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Research Article

ASSESSMENT OF DENTAL FLUOROSIS IN CHILDREN OF JAIPUR DISTRICT, RAJASTHAN, INDIA

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ABSTRACT

Objective: The objective of the present study was carried out to explore the potential association between fluoride concentration in drinking water and severity of dental fluorosis (DF) in the children.

Methods: The study of DF in the children (6-14 years old) was conducted in the two blocks (a) Jamwa Ramgarh block in; Heerawala, Palera, Nayabas, Saipur and Birasana, (b) Amber block in; Jugalpura, Chitanukalan, Sunder ka bas, Peelwa and Sirsali of Jaipur district, Rajasthan, India of the study villages. Totally, 150 children were surveyed. The role of fluoride (F) levels in drinking water in the etiology of DF and the cases of DF in both dentitions and teeth were also assessed using Dean's classification. The fluoride (F) concentration in source of drinking water was estimated by fluoride (F) ion specific electrode (Thermo Scientific Orion Star A329, USA).

Results: The F concentration in (Tube well and Hand pump) water ranges from 0.7 to 15.0 parts per million (ppm) in Jamwa Ramgarh block and 1.40-5. 10 ppm in Amber block. The prevalence of DF 27 (36%) in Jamwa Ramgar block and 26 (34.66%) in Amber block out of 75 children were examined in each block. Significantly increase in levels of F in drinking water is positively correlated with DF.

Conclusion: This study finding has shown the relation of DF to high fluoride (F) levels in drinking water sources. A higher fluoride (F) levels in source of drinking water is a major risk factor for DF. In view of the severity of the problem, the intake of calcium-rich foods and defluoridation techniques may help reducing risk of DF in the children.

Keywords: Dental fluorosis, Dean's classification, Jaipur district.

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INTRODUCTION

Fluorine is the most abundant electronegative element in nature, and about (96%) of fluoride (F) in the human body is found in bones and teeth [1]. In India, fluorosis is the most prevalent endemic disease which coexists in certain geographical regions in the country. Fluorosis is mainly of three type, namely, dental, skeletal fluorosis (SF), and non-skeletal fluorosis (NSF). Dental fluorosis (DF) is a global disease is not new to India, the reason being the shortage of good quality portable water and consumption of fluoride (F) enriched water by people both in the rural and urban areas [2]. A higher level of F exerts a negative effect on the metabolic processes and an individual may suffer from SF, DF, and NSF problem or a combination of the all [3]. Fluoride (F) is toxic to all the systems and causes hyperlipemia, lipid peroxidation, and oxidative stress in various tissues of the human body [4]. In the human body, fluoride enters through the drinking water, food, beverages, tea, fish, dental products, etc [5]. Dentifrices contain 1000 parts per million (ppm) fluorides [6]. Risk of endemic fluorosis was the F level in source of drinking water is more than 1.0 ppm [7]. The available study data suggest that 15 States in India are endemic for fluorosis (F level in drinking water >1.5 ppm) and about (62 million) people in India suffering from dental, SF and NSF including these 6 million children are below the age of 14 years [8].

DF in varying degree has been reported in drinking water with various concentrations of F levels [9-15]. The epidemiological study was conducted by Dean in the year 1930s demonstrated the relationship between the prevalence of mottling and the level of F in source of drinking water. The standard classification of the degree of mottling such as normal, questionable, very mild, mild, moderate, and severe was proposed by Dean [16-20]. DF is mostly seen in children when the F exposure is between (1 to 4 years) of age and mostly occurs in children below the 12 years of age [21].

Rajasthan is highly affected from fluorosis. Almost all 33 districts are endemic for fluorides [22]. A higher level of fluoride (F) in source of drinking water was also found in rural areas of Northern Rajasthan [23]. Ingestion of excess F-contaminated drinking water caused different types of fluorosis. Very few studies have been published in the field of fluorosis. Hence, the objective of the present study was to assess the DF in the children of Jaipur district, Rajasthan, India.

METHODS

Study areas

The study was conducted in the two blocks (a) Jamwa Ramgarh block in; Heerawala, Nayabas, Palera, Saipur and Birasana (b) Amber block in; Jugalpura, Chitanukalan, Sunder ka bas, Peelwa and Sirsali of Jaipur district, Rajasthan, India. Drinking water fluoride (F) levels of more than 1.5 ppm, respectively (Ministry of Drinking Water and Sanitation (MDWS), Government of India and Public Health and Engineering Department (PHED), Government of Rajasthan, Jaipur).

Total 150 male and female children (6-14 years) old exhibiting DF consuming F-contaminated water in endemic fluorosis areas of Jaipur district, Rajasthan, India were selected through a village-level survey was conducted. A pretested questionnaire regarding their socio-demographic, knowledge attitude and practices on defluoridation and fluorosis mitigation, source of drinking water was prepared.

All children were examined for DF using the Dean's method [24]. According to specific clinical diagnostic criteria of development of fluorotic enamel opacities for DF was categorized as normal (Grade 0), questionable (Grade 1), very mild (Grade 2), mild (Grade 3), moderate (Grade 4), and severe (Grade 5). Children who were diagnosed as a Grade 0 or 1 classified as controls, whereas those who were diagnosed as Grade 2, 3, 4, or 5 DF cases.

Collection of water sample and analysis

Source of drinking water (Tube well and Hand pump) was collected in plastic tubes (Tarsons, India) and investigate for fluoride levels. Fluoride (F) concentration in each of the prepared solutions was estimated with the help of an F ion specific electrode (Thermo Scientific Orion Star A329, USA). Deionized water was used for all measurements.100 ppm fluoride stock (Thermo Scientific, USA) was used for calibration to prepare four standard solutions of different F concentration such as (10, 1, 0.1, and 0.01 ppm) by serial dilution.

1 mL of total ionic strength adjustment buffer III solution (Thermo Scientific, USA) was added to each 10 mL of standard solution and the instrument was calibrated. Fluoride estimation in the drinking water was carried out potentiometrically with a fluoride (F) ion specific electrode (Thermo Scientific Orion Star A329, USA) using the method of Hall *et al.* [25].

Ethical clearance

This study protocol was approved by the Institutional Ethical Committee of Desert Medicine Research Centre, Jodhpur, Rajasthan, India. All the research work was performed according to the guidelines of Indian Council of Medical Research, New Delhi, India for human experimentation in biomedical research. An informed and written consent were obtained from the each participant or their parents or legal guardians.

RESULTS

Fluorosis is a major problem in India as well as in Rajasthan. The study area is Jaipur district, Rajasthan, India. Age of the children ranged from (6-14 years) old were selected for the study.

DISCUSSION

Totally, 150 children were involved from the two blocks of the rural area of Jaipur district, Rajasthan, India. Each block was divided into 5 villages. Total 10 villages were involved in the study from each village 15 children were involved in this study protocol. The village wise household survey was also carried out to estimate the fluoride content in the source of drinking water in the both block of the Jaipur district, Rajasthan. The highest amount of the fluoride content was estimated in Birasana village which ranges from (2.5-15 ppm) followed by Saipur (2.20-9.50 ppm), Palera (1.00-2.80 ppm), Heerawala (0.8-2.70 ppm) and Nayabas (0.7-2.10 ppm) in Jamwa Ramgarh block of the Jaipur district, Rajasthan Table 1. Household survey was also carried out in Amber block of Jaipur district to estimate the fluoride content in the source of drinking water. The highest amount of the fluoride content was estimated in Sirsali village which ranges from (2.20-5.10 ppm) followed by Peelwa (0.80-3.50 ppm), Sunder ka bas (0.90-2.50 ppm), Jugalpura (0.80-2.50 ppm) and Chitanu kalan (1.40-2.20 ppm) in Amber block of Jaipur district, Rajasthan Table 2.

DF cases are higher in Birasana village according to Deans classification grading (Fig. 1) normal (2), questionable (3), very mild (2), mild (3). Moderate (3) and severe (2) village followed by Saipur, normal (3), questionable (5), very mild (3), mild (3) and moderate (1) Palera normal (4), questionable (6), very mild (2) and mild (3), Heerawala normal (8), questionable (4), very mild (2) and mild (1), and Nayabas normal (10), questionable (3), very mild (2) and over all the prevalence of DF 27 (36%) in Jamwa Ramgarh block out of 75 children were examined (Table 3). DF cases are also high in Sirsali village according to Deans classification grading normal (2), questionable (4), very mild (4), mild (3) and moderate (2) village followed by Peelwa, normal (5), questionable (4), very mild (2), mild (3) and moderate (1),

Table 1: Fluoride concentration in drinking water sources of the selected five villages
District: Jaipur 1. Block: Jamwa Ramgarh

S. No.	Name of village	Fluoride concentration in drinking water sources Range (ppm)*
1	Nayabas	0.7-2.10
2	Heerawala	0.8-2.70
3	Paleda	1.00-2.80
4	Saipur	2.20-9.50
5	Birasana	2.50-15.00

*Drinking water sources: Hand pump, Tube well, ppm: Parts per million

Table 2: Fluoride concentration in drinking water sources of the selected five villages
District: Jaipur 2. Block: Amber

S. No.	Name of village	Fluoride concentration in drinking water sources Range (ppm)*
1	Chitanu kalan	1.40-2.20
2	Jugalpura	0.80-2.50
3	Sunder ka bas	0.90-2.50
4	Peelwa	0.80-3.50
5	Sirsali	2.20-5.10

*Drinking water sources: Hand pump, Tube well, ppm: Parts per million

Fig. 1: Dental fluorosis (Dean's grading), (a) normal (Grade 0), (b) questionable (Grade 1), (c) very mild (Grade 2), (d) mild (Grade 3), (e) moderate (Grade 4) and (f) severe (Grade 5)

Sunder ka bas normal (7), questionable (3), very mild (2) mild (2) and moderate (1), Jugalpura normal (8), questionable (3), very mild (3) and mild (1), and Chitanukalan normal (9), questionable (4), very mild (2) and over all the prevalence of DF 26 (34.66%) in Amber block out of 75 children were examined in Jaipur district, Rajasthan (Table 4).

The fluoride (F) concentration was estimated in source of drinking water which ranges from (0.7 to 15 ppm) in Jamwa Ramgarh block and (1.40 to 5.10 ppm) in Amber block of Jaipur district, Rajasthan has shown in (Tables 1 and 2). The fluoride content in drinking water 1.5 ppm was prescribed by the WHO [26]. This indicates that the occurrence of fluorosis in an area can be affected by so many other factors such as different life styles, nutritional status, climate, altitude, individual susceptibility and biological response, duration of F exposure and dissolved salts in drinking water [27]. Inorganic pollutants in ground water are hazardous for human health [28]. In Rajasthan, Indigenous rocks are rich source of fluoride contaminated water and ground water around the mica mines, Rajasthan has rich sources of mica.

Table 3: Dental fluorosis Dean's classification (grading) of children of Jaipur district of Rajasthan
1. Block: Jamwa Ramgarh

S. No.	Name of village	No. of children examined age (6-14 years)	Dean's classification (grading)						Prevalence of DF in children (%)
			Control		Cases				
			0 (Normal)	1 (Questionable)	2 (Very mild)	3 (Mild)	4 (Moderate)	5 (Severe)	
1	Paleda	15	4	6	2	3	-	-	5 (33.33)
2	Heerawala	15	8	4	2	1	-	-	3 (20)
3	Nayabas	15	10	3	2	-	-	-	2 (13.33)
4	Saipur	15	3	5	3	3	1	-	7 (46.66)
5	Birasana	15	2	3	2	3	3	2	10 (66.66)
Total		75	27	21	11	10	4	2	27 (36)

DF: Dental fluorosis

Table 4: Dental fluorosis Dean's classification (grading) of children of Jaipur district of Rajasthan
2. Block: Amber

S. No.	Name of village	No. of children examined age (6-14 years)	Dean's classification (grading)						Prevalence of DF in children (%)
			Control		Cases				
			0 (Normal)	1 (Questionable)	2 (Very mild)	3 (Mild)	4 (Moderate)	5 (Severe)	
1	Chitanu kalan	15	9	4	2	-	-	-	2 (13.33)
2	Jugalpura	15	8	3	3	1	-	-	4 (26.66)
3	Sunder ka bas	15	7	3	2	2	1	-	5 (33.33)
4	Peelwa	15	5	4	2	3	1	-	6 (40)
5	Sirsali	15	2	4	4	3	2	-	9 (60)
Total		75	31	18	13	9	4	-	26 (34.66)

DF: Dental fluorosis

The prevalence of DF 27 (36%) in Jamwa Ramgarh block and 26 (34.66%) in Amber block out of 75 children were examined in each block as shown in (Tables 3 and 4). Our study finding data show the DF cases are higher in the Jamwa Ramgarh block as compare to Amber block. Many studies in the past have proved the direct link between the concentration of fluoride in source of drinking water and degree of dental fluorosis in the many communities and countries [29-32].

In India, previous study of DF has been reported in human's intake of fluoride (F) concentration which ranges from (0.5 to 1.0 ppm) in drinking water [13,33]. Hundred percentage of DF has been reported where fluoride concentrations of 3.4-3.8 ppm in drinking water [14,34]. The present study revealed that the drinking water of the investigated region was contaminated with fluoride and the children of the study area were chronically exposed to higher levels of F from drinking water sources. In the present investigation, in summary, as well as the water F levels being positively correlated with the severity of DF in the children. However, due to the many limitations in this study, more research with larger sample sizes is needed to arrive at any conclusion.

CONCLUSION

This study data shows the prevalence of DF 27 (36%) in Jamwa Ramgar block and 26 (34.66%) in Amber block of Jaipur district. A higher level of F in source of drinking water is a major risk factor for DF in the children. Hence, it is important to control the F content in the drinking water by establishing defluoridation unit. This study also provides the baseline data and information to public health authorities and significant use in planning of appropriate preventive strategies to control the DF problem in the children of Jaipur district, Rajasthan, India.

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