



Socio-demographic Determinants and Dental Fluorosis Prevalence among 12 to 16-Year Teenagers in Kanpur District, Uttar Pradesh India: An Explorative Study

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Abstract:

Background: Fluorosis, caused by ingestion of an excessive amount of fluoride through food or water, is a major public health problem in India. **Aims:** To analyse the socio-demographic determinants of dental fluorosis prevalence among 12 to 16-Year teenagers in Kanpur District, Uttar Pradesh India. **Methods and Material:** A cross-sectional study was conducted among teenagers, residing in the city since childhood, in the age group of 12-16 years were selected from government schools. Teenagers were categorized into five age groups and were examined for dental fluorosis. Dean's criteria for assessment of dental fluorosis were used. The chi-square test and Spearman correlation were carried out. The level of significance was kept as $p < 0.05$. **Results:** A total of 1461 teenagers were

examined for the present study. A major fraction of the study population was formed by females. It was observed that the max number of participants was affected by varying severity of dental fluorosis with a prevalence of 27.1%. Correlation and logistic regression analysis showed the occupation of parents and dietary patterns to be significantly correlated with the presence of fluorosis in school children. Conclusions: The prevalence and severity of the condition are found to have a huge burden on the given urban population of Kanpur City. As the occupation of parents and dietary patterns showed significant association with fluorosis, further interventional studies are recommended to be conducted considering these socioeconomic factors.

Keywords: Diet, fluorosis, school children, social determinants.

Introduction:

Fluorine is a naturally occurring element and is one of the essential microelements required for proper growth of the body, strengthening teeth, and preventing their deterioration. It exists in nature in the form referred to as fluoride.^[1] Fluoride can prevent dental caries and it is beneficial to bone metabolism as an essential trace element in the body.^[2,3] Increasing evidence has shown that long-term exposure to excessive fluoride will not only increase the risk of dental fluorosis and skeletal fluorosis but also impair neural development.^[4,5] In India, 62 million people including 6 million children, are estimated to have serious health problems due to the consumption of fluoride-contaminated water.^[6] About 96% of the fluoride is found in bones and teeth.^[7] When ingested in small quantities (<0.5 mg/L or 0.7 ppm) fluoride is beneficial for teeth by reducing dental caries, whereas ingestion of higher concentrations (>1.5 mg/L) may cause fluorosis. Dental fluorosis manifests as opaque white spots or lines, and in severe cases, enamel becomes discoloured and brittle, leading to chipping.^[8,9]

In India, fluorosis has been reported endemic in 20 out of 32 constituent states of India, and day by day more new areas have been engulfed by this problem.^[10] The occurrence of dental, skeletal fluorosis, and muscular fluorosis has been reported by various studies conducted in various districts of

Uttar Pradesh.^[11,12] Kanpur district (180 m above mean sea level) is a part of the Central Ganga Plain, an important Industrial town of Uttar Pradesh with industries ranging from that food products to tanneries.^[13] The city harbours a large number of populations because of its industrial significance. Although there is a central water supply in the city most of the people rely on groundwater for drinking and domestic purpose. People who consume groundwater have higher chances of developing dental fluorosis because of the higher level of fluoride in the deep groundwater of the city as reported by the Water Department of Kanpur district and other literature.^[14,15,16] No study with socio-demographic determinants showing the prevalence of dental fluorosis has been carried out so far in this region. Keeping this in mind, the study was conceptualized to analyse the socio-demographic determinants of dental fluorosis prevalence among 12 to 16-year teenagers residing in the Kanpur city of Uttar Pradesh.

Subjects and Methods:

This study aimed to estimate the prevalence of dental fluorosis among 12–16 years teenagers in Kanpur City, Uttar Pradesh. For study purposes, the entire geographical area of Kanpur was divided into four zones: North, West, South, and East. All government higher secondary schools were selected from these four zones. Official permission was obtained from the district educational officer (DEO), Kanpur district. The institutional ethical committee clearance was taken prior and informed consent was obtained from the respective school headmasters and parents of the teenagers. The socioeconomic status (SES) of the teenagers obtained from the school records was recorded according to the modified Kuppuswamy's socioeconomic scale, and the scale was updated using Consumer Price Index 2016.^[17] The scale contains three questions, about the education of parents, occupation of parents, and family income per month in rupees.

For the study, government schools with a sufficient number of teenagers were approached, and care was taken to include a nearly equal number of teenagers from each zone. Based on their ages, the teenagers were separated into five groups. Teenagers were selected randomly from the government schools, satisfying the following inclusion criteria:

- The teenagers in the age group of 12–16 years
- The children who were lifelong residents of that particular region
- The teenagers who were using groundwater as a source of drinking water from birth
- In Teenagers with teeth, at least more than 50% of the crown erupted and no restoration or orthodontic brackets.
- Teenagers without the presence of any systemic disease, acute infection of the oral cavity, and on any medication

A study-specific proforma was prepared based on the World Health Organization oral health assessment form, 1997.^[18] It consisted of two parts, first consisted of information on demographic data, permanent residential address, information on sources of drinking water, and aids used for oral hygiene maintenance and 2nd part consisted of table for recording fluorosis using the Dean's Fluorosis Index (WHO criteria).^[19]

The questionnaire was used to fill out personal data by means of face-to-face interviews to avoid misinterpretation of questions. All the recordings were done in the daylight and the teenager was made to sit in an ordinary plastic chair facing away from direct sunlight. The oral examination of study subjects was conducted one in the respective school's premises using a plane mouth mirror under natural light. Type-III clinical examination was followed throughout the study.^[20] Instruments were used and disinfected with an antiseptic solution after every use. A single examiner performed all the examination procedures in this study so as to maintain consistency and to eliminate inter examiner bias over a period of 2 years and a trained nurse accompanied the examiner to help in recording the data. Assessment of dental fluorosis was done using Dean's index. The recording was made on the basis of the two teeth that are most affected. If the two teeth were not equally affected, the score for the less affected of the two was recorded and dental caries was assessed using dentition status and treatment needs.^[18,21]

Statistical analysis

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). The chi-square test and Spearman correlation were carried out. The level of significance was kept as $p < 0.05$.

Results:

A total of 1461 teenagers were examined for the present study. Teenagers belonged to the age group of 12–16 years. A major fraction of the study population was formed by females which were 58.31% (852) while males formed the remaining 41.68% (609). The number of teenagers belonging to each group was, group A-246 (16.83%), group B-357 (24.43%), group C-391 (26.7%), group D-219 (14.9%), and Group E-248 (16.9%). Socioeconomic status reported for the greater part of the study was upper lower class (415, 28.4%) and lower middle class (289, 19.78%) while 214 (14.64 %) were upper middle and 169 (11.5%) were upper classes. Five hundred and forty-five (37.30%) participant families had less than or equal to four family members and 916 (62.69%) families had more than four family members. [Table 1]

Most of the fathers of teenagers attended senior secondary (28.47%) and pre-university (37.4%). Most of them were into agriculture (36.7%) whereas 409 (27.9%) were business, 342 (23.4%) stated village workers. Among mothers, 594 (40.6%) had attended senior secondary and 432 (29.5%) attended pre-university. Although high proportions of mothers were educated 637 (43.6%) described their occupation as housewives. Illiteracy was reported as zero among both fathers and mothers of study subjects. [Table-2]

The number of teenagers having dental fluorosis also varied according to the grades of fluorosis. In group A, out of a total of 83 teenagers, 6 teenagers (2.43%) had grade 5 fluorosis (severe) In group B, 6.16% of teenagers had grade 1 fluorosis while (2.24%) had grade 5 fluorosis. [Table-3] Among the geographic zones, into which the city was divided, the South zone had 114 teenagers (28.78%) affected while the east zone had 109 teenagers (27.52%) affected with dental fluorosis. [Table 4].

A correlation analysis performed on socio-demographic factors and fluorosis against each other showed the occupation of the father and mother and dietary pattern to be significantly correlated with the presence of fluorosis in study subjects. [Table-5]

Discussion:

Several studies have been reported from the adjacent town of Kanpur, whose results have shown that the area has high fluoride content in water.^[22] The prevalence of fluoride-rich areas and fluorosis in Uttar Pradesh has been reported in the literature for long.^[23,24] In the result of studies conducted in areas of Barabanki,^[25] Meerut,Agra,^[26] Unnao, ^[27] it has been significantly shown that these areas have high fluoride content in the water. Results of a study done by Bhalla et al and Ravalika KN shows 18% as well as 19% dental fluorosis prevalent in school children residing since childhood and consuming groundwater both at school and home.^[16,28] Studies done by Verma et al., Kola SR and Narayanamurthy showed a high prevalence of 64.3%, 70.3%, 31.05% of dental fluorosis, respectively, in the residing areas of children found similar to the present study.^[29,30,31]

The current study not only determines the prevalence of dental fluorosis but also analyzes the socioeconomic factors that have been linked to the disorder, as previously described by Ravalika KN.^[28] The prevalence of dental fluorosis was higher in the current study participants who ate a vegetarian diet than in those who ate a mixed or non-vegetarian diet. This finding is similar to the findings reported by Ravalika KN in the study done in the same age group population where vegetarianism was inversely associated with fluorosis.^[28] Fluoride is almost eliminated through the kidneys, which is directly proportional to the pH of the urine. A diet that prevents urine from becoming acidic or alkaline causes fluoride clearance variations in the urine. 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.^[28]

In our study, both parents' occupations came to be a significant determinant for fluorosis which was dissimilar to the study done by Ravalika KN et al, where only fathers' occupations came to be a determinant for fluorosis.^[28] The current study's prevalence reveals a significant impact of dental

fluorosis in the metropolitan population, where aesthetics will be one of the primary concerns, along with general health.

Limitations

Only an oral examination was performed in this study to report dental fluorosis (since it is an accessible biomarker), but no skeleton fluorosis assessment or medical interventions such as blood and urine fluoride level measurement were performed.

Conclusion

Kanpur City is one of the major industrial towns of Uttar Pradesh, situated on the bank of the Ganges River. Because of the large number of tanneries and other industries, a high quantity of chromium and other heavy metals have been reported in the river water. The groundwater quality is fairly well as reported by the Municipality of Kanpur City. The prevalence of dental fluorosis was found to be greater in this population, indicating a significant burden of the disease in an urban population. The prevalence and severity of the disorder were shown to be associated with dietary patterns and the parent's occupation. These socioeconomic characteristics should be taken into account in further interventional studies. It is recommended that policymakers explore these determining elements while implementing defluoridation schemes complementing conventional models.

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Tables

Table 1:Distribution of study participants according to sociodemographic variables

Sociodemographic variables		Total		Dental Fluorsis	
		Number of study subjects	Percentage (%)	Number of study subjects	Percentage (%)
Age (in years)	Group A-12 years	246	16.83	83	5.68
	Group B-13 years	357	24.43	112	7.66
	Group C-14 years	391	26.76	96	6.57
	Group D-15 years	219	14.98	77	5.27
	Group E-16 years	248	16.97	28	1.91
Gender	Male	609	41.68	152	10.40
	Female	852	58.31	244	16.70
Numbers of members in family	≤4	545	37.30	187	12.79
	>4	916	62.69	209	14.30
Socioeconomic status	Lower	374	25.98	82	5.61
	Upper lower	415	28.40	94	6.43
	Lower middle	289	19.78	78	5.33
	Upper middle	214	14.64	73	4.99
	Upper	169	11.56	69	4.72
Diet	Vegetarian	661	45.24	164	11.22
	Non-Vegetarians	294	20.12	109	7.46
	Mixed	506	34.63	123	8.41

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

Sociodemographic variables		Total		Dental Fluorsis	
		Number of study subjects	Percentage (%)	Number of study subjects	Percentage (%)
Father's education	SS*	416	28.47	116	7.93
	PUC**	401	27.44	97	6.63
	UG#	367	25.11	94	6.43
	PG##	277	18.95	89	6.09
Father's occupation	Agriculture	537	36.75	126	8.62
	Business	409	27.99	97	6.63
	Village worker	342	23.40	69	4.72
	Academicians	116	7.93	54	3.69
	Professionals	57	3.90	50	3.42
Mother's education	SS	594	40.65	137	9.37
	PUC	432	29.56	112	7.66
	UG	399	27.31	109	7.46
	PG	36	2.46	38	2.6
Mother's occupation	Housewife	637	43.60	129	8.82
	Business	352	24.09	111	7.59
	Village worker	201	13.75	87	5.95
	Academicians	18388	12.526.02	53	3.62
	Professionals	88	6.02	16	1.09
Family income (in rupee per month)	≤6000	679	46.47	144	9.85
	6000–18000	518	35.45	129	8.82
	19000–31,000	372	25.46	84	5.74
	32000–47,000	108	7.39	39	2.66

* Secondary school **Pre university course # Undergraduate ## Postgraduate

Table 3: Distribution of study participants according to age group, grades, and percentage of fluorosis

Age group (in years)	Number of children	Questionable fluorosis(%) (grade-1)	Very mild fluorosis (%) (grade-2)	Mild fluorosis (%) (grade-3)	Moderate fluorosis (%) (grade-4)	Severe fluorosis (%) (grade-5)	Total
Group A (12 years)	246(16.83)	16(6.50)	23(9.34)	31(12.60)	7(2.84)	6(2.43)	83
Group B (13 years)	357(24.43)	22(6.16)	41(11.48)	28(7.84)	13(3.64)	8(2.24)	112
Group C (14 years)	391(26.78)	19(4.85)	34(8.69)	27(6.9)	9(2.3)	7(1.79)	96
Group D (15 years)	219(14.98)	13(5.93)	31(14.15)	17(7.76)	11(5.02)	5(2.28)	77
Group E (16 years)	248 (16.97)	3(1.2)	14(5.64)	6(4.41)	3(1.2)	2(0.8)	28
Total	1461	73(4.99)	143(9.78)	109(7.46)	43(4.94)	28(1.91)	

Table 4: Distribution of study participants having dental fluorosis according to the zone

City Geographic zone	Number of teenagers examined	Number of teenagers having dental fluorosis (%)
North Kanpur	238	92(23.23)
South Kanpur	567	114(28.78)
East Kanpur	409	109(27.52)
West Kanpur	247	81(20.45)
Total	1461	396

Table 5: Correlation between fluorosis status of study participants and sociodemographic variable

Sociodemographic variables	Occupation Of father		Occupation of mother		Diet		Fluorosis	
	r	p	r	P	r	p	r	p
Occupation of father	1							
Occupation of mother	0.03	0.591	1					
Diet	0.069	0.374	0.614	0.086	1			
Fluorosis	0.843	0.028*	0.998	0.037*	0.921	0.001*	1	

Only the values showing significance have been tabulated

*Significance, $p < 0.05$