The relationship between dental caries and dental fluorosis in low, moderate and high fluoride areas of Udaipur district, India.

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Abstract

Objective: The purpose of the study was to assess the relationship between dental caries and dental fluorosis in Bhil Tribes living in Udaipur district India, known for endemic fluorosis.
Method: A total of 420 Bhil tribes selected from areas with low (0-1.5mg/l), moderate (1.5-3.0mg/l) and high (>3mg/l) water fluoride concentration were interviewed and examined for caries and dental fluorosis. Dental caries and fluorosis are recorded according to the DMFT system and Dean Fluorosis index. All the Bhil tribes were exposed to a written questionnaire, constructed in English translated into local language and – for control purposes – translated back to English. Intra-oral examination was conducted using Type III examination by two examiners. Inter-examiner variability was checked and Kappa statistics value was 90.2%. Chi-square statistics, independent sample t-test, one-way ANOVA and Multiple linear regression analysis were applied by using SPSS software (version 11.0).
Result: Bhil, Garasia, Meena and Gameti were most commonly present castes among Bhil tribes. The prevalence of dental fluorosis was 33.1% in low, 33.3% in moderate and 33.6% in high fluoride area. In low fluoride area mean number of decayed teeth and mean DMFT was 5.52 and 7.37 respectively while in high fluoride area it was higher, mean decayed and mean DMFT was 9.27 and 12.06 respectively. There was significant difference in mean DMFT between low, moderate and high fluoride areas (P = 0.000). DMFT score was 12.04 in severe fluorosis cases while it was 8.67 in normal fluorosis cases. There was significant difference in mean DMFT between all four castes (Bhil, Garasia, Meena and Gameti).
Conclusion: Dental caries increases with increasing severity of dental fluorosis in low, moderate and high fluoride areas. Thus, a positive relationship between dental caries and dental fluorosis was observed across various tooth types in all the three areas.

Key words: Dental caries, Fluorosis, Bhil tribes.

Introduction

India is home to many tribes who have very interesting history of origin, customs and social practices. So much so that even today they are far distinct from the 'civilized' society around them. While a few tribes are medieval in their origin, mainly due to events in history, there are a few who date their origin back to one of the oldest prehistoric civilizations in world like the Indus valley civilization.
The Bhils are the third largest tribe in India after the Gonds and the Santhals. The Bhils in state of Rajasthan are scattered all over the south eastern and south western districts especially in district of Udaipur, Rajasthan.
The Bhils habitat constitutes about half (173,254 sq. km) area of the state. It falls between north latitude 23^{0} 15 and 77^{0}30 east longitude.
Very little is known regarding the origin of these tribes. In Rajasthan there is no recorded history of Bhils and almost no light on them is thrown by the ancient inscriptions or literary workers. But it is certain that Bhils who inhibit this part of country were recognised as separate ethnic group as early as 500 B.C.
The name Bhil originated from bil, meaning bow, which describes their original talent and strength. Background information is that no oral health; habits study has been conducted on Bhil tribes till date, due to their shy nature, life form nomads and being inaccessible in approach. Tobacco habits were very common in Bhil tribes because of their customs and cultural pattern. The Central Bhil tribes are usually shy and love their independence. Festivals, dance, drama, and music are a large part of their culture.
Each village is led by a head man who deals with disputes. Respect among family members is strong, and there is a great sense of connection between the living and the dead.
It is always difficult to approach the tribes as they are living in isolation and natural surroundings far away from civilization with their traditional values, customs, beliefs and myth intact.
In most industrialized countries, the traditional high prevalence of caries among children and adolescents is declined during recent decades[1-3]. The purpose of controlling dental decay fluoride containing drinking water was the only significant source of fluoride exposure and there is widespread use of fluoride drops, tablets, gels,

mouth rinses and tooth paste[4,5]. Some studies report no change[6], other findings indicate an increase or decline in the prevalence of caries[7,8]. Great variations are seen between and within countries, as well as within different strata of populations. Thus, the average DMFT scores for a country may hide large geographical variations[9]. According to the Dean's Fluorosis Indices[10], even at low fluoride concentration in public water supply and lack of fluoride supplementation, a large Bhil tribes developed opacities in the enamel of whole dentition as a result of slightly subsurface porosities of systemic origin so equivalent to developed caries, therefore represent a positive relationship between dental fluorosis and dental caries. Public policy on the most appropriate concentration for water fluoridation depends upon the trade of between caries control and the undesirable side effects of dental fluorosis[11].

In industrialized countries the caries decline has been related to the use of fluoride in different forms[12-13]. The therapeutic range of fluoride is, however, narrow, and an association between fluoride in drinking water and degree of dental fluorosis has been documented worldwid [14-17]. Fluorotic teeth have also been found in locations with low levels of fluoride in the water supply[18-20]. According to the most reports[21-23], the caries prevalence tends to be reduced with increasing fluoride level in the drinking water, thus indicating a negative association between fluoride and caries. However various studies have indicated no relation[24], or even a positive association between fluoride concentration in drinking water in the prevalence of dental caries in the permanent dentition [18,25]. Results have been reported from Nigeria, where the lowest DMFT scores were observed in the areas with fluoride concentration in the drinking water supply below 0.4mg/litre[26]

* So objectives of the study were:
* To assess caries and dental fluorosis in Bhil tribes born and raised in areas with low, moderate and high fluoride concentration in drinking water.
* To assess the relation between dental fluorosis and caries experience.

Materials and Method:

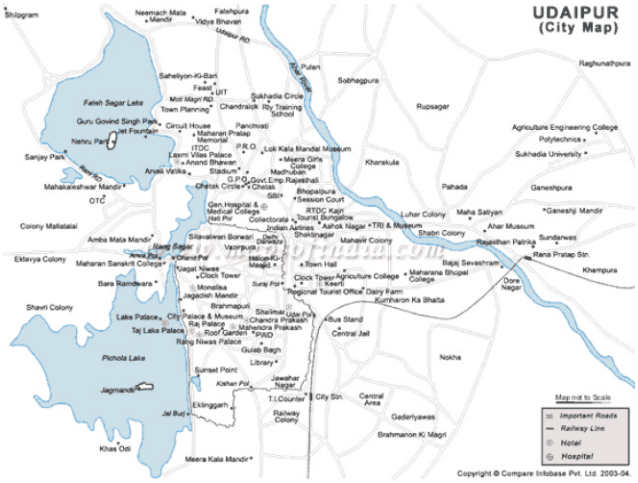
Study area and Study Population

A cross sectional survey study was conducted in January 2009 among 420 Bhil tribes subjects residing in 6 villages within the low, moderate and high fluoride areas of Udaipur which is located in southern east zone of Rajasthan. The villages are of approximately the same size and socioeconomic standards and work selected purposively for the study. The villages lie on the local ground water sources with elevated but different fluoride concentrations. Villages Gogunda and Kherwara rely on ground water with fluoride concentration in range of 0-1.5mg/ltr and are in this paper, called the low fluoride area. The ground water wells of villages Mawli and Kotra contains fluoride in the range of 1.5-3.0mg/ltr and called as moderate fluoride area and the ground water wells of villages Salumber and Dhariawad contains fluoride in range of >3mg/ltr and therefore called as high fluoride area.

Before starting the study ethical clearance was obtained from Ethical Committee of Darshan Dental College and Hospital. Informed consent was sought and obtained from Bhil tribes subjects.

Sample size and Procedure

A total of 420 Bhil tribes were included in the study. All the Bhil tribes were exposed to a written questionnaire, constructed in English translated into local language and - for control purposes - translated back to English. The interviews, performed by trained local assistance, were conducted before clinical examination took place. Sociodemographic characteristics were noted such as occupational status (field workers/ factory workers versus daily labourers) educational status (Primary, Secondary Higher Secondary or Graduation) and family income per month.



Udaipur Map

Clinical Examination

Intra-oral examination was conducted by two examiners using mouth mirror, explorer and adequate illumination after an initial cleaning of the teeth with gauze. Inter-examiner variability was checked and Kappa statistics value was 90.2%. Caries experience was assessed in accordance with DMFT indices as described by (WHO) World Health Organisation[27]. Caries was recorded as being present when a lesion in a pit or fissure or on a smooth tooth surface had a detectable softened floor, undermined enamel or softened wall. A tooth with temporary filling was also included in this category. A tooth was consider missing because of caries if the subject gave a history of pain and/or the presence of a cavity prior to extraction. Dental fluorosis was assessed on vestibular, occlusal and lingual surfaces in accordance with the Dean's Fluorosis Index[28]. Periodontal status was assessed by Community Periodontal Index[27]. The oral hygiene status was determined using the OHI-S index devised by Green and Vermillion (1964)[29].

Statistical Analysis

Data were computerized and analysed using the Statistical Package for the Social Sciences (SPSS) version 11.0. Bivariate analysis was performed using cross tabulation, Chi-square statistics, independent sample t-test, one-way ANOVA and multiple linear regression analysis.

Result

(Table1) reveals the percentage distribution of participating Bhil tribes according to sociodemographic characteristics and area of residence. There were (66.7%) males subjects and (33.3%) females. It also shows that Garasia, were most commonly represented castes in the study. Most of the subjects were educated till primary (38.6 %) and few subjects were graduates. Most of the subjects cleared their teeth with finger only (66.9%) and in high fluoride areas most of the subjects never visited a dentist **(Table 2)**.

(Table 3) depicts that maximum Bhil tribes have moderate (33.8%) and severe (32.1%) type of fluorosis in all the three fluoride areas. Few of subjects showing normal (5.7%) and questionable (6.2%) fluorosis.

(Table 4) reveals mean DMFT according to fluoride area. In low fluoride area mean number of decayed teeth and mean DMFT was 5.52 and 7.37 respectively while in high fluoride area it was higher, mean decayed and mean DMFT was 9.27 and 12.06 respectively. There was significant difference in mean DMFT between low, moderate and high fluoride areas (P = 0.000).

(Table 5) presents that there were no subjects with healthy periodontal status. Shallow pockets and deep pockets and bleeding were more prevalent among all the fluoride area (99.8%). Overall periodontal disease prevalence was 100% with shallow pocket, deep pockets and bleeding as a major part. There were few subjects (0.2%) with calculus who lived in low fluoride area.

Table – 1: Profile distribution of study subjects.

Gender	High	Moderate	Low	Total
Male	80(19.0%)	90(21.4%)	110(26.2%)	280(66.7%)
Female	59 (14.0%)	50 (11.9%)	31(7.4%)	140(33.3%)
Age groups in years				
25 - 34	39(9.3%)	52(12.4%)	39(9.3%)	130(31.0%)
35 - 44	38(9.0%)	36(8.6%)	44(10.5%)	118(28.1%)
45 - 54	40(9.5%)	32(7.6%)	34(8.1%)	106(25.2%)
55 - 64	22(5.2%)	20(4.8%)	22(5.2%)	64(15.2%)
65 - 74	0(0.0%)	0(0.0%)	2(0.5%)	2(0.5%)
Caste				
Bhil	19(4.5%)	7(1.7%)	84(20%)	110(26.2%)
Garasia	16(3.8%)	98(23.3%)	31(7.4%)	145(34.5%)
Meena	85(20.2%)	8(1.9%)	10(2.4%)	103(24.5%)
Gameti	19(4.5%)	27(6.4%)	16(3.8%)	62(14.8%)
Education				
Primary	51(12.1%)	70(16.7%)	41(9.8%)	162(38.6%)
Secondary	40(9.5%)	42(10.0%)	48(11.4%)	130(31.0%)
Higher Secondary	16(3.8%)	8(1.9%)	12(2.9%)	36(8.6%)
Graduate	32(7.6%)	20(4.8%)	40(9.5%)	92(21.9%)
Income in Rs.				
1000 - 2000	37(8.8%)	62(14.8%)	40(9.5%)	139(33.1%)
2000 - 3000	38(9.0%)	42(10.0%)	8(1.9%)	88(21.0%)
3000 - 5000	0(0.0%)	16(3.8%)	45(10.7%)	61(14.5%)
>5000	64(15.2%)	20(4.8%)	48(11.4%)	132(31.4%)

Table 2. Oral health characteristics according to area

Oral hygiene practice –(Mode of brushing teeth)				
Finger	99(23.6%)	94(22.4%)	88(21.0%)	281(66.9%)
Toothbrush	22(5.2%)	20(4.8%)	37(8.8%)	79(18.8%)
Datun	18(4.3%)	26(6.2%)	16(3.8%)	60(14.3%)
Oral Hygiene Practice (frequency of cleaning teeth)				
Twice daily	22(5.2%)	6(1.4%)	32(7.6%)	60(14.3%)
Once daily	88(21.0%)	88(21.0%)	86(20.5%)	262(62.4%)
Sometimes in a week	29(6.9%)	42(10.0%)	29(6.9%)	84(20.0%)
Never	0(0.0%)	4(1.0%)	10(2.4%)	14(3.3%)
Previous visit to dentist				
Yes	42(10.0%)	98(23.3%)	60(14.3%)	200(47.6%)
No	97(23.1%)	42(10.0%)	81(19.2%)	220(52.3%)
Total	139(33.1%)	140(33.3%)	141(33.6%)	420(100.0%)

Table – 3: Dean Fluorosis Index score according to fluoride area.

Dental Fluorosis	**Fluoride Area**			
	High	**Moderate**	**Low**	**Total**
Normal	6(1.4%)	2(0.5%)	16(3.8%)	24(5.7%)
Questionable	0(0.0%)	8(1.9%)	18(4.3%)	26(6.2%)
Very Mild	0(0.0%)	0(0.0%)	44(10.5%)	44(10.5%)
Mild	0(0.0%)	4(1.0%)	45(10.7%)	49(11.7%)
Moderate	0(0.0%)	124(29.5%)	18(4.3%)	142(33.8%)
Severe	133(31.7%)	2(0.5%)	0(0.0%)	135(32.1%)
Total	139(33.1%)	140(33.3%)	141(33.6%)	420(100.0%)

Chi Square: 644.10, P-0.000

Table – 4: Mean DT, MT, FT, and DMFT according to fluoride area.

Fluoride Area	**Mean (S.D.)**			
	DT*	**MT****	**FT*****	**DMFT******
High	9.27(0.83)	2.49(0.94)	0.3(0.46)	12.06(0.95)
Moderate	5.41(1.12)	2.43(1.54)	0.79(0.63)	8.49(1.48)
Low	5.52(0.82)	1.29(0.81)	0.65(1.27)	7.37(1.07)
Total	6.73(2.02)	2.07(1.26)	0.58(0.88)	9.30(2.33)
	F* = 775.131	F**= 49.245	F***=11.639	F****= 597.951
	P* = 0.000	P** = 0.000	P*** = 0.000	P****= 0.000

Table – 5: CPI scores among the Bhil tribes according to fluoride area

Community Periodontal Index (CPI)	**Fluoride Area**			
	High	**Moderate**	**Low**	**Total**
Bleeding	19(4.5%)	64(15.2%)	48(11.4%)	131(31.2%)
Calculus	0(0.0%)	0(0.0%)	1(0.2%)	1(0.2%)
Shallow Pocket (4 – 5mm)	46(11.0%)	48(11.4%)	60(14.3%)	154(36.7%)
Deep Pocket (>6mm)	74(17.6%)	28(6.7%)	32(7.6%)	134(31.9%)
Total	139(33.1%)	140(33.3%)	141(33.6%)	420(100.0%)

Chi square: 57.32, P- 0.000

Table – 6: Simplified Oral Hygiene Index (OHI-S) according to fluoride area.

OHI-S	Fluoride Area			
	High	**Moderate**	**Low**	**Total**
Fair	14(3.3%)	60(14.3%)	30(7.1%)	104(24.8%)
Poor	125(29.8%)	80(19.0%)	111(26.4%)	316(75.2%)
Total	139(33.1%)	140(33.3%)	141(33.6%)	420(100.0%)

Chi Square: 41.62, P-0.000

Table – 7: Stepwise Multiple Linear Regression with DMFT as dependent variable.

Model	R	R Square	Adjusted R Square	F value	P value
a) Fluoride area	0.824(a)	0.679	0.678	884.497	0.000(a)
(b) Sex	0.832(b)	0.693	0.691	469.670	0.000(b)
(c) Mode of tooth brushing	0.838(c)	0.702	0.700	326.752	0.000(c)
(d) Oral hygiene frequency	0.840(d)	0.706	0.703	248.714	0.000(d)

(a) Predictors: (Constant), Fluoride area
(b) Predictors: (Constant), Fluoride area, Sex
(c) Predictors: (Constant), Fluoride area, Sex, Mode of tooth brushing
(d) Predictors: (Constant), Fluoride area, Sex, Mode of tooth brushing, Oral hygiene frequency

(Table 6) shows oral hygiene status of Bhil tribes according to level of fluoride area. 24.8% of sample had fair oral hygiene status and 75.2% had poor oral hygiene status. So, majority of sample were showing poor oral hygiene status.
(Table 7) reveals stepwise multiple linear regression analysis in which dependant variable was DMFT and independent variable were fluoride area, sex, mode of tooth brushing and oral hygiene practice. DMFT showed a close association with fluoride area. Amount of variation was 67.9%, 1.4%, 0.9%, 0.4% for fluoride area, sex, mode of tooth brushing and oral hygiene practice.

Discussion

In the present study, the mean DMFT scores increased with increasing fluoride level, corroborating the fluoride effect reported in several East African studies[30]. Moreover, the mean DMFT increased significantly by increasing Dean fluorosis scores in low, moderate and high fluoride areas. These results, indicating a positive relationship between the severity of dental fluorosis and dental caries, were also confirmed after having sociodemographics forced into the equation.
Caries prevalence increased consistently with increasing severity of dental fluorosis in the whole population. Two possible explanations may be offered. First, in more severe forms of dental fluorosis, post-eruptive changes lead to the loss of outer enamel or formation of pits in teeth. Plaque and food debris may be retained in these areas, contributing to an increased susceptibility to caries. Secondly, because of the present of subsurface hypomineralization, teeth with severe form of diffused opacities may be inherently at risk of caries[31].
According to classification of World Health Organization (WHO)[27], the mean DMFT scores recorded in the study were low; regardless of fluoride concentration of drinking water. The DMFT in Bhil tribes correspond fairly well with previously reported findings among Ethiopian subjects[32-34], but are lower than recently published findings in comparable groups of subjects in other East African countries[18,35].
The findings from the present study support the concept that fluorosis is mostly associated with post-natal fluoride because fluorosis occurred mostly on the later developing teeth and was associated with water fluoride concentration. Although there appeared to be a dose-response relationship between water fluoride concentration and fluorosis prevalence; it was not as strong or as dramatic as the relationship between water fluoride concentration and fluorosis in the permanent dentition as described by Dean fluorosis[36, 37, 38].

More studies are also needed to establish the relationship between dental fluorosis and caries. It is of interest, however to note that the present findings are consistent with previous studies from Africa [18, 39]. This strongly indicate that – within the levels of 'moderate' and 'high' fluoride concentrations, dental caries experience in the permanent dentition increases significantly with increasing fluoride content of the drinking water.

Stepwise multiple Linear Regression analysis shows the significant variation of fluoride area, oral hygiene practice and gender in DMFT. In contrast, some studies have found less caries in fluorotic teeth independent of the fluoride concentration in drinking water. Thus, Yoder et al.[20], in a study of Tanzanian children, showed that the majority of caries was detected in the least fluorosed teeth whereas only 16% was detected in the most severely fluorosed teeth. Nevertheless, in the present study, the pattern of a positive relationship between dental fluorosis and dental caries remained consistent in low, moderate and high fluoride areas.
The present results and those of a few previous studies [40-43] thereby strengthen the notion that there is a systematic and positive relationship between the fluoride content of drinking water and the prevalence and degree of dental fluorosis. Furthermore, dental fluorosis – above a certain level – also seems to vary systematically and positively with dental caries in the permanent dentition.

Conclusion

Dental caries increases with increasing severity of dental fluorosis in low, moderate and high fluoride areas in this study. Thus, a positive relationship between dental caries and dental fluorosis was observed in all the three low, moderate and high fluoride areas.

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