The Effect of Fluoride in the Prevention of Dental Caries and Prevalence of Dental Fluorosis among High and Low Fluoridated Areas of Tamilnadu-A Cross Sectional Survey

Anisha [1], M. Vishali[2], D. Prabu[3], Sunayana Manipal[4], Rajmohan[5], Bharatwaj[6], Prashanthy[7]

[1]Under graduate, [2]Post graduate Student, [3]Master of Dental Surgery, Professor and HOD, 4Master of Dental Surgery, Reader, [5]Master of Dental Surgery, Reader, [6]Master of Dental Surgery, Lecturer, [7]Post graduate Student, Department of Public Health Dentistry, SRM Dental College and Hospital, Ramapuram, Chennai, Tamilnadu, India

Abstract

Aim: To analyze the effect of fluoride in the prevention of dental caries and prevalence of dental fluorosis in high and low fluoridated areas. **Material and Method**: Dean's fluorosis index (1942)-modified was used to analyze the severity and prevalence of dental fluorosis and the caries prevalence was assessed using DMFS index (1931). The school students of age 12-16 years belonging to Chennai and Vellore areas were included in the study. A total of 400 students were examined in which 200 students belongs to Chennai and other 200 students belongs to Vellore representing low fluoridated area (LFA) and high fluoridated areas (HFA) respectively. **Results**: In the LFA the mean value of DMFS was found to be 0.805, hence it was notably greater than the mean DMFS of HFA which was 0.335. The mean Dean's Fluorosis score of LFA was found to be 0.005 which was significantly lower than mean value of Dean's fluorosis at HFA which was 0.7425. **Conclusion**: Mild increase in concentration of fluoride level in drinking water will decrease the incidence of dental caries in adolescents**.** Optimal fluoride levels in drinking water looks to be successful in decreasing caries outcome with low risk of dental fluorosis.

Key words*: Dental caries, Dental Fluorosis, high and low water fluoride level.*

Introduction

Dental caries is one among the most prevalent chronic disease affecting humans of all populations. The multiple disease patterns within and across the countries are associated with several factors like demographic factors, socio-behavioral pattern, environmental factors, and the accessibility and availability of oral health care, particularly, the subjection to various preventing oral health care programs. The principal reason for the increased incidence of dental caries appears to be increase in sugar intake and insufficient availability of fluorides. (1)

Fluorides are the key agent for prevention of dental caries mainly by underlying 3 mechanisms 1) by promoting repair (remineralisation) of early initial white spot lesions caused due to the enamel breakdown induced by the acids produced by the cariogenic bacteria of oral cavity by its activity on fermentable carbohydrate.2) by making tooth enamel more resistant to caries attack by enhancing the chemical nature of enamel more resistant to acid attack and 3) by decrease in the number of plaque bacteria producing acids.

According to WHO report on oral health given in 2003, it had been shown that the decrease in incidence and prevalence of dental caries is achieved by combined action of individual; oral health professional and communities. Accessibility to oral health care is very limited in many developing countries of the world.

Corresponding Author:
Dr. M.Vishali,
Department of Public Health Dentistry, SRM Dental College and Hospital, Ramapuram, Chennai, Tamilnadu, India, E-mail:vishalimahesh95@gmail.com

Considering this many public health approaches came into play which includes water fluoridation, salt fluoridation, milk fluoridation and use of affordable fluoridated toothpaste twice daily.

Level of 1.0mg F/l by means of water fluoridation is considered to be favorable for prevention of dental caries, excessive intake of fluoride at the time of maturation of tooth enamel may lead to dental fluorosis [3]. Hence fluorides rightly known as a double edged sword.

On the other hand, High intake of fluoride will result in, mottled enamel, skeletal fluorosis, osteosclerosis, exostoses, calcification of ligaments. With increase in severity, the subsurface enamel along the tooth becomes increasingly porous (hypomineralised), thereby making it more susceptible for caries [4].

With the use of fluoride dentifrices, the caries decline can be largely attributed but several studies have mentioned about the increase in prevalence of fluorosis due to early utilization of fluoride containing dentifrice. [5]Above the optimum fluoride level, the incidence of caries is reduced but greater the prevalence of fluorosis. However severe fluorosis also seems to be linked with greater caries incidence. This positive relationship was put forth by many scientists. (Ekanayake, L. and Vann der Hoek, W. (2002). [6]

Hence this study was conducted to study the effect of fluoride in between Dental Caries and fluorosis among High and Low fluoridated areas of Tamil Nadu, India.

Materials and Method

The cross-sectional descriptive analysis was done among12-16years aged (indexed age group according to WHO) [7] school children from high and low fluoride areas in Tamil Nadu, India.

According to Chennai metro water, the permissive limits of fluoride in portable water is ≤ 1mg/L [8]. The water fluoride level of Vellore is in the range of 2.25-2.75mg/l. Vellore has been reported as endemic area for dental fluorosis. Eight districts identified as fluorosis endemic. [9]

The sample size was calculated using Multistage Simple Random Method, where we have randomly selected 100 children of age group 12-16 years, from schools in Chennai (Low fluoride area) and 100 children of the same age group from the schools of Vellore (High fluoride area). This study was conducted for a period of two weeks.

The ethnical approval for this study was obtained from the Ethical committee of department of Public Health Dentistry, SRM UNIVERSITY and approval was obtained from School Headmasters and consent was given by all the parents of the school children who were examined for this study.

The study performa consisted of demographic data i.e. Name of the patient, age in years, Date of birth, place of birth, residing area from birth till 10 years of life, source of drinking water. The students were allowed to sit in a shady place and they were examined under sunlight, natural light source. Wooden spatulas were used to retract the cheeks.

The dental fluorosis was assessed using Dean's fluorosis study (1942) modified. And the dental caries was assessed using DMFS (1931).

The excluding criteria for this study was 1. Missing anterior tooth, 2. orthodontic treatment. During orthodontic treatment, there is more presence of local factors which might increase the risk of caries and it might alter the results. All the statistical computations were analyzed using Mann Whitney U test, Chi-square test. Data were look over using STATA for windows

Results

This cross sectional descriptive study was done among students from low fluoride area (Chennai) and high fluoride area (Vellore) in South India. There were 200 students of 12-16years of age from low fluoride area and 200 students of 12-16 years of age in high fluoride area participated in this study.

In the low fluoride area there were 89 females and 111 males and in High fluoride area, there were 120 females and 80 males.

When the population was assessed for duration of stay on the area in LFA, 16students had stayed for <10years and 184 students has stayed for >10years. In the HFA, 9 students had stayed <10years and 191 students had stayed for >10 years.

According to the source of drinking water in LFA, 63 students had used tap water, 11 students had used shallow well water, 21 students had used bore well water and 105 students had used bottled water (purified water). In HFA, 108 students had used tap water, 25 had used shallow well water, 258 had used bore well water and 39 had used bottled water.

Table 1, indicates the mean (SD) Dean's Fluorosis score of LFA was found to be 0.005 which was significantly lower than mean(SD) value of Dean's fluorosis at HFA which was 0.7425. (Mann Whitney Wilcoxon test, $p<0.05$)

Table 2, indicates crude relative risk ratios of water fluoride concentration on caries and fluorosis prevalence as well as regression models adjusted for age as well as status of father's occupation (SES) and there existed a negative and a positive association between fluoride level in drinking water and the risk of caries and fluorosis prevalence, respectively.

In the age- and SES-adjusted model a relative risk ratio of 0.6(0.4-0.8) was calculated. For fluorosis prevalence the risk estimate was 16(8-38) sensitivity analyses for caries (0.7(0.6-0.9)) and fluorosis 15(7-39) yielded to similar estimates as the respective main model.

When the mean caries experience of lifelong residents from high fluoride area was compared to dental fluorosis. According to table 3, the mean DMFS in the HF-area decreases with the increase in dental fluorosis.

TABLE 1 - Mean DMFS and Mean Dean's Score among lifelong residents in LFA and HFA

	Chennai	Vellore	
	Mean (SD)		Mann-Whitney U sig.value
DMFS	0.805(1.406008)	0.335 (1.34977)	0.00*
DEAN'S SCORE	0.005 (0.04987)	0.7425 (0.6817)	0.00*

* Significant value

TABLE 2-Denotes 95% confidence intervals and relative risks for relation between risk of dental caries as well as fluorosis with water fluoride concentration.

MODEL	**CARIES**		**DEAN'S SCORE**	
	Chennai	**Vellore**	**Chennai**	**Vellore**
1	Reference	0.5(0.4-0.7)	Reference	15(8-40)
2		0.6(0.4-0.8)		16(8-38)
3		0.7(0.6-0.9)		15(7-39)

Model #1 - crude relative risk estimates for caries and fluorosis occurrence among lifelong residents

Models #2- adjusted for age and SES

Models #3 - sensitivity models accounting for misclassification of both outcomes adjusted for age and SES

TABLE 3- Mean (SD) of caries experience (DMFS) of lifelong residents from the high-fluoride area related to dental fluorosis (Dean's score)

		DMFS		
Dean's Score		N	Mean	SD
	0	51	1.666667	1.966384
	0.5	49	4.833333	7.652886
	1	67	2.833333	3.125167
	2	19	0.333333	0.816497
	3	5	0	0

($p<0.05$; Mann-Whitney test) (N=size of sample)

Discussion

In this study, we have proved that mild increase in the level of fluoride in drinking water will lower the prevalence of dental caries in adolescents

In Low fluoride area (Chennai) the mean (SD) value of DMFS significantly higher than the mean (SD) DMFS of High fluoride area (Vellore). The mean (SD) Dean's Fluorosis score of Low fluoride area was found to be significantly lower than mean (SD) value of Dean's fluorosis at High fluoride area.

When the mean caries experience of lifelong residents from high fluoride area was compared to dental fluorosis. The mean DMFS in the HF-area decreases with the increase in dental fluorosis, it is important to note here that the Mean Dean's Score in HFA was mild. A negative relationship is proven. Similar relationship was proven by SA Eklund, BA Burt, AI Ismail and JJ Calderone[10]

In areas with very high fluoride levels, DMFS score increases with the increase in the Dean's score. This positive relationship was given by Ekanayake, L. and Vann der Hoek.W. (2002) [6]. Further studies can be done to study more on this topic. A neutral relationship was proposed by Ermis et al (2003) [09]

According to table, the people who are enduring more than 10 years in Vellore, has virtuous tooth condition as the fluorosis content is manifestation high in water.

Wandwossen F, Bjorvatn Ket al, 2004 studied the relation between dental fluorosis and dental caries in areas of high and low fluoride levels of drinking water in Ethiopia [10]. The prevalence rate of 91.8% was obtained for dental fluorosis (moderate area) and prevalence of 100% (high fluoride area). The corresponding mean DMFT and caries prevalence in the areas were 1.2 versus 1.8 and 45.3% versus 61.6% respectively. The positive correlation among fluorosis and caries were noted in both of the areas.

Effectiveness of fluorides for the prevention of dental caries, 2004 proved that the use of fluoride tooth pastes and mouth rinses along with water fluoridation significantly decrease the risk of dental caries.[11] .Cortes D.f., Ellwood et al, 1996 studied Drinking Water Fluoride Levels, Dental Fluorosis, and Caries Experience in Brazil [12]. Here the mean DMFT decreases with increase in fluoride level in drinking water. Caries incidence in 6 permanent teeth was significantly decreases($P<.01$) in areas of 0.7 ppm of F. Higher TF scores and cries risk were noted in areas of 2-3ppm of F so only the optimum fluoride concentration plays a vital role in preventive

community programs in Brazil.

H. Meyer-Lueckel, H. Paris and A.M Kielbassa, studied caries risk among children aged 6-9 years residing in three areas in Iran [13]. Tooth Surface Index of Dental Fluorosis was observed in the low fluoridated communities compared with the naturally fluoridated town hence higher prevalence of fluorosis is seen in naturally fluoridated town. The intake of naturally fluoridated water which contain 1.3 ppm of fluoride has no or little effect on caries prevention but leads to dental fluorosisKaren M. Yoder[1,*], Lameck Mabelya[2],Valerie A. Robison[3], Ann J. Dunipace[4],Edward J. Brizendine[5], George K. Stookey studied " Severe dental fluorosis in a Tanzanian population consuming water with negligible fluoride concentration" [14]. Dental fluorosis is more prevalent in different parts of world even in fluoride-deficient water areas in children under 5 years of age cautions use of fluoride supplements and supervision of their use of toothpaste and defluoridation in endemic areas of fluorosis is recommended as two important preventive procedures for fluorosis. Aesthetic effect of fluorosis can be managed by tooth bleaching with or without micro-abrasion, veneering or crowning. The choice of treatment depends on the severity of the fluorosis and this may be analyzed by the use of Thylstrup and Fejerskov index. [15]

Factors limiting our results- dental setup was not available hence through the utilization of artificial light would enable us to detect caries at the dentinal level; fluorosis was scored without using pressured air.

Conclusion

In this study, we have proved that mild increase in level of fluoride in drinking water will decrease the incidence of dental caries in adolescents**.** Optimal fluoride level in drinking water is known to be effective in decreasing total caries experience. Caries experience in school children at Chennai was low signifying their effective measures on oral hygiene. The caries experience in Vellore was relatively lower when compared to Chennai because of the presence of fluorosis. We conclude that teeth with fluorosis have got lesser chances of developing caries.

Conflict of Interest- Nil

Source of Funding-Self

Ethical Clearance: From Ethical committee of Department of Public Health Dentistry-SRMDCH and the inform concern was obtained from every participants.

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