ORIGINAL RESEARCH

Sociodemographic Determinants of Dental Fluorosis in Mangaluru, Karnataka, India: An Explorative Study

Ravalika KN[1], Rajesh G[2], Rao A[3], Shenoy R[4], Pai M[4]

Abstract

Aim: To analyze the sociodemographic determinants of dental fluorosis among high school children aged 12–16 years in Mangaluru, Karnataka, India.

Materials and method: A cross-sectional study was conducted. Simple random sampling technique was employed to select the three schools for the present study. Demographic details and previous medical history was assessed by administering the questionnaire to the study subjects. Presence of dental fluorosis was assessed using the World Health Organization (WHO) oral health assessment form of 2013.

Results: A total of 500 students were examined for the present study. A major fraction of the study population was formed by males. It was observed that 95 participants were affected by varying severity of dental fluorosis with the prevalence of 19%. Correlation and logistic regression analysis showed the occupation of father and dietary pattern to be significantly correlated with the presence of fluorosis in study subjects.

Conclusion: Prevalence and severity of the condition are found to have a huge burden in the given urban population of Mangaluru city. As the occupation of father and dietary pattern showed significant association with fluorosis, further interventional studies are recommended to be conducted considering these socioeconomic factors.

Clinical significance: Results of the present study will further our understanding of the association between prevalence and social determinants of dental fluorosis, which may be critical for prevention and control of the condition.

Keywords: Diet, Fluorosis, School children, Social determinants.

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Introduction

Fluorosis is a painful crippling disease resulted by excessive intake of fluoride.[1] The element Fluorine is the most electronegative element on earth and is found naturally as fluorides. These fluorides may enter the body due to the consumption of drinking water, food, various dental products like toothpastes and mouth rinses; drugs, fluoride fumes, and dust released from industries working with fluoride-containing salt, materials and or hydrofluoric acid.[2]

Fluorine is noted as the 13th element present most abundantly in the earth crust.[3] This element was first isolated by a French chemist and a Nobel laureate Henri Moissanin the year 1886.[4] As per the WHO, within a safety limit of 0.6 ppm, ingestion of fluoride has a useful role in bone and teeth formation, whereas increased ingestion causes the condition of fluorosis and hence fluoride is well known as a double-edged sword. WHO standards permit not more than 1.5 mg/L as a safe limit of fluoride in drinking water as suitable for daily consumption, fluorosis remains to be an endemic problem worldwide.[5] It has been a crucial public health problem worldwide, in 24 countries, including India, which lies in the geographical belt of naturally occurring fluoride extending from Turkey to China and Japan via Iraq, Iran, and Afghanistan. Many more places diagnosed by fluorosis are being explored regularly in different parts of our country.[6]

Dental fluorosis is "a specific disturbance in tooth formation caused by excessive fluoride intake during the development of teeth". The severity of dental fluorosis is precisely related to the fluoride content and its concentration in the drinking water supply.[7] This condition is endemic in 19 states of India.[8] High amounts of fluoride consumption from such drinking water are considered as a main etiological factor for dental fluorosis. There is also a variation of this prevalence and severity of fluoride within the same community and between neighboring communities making dental fluorosis a multifactorial problem.[9]

[1-4]Department of Public Health Dentistry, Manipal College of Dental Sciences, Manipal Academy of Higher Education, Manipal, Mangaluru, Karnataka, India

Corresponding Author: Rajesh G, Department of Public Health Dentistry, Manipal College of Dental Sciences, Manipal Academy of Higher Education, Manipal, Mangaluru, Karnataka, India, e-mail: drrajeshgrao@gmail.com

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Variations in ecosystems, changes in climate and to some extent the way of individual lifestyle result in the availability and intake of fluoride in individuals and hence, approximated values of bioavailability of fluoride may vary with respect to seasonal and geographical variations. Factors like biological variation, dietary habits, and environmental factors have been involved in the differences in prevalence and degree of dental fluorosis, and these factors act as strong determinants of the condition. Therefore, it is important for the researchers and healthcare practitioners to gain extensive insights not only with respect to the fluoride content of drinking water available, but also any such socioeconomic determinants, to promote good oral and general health.[10]

Karnataka, a state in the southern part of India where the Western and Eastern Ghats meet into the mosaic, in the western section of the Deccan peninsular part. It is one of the fluoride endemic states in the country with 13 out of 30 districts showing varying levels of severity of dental fluorosis, including the Dakshina Kannada where the present study was conducted. The fluoride concentration in drinking water in Karnataka is found to

vary substantially and the mean values recorded in the North-Eastern zone are 1.61 ppm and in the South-Western 0.41 ppm.[10] In this state, more than four lakh children have been affected by this disease according to the latest statistics.

Therefore, this study was conceptualized to analyze the sociodemographic determinants of dental fluorosis among high school children aged 12–16 years in Mangaluru, Karnataka, India.

Materials and Methods

A cross-sectional study was conducted in Mangaluru among high school children aged 12–16 years. Ethical approval was obtained from the Institutional Ethics Committee (IEC) of Manipal College of Dental Sciences, Mangaluru, Karnataka, India. List of schools in Mangalore was obtained from the Block Education Officer. A simple random sampling technique was employed to select the three schools for the present study. Permission from the principals of respective schools was obtained to conduct the study. A signed form of informed consent was taken from parents of participants prior to the conduction of the study and informed assent was obtained from the study subjects.

Examiner calibration was undertaken to establish inter-examiner reliability and assessed using kappa statistics (0.8). A sample size of 500 was fixed for the study. Inclusion criteria included high school children aged 12–16 years in Mangaluru whose parents provided signed informed consent for their participation in the study and those who resided in the city since birth without any transferable jobs. Therefore, all the participants included in the study were born in Mangalore city and had not immigrated into the city after birth from outside. The criteria for exclusion were differently abled, children with orthodontic brackets or crowns and those who have undergone or are undergoing treatment for any systemic disease or condition.

Demographic details, oral hygiene practices, dietary pattern, and previous medical history of the study subjects was recorded by a questionnaire containing 22 items. Presence of dental fluorosis in study subjects was assessed in school settings, using the WHO oral health assessment form 2013 which is according to WHO's a modification of Deans Fluorosis index.[11] Assessment of the prevalence of any other conditions was not included in the present study as they were not in accordance with the objectives outlined. A single examiner carried out the examination, and a trained recorder accompanied the examiner to help in recording the data (Annexure).

The obtained data were coded and compiled systematically using the Microsoft Excel program. Statistical analysis of the data was done in the statistical package for social sciences (SPSS), version 20.0 (SPSS Inc., Chicago IL). Cross-tabulations, Chi-square test, analysis of variance (ANOVA), correlation, and regression analysis was carried out. Level of significance was kept as 5%.

Results

A total of 500 students were examined for the present study. Study subjects belonged to the age group of 12–16 years. A major fraction of the study population was formed by males which were 69.5% (347) while females formed the remaining 30.5% (153). Socioeconomic status reported for the greater part of the study was lower middle class (329, 65.7%) while 169 (33.7%) were of upper middle and 2 (0.4%) were of upper lower classes. Three hundred and four (60.5%) participant families had less than or equal to four family members and 196 (39.5%) families had more than four family members (Table 1).

Most of the fathers of study subjects attended pre-university (38.1%) and high school (36.1%). Nearly one half of them were into business (49.1%) whereas eighteen (3.6%) were into fishing and agriculture, one hundred and 37 (27.3%) stated clerical jobs, nineteen (3.8%) were technicians and eighty (16.0%) were professionals.

Among mothers, nearly two one-half of them attended pre-university (43.2%). Although high proportions of mothers were

Table 1: Distribution of study subjects according to sociodemographic variables

Sociodemographic variables		*Total*		*Fluorosis*	
		Number of study subjects	*Percentage (%)*	*Number of study subjects*	*Percentage (%)*
Age	12 years	43	8.7	2	0.4
	13 years	93	18.7	19	3.8
	14 years	218	43.5	50	10
	15 years	138	27.5	22	4.4
	16 years	8	1.6	2	0.4
Gender	Male	347	69.5	65	13
	Female	153	30.5	30	6
Numbers of members in family	≤4	304	60.5	53	10.6
	>4	196	39.5	42	8.4
Socioeconomic status	Lower	0	0	0	0
	Upper lower	2	0.4	0	0
	Lower middle	329	65.7	60	12
	Upper middle	169	33.7	35	7
	Upper	0	0	0	0
Diet	Vegetarian	69	13.8	18	3.6
	Mixed	431	86.2	77	15.4

Table 2: Distribution of study subjects according to parents' education and occupation

Sociodemographic variables		Total		Fluorosis	
		Number of study subjects	Percentage (%)	Number of study subjects	Percentage (%)
Father's education	SSLC	181	36.1	37	7.4
	PUC	191	38.1	33	6.6
	UG	123	24.6	23	4.6
	PG	5	1.0	2	0.4
Father's occupation	Fishing, agriculture	18	3.6	2	0.4
	Business, Shopkeepers	246	49.1	50	10
	Clerks	137	27.3	25	5
	Technicians	19	3.8	4	0.8
	Professionals	80	16.0	14	2.8
Mother's education	SSLC	159	31.8	24	4.8
	PUC	216	43.2	47	9.4
	UG	115	23.0	23	4.6
	PG	10	2.0	1	0.2
Mother's occupation	Home maker	343	68.6	68	13.6
	Business, shopkeepers	9	1.8	2	0.4
	Clerks, anganwadi workers, tailors	137	27.4	24	4.8
	Technicians	11	2.2	1	0.2
Family income	≤6323	17	3.4	1	0.2
	6323–18,949	166	33.2	27	5.4
	18,949–31,589	184	36.8	36	7.2
	31,589–47,262	54	10.8	11	2.2

Table 3: Distribution of study subjects according to fluorosis severity

Severity	Numberof study subjects	Percentage (%)
Total	95	19
Mild	37	7.4
Moderate	31	6.2
Severe	27	5.4

educated, nearly two thirds (68.6%), described their occupation as homemakers while others were working women (157, 31.4%). Illiteracy was reported as zero among both fathers and mothers of study subjects (Table 2).

It was observed that 95 participants were affected by varying severity of dental fluorosis with an average of 2 teeth being affected in each participant. The prevalence was calculated which came out to be 19%, with 37 participants showing mild form, 31 participants having moderate form and 27 having a severe form of dental fluorosis (Table 3).

A correlation analysis performed on sociodemographic factors and fluorosis against each other showed occupation of father and dietary pattern to be significantly correlated with the presence of fluorosis in study subjects (Table 4). Logistic regression analysis also showed a significant association between father's occupation and dental fluorosis prevalence (Table 5).

Discussion

The present study attempted to determine the impact of socio-economic factors among high school children aged 12–16 on prevalence and severity of dental fluorosis in Mangaluru, a city in South India.

Karnataka stands among the fluoride endemic regions and states in India. Thirteen districts, including the district of Dakshina Kannada, located in the southwestern belt of the state have consistently reported a relatively high level of fluoride in their groundwaters. The prevalence and degree of dental fluorosis were quantified in this part of the state earlier, however, limited studies have been done in Mangaluru city to analyze the burden of this condition.

The present study not only gives the prevalence of the dental fluorosis but also explores the socioeconomic determinants which were reported to be associated with the condition as pointed out in previous research done by Perez et al. and Villa et al.[12,13]

Prevalence of dental fluorosis was 19% among participants, i.e., 95 study subjects showed various degrees of the condition. Studies were done by Chandrashekar and Issac et al., in the same age group of population and region, reported a prevalence of 13.2% and 24% respectively.[14,15] Studies done by Verma et al., Bharathi and Narayanamurthy showed a high prevalence of 64.3%, 56.2%, 31.05% of dental fluorosis, respectively, in the same state.[16-18]

In the present study, various socioeconomic factors such as age, sex, education, occupation and income of parents of study

Table 4: Correlation between fluorosis status of study subjects and sociodemographic variable

Sociodemographic variables	*Occupation of father*		*Diet*		*Fluorosis*	
	r	*p*	*r*	*p*	*r*	*p*
Occupation of father	1					
Diet	0.023	0.412	1			
Fluorosis	**0.186**	**0.038***	**0.172**	**0.048***	1	

Only the values showing significance have been tabulated
Bold values indicate statistical significance
*Significance, $p < 0.05$

Table 5: Logistic regression analysis of fluorosis status of study subjects and sociodemographic variables

	Fluorosis	
Sociodemographic variables	*r*	*p*
Age	1.113	0.762
Gender	0.691	0.500
Education of father	1.409	0.441
Occupation of father	**0.454**	**0.018***
Education of mother	0.811	0.652
Occupation of mother	0.830	0.535
Family income	0.614	0.090
Family members	1.294	0.616
Socioeconomic status	4.948	0.135
Diet	2.853	0.076

Bold values indicate statistical significance
*Significance, $p < 0.05$

subjects, number of family members, socioeconomic status and dietary patterns were considered and analyzed against fluorosis for their association. Of all the factors considered, a dietary pattern followed by the study subjects and the occupation of their fathers showed significant association with the prevalence of dental fluorosis among them.

In study subjects who enjoyed a vegetarian diet, the prevalence of dental fluorosis was four times more than those who followed a mixed dietary pattern. This finding is similar to the findings reported by Awadia et al., and Abuhallub in studies done in the same age group population where vegetarianism was inversely associated with fluorosis.[19,20] Absorbed fluoride is excreted almost exclusively by process of kidneys which is directly related to the urinary pH. A diet that interferes with the acidification and alkalinization of urine promotes indicative differences in urinary clearance of fluoride. This principle applies to protein-rich and vegetarian diets. Diet-induced changes with long-term effects on urinary pH play a role in decreasing (vegetarian-induced alkaline urine) or increasing (protein-induced acidic urine) the chances of developing dental fluorosis.[21]

In our present study father's occupation came to be a significant determinant of fluorosis. Contrasting findings were reported in studies done by Hoek et al., Baskaradoss et al., Choubisa et al., who showed no significant association with dental fluorosis.[22-24]

Results show that other socioeconomic factors which came out to be insignificant and this is similar to results reported by Naidu et al., whereas study done Perez et al., Villa et al., showed dissimilar findings.[12,13,25]

Prevalence in the present study reflects a huge burden of dental fluorosis in the population belonging to the urban population where aesthetics will be one of the main concerns along with general health. Hence dental fluorosis can be considered a crucial public health problem to be addressed by further conducting intervention studies and including various socioeconomic determinants.

The findings of the present study must be viewed in light of its limitations. Firstly, cross-sectional exploratory correlational research may not allow the establishment of a causal relationship between variables being assessed in the study. Secondly, the prevalence of dental fluorosis has not been related to water fluoride level in this study. Thirdly, one inherent limitation of the present study might be social desirability bias, a usual problem of research using self-reported measures, might have altered their answering patterns especially while answering socioeconomic status questions as none of the participants claimed to be belonging to lower socioeconomic class.

Considering the insignificant factors and mentioned limitations, further research is required in this field to explore the possible relation between socioeconomic determinants and dental fluorosis.

Conclusion

Prevalence of dental fluorosis in this population was found to be 19%, reflecting a huge burden of the condition in an urban population. Dietary patterns and the father's occupation showed significant association with the prevalence and severity of the condition. Further interventional studies are recommended to be conducted considering these socioeconomic factors. Policy makers are suggested to work through these determining factors while implementing defluoridation programs along with the traditional ones.

Clinical significance

Results of the present study will further our understanding of the association between prevalence and social determinants of dental fluorosis which may play a critical role in the prevention and control of fluorosis in the community.

References

1. Shah MS, Vishnupriya V, Gayathri R. Awareness about Fluorosis-A Survey. Journal of Pharmaceutical Sciences and Research 2016;8(6):530-532.
2. Kanduti D, Sterbenk P, Artnik B. Fluoride: a review of use and effects on health. Mater Sociomed. 2016; 28(2):133-137.
3. Krebs RE. The history and use of our earth's chemical elements: a reference guide. 2nd edition. USA: Greenwood Publishing Group; 2006.
4. Wisniak J, Moissan H. The discoverer of fluorine. Educación Química. 2002;13(4):267-274.

5. Karmakar PS, Nandi DK. Impact of fluoride consumption in puruliadistrict West Bengal. JETIR 2018;5(2):876-878.
6. Arlappa N, Aatif Qureshi I, Srinivas R. Fluorosis in India: an overview. Int J Res Dev Health 2013;1(2):97-102.
7. Chaudhry M, Prabhakar I, Gupta B, et al. Prevalence of Dental Fluorosis Among Adolescents in Schools of Greater Noida, Uttar Pradesh. J Indian Assoc Public Health Dent 2017;15:36-41.
8. Abhimanyu M, Prafulla KM. Dental Fluorosis- Revisited. Biomed J Sci & Tech Res 2018;2(1):1-5.
9. de CarvalhoaFábio CA, de Carvalho S, Grizzo LT, et al. Toenail fluoride ion concentrations, dental fluorosis in the primary dentition, and various sociobehavioral factors in children living in a fluoridated city in brazil. Fluoride. 2017 Apr 1;50(2):269-275.
10 Chowdhury CR, Shahnawaz K, Kumari D, et al. Spatial distribution mapping of drinking water fluoride levels in Karnataka, India: fluoride-related health effects. Perspectives in Public Health. 2016 Nov;136(6):353-360.
11. World Health Organization. Oral health surveys: basic methods. 5th edition. Geneva:World Health Organization; 2013.
12. Pérez-Pérez N, Irigoyen-Camacho ME, Boges-Yañez AS. Factors affecting dental fluorosis in low socioeconomic status children in Mexico. Community Dental Health 2017;34(2):66-71.
13. VillaAE, Guerrero S. Caries experience and fluorosis prevalence in Chilean children from different socio-economic- status. Comm Dent Oral Epidemiol 1996;24(3):225-227.
14. Chandrashekar J, Anuradha KP. Prevalence of dental fluorosis in rural areas of Davangere, India. International Dental Journal 2004;54(5):235-239.
15. Isaac et al. Prevalence and manifestations of water-born fluorosis among schoolchildren in Kaiwara village of India: a preliminary study. Asian Biomed 2010;3(5):563-566.
16. Verma A, Shetty BK, Guddattu V, et al. High prevalence of dental fluorosis among adolescents is a growing concern: a school based cross-sectional study from Southern India. Environmental health and Preventive Medicine 2017;22(1):17.
17. Bharati P, Rao M. Epidemiology of fluorosis in Dharwad district, Karnataka. Journal of Human Ecology 2003;14(1):37-42.
18. Narayanamurthy S, Santhuram A. Prevalence of dental fluorosis in school children of Bangarpettaluk, Kolar district. Journal of Orofacial Sciences. 2013;5(2):105-108.
19. AwadiaAK, Haugejorden O, Bjorvatn K, Birkeland JM. Vegetarianism and dental fluorosis among children in a high fluoride area of Northern Tanzania. Int J Paediar Dent 1999;9(1):3-11.
20. Abuhaloob L, Abed Y. Dietary behaviours and dental fluorosis among Gaza Strip children. Eastern Mediterranean Health Journal 2013;19(7).
21. Whitford GM. Determinants and mechanisms of enamel fluorosis. Ciba Foundation Symposium 1997;205:226-241.
22. Van Der Hoek W, Ekanayake L, Rajasooriyar L, et al. Source of drinking water and other risk factors for dental fluorosis in Sri Lanka. International Journal of Environmental Health Research 2003;13(3):285-293.
23. Baskaradoss JK, Clement RB, Narayanan A. Prevalence of dental fluorosis and associated risk factors in 11–15 year old school children of Kanyakumari District, Tamilnadu, India: A cross sectional survey. Indian Journal of Dental Research 2008;19(4):297.
24. Choubisa SL, Choubisa L, Choubisa D. Osteo-dental fluorosis in relation to age and sex in tribal districts of Rajasthan, India. J Environ Sci Eng 2010;52(3):199-204.
25. Naidu et al. Prevalence and self-perception of Dental Fluorosis among 15 year old school children in Prakasham district of south India. J Int Oral Health 2013;5(6):67-71.

Annexure: Questionnaire

DEMOGRAPHIC DETAILS

Name of the child:_____ Age: Gender: M/F

Name of School:_____ Class:_____

Address: _____

_____

_____

Occupation of father:_____ Occupation of mother:_____

Education of father:_____ Education of mother:_____

Income of father: _____ Income of mother: _____

Number of members in the family: _____

Family income (per month): _____

Dietary habits: ☐ vegetarian / ☐ mixed diet

Medical History of the child: _____

(Please specify the condition if present and its duration)

Oral hygiene practices of children:

Material used: ☐ Toothbrush ☐ Fingers ☐ any other (specify)

Material used: ☐ Toothpaste ☐ Tooth powder ☐ any other (specify)

Duration of brushing: <5 min / 5–10 min

Number of times in a day: _____

Brushing method: ☐ Horizontal ☐ Vertical ☐ Combination

Frequency of changing toothbrush: ☐ <3 months ☐ 3–6 months ☐ >6 months

Any other oral hygiene aid used (please specify if yes):