Prevalence Of Dental Caries In Relation With Different Fluoride Levels In Drinking Water Among School Going Children In Sarada Tehsil Of Udaipur District, Rajasthan

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Abstracts: Aim: To determine the fluoride concentration in drinking water of villages in Sarada tehsil of Udaipur district, Rajasthan and estimate the prevalence of dental caries in relation with different fluoride levels in drinking water among school going children of 6-12 years age group of the same. Material & Methods: Dental caries for permanent teeth as well as primary teeth was recorded using WHO (1997) in school children of selected villages. The drinking water samples of all the selected villages were collected in polyethylene bottles and the fluoride content of these samples was determined by fluoride ion selective method using Orion microprocessor analyser. Results: The overall prevalence of dental caries in permanent dentition was found to be 81.35% while in primary dentition it was 65.97%. As the water fluoride level increased, there was a decrease in mean dmft scores. There was a significantly very strong positive correlation between water fluoride level and caries experience in permanent dentition and a significantly very strong negative correlation between water fluoride level and caries experience in primary dentition. Conclusion: The study demonstrates the relation between dental caries in primary and permanent teeth with fluoride levels in drinking water. Thus, neither more nor less but optimum amount of fluoride in drinking water is essential for maintaining good oral health and caries free mouth of a child. [Sarvaiya B et al NJIRM 2012; 3(5) : 118-123]

Keywords: dental caries, fluoride, drinking water

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Introduction: Fluoride has been recognized as the central component in strategies to prevent dental caries. Dental caries is a disease that has major health, economic, and social effects on communities worldwide. It is a microbial disease of the calcified tissues of the teeth, characterized by demineralization of inorganic portion and destruction of the organic substances of tooth.[1] Caries prevalence tend to reduce with increasing fluoride level in the drinking water, thus indicating a negative association between fluoride and caries.[2] However, various studies have indicated no relation[3] or even positive relation between the fluoride concentration in the drinking water and prevalence of dental caries in the permanent dentition.[4,5] Although a number of studies have dealt with the relationship between dental caries and dental fluorosis, the relationship between them is not clearly decided.[6,7] The Bureau of Indian Standards (BIS) has set the maximum permissible level of fluoride in drinking water at 1 ppm. Fluoride level of drinking water to optimal concentration has been firmly established as a safe and effective public health measure that consistently reduces caries an average of 50-65% among persons who consumed the water regularly since birth.

Highly rich fluoride groundwater has been reported to exist in the districts Ajmer, Barmer, Bharatpur, Bhilwara, Bikaner, Churu, Dungarpur, Jaipur, Jodhpur, Jhunjhunu, Kota, Pali, Nagur, Sikar, Sirohi, Tonk and also in some parts of Udaipur. In Udaipur district, the tehsils in which majority of villages have fluoride content more than 1.5 ppm are Mavli, Salumber, Sarada.[8] But recently water work projects have been started to provide safe water in almost all villages in every tehsil. But Sarada tehsil is still untouched and people of this tehsil drink water from their local water sources since years. Moreover people living here are tribal population; hence have same diet and same socio economic status. So the severity of dental caries in this area can be mainly related with the varying fluoride concentration in drinking water. Till today no data is available on the prevalence and severity of dental caries in school children of Sarada tehsil of Udaipur district.

Thus the aim of the study was to determine the fluoride concentration in drinking water of villages

in Sarada tehsil of Udaipur district, Rajasthan and estimate the prevalence of dental caries in relation with different fluoride levels in drinking water among school going children of 6-12 years age group.

Material & Methods: The present analytical study was conducted among 6-12 year old school children of Sarada Tehsil, Udaipur district, Rajasthan, India in collaboration with Jalseva Talim Sanstha, Water Supply & Water Storage, Gandhinagar, Gujarat during the period of June-October, 2010. Informed consent was obtained from the school head master before the onset of study. The size of the sample was estimated to be 1000. A total of 1008 children participated in the study. The pilot study subjects were not included in the main study. School going children aged 6-12 years who were lifelong residents of that particular region and who were using the same source of drinking water from birth were included in the study. Children who were not the permanent residents of that particular area and with change of source of drinking water, those with orthodontic brackets, dentofacial deformities or any syndromes or uncooperative, medically and physically compromised patients were excluded from the study. Stratified sampling procedure was used for the main study.

For study purpose, the entire geographical area of Sarada tehsil was divided into 4 zones: North, West, South and East. From each zone, the following villages were selected by simple random sampling from those villages which fulfilled the inclusion criteria. Self administered questionnaire were distributed among the school children present in the school on the day of examination. They were asked to fill the questionnaire which consisted of information on demographic data, permanent residential address and type of drinking water source. Dental caries using DMFT index for permanent teeth and dmft for primary teeth using WHO (1997) were recorded. The clinical examination was carried out under the adequate natural light in school premises or corridors.

Collection of water sample was done based on national oral health survey and fluoride mapping 2002-03. Drinking water was collected in precleaned polyethylene bottles; it was then given a serial number, which represented a particular village. The common water sample drunk by school children of a particular village was taken. The fluoride content of these samples was determined by fluoride ion selective method using Orion microprocessor analyser at Jalseva Talim Sanstha, Water Supply and Water Storage, Gandhinagar, Gujarat. All the examination was carried out by a single examiner (i.e. investigator herself) and recording was done by another person, who was familiar with the local language and assisted the examiner in recording the details. Statistical analysis was done using Statistical Package of Social Science (SPSS Version 15; Chicago Inc., USA).

Results: Table 1 shows distribution of study group according to age and gender. The age group of the population ranged from 6-12 years. Among the total population of 1008 children, 200 of them belonged to age group of 6-8 years, 341 of them belonged to 8-10 year age group and 467 of them to the 10-12 year age group. Out of the total population, 520 (51.60%) were males and 488 (48.40%) were females.

Table 1: Distribution of study group according to age and gender

Age group (in years)	Sex		Total
	Female	Male	
6-8	102 (51.00%)	98 (49.00%)	200 (100%)
8-10	149 (43.70%)	192 (56.30%)	341 (100%)
10-12	237 (50.70%)	230 (49.30%)	467 (100%)
Total	488 (48.40%)	520 (51.60%)	1008 (100%)

Table 2 shows the prevalence of dental caries in permanent dentition at varying levels of fluoride concentration in drinking water. Prevalence of dental caries in permanent dentition at fluoride concentration of 0.8 ppm was 35.71%, at 1.2 ppm it was 71.76%, at 1.7 ppm was 73.49%, at 2.1 ppm it was 77.21%, at 2.4 ppm it was 89.88%, at 2.7 ppm it was 90.27%, at 3.2 ppm it was 90.30%, at 3.6 ppm it was 90.54% and at 4.1 ppm it was 92.37%. An increase in DMFT with corresponding

increase in water fluoride content was found. The overall prevalence of dental caries in permanent dentition was found to be 81.35%.

Table 2 : Prevalence of dental caries in permanent dentition at varying levels of fluoride concentration in drinking water

Fluoride conc in drinking water	No. of caries free children	No. of children with dental caries	Total
0.8	54 (64.29%)	30 (35.71%)	83 (100%)
1.2	24 (28.24%)	61 (71.76%)	84 (100%)
1.7	22 (26.51%)	61 (73.49%)	85 (100%)
2.1	31 (22.79%)	105 (77.21%)	136 (100%)
2.4	17 (10.12%)	151 (89.88%)	168 (100%)
2.7	11 (7.73%)	115 (90.27%)	126 (100%)
3.2	13 (9.70%)	121 (90.30%)	134 (100%)
3.6	9 (9.46%)	109 (90.54%)	118 (100%)
4.1	7 (7.63%)	67 (92.37%)	74 (100%)
Total	188 (18.65%)	820 (81.35%)	1008 (100%)

Comparison between water fluoride level and mean DMFT values is made in **Table 3.** Results stated that there was a gradual increase in mean DMFT values from 0.50 to 2.73 as water fluoride level increased from 0.8 ppm to 4.1 ppm with the mean DMFT of 1.99±0.77. Correlation coefficient between mean DMFT & dmft and water fluoride level reveals that there was a significantly very strong positive correlation (p=0.001) between water fluoride level and mean DMFT scores that meant that as water fluoride level increased, there was an increase in dental caries experience.

Table 4 shows the prevalence of dental caries in primary dentition at varying levels of fluoride concentration in drinking water. Prevalence of dental caries in primary dentition at fluoride concentration of 0.8 ppm was 84.52%, at 1.2 ppm it was 100%, at 1.7 ppm was 83.13%, at 2.1 ppm it was 59.56%, at 2.4 ppm it was 57.74%, at 2.7 ppm it was 58.73%, at 3.2 ppm it was 65.67%, at 3.6 ppm it was 61.86% and at 4.1 ppm it was 36.48%. The overall prevalence of dental caries in primary dentition was found to be 65.97%**.**

Comparison between water fluoride level and mean dmft values is made in **Table 5.** Results stated that the mean dmft value was highest (3.44) at 1.2 ppm of water fluoride level and lowest (0.36) at 4.1 ppm with the mean dmft of 1.56±1.12. Correlation coefficient between mean dmft and water fluoride level showed a statistically very strong negative correlation between water fluoride level and mean dmft scores. This meant that as water fluoride level increased, there was a decrease in dental caries experience.

Table 3: Relation between DMFT and water fluoride levels

Fluoride conc in drinking water (in ppm)	Mean DMFT	Mean± SD of fluoride conc in drinking water	Mean±SD of DMFT	Correlation coefficient 'r'	Regression coefficient 'b'	Prediction equation
0.8	0.50	2.39± 1.21	1.99± 0.77	0.95	0.64	DMFT=0.64 (fluoride conc)+ 0.40
1.2	1.18					
1.7	1.48					
2.1	1.74					
2.4	2.32					
2.7	2.38					
3.2	2.46					
3.6	2.70					
4.1	2.73					

Discussion: The intent of the study was to examine the effect of different fluoride levels in drinking water on dental caries in Sarada tehsil of Udaipur district in Rajasthan. School based approach was used to assess the prevalence of dental fluorosis and dental caries in the present study. School

children of age group 6-12 years were chosen. As this being the period of mixed dentition, effect of dental caries can be assessed on both the primary as well as permanent dentition. Moreover the sample population of this particular age group was readily available from primary schools only.

The present study reported high concentration of fluoride in groundwater (hand pump and open well as compared to surface water of rivers). The average fluoride concentration was recorded to be 2.42 mg/dl. Similarly, a study from the Northern Rajasthan, India, reported fluoride concentration in groundwater in the range of 4.78-1.01 mg/L with the average concentration being 2.82 mg/1.[9]

Table 4: Prevalence of dental caries in primary dentition at varying levels of fluoride concentration in drinking water

Fluoride conc in drinking water (in ppm)	No. of caries free children	No. of children with dental caries	Total
0.8	13 (15.48%)	71 (84.52%)	83 (100%)
1.2	0 (0%)	84 (100%)	84 (100%)
1.7	14 (16.87%)	69 (83.13%)	85 (100%)
2.1	55 (40.44%)	81 (59.56%)	136 (100%)
2.4	71 (42.26%)	97 (57.74%)	168 (100%)
2.7	52 (41.27%)	74 (58.73%)	126 (100%)
3.2	46 (34.33%)	88 (65.67%)	134 (100%)
3.6	45 (38.14%)	73 (61.86%)	118 (100%)
4.1	47 (63.51%)	27 (36.48%)	74 (100%)
Total	343 (18.65%)	665 (65.97%)	1008 (100%)

Climate has a significant influence on the fluoride concentration in water, with fluoride content increasing after a drought and decreasing, as a result of dilution, after heavy rains.[10,11] Therefore, the water samples in this study had been collected in October 2010 during the dry season.

In the present study, the overall prevalence of dental caries in permanent dentition was found to be 81.35%. In this study, the prevalence of dental caries in permanent dentition at fluoride concentration of 0.8 ppm was 35.71% and at 4.1 ppm it was 92.37%. An increase in dental caries experience in permanent dentition with corresponding increase in water fluoride content was found. In the present study, there was a gradual increase in mean DMFT values as water fluoride level increased from 0.8 ppm to 4.1 ppm, which was statistically significant. This showed that as water fluoride level increased, there was an increase in dental caries experience.

Table 5: Relation between dmft and water fluoride levels

Fluoride conc in drinking water	Mean dmft	Mean + SD	Mean±SD of dmft	Correlation coefficient 'r'	Regression coefficient 'b'	Prediction equation
0.8	3.10	2.39 ± 1.21	1.56 ± 1.12	-0.91	-0.91	dmft = -0.91 (fluoride conc) +.3.73
1.2	3.44					
1.7	2.41					
2.1	1.09					
2.4	1.10					
2.7	0.99					
3.2	0.85					
3.6	0.73					
4.1	0.36					

In a study carried out by Budipramana ES et al[6], caries prevalence in the subdistrict of Asembagus with fluoride content in drinking water ranging from 0.41-3.25 was 62% for permanent teeth. A positive relationship between fluoride water content and mean DMFT was found. In a study conducted by Budipramana ES et al[12], prevalence of dental caries was 83% in second metropolis city

of indonesia.the fluoride level in the study was 0.25mg/dl. Several other studies have found a positive association between high fluoride levels in the drinking water and dental caries in permanent dentition.[3,5]

The possible explanation for this observation is, as the water fluoride level increases, enamel defects (fluorosis) such as pitting, loss of outer enamel, etc also increases which makes a tooth more susceptible to food lodgment and leads to initiation of dental caries. In short, "with more severe forms of fluorosis, caries risk increases because of pitting and loss of the outer enamel.[13] The decay rate in the permanent dentition gradually increases with increasing fluorosis severity, a finding not observed in the primary dentition.[14] In the present study, dental fluorosis was not observed in primary dentition which lead to avoidance of enamel defects such as pitting, loss of outer enamel making the tooth less susceptible to food lodgement and development of caries. This could be the explanation why dental caries is less prevalent in primary teeth inspite of increase in water fluoride concentration.

In the present study, the overall prevalence of dental caries in primary dentition was found to be 65.97% with the range of fluoride concentration of 0.8-4.1ppm. In this study, prevalence of dental caries in primary dentition at fluoride concentration of 0.8 ppm was 84.52% and at 4.1 ppm it was 36.48%.Prevalence of dental caries in a study carried out by Budipramana et al [6] in the subdistrict of Asembagus with fluoride content in drinking water ranging from 0.41-3.25 was found to be 68% for primary teeth.

In the deciduous dentition, the mean dmft value was 3.10 at 0.8 ppm of fluoride concentration and decreased to 0.36 at 4.1 ppm of fluoride concentration. There was a negative correlation between water fluoride level and mean dmft scores that meant that as water fluoride level increased, there would be decrease in dental caries experience, which was statistically significant.

In a study carried out by Ibrahim YE et al[15] in the primary teeth, caries experience was significantly lower in high fluoride area (2.5 ppm) than in low fluoride area (0.5 ppm). In a study carried out by Budipramana ES et al[6], there was a significant decrease in mean dmft with increase in water fluoride concentration. The higher prevalence of dental caries in permanent teeth compared to primary teeth is suggestive of exposure to a greater cariogenic challenge after the eruption of the permanent teeth. The difference in caries experience in permanent and primary dentition may indicate difference in the living habit between younger and older age groups.[15] Information on caries prevalence and availability of dental care are fundamental in order to make rational choices, implement cost effective interventions and thus to realize the considerable savings inherent in avoiding unnecessary and costly water treatment programs.

Conclusion: The following conclusions were drawn from the study:

1. The overall prevalence of dental caries in permanent dentition was found to be 81.35% while in primary dentition it was 65.97%.
2. As the water fluoride level increased, there was an increase in mean DMFT scores. Thus, there was a significantly very strong positive correlation between water fluoride level and caries experience in permanent dentition.
3. As the water fluoride level increased, there was a decrease in mean dmft scores. Thus, there was a significantly very strong negative correlation between water fluoride level and caries experience in primary dentition.

This study demonstrates the relation between dental caries in primary and permanent teeth with fluoride levels in drinking water. Thus, neither more nor less but optimum amount of fluoride in drinking water is essential for maintaining good oral health and caries free mouth of a child.

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