ORIGINAL RESEARCH

Prevalence of fluorosis in primary dentition

in Udaipur City, Rajasthan.

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Abstract

Aims: To assess the prevalence of dental fluorosis in primary dentition and find its association with fluoride concentration of water in Udaipur city, Rajasthan, India. **Methods**: A sample of 1157 kinder garden students aged 3-5 years were randomly selected from 19 schools and examined for dental fluorosis using the Dean's Fluorosis Index. **Results**: Out of 1157 students (mean age 4.06±0.84) examined the prevalence of dental fluorosis was 43.1% (n=499). Incisors were the most commonly affected 85.77% (maxillary incisors=82.5% and mandibular incisors=3.2%) followed by canines 13.82% (maxillary canine=9.01% and mandibular canine=4.81%) and molars 0.4% (maxillary molars=0 and mandibular molars=0.4%). There was a significant association between prevalence rate and severity of dental fluorosis with the water fluoride concentration with $p<0.05$. **Conclusions**: Primary tooth fluorosis was most commonly seen in incisors and the primary molars were the least affected. Also the prevalence and the severity of the primary tooth fluorosis was directly proportional to the fluoride concentration of the water i.e. the prevalence and severity was higher in zones with high water fluoride concentration as compared to the zones with lower water fluoride concentration.
KEY WORDS: Dental Fluorosis, Drinking water, Prevalence, Primary Dentition

Introduction

The effect of excessive fluoride on the dentition is well documented. There have been an increasing number of studies on the prevalence of dental fluorosis in the permanent dentition and its risk factors.[1-3] However, only fewer studies have assessed the prevalence of primary tooth fluorosis. [1] Most of the previous studies conducted in Western countries describe the prevalence of primary tooth fluorosis in low fluoride areas. In the United Kingdom, Booth et al. found primary tooth fluorosis prevalence in a

community with 0.3 ppm F (32%) to be similar to that in a community with 1.0 ppm F (34%). Primary tooth fluorosis was found to be somewhat more common in the incisors than in the first molars, although fluorosis on the primary first molars was significantly (P=.005) more prevalent in the 1.0 ppm F community than in the non-fluoridated community. [1,4] A study on primary tooth dental fluorosis in the United States conducted by Leverett et al. in non-fluoridated areas (0.3 ppm) found that about 3 percent of children had primary fluorosis at age 5 years. The highest prevalence was in the primary second molars, which accounted for 70 percent of all affected teeth.[1,5] In a study to determine the prevalence of primary tooth fluorosis in the dentitions of 5-year-old schoolchildren in Ireland, the prevalence in the fluoridated group (n=208) was 32% .[6]Another study conducted in 7-8 years old Chinese school children in areas with fluoride concentrations in the

drinking water ranging from 0.35 to 7.6 mg/L showed the prevalence of dental fluorosis in primary teeth to be 6.2% to 96.6% according to the fluoride concentration of the drinking water. [7]

The prevalence of primary teeth fluorosis is usually less as compared to permanent tooth fluorosis. One possible reason of low prevalence of fluorosis in primary dentition is that the much of the mineralization process occurs in the intra-uterine phase, where the placenta serves as a partial barrier to the transfer of fluoride to the developing primary teeth.[8,9] Other reasons for lower prevalence in the younger age groups may be that (i) the period of enamel formation for primary teeth is shorter and hence the exposure to fluoride is shorter [9,10] (ii) the enamel of primary teeth is thinner than that of permanent teeth [9,10] and (iii) In contrast to enamel the mineralizing bone tissue will not only gradually take up and accumalate fluoride but

will also release fluoride during remodeling.[11]

Primary teeth dental fluorosis may be related to occurrence of fluorosis in the permanent dentition. [12] Primary molar fluorosis were significantly more likely to have definitive permanent incisor fluorosis (76% vs. 32%), and permanent molar fluorosis (59% vs. 16%). Detection of primary tooth fluorosis in pre-school children should alert clinicians and parents to the high likelihood of subsequent fluorosis in the permanent dentition.[12]

Fluorosis is an endemic condition prevalent in 17 states of India [9] and it continues to remain a challenging national dental health problem. [13] Rajasthan state with its high fluoride belts, can serve as a natural laboratory to study the effect of high concentration of fluoride in the primary dentition. In Rajasthan highly rich fluoride ground water, exceeding 10mg/ml has been

reported to exist in the districts of some parts of Udaipur, Jodhpur, Kota, Bikaner, and Jaipur. [14] Hence the aim of the present study was to assess the prevalence of dental fluorosis in primary dentition and find its association with water fluoride concentration among 3-5 year old school children of Udaipur city, Rajasthan, India.

Method

A cross sectional study was conducted amongst 1157, 3-5 year old (pre-school) kinder garden students of Udaipur city, Rajasthan, India. Data was collected from all kinder garden students of 19 different kinder garden schools of Udaipur city. Udaipur city is divided into five different zones namely east, west, north, south, and central zone. Randomly 4 schools were selected from the east zone, west zone, north zone each, and the south zone and where as 3 schools were selected from the Central zone. The study was

conducted during the months of August 2012 to October 2012. Before start of the study, ethical clearance was obtained from the Ethical committee of Darshan Dental College and Hospital, Udaipur, Rajasthan, India. Written inform consent from parents and approval from concerned kinder garden school authorities was obtained. The study population was obtained based on the inclusion criteria which were: (1)Children aged 3 to 5 years (2)Children present on the day of examination (3)Children with no other systemic complications contradicting the oral examinations (4)Children having written informed consent from their parents.

Clinical examinations were carried out under adequate natural light in the school premises. Oral examination was performed by three trained and calibrated dentists. The tooth surfaces were not dried and the prevalence and severity of fluorosis was assessed using the Dean's

fluorosis index according to WHO criteria.[15]

Dental fluorosis was distinguished from other lesions, such as isolated non-fluoride opacities, based on differences in shape, demarcation, color, and detection ability of the lesions by applying Fejerskov's [16] criteria for differential diagnosis of fluorosis. Also, fluorosis was distinguished from enamel demineralization ("white spot" lesions) based on color, texture, demarcation, and relationship to the gingival margin, with areas closely adapted to and paralleling the gingival margin generally being consistent with demineralization, while areas more variable in their approximation to the gingival margin generally being consistent with fluorosis.

At the end of the day, students were re-examined by each examiner to maintain the intra-examiner consistency. Information regarding

the fluoride concentration of water of each zone was obtained from the office of Senior Chemist, Ground water department Regional chemist laboratory, located at Sukher area of Udaipur city, Rajasthan, India. SPSS (Statistical Package for Social Sciences) software, version 15.0 was used for data analysis and association between dental fluorosis and age group, tooth group and zones was obtained using the Chi Square test. The level of significance was set at $p<0.05$.

Result

Out of total 1157 study subjects examined for dental fluorosis 499 children had primary tooth fluorosis with the prevalence rate of 43.1%. Table 1 summarizes the prevalence and severity of the dental fluorosis with respect to the age group. No significant difference was observed in the prevalence and severity of fluorosis across the different age groups, $p >0.05$ (statistically not significant).

Table 2 shows the distribution of fluorosis in the primary dentition. The result demonstrated that the incisors were dominantly affected, more particularly the maxillary incisors with prevalence rate 82.56% followed by maxillary canine (9.01%). The primary molars were the least affected (0.4%). It was observed that zone water fluoride concentration was directly proportional to the prevalence rate in various zones. The highest prevalence was seen in the North zone(50%) while the lowest prevalence was seen in Central zone (35.6%). The association between the prevalence of fluorosis and zones was statistically significant p= 0.019. In north zone the prevalence rate was higher because its water fluoride concentration was higher as compared to other zones while in contrast, the prevalence rate in central zone was lower as compared

to other zones with its water fluoride

concentration being lower as

Table 1: Prevalence and severity of dental fluorosis according to age of the school children

Age (Years)	Total No of children examined	Prevalence of Dental fluorosis	Dean's fluorosis score					
			0	1	2	3	4	5
3	380	168 (44.21 %)	212 (55.78%)	106 (27.89%)	34 (8.94%)	14 (3.68%)	8 (2.1%)	6 (1.57%)
4	327	135 (41.28 %)	192 (58.71%)	82 (25.07%)	31 (9.48%)	14 (4.28%)	6 (1.83%)	2 (0.61%)
5	450	196 (43.55 %)	252 (56%)	111 (24.66%)	47 (10.44%)	25 (5.55%)	8 (1.77%)	7 (1.55%)
Total	1157	499 (43.12 %)	656 (56.7%)	299 (25.8%)	112 (9.7%)	53 (4.6%)	22 (1.9%)	15 (1.3%)

Table 2: Prevalence of dental fluorosis according to tooth type

Age (Years)	Prevalence	Incisors		Canine		Molars	
		Maxillary	Mandibular	Maxillary	Mandibular	Maxillary	Mandibular
3 (n=380)	168	143 (85.11%)	8 (4.76%)	12 (7.14%)	5 (2.97%)	0 (0%)	0 (0%)
4 (n=327)	135	113 (83.7%)	1 (0.74%)	14 (10.37%)	6 (4.44%)	0 (0%)	1 (0.74%)
5 (n=450)	196	156 (79.59%)	7 (3.57%)	19 (9.69%)	13 (6.63%)	0 (0%)	1 (0.51%)
Total (n=1157)	499	412 (82.56%)	16 (3.2%)	45 (9.01%)	24 (4.81%)	0 (0%)	2 (0.4%)

compared to the other zones (Table 3). Table 4 shows the association between zones and severity of dental fluorosis. A highly significant co-relation was found between them with P=0.00 (statistically significant). The north zone where the prevalence rate was high showed more amount of severe fluorosis as compared to rest of the zones while moderate to severe fluorosis cases were absent in the central zone, where predominantly questionable to mild fluorosis was observed.

Table 3: Prevalence of dental fluorosis according to the various zones of Udaipur city.

ZONES	WATER FLUORIDE CONCENTRATION (PPM)	Normal	Affected
EAST (n=232)	2.7	131 (56.5%)	101 (43.5%)
WEST (n=239)	2.66	133 (55.6%)	106 (44.4%)
NORTH (n=288)	2.9	144 (50%)	144 (50%)
SOUTH ((n=218)	2.4	134 (61.5%)	84 (38.5%)
CENTRAL (n=180)	2.4	116 (64.4%)	64 (35.6%)

*x^2=11.79, d.f.=4, p=0.019

Discussion

The present study was undertaken to assess the prevalence of dental fluorosis in primary dentition and find its association with fluoride concentration of water in Udaipur city of Rajasthan, India. The kinder garden students were selected as they represent the best age to assess the primary teeth fluorosis. As no indices have been specifically developed and there are no published criteria specific for primary tooth fluorosis, criteria was based on Dean's fluorosis index.[1] Substantial efforts were made to characterize primary tooth fluorosis through photographs

obtained from other clinicians and researchers, correspondence with other investigators, and extensive review of the literature as some the studies have misclassified other conditions as primary tooth fluorosis or did not recognize primary tooth fluorosis when it was present. [1] In

addition Fejerskov's [16] criteria was used to distinguish fluorosis from non fluoride opacities based on area affected, lesion shape, demarcation, color and teeth affected. The present study showed the net prevalence rate of primary tooth fluorosis in Udaipur.

Table 4: Severity of dental fluorosis according to zones

Zones	Dean's fluorosis score						
	0	1	2	3	4	5	Total
East	131 (56.5%)	57 (24.6%)	24 (10.3%)	11 (4.7%)	7 (3%)	2 (0.9%)	232 (100%)
West	133 (55.6%)	62 (25.9%)	20 (8.4%)	16 (6.7%)	7 (2.9%)	1 (0.4%)	239 (100%)
North	144 (50%)	76 (26.4%)	33 (11.5%)	19 (6.6%)	4 (1.4%)	12 (4.2%)	288 (100%)
South	132 (60.6%)	58 (26.6%)	18 (8.3%)	6 (2.8%)	4 (1.8%)	0 (0%)	218 (100%)
Central	116 (64.4%)	46 (25.6%)	17 (9.4%)	1 (0.6%)	0 (0%)	0 (0%)	180 (100%)
Total	656 (56.7%)	299 (25.8%)	112 (9.7%)	53 (4.6%)	22 (1.9%)	15 (1.3%)	1157 (100%)

*x^2=51.72, d.f.=20, p=0.00

Rajasthan to be 43.12%. Primary tooth fluorosis was more in maxillary incisors and the primary molars were least affected which was similar to

the study done by Booth et al [4] in United Kingdom. In contrast, Warren JJ and Levy SM[1] found the primary

tooth fluorosis to be more among the primary molars and least in incisors.

A strong relation has been found between fluoride contents of drinking water and the prevalence and the severity of the fluorosis. A dose-response relationship was observed between water fluoride concentration and the fluorosis prevalence and severity similar to the results of Warren JJ. [1] The prevalence and severity of primary tooth fluorosis was much higher in North zone with its water fluoride concentration being higher as compared to other zones. While not a single case of moderate to severe fluorosis was seen in central zone in correspondence to its lower water fluoride concentration. Score 1-4 in Dean's index indicate mottling and higher scores are a measure of pitting. Majority of the primary teeth showed mottling only, few teeth had scores higher than four which was similar to the result found by Burger P and Cleaton-Jones P. [17] This supports the concept that

fluorotic changes increase in severity with rise in fluoride concentration in the drinking water. [10,17]

Assessment of milder forms of primary tooth fluorosis is very sensitive to the source of light; unlike diagnosis of macroscopic changes with various degrees of surface defects due to their thinner enamel covering normally have a more whitish appearance than permanent teeth. For this reason, it is likely that the degree of dental fluorosis in the primary teeth has been underscored. More, generally the diagnostic difficulties associated with the assessment of the mild dental fluorosis in primary teeth may explain the reason for very few clinical studies recording prevalence of fluorosis in the primary dentition.[10] One additional diagnostic difficulty is that the primary tooth fluorosis can easily be overlooked or confused with other conditions such as white spot lesions or isolated opacities .[1] More over the ambiguous

opinion regarding the protective function of placenta against the fluoride may therefore be another explanation for why dental fluorosis in the primary teeth has apparently been overlooked in clinical studies. [10] Finally, it is important to note that although primary tooth fluorosis was associated only with water fluoride concentration in the present study, its prevalence, like that of permanent tooth fluorosis, is dependent on total fluoride intake from all sources.

Thus, further research, including continued analyses of data from the present study, is needed to better characterize the link between total fluoride intake and dental fluorosis in both the primary and permanent dentitions. Adding to the limitation of the study, it was not possible for us to record the nutritional status of each child. Additional research is warranted on prevalence of fluorosis in primary dentition as some of the studies have shown its impact and implementation on the permanent

dentition.[12] One possible reason may be the overlap of the fluoride intake during the same developmental period. There could be other factors modifying the association between the primary and permanent tooth fluorosis. This may include slight differences in the process of tooth formation between primary and permanent teeth, genetic factors, and differences in individual metabolism and susceptibility. The data provided by the study is important to make the parents, clinicians and the health administrators aware of the prevalence and severity of dental fluorosis among the children residing in Udaipur city of Rajasthan. Reductions in the fluoride intake would help to prevent fluorosis of later-erupting teeth (2nd molars, canines and premolars), which could be of some esthetic importance. Identification of primary tooth fluorosis in an older child could potentially be very valuable in avoiding excessive fluoride ingestion for the younger siblings, for both

earlier and later-erupting teeth. Therefore, providers should counsel parents of young children in order to best balance the caries preventive benefits of fluoride with risks of dental fluorosis. [12] The data can also be utilized as preliminary source of information to carry out the future epidemiological investigations to assess dental fluorosis and to evaluate the risk factors associated with the condition in the study region.

Conclusion

To conclude, primary tooth fluorosis prevalence was most commonly seen in incisors and the primary molars were least affected. Also the prevalence and the severity of the primary tooth fluorosis were directly proportional to the fluoride concentration of the water i.e. the prevalence and severity was higher in zones with high water fluoride concentration as compared to the zones with lower water fluoride concentration.

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