can act as a pointer to public health physicians, dentists, administrators, planners, and water supply authorities. The information furnished can be utilized as preliminary data, and a well-designed epidemiological investigation can be undertaken at village level and district level to confirm and assess dental fluorosis and to evaluate the risk factors associated with the condition. It is recommended to reduce the fluoride content of drinking water in the high fluoride area by making either alternative water source available or providing water with reduced fluoride content.Health care and public health professionals can counsel parents and caregivers regarding dental fluorosis

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Tables and graphs:

TABLE 1: Descriptive status of participants. Prevalence of dental fluorosis.

AGE	TOTAL		FLUOROSIS		X^2 score	P value
	MALE	FEMALE	MALE	FEMALE		
6yr	41	40	07	06	0.064	0.799
7yr	33	24	15	13	0.422	0.515
8yr	122	130	45	54	0.571	0.449
9yr	134	162	47	81	6.656	**0.009***
10yr	166	159	74	68	0.108	0.742
11yr	131	116	45	59	6.880	**0.008***
12yr	119	123	71	57	4.308	**0.037***
TOTAL	**746**	**754**	**304 40.75%**	**338 44.82%**	2.545	**0.110**
Total prevalence	**1500**		**642 42.80%**			

TABLE 2:DEAN'S FLUOROSIS SCORE

AGE groups	DEAN'S FLUOROSIS SCORE					
	0 Normal	0.5 Questionable	1 Very mild	2 Mild	3 Moderate	4 Severe
6yr	71	04	04	02	-	-
7yr	26	19	07	05	-	-
8yr	153	36	48	05	07	03
9yr	168	39	72	14	03	-
10yr	183	48	77	14	-	03
11yr	143	54	39	08	-	03
12yr	114	44	65	19	-	-
TOTAL	858 (57.20%)	244 (38%)	312 (48.59%)	67 (10.43%)	10 (1.55%)	09 (1.4%)
		642 (42.80%)				

Table. 3 Mean fluorosis score in high fluoride water area.Results of the pearson correlation

Area	Fluoride water level	Mean Fluorosis score (456)	R value	P value
Khijdia	1.28	1.5	**0.842** strong positive correlation.	0.0078*
Bora	2.0	1.75		
Dhata	1.3	1.20		
Panvi l	2.9	2.0		
Ayodhyapuram	1.9	1.75		
Rampara	1.26	1.0		
Akwada	1.73	1.2		
Vallabhipur	1.24	1.0		

Table 4. Mean fluorosis score in high fluoride water area. Results of the pearson correlation

Area	Fluoride water level	Mean Fluorosis score (186)	R value	P value
Gariyadhar	0.45	0.5	**0.742**	0.0001*
Dhasa	0.33	0	moderate positive correlation,	
Ambala	0.45	0.5		
Palitana	0.26	0		
Piparala	0.26	0		
Timbi	0.79	0.5		
Jalia	0.40	0		
Mahuva	0.87	0.5		
Talaja	0.51	0.20		
Ghogha	0.28	0.20		
Pasvi	0.30	0		
Kundheli	0.33	0		
Bhavnagar	0.38	0.20		
Gadhada	0.31	0.20		

Graph 1. **Pearson correlation indicated that there is a significant large positive relationship between x-ground fluoride water and y-dental fluorosis (r(20) = .953, p < .001).**

Line Fit Plot