

Original Research Article

Prevalence of Dental Caries and Dental Fluorosis in Association with Fluoride Drinking Water in Nalgonda District-A Cross Sectional Study

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Abstract: *Background:* Fluoride is a double-edged sword. The assessment of dental caries and dental fluorosis in endemic fluoride areas will facilitate in assessing the relation between fluoride concentrations in water with dental caries, dental fluorosis simultaneously. *Aim of the study:* The aim of the study was to assess the prevalence of dental caries and dental fluorosis in association with fluoride drinking water in district of Nalgonda and to create awareness among school children regarding fluorine and its effects. *Materials and methods:* A cross-sectional study was conducted among 12 and 15 years old school children in Nalgonda district for a period of 6 months. Ten schools were selected in Nalgonda district using lottery method of simple random sampling. The oral examination of available 12 and 15 years old school children fulfilling the inclusion and exclusion criteria was carried out to assess dental caries and fluorosis. A pre designed questionnaire was used to collect the desired information of school children. The clinical examination was conducted by a single trained and calibrated examiner using the mouth mirror and community periodontal index probe under natural daylight. Decayed, missing and filled teeth (DMFT index) and Modified Dean's Fluorosis Index was calculated. Water samples were collected in a 500ml bottle from drinking source which was used by children, and all the bottles were labelled and sent to the laboratory for estimation of fluoride concentration. The obtained data was subjected to statistical analysis using SPSS 20 software. *Results:* The overall prevalence of dental caries among the school children was 41% (226/556). The prevalence of dental caries was significantly higher among females 47 % (135/285) compared with males 33.6% (91/271). The overall prevalence of dental fluorosis among school children was 62% (343/556). There were no gender differences in the prevalence of dental fluorosis. *Conclusion:* The prevalence of dental caries was more in low and medium fluoride areas followed by high and very high fluoride area. There is a positive correlation between water fluoride content and prevalence of dental fluorosis. The prevalence of dental fluorosis was more in very high and high fluoride areas compared to low fluoride areas.

Keywords: Dental caries, Dental fluorosis, Endemic fluoride area, Prevalence.

INTRODUCTION

The fluorides, most active elements of halogen group were widely distributed in nature and it has been estimated that the element fluorine in the form of fluoride constituents 0.32% of the earth's crust (WHO, 1984) [1] Fluoride is generally released into subsoil water sources by slow natural degradation of fluorine contained in rocks. Fluorine is required for normal growth, development and maintenance of human health. About 96% of Fluorine is found in bones and teeth and is required for mineralization of bones and formation of caries resistant dental enamel. Various dietary components influence the absorption of fluorides from gastrointestinal tract and the absorbed fluorides are distributed throughout the body. Principal sources of fluoride are drinking water, sea fish, cheese and tea [2, 3].

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Deficiency of Fluoride leads to defective enamel formation in teeth and the excess leads to dental, skeletal, and non-skeletal fluorosis in the form of muscle weakness, tiredness, fatigue, anemia, dyspepsia, male infertility, polyuria, polydipsia, repeated stillbirths, abortions, and so on. Hence, it is essential to keep the fluoride consumption at an optimum level. The Bureau of Indian Standards (BIS) has set the standards for fluoride levels in drinking water with maximum desirable limit as 1.0 mg/L and permissible limit in the absence of alternate source as 1.5 mg/L [4].

Dental fluorosis is a disturbance in tooth formation caused by excessive intake of fluoride during tooth development. The degree of severity of the clinical manifestations of this form of chronic fluoride intoxication depends on the amount, form and frequency of fluoride ingestion, the duration of exposure, the age of the person, the bioavailability of the fluoride compound and possibly other yet unknown factors [5]. Fluoride prevents tooth decay by making the enamel more resistant to the action of acids. They accelerate the buildup of healthy minerals in the enamel, further slowing the occurrence of decay [6].

The literature on the relation between fluoride concentrations in drinking water with dental caries is conflicting. Some studies reveal an inverse relation [7, 8] while others found no relation [9] or a positive association [10, 11].

Fluorosis has its impact on 21 states of India. Nalgonda District in Telangana is an endemic fluoride area with fluoride concentration in drinking water ranging from below optimum to optimum and above optimum levels. The district has 1155 revenue villages with 3,359 habitations out of which, 1,122 habitations were identified as fluoride affected [12]. The sparse literature on the relation between dental caries, dental fluorosis with fluoride concentration in drinking water among the school going children in Nalgonda district prompted us for the present study to assess dental caries and dental fluorosis prevalence among 12 and 15 years old school children in Nalgonda district, Telangana, India.

AIMS AND OBJECTIVES

- To assess the prevalence of dental caries and dental fluorosis in association with fluoride drinking water in district of Nalgonda.
- To create awareness among school children regarding fluorine and its effects

MATERIALS AND METHODS

This cross-sectional study was conducted among 12 and 15 years old school children in Nalgonda district for a period of 6 months. Nalgonda has 57 mandals, all the mandals in Nalgonda were listed and all the government schools in these mandals were listed. Using this as the sampling frame 10 mandals and one school from each mandal was selected using lottery method of simple random sampling. Selected schools were listed and permission to conduct study in these schools were obtained from district educational officer and concerned head masters. The schedules were sent to the concerned headmasters in advance. On the day of clinical examination, the list of all grade 6th and 9th were procured and the details related to their date of birth were checked. The data were obtained from those subjects satisfying the criteria as listed below.

INCUSION CRITERIA

- Children who completed 12 years and 15 years on the day of examination.
- School children who were lifelong resident in that region and who were using one source of drinking water from birth to at least ten years of their life.
- Children with all permanent teeth except third molar with at least 50% of crown erupted.

EXCLUSION CRITERIA

- Children aged less than 12 years as well as more than 15 years.
- Migrated children from some other place.
- Children with a history of drinking water from more than one source in initial 10 years of their life.
- Children with orthodontic brackets were excluded.
- Children with severe extrinsic stains.

A pre designed questionnaire was used to collect the desired information such as age, gender, oral hygiene practices, diet chart, occupation and income status of parent, permanent address and source of drinking water. Standard infection control guidelines were applied. One trained examiner conducted the clinical examination of the selected child using a mouth mirror and community periodontal index probe. The clinical examination was carried in the school premises under natural day light on the plastic chair, study subjects were made to sit on a chair in an upright position and DMFT index and Modified Dean's Fluorosis Index (1942) [13] were conducted. Water samples were collected in a 500ml bottle from drinking source which was used by children, and all the bottles were labelled and sent to the

laboratory for estimation of fluoride concentration. Water fluoride analysis was done using Alizarin visual method [14]. The obtained data was subjected to statistical analysis using SPSS 20 software.

RESULTS

A total of 556 school children were examined in the present study. Out of 556 school children 271 were males and 285 were females. (Table 1 & 2)

Dental caries prevalence

The overall prevalence of dental caries among the school children was 41% (226/556). The prevalence of dental caries was more in low and medium fluoride areas followed by high and very high fluoride area. The prevalence of dental caries was significantly higher among females 47 % (135/285) compared with males 33.6% (91/271). The prevalence of dental caries was more among 15 years old children 42% (133/316) compared with 12 years old children 39% (93/240). (Table 3)

Dental fluorosis prevalence

The overall prevalence of dental fluorosis among school children was 62% (343/556). The prevalence of dental fluorosis among females was 60 % (171/285) and among males was 63% (172/271). There were no gender differences in the prevalence of dental fluorosis. The prevalence of dental fluorosis was more among 15 years old children (66%) compared with 12 years old children (56%) (Table 4).

A total of 101 subjects were examined in Suryapet. Out of 101 study subjects 55 were males and 46 were females. In males among 12 years old age group, 17 subjects were examined, out of which 8 were affected with Dental Fluorosis and 4 were having Dental Caries. In males among 15-year-old age group, 38 subjects were examined, out of which 30 were affected with dental fluorosis and 13 were having dental caries. In females among 12 years old age group, 28 subjects were examined, out of which 18 were affected with Dental Fluorosis and 13 were having Dental Caries. In females among 15 years old age group, 18 subjects were examined, out of which 10 subjects were affected with Dental Fluorosis and 13 subjects were affected with dental caries. Overall prevalence of Dental Fluorosis was 58% and Dental Caries was 43% in Suryapet. Fluoride concentration in Suryapet drinking water was found to be 1.4 ppm (Table 3, Table 4, Table 5).

A total of 77 subjects were examined in Tadakamalla village. Out of 77 study subjects 35 were males and 42 were females. In males among 12 years old age group, 23 subjects were examined, out of which 12 were affected with Dental Fluorosis and 8 were having Dental Caries. In males among 15-year-old age group, 12 subjects were examined, out of which 6 were affected with dental fluorosis and 5 were having dental caries. In females among 12 years old age group, 24 subjects were examined, out of which 12 were affected with Dental Fluorosis and 10 were having Dental Caries. In females among 15 years old age group, 18 subjects were examined, out of which 12 subjects were affected with Dental Fluorosis and 10 subjects were affected with dental caries. Overall prevalence of Dental Fluorosis was 54% and Dental Caries was 43% in Tadakamalla. Fluoride concentration in Tadakamalla drinking water was found to be high 1.8 ppm. (Table 3, Table 4, Table 5)

A total of 128 subjects were examined in Narketpally. Out of 128 study subjects 62 were males and 66 were females. In males among 12 years old age group, 19 subjects were examined, out of which 11 were affected with Dental Fluorosis and 9 were having Dental Caries. In males among 15-year-old age group, 43 subjects were examined, out of which 32 were affected with dental fluorosis and 15 were having dental caries. In females among 12 years old age group, 29 subjects were examined, out of which 20 were affected with Dental Fluorosis and 11 were having Dental Caries. In females among 15 years old age group, 37 subjects were examined, out of which 26 subjects were affected with Dental Fluorosis and 15 subjects were affected with dental caries. Overall prevalence of Dental Fluorosis was 70% and Dental Caries was 39% in Narketpally. Fluoride concentration in Narketpally drinking water was found to be very high 8.49 ppm. (Table 3, Table 4, Table 5).

A total of 145 subjects were examined in Yadavalli village. Out of 145 study subjects 75 were males and 70 were females. In males among 12 years old age group, 16 subjects were examined, out of which 6 were affected with Dental Fluorosis and 3 were having Dental Caries. In males among 15 years old age group, 59 subjects were examined, out of which 42 were affected with dental fluorosis and 8 were having dental caries. In females among 12 years old age group, 34 subjects were examined, out of which 24 were affected with Dental Fluorosis and 20 were having Dental Caries. In females among 15 years old age group, 36 subjects were examined, out of which 26 subjects were affected with Dental Fluorosis and 22 subjects were affected with dental caries. Overall prevalence of Dental Fluorosis was 68% and Dental Caries was 37% in Yadavalli. Fluoride concentration in Yadavalli drinking water was found to be very high 11.75 ppm. (Table 3, Table 4, Table 5).

A total of 105 subjects were examined in Narsingbatla village. Out of 105 study subjects 44 were males and 61 were females. In males among 12 years old age group, 20 subjects were examined, out of which 5 were affected with Dental Fluorosis and 5 were having Dental Caries. In males among 15 years old age group, 24 subjects were examined, out of which 20 were affected with dental fluorosis and 21 were having dental caries. In females among 12 years old age group, 30 subjects were examined, out of which 18 were affected with Dental Fluorosis and 10 were having Dental Caries. In females among 15 years old age group, 31 subjects were examined, out of which 12 subjects were affected with Dental Fluorosis and 11 subjects were affected with dental caries. Overall prevalence of Dental Fluorosis was 52% and Dental Caries was 45% in Narsingbatla. Fluoride concentration in Narsingbatla village drinking water was found to be high 4.41 ppm. (Table 3, Table 4, Table 5)

Table 1: Males and Females screened in different fluoride areas

Fluoride areas	Males		Females		Total
	12 years	15 years	12 years	15 years	
Suryapet	17	38	28	18	101
Tadakamalla	23	12	24	18	77
Narketpally	19	43	29	37	128
Yadavalli	16	59	34	36	145
Narsingbatla	20	24	30	31	105
Total	95	176	145	140	556

Table 2: Age and gender distribution of the study population in different fluoride areas

Fluoride areas	12 years			15 years			12 and 15 years Combined		Total
	M	F	M and F	M	F	M and F	M	F	
Suryapet	17	28	45	38	18	56	45	56	101
Tadakamalla	23	24	47	12	18	30	47	30	77
Narketpally	19	29	48	43	37	80	48	80	128
Yadavalli	16	34	50	59	36	95	50	95	145
Narsingbatla	20	30	50	24	31	55	50	55	105
Total	95	145	240	176	140	316	240	316	556

Table 3: Prevalence of dental caries among 12 and 15 years old school children in different fluoride areas

Fluoride areas	12 years			15 years			12 and 15 years combined		
	Males	Females	Overall	Males	Females	Overall	Males	Females	Overall
Suryapet	4	13	17	13	13	26	17	26	43
Tadakamalla	8	10	18	5	10	15	13	20	33
Narketpally	9	11	20	15	15	30	24	26	50
Yadavalli	3	20	23	8	22	30	11	42	53
Narsingbatla	5	10	15	21	11	32	26	21	47
Total	29	64	93	62	71	133	91	135	226

Table 4: Prevalence of dental fluorosis among 12 and 15 years old school children in different fluoride areas

Fluoride areas	12 years			15 years			12 and 15 years combined		
	Males	Females	Overall	Males	Females	Overall	Males	Females	Overall
Suryapet	8	18	26	30	3	33	38	21	59
Tadakamalla	12	12	24	6	12	18	18	24	42
Narketpally	11	20	31	32	26	58	43	46	89
Yadavalli	6	24	30	42	26	68	48	50	98
Narsingbatla	5	18	23	20	12	32	25	30	55
Total	42	92	134	130	79	209	172	171	343

Fluoride areas	Fluoride content in drinking water
Suryapet	1.4ppm
Tadakamalla	1.8ppm
Narketpally	8.49ppm
Yadavalli	11.75ppm
Narsingbatla	4.41ppm

DISCUSSION

The present study was conducted among 12 and 15 years old school children in Nalgonda district, Telangana, India. The WHO in its manual on basic oral surveys (1994) [15] has specified 5, 12, 15, 35-44 and 65-74 years as index age groups for assessing the oral health status. Among these, 12 years is considered the global monitoring age for international comparison of dental caries and 15 years represent the other adolescent age group. Moreover, these are the two age groups for obtaining a reliable sample from the school system. This prompted us in the selection of 12 and 15 years old school children as the study participants in the present study.

The prevalence of dental caries was more in low and medium fluoride areas followed by high and very high fluoride area. This clearly suggests that fluoride in drinking water offer maximum protection against dental caries. The results of the present study were consistent with the findings of Shekhar *et al.* [16], Murray JJ *et al.* [17], Subba Reddy VV *et al.* [18], Ekanayake L *et al.* [19]. Prevalence of dental caries was more among 15 years old school children when compared to 12 years old school children. The irreversible nature of the disease and longer exposure of teeth to deleterious oral environment may explain more prevalence in 15 years old children.

We found a higher prevalence of dental caries among females compared with males. In the absence of dietary differences, the higher caries prevalence among females is attributed to early eruption of teeth among females and thereby longer exposure to deleterious oral environment [20]. The body surface area among males is more than that for females. Due to greater physical activity, boys consume more water than compared to girls. The frequent water consumption results in frequent exposure of teeth to fluoridated water and higher level of protection among boys compared to girls. The results of our study were in agreement with other studies conducted in past [21, 22].

In the current study sample, there is a positive correlation between water fluoride content and prevalence of dental fluorosis. The prevalence of dental fluorosis was more in very high and high fluoride areas compared to low fluoride areas. Our findings are in agreement with several other studies conducted in the past [23-25]. Prevalence of dental fluorosis is high at low fluoride exposure in normal fluoride group, though the fluoride exposure through water is less in that area. The reason may be due to the fluoride ingestion through food which needs further in-depth analysis. There were no gender differences in the prevalence of dental fluorosis. The prevalence of dental fluorosis was more among 15 years old children (66%) compared with 12 years old children (56%).

CONCLUSION

The results strongly support the findings of previous studies conducted in endemic fluoride areas. The prevalence of dental caries was more in low and medium fluoride areas followed by high and very high fluoride area. The prevalence of caries was more among females compared to males and 15 years old children had more caries prevalence than 12 years old school children. There was a positive correlation between fluoride concentration in drinking water and prevalence of dental fluorosis with no gender predilection. The prevalence of dental fluorosis was more in very high and high fluoride areas compared to low fluoride areas. The study can be further continued by increasing the sample size and by including more number of villages with in the district and also by adding various periodontal indices so that oral hygiene of the patients can be correlated with dental caries in dental fluorosis patients.

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