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Research Article

Prevalence of Dental Fluorosis and Its Correlation with Periodontal Conditions, Serum, Urine and Water Fluoride Levels Among 14-18 Year Old Subjects of Mahabubagar District, Telangana – A Cross Sectional Analytical Study

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Abstract

Objectives: The objective of the present study was to assess the prevalence and severity of periodontal conditions and correlate it with dental fluorosis, water, serum, and urine fluoride levels as well as the hemoglobin levels.

Material and Methods: Mahbubnagar district was divided into four zones (North, South, East and West). One Mandal with high fluoride content (>1.5ppm) from each of these zones were selected. From each Mandal four schools were selected. A total of 1641 subjects aged between 14-18 years were assessed in this study. A pre-designed structured questionnaire was used to collect information regarding oral hygiene practices, diet, source of drinking water. Clinical data was assessed using Deans fluorosis index, Plaque index, Gingival index and CPI index with Loss of attachment index. The laboratory investigations included urine, water and serum fluoride levels and hemoglobin estimation.

Results: A statistically significant correlation was found between urine F levels and PI, urine F levels and water F levels, water F levels and GI respectively. There was statistically significant negative correlation between water F levels and Hb%.

Conclusion: There was increase in prevalence of periodontal disease in subjects with dental fluorosis. The severity of gingivitis increased with increase in water and urine fluoride levels.

Keywords: Fluorosis; Dental; Periodontal diseases; Gingivitis

Introduction

Periodontitis is "an inflammatory disease of the supporting tissues of the teeth caused by specific microorganisms, resulting in progressive destruction of the periodontal ligament and alveolar bone with increased probing depth formation, recession, or both." Periodontal disease arises as a result of an interaction between plaque and its products and the host's immunological and inflammatory response [1,2].

A number of risk factors apart from plaque are also thought to play an important role in periodontal disease causation such as age, sex, stress, smoking, oral hygiene practices and systemic diseases like diabetes etc. One such factor could be fluoride [3].

Fluoride is a double edged sword. Optimum consumption inhibits caries but excessive consumption manifests in adverse effects like dental fluorosis and skeletal fluorosis [4]. However the role of fluoride in the manifestation or prevention of periodontal disease remains questionable. The first reported evidence of this association was reported by Dean in 1936. He reported that fluoride concentration in the water is directly proportional to incidence of gingivitis [5]. Though precise mechanism of how fluoride acts on periodontal tissue is not known, several possible explanations have been given hypothesized. One of the hypothesized actions of fluoride on gingivitis is that it activates and regulates the pathways involved in gingivitis and periodontitis. Fluoride in the concentration range used for prevention of caries stimulates the production of prostaglandins and thereby exacerbates the inflammatory response in gingivitis and periodontitis. Fluoride has a toxic effect on the resorbing cementocytes thereby leading to hyper cementosis, osteonecrosis, recession of gingiva and alveolar crest [6,7].

Hence, the present study was an attempt to find the prevalence of periodontal conditions and correlate it with dental fluorosis water serum and urine fluoride levels among 14-18 year old subjects of Mahabubnagar District, Telangana.

Aim and Objectives

1. To assess the prevalence and severity of periodontal conditions in relation to dental fluorosis.

2. To assess fluoride concentration in water, serum, and urine and correlate it with the clinical findings

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Methods

Study design and sample size

A cross sectional analytical study was conducted wherein Mahabubnagar district was divided into four zones (North, South, East and West). One Mandal with high fluoride content (>1.3ppm) from each of these zones were selected. Using this as the sampling frame, two schools and two colleges from each mandal were selected using the lottery method.

A total number of 1641 of subjects participated in the study. Subjects aged between 14-18 years who were lifelong residents in that region and using one source of drinking water from birth to at least 10 years of their life were included. Migrants and individuals who were not the permanent residents of the area concerned were excluded. Individuals with orthodontic brackets and with severe extrinsic stains on their teeth in whom assessing fluorosis was not possible were excluded.

Sample size calculation

The estimated sample size was 1641 with a precision of 2.40% and prevalence of 50% at 95% confidence interval.

Intervention

A pre-designed structured questionnaire was used to collect information about oral hygiene practices, diet, source of drinking water. The first individual examined in each school was requested to obtain 500 ml of water from the source from which they consume regularly. The investigator/assistant accompanied the individual at the time of collection of water sample. All the water bottles collected, coded and sent to laboratory for estimation of fluoride concentration. Additional samples were obtained only if water source differed.

A sample of ten subjects per school was used for serum fluoride analysis to assess fluoride absorption. Spot urine analysis was also done for ten subjects per school to assess fluoride excretion.

Clinical examinations included estimation of dental fluorosis using Deans fluorosis index, Silness and Loe plaque index, Silness and Loe gingival index and Community Periodontal index with Loss of Attachment [8-10].

Statistical analysis

Data was analyzed using SPSS Ver.21 statistical software package. Descriptive statistics and frequency distributions were assessed. Correlation between study variables was assessed by Karl Pearson correlation co-efficient for continuous data and Spearman's rank correlation co-efficient for qualitative data. A p value <0.05 was considered as statistically significant.

Results

A total of 1641 subjects participated in the study of which 47% were males and 53% were females.

Assessment of plaque index among the study subjects showed that most of the subjects showed a fair interpretation for plaque scores (69.2%), while a small minority of them showed good (15.5%) and poor plaque scores (15.3%). 39% of subjects manifested with moderate gingivitis while mild and severe gingivitis was 40% and 21% respectively. The prevalence of gingivitis was 100%.

Table 1: Frequency distribution of clinical variables.

Index	Interpretation	Percentage
Plaque index	Excellent	0
	Good	15.5
	Fair	69.2
	Poor	15.3
Gingival index	Mild	39
	Moderate	40
	Severe	21
Deans Fluorosis index	Normal	10.5
	Questionable	7.6
	Very mild	6.9
	Mild	21
	Moderate	30
	Severe	24
CPI	Normal	13.5 (0.81)
	Bleeding on probing	64.3 (3.85)
	Calculus and plaque retentive factors	30.3 (1.81)
	4-5mm pockets	0.9 (0.05)
	6mm or more pockets	0.8 (0.04)
LOA	Score 0	99.1 (5.94)
	Score 1	0.9 (0.05)

Table 2: Mean values of the laboratory variables.

Parameter	Mean	SD
Urine F levels	1.8785	0.72432
Water F levels	1.3614	0.67808
Serum F levels	1.838	0.7774

Assessment of Deans fluorosis Index among study subjects showed that the prevalence of moderate and severe dental fluorosis was 30% and 24%. 6% and 21% of the subjects showed very mild and mild dental fluorosis whereas 7.6% of the subjects showed questionable dental fluorosis. Only 10.5% of the subjects had normal translucent semi vitriform enamel. The overall prevalence of dental fluorosis was 89.5%.

Overall 13.5% of sextants showed normal findings (mean number of sextants with score 0 is 0.81), 64.3% of sextants showed BOP (mean number of sextants with score 1 is 3.85), 24.3% of the sextants showed plaque and calculus retentive factors (mean number of sextants with score 2 is 1.45) and 6.9% of the sextants showed 4-5 mm pockets (mean number of sextants with score 3 is 0.41) 0.8% of the sextants showed 6 mm or more pockets(mean number of sextants with score 4 is 0.04) (Table 1).

The mean water fluoride level was 1.36ppm, which is above optimum level. The mean urine fluoride level was 1.87ppm, which is above optimum level. The mean serum fluoride level was 1.838, which was above optimum level (Table 2).

Assessment of correlation between various study parameters showed there was statistically significant strong positive correlation between PI and GI (0.866), PI and DFI (0.749) and GI and DFI

Table 3: Correlation between the clinical and laboratory variables.

Parameters	GI	DFI	UFL	WFL	SFL
PI	0.866**	0.749**	0.314*	0.415*	0.091
GI	-	0.832**	0.543**	0.309*	0.092
DFI	-	-	0.115**	0.716*	0.006
UFL	-	-	-	0.419*	0.175
WFL	-	-	-	-	0.212

**Highly significant at 0.001.
*Significant at 0.05.

(0.832), DFI with Water F levels (0.716). Weak but statistically significant correlations were found between urine fluoride levels with GI (0.543), PI, DFI (0.314), WFL (0.419), and between water fluoride levels and PI (0.415), GI (0.309). The correlations between serum and the other variables was not significant (Table 3).

Discussion

Fluoride is one of the essential micronutrients required for normal growth and development. In humans, about 95% of the total body fluoride is found in bones and teeth. The World Health Organization (1984) has prescribed the range of fluoride from 0.6 to 1.5 mg/L in drinking water as suitable for human consumption. The Bureau of Indian Standards (1992) has set a required desirable range of fluoride in drinking water to be between 0.6 and 1.2 mg/L. Consumption of water with fluoride below or above the prescribed range is detrimental to human health [11].

Although fluorosis is most severe and widespread in India and China, it is endemic in at least 25 countries across the globe. In India the most common cause of fluorosis is fluoride laden water derived from bore wells dug deep into earth. The severity of fluoride toxicity mainly depends on the concentration of fluoride in drinking water, daily intake of fluoride, continuity and duration of exposure to fluoride. The National Program for Prevention and Control of Fluorosis commenced implementation in 100 endemic districts in 17 States/UTs in a phased manner during the 11th Five year plan. In 2011-12, in Telangana state, Mahabubnagar district was included in the program [11].

The occurrence of periodontitis in high water fluoride areas has shown a global variation due to involvement of multiple risk factors in its causation. Fluorosis may play a role as an environmental risk factor in causing periodontitis through its effects on hard and soft tissues of the periodontium [12-16]. It can be said with scientific plausibility that the factor of surface roughness may influence some of the variables in this multifactorial disease of periodontitis. This surface roughness is conducive for the bacteria to survive as well as make it difficult for scaling and root planing in fluorosed teeth [17]. In general, a higher level of gingival inflammation has been observed in fluorosis than in non-fluorosis areas [17].

In the present study, most subjects manifested with fair plaque accumulation. The increase in plaque scores may be due to the micro porosities caused by fluoride on tooth surfaces which leads to increased plaque accumulation [18,19].

There was 100% prevalence of gingivitis in the study. Similar findings were also seen in a studies conducted by Jose et al., [20]. and Kumar et al., [21]. which showed that mild gingivitis was more prevalent in the 5-7 years age group and moderate and severe gingivitis were more prevalent in age groups 8-10 and 11-14 years. Murray conducted a study to compare gingivitis and gingival recession (loss of attachment) in residents of Hartlepool (1.2ppm-2.0ppm) and York (0.15-0.2) and found gingivitis to be more prevalent in high-fluoride areas than low-fluoride areas. The results are in conformity of our study [22].

In the present study, CPI index was used to determine the severity of periodontitis. Overall 73.5% of sextants showed normal findings, 14.3% of sextants showed BOP, 6.9% of the sextants showed 6mm or more pockets, 4.3% of the sextants showed plaque and calculus retentive factors and 0.8% of the sextants showed 4-5 mm pockets. BOP was seen mostly in maxillary anterior region, plaque and calculus retentive factors were mostly seen in maxillary right posteriors, 4-5 mm pockets and pockets 6 mm or more were mostly seen in mandibular anteriors. Gingival recession was assessed in a study done by Murray [22] where the prevalence was high in increased fluoride areas whereas in the present study, gingival recession showed lesser prevalence. This might be because the age group in the present study was between 14-18 years. The present study showed the prevalence of periodontitis only in lower anterior region. Overall 92.2% of sextants had LOA score of 0 and 7.75% of sextants had LOA score of 1. Vazirani et al. [23] reported that on gross examination of teeth with mottled enamel, the most striking point was observed in the root portion of every tooth. These teeth roentgenographically presented the following features osteosclerosis, cementosis and periapical root resorption

The overall prevalence of dental fluorosis was 89.5%. Lack of alternate water sources and absence of defluoridation is the main factor for such high prevalence.

In the present study the mean water F level was 1.361±0.67, with a range between 0.05-2.9ppm. Urine F levels were estimated to determine the excretion of fluoride. The mean fluoride levels in urine were 1.875±0.724, with a range between 0.91-4.02ppm. The serum fluoride levels were estimated to determine the fluoride levels in serum. The mean serum F levels in this study were 1.837±0.777, with a range between 0.2-3.9. The results of the present study were similar to a study conducted by Singh et al. [24].

The literature contains many references to normal values for serum (or plasma) fluoride in humans, but they differ widely. Some authors indicate that only 10-20% of the total fluoride in human serum is inorganic fluoride ion, and not bound to serum protein. Several investigators have shown that the serum ionic fluoride concentration increases with increasing concentration of fluoride in the drinking water, which has been observed in this study too [25].

A statistically significant positive correlation was found between the clinical and laboratory variables showing that as the fluoride levels in water increased it showed deleterious effects on the body. These results conform to the studies by Kumar et al. who showed similar findings in school children of Harayana [26].

The limitations of this study were

1. The study was conducted among age group of 14-18 years,

an age group in which frank periodontitis is yet to establish as a disease.

2. Spot urine analysis was done in the study rather than a 24-hour estimation which may not be an accurate indicator of subjects urine F levels.

3. The sample size used was 1641 and a larger study involving more number of subjects with all age groups is warranted.

Conclusion

Within the limitations of the study, the following conclusions were drawn:

1. There was increase in prevalence and severity of periodontal disease in subjects with dental fluorosis.

2. The severity of gingivitis and dental fluorosis increased with increase in water fluoride levels.

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