ORIGINAL ARTICLE

Relationship between the Prevalence of Fluorosis and Dental Caries in the Kutch District of Gujarat- A Cross-Sectional Study

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Abstract

Background and Aim: Though the recent reports demonstrate a decline in the dental caries trend in most developed nations, mainly attributed to the use of fluorides in different forms. The association between dental caries and endemic fluorosis has not been extensively researched in epidemiological studies in various states of India; hence the present study was conducted to assess the relation between the prevalence and severity of fluorosis and dental caries in the Kutch district in Gujarat. Material and Methods: The study was conducted over a period of 6 months. A total of 600 students aged between 9-19 years in various schools of the Kutch district of Gujarat were examined for dental caries and fluorosis. The students were divided into 3 groups as Group I (9-12 years), Group II (13-15 years) and Group III (16-19 years). Dental fluorosis among the students was assessed using Deans Fluorosis Index (Modified criteria- 1942). DMFT index (decayed, missing and filled teeth) for permanent dentition was used for determining the prevalence of dental caries. Results: Out of 600 students examined, 305 students had no or questionable fluorosis while only one student had severe fluorosis. While examining caries prevalence, 489 students had caries while 111 had no dental caries. Group II had highest incidence of caries. Group II had highest prevalence of fluorosis as 162 students had fluorosis and Group I had lowest prevalence of fluorosis as 34 students in this group had fluorosis. 190 males and 92 females had fluorosis while 301 males and 178 females had caries. Conclusion: According to the results of the present study conducted in an endemic fluorosis district of Gujarat (Kutch), a significant association between dental caries and dental fluorosis is observed in age group 13-15 years. AlsoDMFT score was high in students having fluorosis mainly in age group 13-15 years which shows direct relationship among the caries prevalence and fluorosis.

Keywords: Dental caries, DMFT, Endemic fluorosis, Kutch

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Introduction

Dental caries is an ancient disease, dating back to the time that agriculture replaced hunting and gathering as the principle source of food, although the prevalence and severity was much lower than what we see today. Though the recent reports demonstrate a decline in the dental caries trend in most developed nations, mainly attributed to the use of fluorides in different forms, [1] it is still existing as a disease of high propensity in many underdeveloped and developing countries of Africa and Asia including India due to lack of public awareness and motivation, inadequate resources for sophisticated dental treatments and changing dietary habits.[2]

According to Miller, when acidogenic microorganisms of saliva act on the accumulated carbohydrates from food, an acid is produced which dissolves the inorganic part of the tooth. The proteolytic enzymes produced by the proteolytic organisms dissolve the organic portion of the tooth. This explains the mechanism of dental caries development in a

tooth.[4] Fluoride is used in dentistry to prevent caries by forming calcium fluorapatite crystals. It is seen that tooth which has calcium fluorapatite crystals is resistant to dissolution by acid and thus is resistant to caries.[5]

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 (fluoride level in drinking water >1.5 mg/l), five of these have category III (>50% of the districts affected) which includes Gujarat.[6] The Assam region of North East India has also been recognized as a fluoride-affected area[7] World Health Organization (WHO) has set the upper limit of fluoride concentration in drinking water at 1.5 mg/l.[8] The Bureau of Indian Standards, has therefore, laid down Indian standards as 1.0 mg/l as maximum permissible limit of fluoride with further remarks as "lesser the better".[9] The WHO in Oral Health Report (2003)[10] has stated fluoride as most effective agent in dental caries prevention.

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).

Dean et al[11] studied the effect of fluoride on prevention and control of dental caries in the United States of America in 1940s. Since then, various studies have been conducted which stated a direct relationship between fluoride and fluorosis and an inverse relation between fluoride and dental caries, but the number of studies which investigated the association between endemic fluorosis and dental caries is scarce.[12,13] Some recent studies suggested that defects in enamel in hypoplastic teeth also including severe dental fluorosis may promote dental caries.[14-16]

The association between dental caries and endemic fluorosis has not been extensively researched in epidemiological studies in various states of India; hence the present study was conducted to assess the relation between the prevalence and severity of fluorosis and dental caries in the Kutch district in Gujarat.

Materials and Methods

The study was cross-sectional in nature, and an ethical clearance was obtained from the institutional ethical committee. The study was conducted over a period of 6 months. Informed consent was taken from all of the participants. A total of 600 students aged between 9-19 years in various schools of the Kutch district of Gujarat were examined for dental caries and fluorosis. The students were divided into 3 groups as Group I (9-12 years), Group II (13-15 years) and Group III (16-19 years). The study was carried out by single trained researcher who had sound knowledge of the coding systems used in the study. The students were examined clinically in natural day light with the help of diagnostic instruments. Dental fluorosis among the students was assessed using Deans Fluorosis Index (Modified criteria- 1942)[17] wherein 2 severely affected teeth were observed for grading of fluorosis and graded as normal, questionable, very mild, mild, moderate and severe by giving the scores as 0,0.5,1,2,3,4 respectively. DMFT index (decayed, missing and filled teeth) for permanent dentition was used for determining the prevalence of dental caries. Each tooth was assessed and coded according to the criteria prescribed by World Health Organization (WHO).[18]

Statistical analysis: The recorded data was compiled and entered in a spreadsheet computer program (Microsoft Excel 2007) and then exported to data editor page of SPSS version 15 (SPSS Inc., Chicago, Illinois, USA). Descriptive statistics included computation of percentages, means and standard deviations. For all tests, confidence level and level of significance were set at 95% and 5% respectively.

Results

Out of 600 students examined, 305 students had no or questionable fluorosis while only one student had severe fluorosis. Rests of the students were in the category of very mild, mild and moderate fluorosis. While examining caries prevalence, 489 students had caries while 111 had no dental caries. Group II had highest incidence of caries. Group II had highest prevalence of fluorosis as 162 students had fluorosis and Group I had lowest prevalence of fluorosis as 34 students in this group had fluorosis. 190 males and 92 females had fluorosis while 301 males and 178 females had caries. Tables 1-4 depict association of caries

with fluorosis in different age groups and in total.

Table 1: Association of caries and fluorosis in age group 9-12 years

Variable	Caries	No caries	Total	P value
Fluorosis	52	8	60	
No Fluorosis	24	10	34	0.01*
Total	76	18	94	

Test applied chi-square test, indicates statistically significance at≤0.05*

Table 2: Association of caries and fluorosis in age group 13-15 years

Variable	Caries	No caries	Total	P value
Fluorosis	135	27	162	
No Fluorosis	153	43	196	0.09
Total	288	70	358	

Test applied chi-square test, statistically significance at≤0.05

Table 3: Association of caries and fluorosis in age group 16-19 years

Variable	Caries	No caries	Total	P value
Fluorosis	54	6	60	
No Fluorosis	71	17	88	0.1
Total	125	23	148	

Test applied chi-square test, statistically significance at≤0.05

Table 4: Association of caries and fluorosis in total cases

Variable	Caries	No caries	Total	P value
Fluorosis	241	41	282	0.001*
No Fluorosis	248	70	318	
Total	489	111	600	

Test applied chi-square test, indicates statistically significance at≤0.05*

Discussion

The earth's crust in India has about 12 of the 85 million tons of fluoride found throughout the world. Therefore, it is not surprising that 17 states in India are endemic for fluorosis. Dental caries and fluorosis have been studied together in various populations worldwide to notice the relationship between these conditions with controversial results.[20.21] but there is no consensus on whether dental fluorosis increases, decreases or has no effect on the risk of dental caries.[22] In the present study, caries prevalence was found to be 81.5% which is quite higher in comparison to National Oral Health Survey which states that caries prevalence was increasing with age from 51.9% to 63.1% in 5-15 years age group.[23] According to the study conducted by Kotecha et al in a district of Gujarat state,, the prevalence of dental fluorosis in high fluoride area where drinking water fluoride level was more than 1.5mg/l was 59.31%.[24] Another study conducted by Choubisa reported the prevalence of dental fluorosis as 45% among 21 different villages in southern Rajasthan where fluoride concentrations in drinking water range from 1.5 to 4.0 ppm.[25] A study conducted in an isolated village in Maharashtra also found the prevalence of dental fluorosis as 43%.[26] In the present study, 47% prevalence of fluorosis was seen in the study population which is comparable to these studies in spite of different levels of fluoride in drinking water.

Dental caries is a multifactorial disease where age and sex can act as independent risk factors. To highlight the relation between fluorides and dental caries irrespective of age and gender, a separate comparison was made in each subgroup, age groups combined and sex combined, before giving the comparison with both age and sex combined. It is clear from these findings that fluoride concentrations of < 0.7 PPM and > 4 PPM are detrimental to dental health.

Race, age, sex, socio-economic status, dietary habits, frequency, time, and type of sweet consumed, level of exposure to fluorides, and oral hygiene practices are some risk factors for dental caries. In case of caries prevalence in the present study, Group I (9-12 years), had caries prevalence of 15.5% while in Group II (13-15 years), it was 58.8%. Also, in Group III (16-19 years), prevalence of caries was 25.5% which is almost similar to a study conducted by Ganesh et al[27] in which the students were grouped according to the levels of fluoride in drinking water in the area and the study was conducted on students aged 15-17 years. While comparing the caries prevalence amongst male and female students, in the present study, 61.5% of males and 36.4% of females had caries while in the study conducted by Ganesh et al,[27] 28% males and 25.1% females had dental caries. Also, in the present study while studying prevalence of fluorosis among male and female students, 67.3

% males and 32.06 % females had fluorosis while in the study conducted by Kotecha et al,[24] prevalence of dental fluorosis in high fluoride area was 61.30% in males and 57.26% females.

In the present study, in Group I (9- 12 years), 21.2% prevalence for fluorosis was there while in Group II (13-15 years) it was 57.4% and in Group III (16-19 years) it was 21.2% while in a study conducted by Costa et al[28] in rural districts of Minas Gerais, Brazil with endemic fluorosis, prevalence was found to be 34.6% in 10-12 year old children, 46.7% in 13-15 year olds and 48.7% in those aged between 16-22 years. While studying the association between dental fluorosis and dental caries, it was found that in Group I, those having fluorosis had mean DMFT score of 3 which is in contrast to the study conducted by Costa et al[28] where the mean and median values of DMFT in individuals aged between 10 and 12 years were low, 1.38 and 0.00 respectively. In present study, Group II and Group III, students who had fluorosis had a DMFT score of 4.22 and 5.18 respectively, which is almost similar to the study conducted by Ganesh et al[27]. The subjects in high fluoride areas will have confluent pitting because of severe fluorosis. The morphological alteration in the teeth may facilitate retention of food, predisposing the tooth surface for caries. This may be the possible reason for high caries experience in the very high fluoride area. A study by Budipramana *et al*,[29] found the prevalence of dental caries to be more in either below optimal and high fluoride areas than in optimal fluoride areas. Our study results were in agreement with this study as well as studies by Grobler[30] and Ibrahim *et al.*[31] While discussing effect of fluoride in drinking water on dental fluorosis, one major confounder may be for those who stay currently in high or normal fluoride areas but at the time of the permanent dentition (first 6 years of their life) may not be staying there and, therefore, would be misleading the analysis. To correctly interpret the data, we need to have the exact information of their stay at the time of dentition. Alternatively, we restricted the analysis to those who were staying in the same villages since birth. For reanalysis, the study population was excluded for those who have not been staying in the respective villages from the birth. The difference in dental caries decreased while difference in dental fluorosis increased justifying the need for removing the confounder in the analysis. The crude, and age and sex adjusted relative risk also increased for dental fluorosis for high fluoride area. Further, it also indicates that fluoride in water is more a risk factor for fluorosis than a protective factor for dental caries.

Conclusion

According to the results of the present study conducted in an endemic fluorosis district of Gujarat (Kutch), a significant association between dental caries and dental fluorosis is observed in age group 13-15 years. Also DMFT score was high in students having fluorosis mainly in age group 13-15 years which shows direct relationship among the caries prevalence and fluorosis. Hence there is a need for community health activities and awareness programs to improve oral health of the people in this particular stratum of population.

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