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EFFECTS OF FLUORIDE AND NUTRITITIONAL STATUS ON DEVELOPMENTAL DEFECTS OF ENAMEL AMONG SCHOOL GOING CHILDREN AGED 12-13 YEAR IN DAVANGERE, SOUTH INDIA

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ABSTRACT

Introduction: Developmental defects of enamel are visible deviations from the normal translucent appearance of tooth enamel resulting from enamel organ dysfunction. It is increasingly evident that developmental defects of enamel are common and distribution is wide spread. The influence of excessive fluoride in drinking water and nutritional deficiencies have significant role in the very occurrence of developmental defects of enamel and this study aims to evaluate the same among school children aged 12-13 years in Davangere, South India. **Materials and Methods:** A total of 353 school going children aged 13 years were included in the study. Four villages were randomly selected from Davangere. Developmental defects of enamel were recorded using Modified DDE index and the defects were classed as demarcated, Diffused and Hypo plastic. Fluoride concentration in the water sample was estimated by using ORION- ION SPECIFIC ELECTRODE METHOD. Nutritional status was determined by height for age percentage of the median of the reference population, HAM. All categorized data were analyzed by Chi-square test for difference between groups and significance for all statistical tests was predetermined at probability values of 0.05 or less. **Results:** Over all prevalence of developmental defects of enamel was 94.9%. Diffused defects were the highest with 63.5%, followed by hypo plastic defects with 17.8% and the least was demarcated defects i.e. 13.6%. The prevalence of developmental defects of enamel increased with increase in fluoride content in the drinking water source. Regarding the nutritional status, 48.2% were malnourished. Diffused defects were more common among the malnourished group with 65.2%. **Conclusion:** Malnutrition plays an important role along with fluoride in the occurrence of developmental defects of enamel. Results should emphasizes the health promoters to go for defluoridation plants and stress more on the importance of nutrition, thus aiding in improving the health of the individual.

KEYWORDS: Developmental defects of enamel, nutritional status, fluoride concentration, school children.

INTRODUCTION

Developmental defects of enamel are visible deviations from the normal translucent appearance of tooth enamel resulting from enamel organ dysfunction. It is increasingly evident that developmental defects of enamel are common and distribution is widespread.[1] The high frequency of enamel defects suggests that the normal progress of enamel formation is highly susceptible to interference and disruption. Advances in our understanding of the complicated secretory and maturation phases of amelogenesis have required a re-appraisal of the concepts of defect formation. Nearly hundred different causes for developmental defects of enamel have been listed. In any one case it is barely possible to identify the suspected etiological factor or combination of factors such as childhood diseases, malnutrition, disturbances in calcium and phosphate metabolism, trauma, drugs like tetracycline and fluoride exposure. (Murray 1086; Murray et.al, 1991; Galagan and Vermillion 1957; Myers 1978; and Pindborg 1882) These factors have been linked to the occurrence, distribution and severity of specific types of defects. Nevertheless, the etiology of many defects ranging from minor blemishes to severe hypoplasia remains puzzling and a challenge to our understanding of amelogenesis and the factors which can influence it.[2,3]

Developmental defects of enamel are defined as "disturbance in hard tissue matrices and in its mineralization, arising during odontogenesis, caused by an insult to the ameloblast cells.[4] Clinically the defect is visually and morphologically identified by various irregularities such as pits, grooves or absence of enamel structure over the tooth surfaces." It is also manifested as demarcated or diffuse opacities, enamel hypoplasia or enamel hypo-mineralization.[5]

The relationship of enamel defects to fluoride in drinking water was unraveled only in the last 75 years.[6] Studies have frequently established the increase in number of enamel defects as the fluoride concentration in the drinking water exceeds 1 ppm and the intensity of the lesion are related to a variety of factors which influence the fluoride intake such as climatic condition and nutrition.[3,7,8] Some of the studies by Galagan and Vermillion 1957; Myers 1978; Pindborg 1962; comprehensively reviewed the etiology of developmental defects of enamel as influenced by factors other than fluoride. Many of these factors are rare and unlikely to influence the prevalence of developmental defects of enamel on a population basis.

Fluoride reaches the drinking water sources by dissolution of fluoride bearing rocks, soils and surface dust. The common fluoride bearing rocks are granites, granodiorites, schist's, and grey wacks. These forms of rocks are common in Davangere district, Karnataka. Fluoride finds its way into the human body through drinking water and vegetations grown in these areas.[9] The majority of the population of Davangere district depends on ground water for domestic and agricultural purposes. It is possible that unacceptable levels of fluoride in the ground water are contributing to the higher prevalence of enamel defects in these areas. A literature search revealed the presence of high concentrations of fluoride in water sources from villages of various taluks of Davangere district.[10] In addition to higher levels of fluoride available in the local drinking water, the people of Davangere are exposed to commercially available fluoridated dental products and fluoride from other dietary sources. The incidence of developmental defects of enamel is best correlated with the cumulative fluoride exposure to the developing dentition. If the total fluoride exposure to the developing teeth is excessive, developmental defects of enamel will result.

Some of the studies have been comprehensively reviewed the etiology of developmental defects of enamel by factors other than fluorides. Many of these factors are rare and unlikely to influence the prevalence of defects on a population basis. One factor however which has been shown to be relevant is malnutrition. This relation between malnutrition and defective enamel has been demonstrated in several regions of the world. (Sweeney et.al, 1971; Enwonwu 1973; Li et.al, 1996; Mellanby 1918 and 1937; Rugg Gunn 1993) However nutrition is not a significant etiological factor in well nourished New Zealand study (Suckling and Pearce 1984) but nutrition only becomes etiologically important when the prevalence of malnutrition is reasonably high.[4,7-10]

Based on the fluoride concentrations in the drinking water sources, malnutrition and the demand by the population for action to solve the public health problem, it is therefore important to record the prevalence and severity of developmental defects of enamel in the permanent dentition of Davangere children and to examine the effects of water fluoride concentrations and nutritional status on the prevalence of these defects both independently and in combination. So the study aims to determine the prevalence of developmental defects of enamel and its associations if any, with different fluoride concentrations and nutritional status among 12-13 years old school going children in rural areas of Davangere, South India.

METHODOLGY

A school based approach was used. A total of 353 available students aged 13 years belonging to 4 schools of different villages constituted the study population. Only the students who were permanent residents of the respective villages were considered and included in the study where as the students belonging to other villages but studying in the same school was not included in the study. Age group of 12-13 years old children was chosen because all of their permanent teeth, except for the third molars were assumed to have erupted by that age. This age group also has the added advantage of being unlikely to present behavioral and management problems and hence would co-operate better.

Prior to scheduling the survey, official permission was obtained from the concerned authorities. Informed consent was obtained from every student and their parents participating in the study prior to dental examination. The proposed study was reviewed by the Ethical committee of Bapuji Dental College and Hospital, Davangere and clearance was obtained. Prior to scheduled, the investigator visited the respective schools to obtain permission and fix the scheduled date and time. The students were requested to be present on the scheduled date and time. A detailed weekly schedule was prepared well in advance. On an average 30-40 subjects were interviewed and examined in any given day during the survey period. Although a detailed schedule plan was prepared meticulously few adjustment and changes were called for while working it out practically. Duration for data collection for each subject ranged from 5-8 minutes.

The calibration of investigator was done in the Department of Preventive and Community Dentistry, in order to limit the examiner variability. The Kappa co-efficient value of intra-examiner reliability for developmental defects of enamel was 0.95. These values reflected high degree of conformity in observations.

A specially prepared and pretested format, exclusively designed for recording all the required and relevant general information and clinical findings was used for recording the data.

A pilot survey was undertaken to test the feasibility of the study including the assessment of clarity, validity, and applicability of the questionnaire followed by the procedure to be employed for examination and recording of developmental defects of enamel, nutritional status and estimation of fluoride concentration in the drinking water.

Examination of the selected children was done within the premises of the school under available natural daylight with the student seated on a chair with a back rest. The subjects were positioned so as to receive maximum natural illumination. Artificial illumination was also used at times when required using torch light. The examiner sitting to the right and front of the seated student examined the specific teeth surfaces for developmental defects of enamel as described by Modified DDE index (according to WHO Oral health survey Basic Methods, 1997).[11] Enamel abnormalities were classified into one of the three types on the basis of their appearance (i.e. demarcated, diffused and hypo plastic). Height of each subject was also recorded. Prior to each examination the required general information from every student was obtained by the examiner by asking relevant questions. The scores dictated by the examiner were recorded in the proforma by the trained recorder seating close to the examiner so that instructions and codes could be easily heard and the examiner could see that findings were being recorded correctly. All necessary aseptic precautions were taken during the examination procedure. The information relevant to the source of drinking water and duration of residence at the present address were also obtained. Water sample was collected from the source place using 500 ml plastic bottles. The bottles were doubly rinsed with distilled water and labeled, coded before sending it to the laboratory for estimation of fluoride concentration.

FLUORIDE CONCENTRATION ESTIMATION

The fluoride concentrations/levels of the drinking water were detected by standard methods (IS 1992, Neeri 1988, and APHA 1985). The Ion Selective Electrode method was used to estimate the fluoride content in drinking water. The estimation was done on Orion ion meter model 720A with fluoride sensitive electrode, model number 9409BN and single junction reference electrode model number 90-01 using TISAB (Total Ionic Strength Adjustment Buffer) solution after proper calibration.[12]

NUTRITIONAL STATUS

Nutritional status was assessed by measuring height and age of the subject. Height was measured without shoes or head –wear using a single vertical stadiometer, to the nearest 0.5cm. Weight measurements were not used in this part of the study. Age on the day of examination was calculated. Using height (WHO and CDC 1990), the height for age percentage of the median of the reference population (HAM) was calculated for each child using the formulae,

$$\text{Height/Age (\%)} = \frac{\text{Height of the child X 100}}{\text{Height of a normal child at same age}}$$

Height of a normal child at same age was determined according to the information obtained from BAPUJI CHILD HEALTH INSTITUTE AND RESEARCH CENTRE, DAVANGERE, based on the local conditions. The children were classed as well nourished if their HAM scores was 95% and over and malnourished if their HAM score was less than 95% (Waterlow et al, 1977).[13]

The data so obtained was compiled systematically. A master table was prepared in MS Excel worksheet and the total data was subdivided and distributed meaningfully and presented as individual tables along with graphs.

Statistical procedures were carried out in 2 steps,
1. Data compilation and presentation
2. Statistical analysis

Data comparison was done by applying specific statistical tests to find out the statistical significance of the comparisons. Chi-Square test was used for estimation of statistical significance between groups.

1. *Formula for Chi-square test* (χ^2 test)

Chi –Square test: This is a non-parametric test, used when data are expressed in frequency or proportion or percentages. It is useful for discrete data.

$$\chi^2 = \Sigma \frac{(\text{Observed frequencies} - \text{Expected frequencies})^2}{\text{Expected frequencies.}}$$

$$\chi^2 = \Sigma \frac{(O - E)^2}{E} \qquad \Sigma \text{ - denotes summation}$$

Where O - Observed frequency
E - Expected frequency

$$\text{Expected frequencies} = \frac{\text{Row total X Column total}}{\text{Grand total}}$$

Significance for statistical tests was predetermined at probability values of 0.05 or less.

RESULTS

The results of the present study were systematically compiled and analyzed. The results were presented under various parameters under the study. Of the total 353 subjects, 70% were males and the rest 30% were female students. A maximum of 32.3% belonged to Bannikodu village; followed by 26.3% who belonged to Bevanahalli Village and rest 21.5% and 19.8% belonged to Hebbal and Banuvalli villages respectively.

The mean concentration of fluoride in the drinking water among different study villages are shown in Table 1. The least fluoride concentration in the drinking water was found in Hebbal with 0.75ppmF, followed by Bannikodu and Banuvalli being 2.38ppmF and 2.91ppmF respectively and highest being at Bevanahalli 4.34ppmF.

The overall prevalence of developmental defects of enamel among the study subjects was 94.9%. Diffuse type of defects were the most common with 63.5%, followed by hypo plastic defect constituting 17.8% and demarcated defects having 13.6%. In Hebbal village where there was least fluoride in drinking water, the overall prevalence of developmental defects of enamel was 88.2% whereas in Bevanahalli village where the fluoride concentration in drinking water was the maximum, the overall developmental defects of enamel were 94.6%. This shows that there is significant increase in the prevalence of enamel defects with increase in the fluoride concentration. The results were statistically significant P<0.001.

Nutritional status was assessed by determining the height for age at the time of the study. The children were classed as well-nourished if their HAM score was >95% and malnourished if their HAM score was <95%. 51.8% of the study subjects were well-nourished and the remaining 48.2% were malnourished. Among well-nourished children, 92.3% were having at least one type of enamel defects; the diffuse type of defects were the most common 57.9%, where as in malnourished children, 98.2% showed enamel defects; the diffuse type of defects was the most common 72.9%. The results were statistically significant (P<0.05).

The association between nutritional status, fluoride concentration and developmental defects of enamel defects are shown in table 4: Among well nourished children, there was a strong association between fluoride level and developmental defects of enamel (OR = 4) and among malnourished, there was weak association between fluoride level and developmental defects of enamel (OR =2.3) compared to well-nourished children. This shows that even malnutrition plays a role in the occurrence of developmental defects of enamel.

TABLES AND GRAPHS

Table I: Shows the distribution of study population according to place, fluoride concentration and Gender.

Sl No	Places	Fluoride Concentration in Drinking Water	Male N (%)	Female N (%)	Total N (%)
1)	Hebbal	0.75ppmF	42 (11.9%)	34 (9.6%)	76 (21.5%)
2)	Bannikodu	2.38ppmf	72 (20.4%)	42 (11.9%)	114 (32.3%)
3)	Banuvalli	2.91ppmF	60 (17%)	10 (2.8%)	70 (19.8%)
4)	Bevanahalli	4.34ppmF	73 (20.7)	20 (5.7%)	93 (26.3%)
	Total		247 (70%)	106 (30%)	353 (100%)

Table II: Shows the prevalence of developmental defects of enamel and fluoride concentration in drinking water.

Places	Normal	Demarcated	Diffused	Hypo Plastic	Total
Hebbal 0.75ppmF	9 (11.8%)	27 (35.5%)	31 (40.8%)	9 (11.8%)	76 (100%)
Bannikodu 2.38ppmF	4 (3.4%)	4 (3.4%)	80 (70.2%)	26 (22.8%)	114 (100%)
Banuvalli 2.91ppmF	0	17 (24.3%)	43 (61.4%)	10 (14.3%)	70 (100%)
Bevanahalli 4.34ppmF	5 (5.4%)	0	70 (75.3%)	18 (19.4%)	93 (100%)
Total	18 (5.1%)	48 (13.6%)	224 (63.5%)	63 (17.8%)	353 (100%)

X 2 = 77.6 df = 9 P<0.001 H S.

Table III: Shows nutritional status and occurrence of developmental defects of enamel.

Nutritional Status	Normal	Demarcated	Diffused	Hypo Plastic	Total
HAM>95% Well nourished	14 (7.7%)	33 (18%)	106 (57.9%)	30 (16.4%)	183 (100)
HAM<95% Malnourished	3 (1.8%)	17 (10%)	124 (72.9%)	26 (15.3%)	170 (100)
Total	17 (4.8%)	50 (14.2%)	230 (65.2%)	56 (15.9%)	353 (100)

Table IV: Shows the association between nutritional status, fluoride level and developmental defects of enamel (DDE).

Nutritional status	Fluoride level(ppm)	DDE Present n (%)	DDE Absent n (%)	Total n (%)	Significance
Well nourished	>2	122 (95.3%)	6 (4.7%)	128 (100%)	X2=6.97 P<0.01(S) OR =4.0
	0.75	46 (83.6%)	9 (16.4%)	55 (100%)	
Malnourished	>2	146 (98%)	3 (2.0)	149 (100%)	X2=0.43 P=0.51, NS OR= 2.3
	0.75	21 (100%)	0	21 (100%)	

DISCUSSION

Developmental defects of enamel are morphological and esthetic imperfections which often negatively influence not only physical health but also mental and social aspect. Although several reasons are linked with developmental defects of enamel, fluoride concentration in the drinking water perhaps maybe the most important risk factor, at least in endemic fluoride areas. Davangere district is classified under endemic fluoride belt in India having significant high concentration of fluoride in drinking water. Fluorosis was probably a powerful motivating factor for research activity for many investigators interested in enamel defects. A systematically obtained epidemiological data is very important for quantification and analysis, in order to understand the distribution and the dynamics of a disease. Such information can be compared with the data obtained from different population and countries in order to check the validity and draw meaningful conclusions. And also nutritional status of the individuals has shown significant associations resulting in development of enamel defects. In communities with high prevalence of malnutrition and wide spread rural living, there is still no baseline data on its prevalence, which would further substantiate the exact cause of developmental defects of enamel. So this study aimed to examine the prevalence of developmental defects of enamel in endemic communities under blind conditions, against a background of increased bioavailability of fluoride and questions being posed as to whether the prevalence of defects is alarming or not. And the study also aimed to determine the concentration of fluoride content in the drinking water in the study area, with its result, most of the areas had higher concentration of fluoride thus supporting the area to be endemic, with Hebbal being the least 0.75ppm F and Bevanahalli being highest of 4.34ppm F.[14, 15]

CONCENTRATION OF FLUORIDE IN DRINKING WATER SOURCE

The fluoride concentration in drinking water from the study areas of Davangere, South India, ranged from 0.75 ppm to 4.34 ppm. Davangere has been recognized as endemic fluoride area. According to study reports of Karanth (1987), the important fluoride bearing minerals are fluorite (CaF_2), actinolite, cryolite, hornblende and micas. The concentration of fluoride in groundwater is limited due to low solubility of most of the fluorides; however, due to variation in meteorological condition, the solubility of fluoride minerals varies from season to season.

There are very few reports available in the literatures regarding the distribution of fluoride concentration in drinking water in different areas of Davangere. Reports of studies[10,11,16] have revealed that the fluoride concentration of drinking water greatly differs in different villages of Davangere because of geological heterogeneity observed in this place. Certain villages are noticed to have significantly higher concentration of fluoride in drinking water. This may be due to the gneissic and granitic formation or black loamy and sandy soils. It may also be due to evaporation and evapo-transpiration as well as over exploitation of ground water to meet the domestic demands. There are certain references which have considered the chlorite-Schist seen more in black soil and poor degree of fresh water exchange in aquifer –systems (Das et al 1998) as responsible for high levels of fluoride in drinking water.

DEVELOPMENTAL DEFECTS OF ENAMEL

The use of Modified DDE index, proposed by WHO (WHO Basic Oral Health Survey -1997) is well accepted and its applications to express defects as either demarcated, diffuse or hypo plastic is widespread. Only the buccal surfaces were examined, as prevalence of defects is higher on these surfaces, which are aesthetically the only surfaces of importance.

The overall prevalence of developmental defects of enamel with varying concentrations of fluoride in drinking water was 92.8%. There are not many studies using modified DDE index which have tabulated the prevalence of enamel defects according to fluoride level except Rugg-Gunn et al, (1997), Ekanayake L and W.Van der Hoek, (2002). The results of which are similar to that of the present study. The studies of Lizuka et al, (1980); Subba Reddy and Tewari, (1985); Chellappah N.K, Vignesha H and Lo G.L, (1990); Chandrasekhar and Anuradha, (2004) have also yielded similar results although using different indices to record the enamel defects. Suckling and Pearce, (1984); Cutress et al, (1985); de Liefde and Herbison, (1985); Suckling, Brown, and Herbison, (1985); Dummer, Kingdon and Kingdon, (1986); Brook A.H and Smith J.M, (1998); Gopalakrishnan et al, (1999); Brook A.H, Fearne J.M and Smith J.M, (1997); Clarkson, O'Mullane and O'Hickey, (1988); Mackay T.D and Thompson W.M, (2005) have reported statistically not a significant association between fluoride concentration in drinking water and developmental defects of enamel. This difference may be attributed to different climatic condition to which the populations belong.[13,17-24]

A majority of above said studies were conducted in such countries where the climatic conditions are non-tropical. The mean annual temperature is perhaps considerably less when compared to India. The volume of water intake greatly differs depending on the local temperature. Tropical condition promotes water consumption and in addition malnutrition is far more common in rural areas of India which is another significant factor which can increase the severity of dental Fluorosis even with a small rise in fluoride concentration. As this study is conducted in endemic fluoride areas, a positive correlation is found between fluoride concentration of drinking water and developmental defects of enamel. A majority of the developmental defects of enamel may be attributed to a complex interplay between several risk factors like higher levels of fluoride in water, climatic condition, altitude, malnutrition, childhood illness, trauma, certain drugs like tetracycline, low birth weight, defect in the tooth forming cells (ameloblast), factors affecting mineralization, calcium and phosphate deficiencies, food habits(Jowar eating which contains molybdenum which promotes retention of fluoride), genetic predisposition…etc. The sphere of research related to developmental defects of enamel has time and again revealed varying results and conflicting reports. None of the studies in the literatures have reported clearly a set of etiological factors responsible for developmental defects of enamel with respect to their studies. There are obvious gray areas, which require to be filled up by conducting more systematic research.

The severity of type of defect showed a linear increase with increase in fluoride concentration in drinking water, which was found to be statistically highly significant. Among types of enamel defects scored under modified DDE index, the mildest form of defect found in the present study was demarcated opacity (13.6%) and hypoplasia was the severe form of defect in 17.8% of the study population. When the total study population was considered, diffuse opacities were the most commonly seen defect with an overall prevalence of 63.5% at fluoride concentrations ranging between 0.75 – 4.34 ppm. Similar findings were reported by Angelillo et al, (1990); Nunn et al, (1994); Rugg-Gunn et al, (1997), J Clarkson and O'Mullane, (1989); and Cutress et al, (1985), in areas with varying levels of fluoride in drinking water. According to Suckling and Pearce, (1984); DenBesten, (1999) and Mackay T.D & Thompson W.M, (2005) prevalence of diffuse opacities significantly increases with increased exposure of fluoride in drinking water. Similar findings with respect to dental fluorosis were reported by Warnakulasooriya et al, (1992); Heller et al, (1997); El-Nadeef and Honkala, (1998) and Grobler et al, (2001). This could be explained on the basis of the findings of Fejerskov et al. They have shown that a linear dose-response relationship exists between fluoride intake and dental fluorosis and the relationship was such that even with very low fluoride intakes from water, some degree of fluorosis does occur.[13,15,25-30]

The prevalence of hypo plastic defects was 17.8% at varying fluoride concentration of 0.75 to 4.34 ppm. Similar finding were reported by Angelillo et al, (1990) and Rugg Gunn et al, (1997). Not many studies have reported regarding hypo plastic defects and thus comparison could not be made. Nunn et al (1992, 1993) and Crooks M C (1990) have reported that hypo plastic lesions were prevalent in Sri Lanka and on the island of Rarotonga respectively.[31-33]

This study on developmental defects of enamel is controversial in its own terminology as it has been widely described with time in different ways by different authors, so for our purpose the studies of dental fluorosis (type of developmental defects of enamel) were included in the discussion. Since there are limited studies on enamel defects, further research is required for understanding and comprehending this condition. This being a cross-sectional study can best provide a snap picture of the situation but in order to have comprehensive information on dynamics of the disorder, one should conduct a longitudinal study (Cohort study).

Nutritional status and developmental enamel defects

In recent years, a number of studies have examined the association between the prevalence of enamel defects and nutritional status in various population groups (Rugg-Gunn et al 1997; Suckling et al 1987; Enwonwu. CO (1973). The majority of these studies have attempted to use hypoplasia /enamel defects as an indicator of malnutrition in a given population.

Among the well nourished children only 92.3% had at least one type of defect in their teeth where as in malnourished 98.2% had enamel defects, mainly diffused type of defects were common. Similar results have been shown in above studies.[13,34-36]

In developing countries high prevalence of linear enamel hypoplasia has been significantly associated with malnutrition. Although it is reasonable to assume that ameloblasts are affected by severe generalized malnutrition, deficiency of certain nutritional elements directly associated with epithelial cell function and mineralization process must be particularly important thus deficiency of vitamin A and D have been documented to result in enamel hypoplasia.

In rural areas the high prevalence of malnutrition is related to inadequate nutrient intake and poor economic conditions, similar results were found in Rivera and Rivera 1984, IPEA, 1996) So this results should emphasize on health care workers to bring the importance of nutrition more aware and thus aid in improving the resistance to diseases.

Association between Fluoride level, Nutrition status and developmental defect of enamel

It was shown in the study that there was a strong association between the fluoride level in the drinking water and developmental defects of enamel (OR=4) and in malnourished children a weak association between fluoride level and developmental defects of enamel. This shows that malnutrition also plays an important role along fluoride level in the occurrence of developmental defects of enamel (Rugg Gunnetal1977).[13] So in conclusion fluoride Concentration in drinking water and nutritional status have shown to be independently and in combination related to the prevalence and severity of developmental defects of enamel. This should be considered by public health planners.

CONCLUSION

It is concluded that, Developmental defects of enamel were commonly observed among school children of Davangere, South India. There was a positive correlation associated between the severity of developmental defects of enamel and fluoride concentration in the drinking water and Nutritional Status of the study subjects. The presence of fluoride in drinking water might have contributed to the risk of developing enamel defects such as demarcated opacities, diffused opacities and hypoplasia, which were esthetically unacceptable. Thus the development of simple, effective, inexpensive methods of defluoridation that are suitable and acceptable to the rural community in high fluoride rural areas of Davangere should be considered, if alternative low fluoride sources of drinking water are not available. Since the present study was based on selected children and selected villages of Davangere, the results warrant a fully fledged epidemiological study to get a clear picture of the extent of problem.

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