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Prevalence of Dental, Skeletal and Non-Skeletal Fluorosis in Children of Jaipur District of Rajasthan

KEYWORDS: Dental Fluorosis, Jaipur District, Biochemical Parameters

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ABSTRACT *The study of dental, skeletal and non skeletal fluorosis in the children (6-14 years) was conducted in the two blocks (a) Palera, Heerawala, Nayabas, Saipur and Birasana of Jamwaramgarh block, (b) Chitanukalan,Jugalpura,Sunder ka bas ,Peelwa and Sirsali of Amber of Jaipur district of Rajasthan, India. The role of fluoride level of drinking water in the etiology of dental fluorosis and the cases of dental fluorosis in both dentitions and teeth were also assessed using DEANS classification. The fluoride content in the drinking water, blood and urine was estimated by ion specific electrode (Thermo Scientific Orion Star A329). The fluoride concentration in drinking water ranges from 0.7 to 15 ppm. Analysis of the samples showed the fluoride content in abnormal range both in the serum and urine of the children of the study villages. Increased fluoride concentration in drinking water is also responsible for the increased the disease pattern.*

Introduction:
In India, Fluorosis (due to consumption of excess fluoride) is the most prevalent endemic disease which coexists in certain regions in the country. Fluorine is the most abundant element in nature, and about 96% of fluoride in the human body is found in bones and teeth (1). Flurorsis is mainly three types i.e., dental, skeletal and non skeletal Flurorsis. Dental fluorosis is a global multifactorial disease is not new to India, the reason being the shortage of good quality potable water and consumption of fluoride enriched water by people both in the urban and rural areas. Fluorides are mainly found in ground water when derived by the solvent action of water on the rocks and the soil of the earth's crust (2). Higher fluoride concentration exerts a negative effect on the course of metabolic processes and an individual may suffer from skeletal fluorosis, dental fluorosis, non-skeletal manifestation or a combination of the above (3). There is a risk of endemic fluorosis where the fluoride level is more than 1.0 mg L-1 in drinking water (4). Dental fluorosis, in varying degree of incidences has been reported in drinking water with various concentrations of fluoride levels (5-11). The available data suggest that 15 States in India are endemic for Fluorosis (fluoride level in drinking water >1.5 mg/l), and about 62 million people in India suffer from dental, skeletal and non-skeletal Fluorosis. Out of these; 6 million are children below the age of 14 years (12).

Skeletal changes and mottled enamel may result when drinking water content of fluoride exceeds 2 ppm (13). The estimated range of safe and adequate intake of fluorides for adults is 1.5 to 4.0 mg per day and it is less for children and those with renal disease (14). In skeletal fluorosis, the patients often complain of a vague discomfort and parenthesize in the limbs and the trunk, pain and stiffness in the back appear next, especially in the lumbar region, followed by dorsal and cervical spines (15).

Drinking water is the main source of fluoride, the causative factor for dental mottling. Low precipitation rate, unlimited use of ground water leads to the enrichment of various minerals including fluoride in the sub-soil structure (16). In addition to drinking water, fluoride enters the human body through air, food, beverages, fluoride enriched medicines, dental products like dentifrices and mouth rinses, sea fish, cheese and tea (17-21).

Rajasthan is highly affected from fluororsis. All the 33 districts have been declared as fluorosis prone area. Very little study has been published in the field of fluorosis. Hence, the objectives of present study are to assess the prevalence of dental, skeletal and non-skeletal fluorosis in endemic fluoridated areas of Jaipur district of Rajasthan.

MATERIALS AND METHODS
Study areas: The study was conducted in the two blocks (a) Palera, Heerawala, Nayabas, Saipur and Birasana of Jamwaramgarh block, (b) Chitanukalan,Jugalpura,Sunder ka bas ,Peelwa and Sirsali of Amber of Jaipur district of Rajasthan, India with drinking water F levels of more than 1.5 ppm, respectively (Ministry of Drinking water and sanitation, Government of India and Public Health and Engineering Department, Government of Rajasthan, Jaipur).Except for the drinking water, there were no other sources of F exposure in the villages.

A sample group of 150 male and female children 6 to 14 years old exhibiting dental, skeletal and non-skeletal fluorosis consuming fluoride-contaminated water in endemic fluorosis areas of Jaipur district of Rajasthan, India were selected through a village level survey was conducted.

A detailed questionnaire regarding their demographic details, written consent was taken and duration of F exposure.

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Dental fluorosis by Dean's classification:

Dental fluorosis is characterized by Dean's classification (22).

Table.1 Dean's classification

Classification	Criteria – description of enamel
Normal	Smooth, glossy, pale creamy-white translucent surface
Questionable	A few white flecks or white spots
Very Mild	Small opaque, paper white areas covering less than 25% of the tooth surface
Mild	Opaque white areas covering less than 50% of the tooth surface
Moderate	All tooth surfaces affected; marked wear on biting surfaces; brown stain may be present
Severe	All tooth surfaces affected; discrete or confluent pitting; brown stain present

UNICEF's Clinical Test for skeletal fluorosis: Three simple clinical tests

COIN TEST: The subject is asked to lift a coin from the floor without bending the knee. A fluorotic subject would not be able to lift the coin without flexing the large joints of lower extremity.

CHIN TEST: The subject is asked to touch the anterior wall of the chest with the chin. If there is pain or stiffness in the neck, it indicates the presence of fluorosis.

STRETCH TEST: The individual is made to stretch the arm sideways, fold at elbow and touch the back of the head. When there is pain and stiffness, it would not be possible to reach to the occiput indicating presence of Fluorosis**.**

Non skeletal fluorosis: some biochemical analysis of clinical test are liver function test and renal function test performed to diagnose non skeletal fluorosis.

Fluoride sample collection and analysis*:* A 4 ml venous blood sample was collected from each selected subject after overnight fasting in a plain plastic Vacutainer (BD) tubes without any anticoagulant. A 24 hr urine sample and source of drinking water Tube well and Hand pump. Drinking water were collected in plastic falcon (Tarsons) tubes and investigated for fluoride levels. F concentration in each of the prepared solutions was estimated with the help of a F ion specific electrode (Thermo Scientific Orion Star A329). De ionized water was used for all measurements. For calibration, four standard solutions of 10, 1, 0.1 and 0.01 ppm F concentration were prepared by serial dilution.

1 mL of TISAB III was added to each 10 mL of standard solution and the instrument was calibrated. When calibrating, it was assumed that the added TISAB III had no effect on the standard concentration.

Fluoride determination in the drinking water was carried out potentiometrically with a fluoride ion specific electrode (Thermo Scientific Orion Star A329). Urinary fluoride was estimated by the method of Hall et al (23).

Blood samples were left to clot at room temperature, and serum was separated by centrifugation. Serum fluoride was also estimated by the method of Hall et al (23). Using the Thermo Scientific Orion Star A329.

Ethical approval: The protocol for this study was approved from the Ethical Committee of Desert Medicine Research Centre, Jodhpur. All work was performed according to the ICMR guidelines, New Delhi, India for human experimentation in biomedical research. Before the sample collection a written consent was obtained from each Participant.

RESULTS AND DISCUSSION

Fluorosis is major problem in India as well as in Rajasthan**.** Study area is Jaipur District of Rajasthan. Age of the children is 6-14 years old school going children.

Table.2. House Hold Survey of Children of Jaipur district of Rajasthan:
District: Jaipur 1. Block: Jamwaramgarh

S.No.	Name of village	Name of habitation	Demographic survey of Children age (6-14 yrs)	children of dental Fluorosis	Children of skeletal fluorosis	children of Non-skeletal fluorosis
1	Palera	Palera	15	5	1	0
2	Heerawala	Heerawala	15	3	0	0
3	Nayabas	Nayabas	15	2	0	0
4	Saipur	Saipur	15	7	3	1
5	Birasana	Birasana	15	10	5	1

Table.3. House Hold Survey of Children of Jaipur district of Rajasthan:
District: Jaipur 2. Block: Amber

S.No.	Name of village	Name of habitation	Demographic survey of Children age (6-14 yrs)	children of dental Fluorosis	Children of skeletal fluorosis	children of Non-skeletal fluorosis
1	Chitanukalan	Chitanukalan	15	2	0	0
2	Jugalpura	Jugalpura	15	4	0	0
3	Sunder ka bas	Sunder ka bas	15	5	1	1
4	Peelwa	Peelwa	15	6	2	1
5	Sirsali	Sirsali	15	9	3	2

Table.4. Village Wise biochemical analysis of Children: water intake, blood (Serum) and Urine fluoride
District: Jaipur 1. Block: Jamwaramgarh

S.No	Name of Village	No. of children Examined	Age range (years)	No. of female Children	No. of male Children	Drinking water F Range (PPM)	Urine F Range (PPM)	Serum F range (PPM)
1.	Nayabas	15	7-13	4	11	0.7-2.10	0.7-2.20	0.02-0.068
2	Heerawala	15	7-14	3	12	0.8-2.70	0.80-2.50	0.024-0.088
3	Paleda	15	8-13	10	5	1.00-2.80	1.10-2.70	0.026-0.14
4	Saipur	15	7-14	8	7	2.20-9.50	2.00-9.70	0.078-0.22
5	Birasana	15	8-14	10	5	2.50-15.00	2.50-14.00	0.078-0.26

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Table.5. Village Wise biochemical analysis of Children: water intake, blood (Serum) and Urine fluoride
District: Jaipur 2. Block: Amber

S.No	Name of Village	No. of children Examined	Age range (years)	No. of female Children	No. of male Children	Drinking water F Range (PPM)	Urine F Range (PPM)	Serum F range (PPM)
1.	Chitanu kalan	15	8-14	3	12	1.40-2.20	1.20-3.00	0.042-0.22
2	Jugalpura	15	8-14	5	10	0.80-2.50	0.90-2.60	0.020-0.12
3	Sunder ka bas	15	7-14	7	8	0.90-2.50	0.90-2.70	0.035-0.16
4	Peelwa	15	7-14	3	12	0.80-3.50	0.70-3.40	0.030-0.18
5	Sirsali	15	8-14	4	11	2.20-5.10	2.10-5.10	0.067-0.18

Total 150 subjects are involved from the two Blocks of rural area of Jaipur District. Each Block is divide in 5 village. Total 10 villages are involved in the study. From each village 15 children are involved in the study protocol. House hold data are shown in table.2-3 for both the block. Dental fluorosis cases are very high in the villages followed by the skeletal and non-skeletal fluorosis in the both block of the Jaipur district of Rajasthan.

House hold survey showed that dental, skeletal and non-skeletal fluorosis cases are high in Birasana village followed by Saipur, Palera, Heerawala and Nayabas in Jamwaramgarh block of the Jaipur district Table.2. House hold survey in Amber block showed that dental, skeletal and non-skeletal fluorosis cases are high in Sirsali village followed by Peelwa, Sunder Ka Bas, Jugalpura and Chitanukalan village of the Jaipur district Table.3.

Village wise survey also carried out for estimate the fluoride content in the drinking water in the both block of the Jaipur district of Rajasthan. Highest amount of the fluoride content was found in Birasana village (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 Jamwaramgarh block of the Jaipur district Table.4. Village wise survey also carried out in Amber Block of Jaipur district for estimate the fluoride content in the drinking water. Highest amount of the fluoride content was found in Sirsali village (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) Table.5.

Village wise biochemical analysis carried out for estimate the fluoride content in the urine and blood of the children in the both block of the Jaipur district of Rajasthan. Highest amount of the fluoride content in urine and blood was found in children of the Birasana village (2.50-14.00 PPM), (0.078-0.26 PPM) followed by Saipur(2.00-9.70 PPM), (0.078-0.22 PPM) Palera(1.10-2.70 PPM), (0.026-0.14 PPM), Heerawala(0.80-2.50 PPM), (0.024-0.088 PPM) and Nayabas (0.7-2.20 PPM), (0.02-0.068 PPM) in Jamwaramgarh block of the Jaipur district Table.4. Village wise biochemical analysis also carried out Amber block of Jaipur district for estimate the fluoride content in the urine and blood of the children of the Jaipur district of Rajasthan. Highest amount of the fluoride content in urine and blood was found in children of the Sirsali village (2.10-5.10 PPM), (0.067-0.18 PPM) followed by Peelwa (0.70-3.40 PPM), (0.030-0.18 PPM) Chitanu kalan (1.20-3.00 PPM), (0.042-0.22 PPM), Sunder ka bas (0.90-2.70 PPM), (0.035-0.16 PPM) and Jugalpura (0.90-2.60 PPM), (0.020-0.12 PPM) Table.5.

The F concentration (ppm) found in blood, urine, tended to increase with increased F exposure from using drinking water with higher F levels (Table.4-5). Individual F levels are seen to overlap between the three groups in all three biological samples. This indicates the presence of confounding variables other than water F level which might have accounted for these individual differences. It is worth noting that the F levels in the serum samples are lower than the associated drinking water F levels in all the three groups reflecting a steady state concentration achieved in the serum by exchange with the body F stores. Although the F levels in urine also reveal a similar trend, the observed day to day and individual variations in the urinary F levels (24) and the variables (25-27) affecting them, make urinary F levels an imprecise tool to estimate the effect of environmental fluoride. In the present investigation, the mean F content of urine always exceeded that of water by a significant margin, perhaps due to a very long duration of F exposure in the study areas. This increases the validity of urinary F level as a biomarker of chronic F exposure and even as a potential indicator for clinical fluorosis.

In summary, as well as the water F levels being positively correlated with the serum and urine F levels, the high water F levels found in the present study indicate that F obtained from the systemic circulation to the urine and blood is deposited, either by secondary concentration or by continuous incorporation, thus making blood and urine F a useful biomarker for both subchronic and chronic F exposures. The blood and urine l F values are also responsive to even slight differences in drinking water F concentration. The user-friendly technique for the measurement of nail F and its ease of establishment at a basic rural/urban laboratory setting suggest that f content in urine and blood have a strong potential for use as a biomarker in epidemiological surveys. However, due to the many limitations in this study, more research with larger sample sizes is needed to arrive at any definite conclusion.

Conclusion:

Increasing fluoride level in water is a major risk factor for dental, skeletal and non skeletal fluorosis in the children (6-14 years). Permanent dentition is involved more in dental fluorosis than primary dentition. Maxillary teeth are more commonly affected than homologous mandibular teeth and maxillary central incisors are found to be the most commonly affected teeth, whereas first molars are the least commonly affected. The current study regarding dental, skeletal and non skeletal fluorosis in the children (6-14 years) also revealed that increased fluoride levels in water also increased the disease incidence.

A significant increased level of serum fluoride and urine fluoride levels was also noted in samples. Hence, it is very important that to prevent the fluoride content in the drinking water and food contents. Proper defluoridation plants can be established for control the fluoride level in the drinking water. Proper intervention study may be planned in the future to control the fluorosis problem in the children of Jaipur District of Rajasthan, India.

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