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DENTAL SKELETAL AND NON SKELETAL FLUOROSIS IN CHILDREN IN THE VARANASI REGION

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ABSTRACT

A crucial oligo-element is fluoride. It is necessary for the growth of the teeth and the bone. Dental caries is caused by insufficient fluoride ingestion. fluorosis brought on by consuming fluoride in food and water. The transformation of the enamel's hydroxylapatite crystals into fluorapatite depends on fluoride. Because of its strength, this fluorapatite resists demineralization by acid. Conversely, consuming more fluoride from drinking water than is considered safe can result in a range of negative side effects, such as skeletal or dental fluorosis. As a result, the ICMR and WHO advised that 1.5 ppm of fluoride be allowed in drinking water. Varanasi district, India, the study of dental, skeletal, and non-skeletal fluorosis in children (6–12 years) was carried out. Using the DEANS classification, the incidence of dental fluorosis in both dentitions and teeth as well as the contribution of drinking water fluoride levels to the etiology of dental fluorosis were evaluated. Using an ion-specific electrode, the fluoride level of the drinking water, blood, and urine was determined (Thermo Scientific Orion Star A329). Drinking water has fluoride concentrations ranging from 0.7 to 15 parts per million. The youngsters from the study villages had serum and urine with fluoride contents that were abnormally high, according to the analysis of the samples. The elevated illness pattern can also be attributed to higher fluoride concentrations in drinking water.

Keyword: Fluorosis, Fluoride, Bone, Urine, Water, Blood, Teeth

1. INTRODUCTION

The negatively charged ion of the fluorine atom (F) is called fluoride. The letter F represents fluorine. Fluoride, represented by the symbol F~~u~~, is the electrically charged fluorine anion with a charge of -1. Any chemical or inorganic material containing the fluoride ion is referred to as fluoride. About 96% of fluoride is found in teeth and bones, and it is essential for the mineralization of bones and the growth of dental enamel. The most popular places to consume fluoride are toothpaste, children's formula, supplements, and fluoridated drinking water. The Indian Council of Medical Research and the World Health Organization recommend that drinking water have no more than 1.5 parts per million of fluoride. Dental fluorosis was mostly seen in endemic areas where drinking water had high fluoride intake. Fluorosis comes in three primary forms: non-skeletal, skeletal, and dental. Dental fluorosis is a multifactorial disorder that affects people worldwide because the nation lacks clean, potable water and because both urban and rural citizens drink fluoride-enriched water.

Excessive fluoride exposure can cause dental fluorosis, which is characterized by increased subsurface enamel porosity and a well-mineralized surface layer of enamel. High fluoride concentrations will affect the ameloblast, the cell that makes enamel, especially during enamel production during tooth development. Enzyme proteinases are prevented from breaking down the matrix proteins during the maturation phase by a decrease in free calcium ion concentration in the mineralizing matrix brought on by an increase in fluoride during enamel mineralization. This delays the breakdown of matrix proteins. Maintaining fluoride exposure at prescribed levels is essential to reaping the benefits of fluoride's beneficial effects on avoiding caries and fluorosis.

1.1 HISTORICAL PERSPECTIVE OF FLUOROSIS

The discovery of abnormal stains on teeth for the first time marked the beginning of the fluorosis adventure. People became quite curious about these stains, which started the process of developing dental fluorosis.

In 1901, Frederick McKay, having recently graduated from dental school, moved to Colorado Springs to open a dental practice. Upon discovering that many of the people in the area had dark stains on their teeth—a condition known as "Colorado Stain"—he was taken aback. Occasionally, these stains were so strong that it looked if they were covered in bitter chocolate. When McKay realized this, he started hurriedly looking up the ailment that was causing the stains.

McKay asked renowned dental researcher Dr. G.V. Black for help in locating the source of the stain that was affecting citizens in Colorado Springs. In 1909, Black accepted the invitation and made his way to Colorado. After working together for six years, the two found that the stain affected roughly 90% of children born in Colorado Springs. When scientists discovered that teeth with mottling were remarkably resistant to dental decay, they were surprised and gave the brown stain a more scientific name: tooth mottling, which was eventually changed to fluorosis. They continued despite not being able to identify the cause of the teeth mottling, despite the stain's anti-cavity qualities.

McKay was always searching for a way to get rid of the brown stains. He was so concerned by a recent rise in tooth mottling in Oakley, Idaho, that he drove from Colorado Springs to study it in 1923. The parents say the stains started to show up shortly after Oakley built a municipal water conduit to a warm spring five miles distant. McKay convinced town officials to forgo the pipeline and use a nearby spring as their water source after testing the water and determining that it was normal. The brown streaks eventually disappeared once the town complied.

Mckay was able to pinpoint the source of the tooth mottling even if he was unable to pinpoint the precise cause. Next, McKay went to Bauxite, Arkansas, which is the location of the aluminum mill owned by the Aluminum Company of America (ALCOA). The individuals that lived in the nearby towns did not have discolored teeth, unlike the bauxite population. Following his request that the locals study the water, McKay departed for Colorado.

Churchill found out that there was a lot of fluoride in the Bauxite water a few days after the examination was completed.

Churchill informed McKay of the fluoride results in the letter and suggested that he check samples from Colorado Springs and Oakley for greater fluoride levels. Within a few months, McKay figured out the cause of the dark stain: teeth were, in fact, being stained by high fluoride levels.

Once the National Institutes of Health (NIH) became aware of Mckay and Churchill's findings, they decided to investigate the effects of water-borne fluoride on teeth. The first method to measure the fluoride content of water was created by Elias Elvove and Dr. T. Dean. By the late 1930s, the NIH had determined that enamel fluorosis could not be caused by fluoride concentrations as high as 1.0 ppm.

1.2 INDIAN PERSPECTIVE

This illness affects twenty-four countries, including India. Of the 85 million fluoride deposits on the earth's crust, only 12 million are located in India.[8] According to a recent report, 66 million people in 275 districts in India are susceptible to fluorosis. A different study revealed that an estimated 6 million Indian toddlers suffer from fluorosis. Fluoride pollution in water affects the following states: West Bengal, Punjab, Rajasthan, Tamil Nadu, Maharashtra, Madhya Pradesh, Andhra Pradesh, Bihar, Chhattisgarh, Orissa, Haryana, Karnataka, Madhya Pradesh, and Uttar Pradesh. About 9000 communities are affected, with a population of 30 million people.

1.3 DENTAL FLUOROSIS

Dental fluorosis is a highly common disorder characterized by the hypomineralization of dental enamel, which is caused by excessive fluoride consumption during enamel development. Dental caries is more common in children with moderate to severe dental fluorosis. Large, irregular holes exist between the enamel prisms of severely fluorosed enamel, allowing acid and germs to easily permeate. There appear to be several visible changes in the enamel that cause different levels of intrinsic tooth discoloration and sometimes even physical damage to the teeth. The patient's age, dosage, duration, and exposure all affect

how bad the illness is. The correlation between dental fluorosis and drinking water fluoride levels is widely established. The three main extra variables that might cause dental fluorosis are toothpaste that has been fluoridated, baby formula that is ingested before the age of seven, and fluoride supplements. When it comes to permanent teeth, dental fluorosis is mostly an aesthetic concern. Children who are exposed to excessive amounts of fluoride between the ages of 20 and 30 months are more prone to develop dental fluorosis. It's also important to keep in mind that, in terms of fluoride overexposure, a child would not be at risk until they were between the ages of 1 and 4. In a clinical sense, Dental fluorosis is characterized by brownish staining of the teeth, pitted and mottled enamel, and bilateral widespread, thin, horizontal white striations with stained plaque. Fluorosis leaves behind persistent stains and patches that have the potential to deepen over time. Furthermore, the degree of fluorosis in the teeth is influenced by the thickness of the enamel. Consequently, the more enamel there is, the more severe the dental fluorosis, which manifests as snow-capped cusp tips and incisal edges. Fluorosis is symmetrically distributed; however the type of tooth determines how severe it is. Because fluorosis affects premolars more frequently and severely than other teeth, it is especially problematic for these teeth because they develop and mineralize later in life. Asymmetrical lesions resulting from dental fluorosis in the primary dentition are possible, although there is less possibility of structural damage because the severity of the condition is lower than in the permanent dentition.

1.4 SKELETAL FLUOROSIS

After ingesting high amounts of fluoride, skeletal fluorosis is a disorder that is known to occur in areas where groundwater is the primary source of drinking water. Since cancellous (spongy) bones have a better blood supply than compact (cortical) bones, they prefer to accumulate fluoride. When it affects the main bones and joints, it occurs.

Individuals suffering with skeletal fluorosis often report

1. Widespread pain and paraesthesia throughout the trunk and limbs, followed by stiffness and pain in the back, especially in the dorsal and cervical vertebrae and the lumbar region.
2. The increasing outward bending of the hands and legs, during which these limbs lose their outlines, is the hallmark of knock-knee syndrome.
3. The most vulnerable people are those who are nursing, pregnant, or children. Pregnant women who consume excessive amounts of fluoride may also put the fetus at risk.
4. Severe fluorosis, often known as "crippling fluorosis," causes the sufferer to become virtually immobile by stiffening their spine and joints.

If the fluoride content is between 4 and 10 mg/L, skeletal fluorosis may develop.

1.5 NEED OF THE STUDY

The most common endemic ailment in India is fluorosis, which is brought on by excessive fluoride consumption and coexists in some areas of the nation. The most prevalent element in nature is fluorine, which makes up 96% of the fluoride in human bones and teeth. There are primarily three types of fluororrhea: skeletal, non-skeletal, and dental. India has long been affected by dental fluorosis, a multifactorial worldwide illness brought on by the lack of clean drinking water and the use of fluoride-enriched water by both urban and rural residents. When water acts as a solvent on rocks and dirt in the earth's crust, fluorides are mostly found in ground water. Elevated concentrations of fluoride have an adverse impact on metabolic processes, leading to skeletal fluorosis, dental fluorosis, non-skeletal manifestations, or a combination of these. When drinking water contains more fluoride than 1.0 mg L-1, there is a chance of endemic fluorosis. Fluoride concentrations in drinking water have been found to cause dental fluorosis in variable degrees of cases. According to the information that is currently available, fluorosis (fluoride levels in drinking water greater than 1.5 mg/l) is prevalent in 15 states in India, affecting approximately 62 million individuals who have dental, skeletal, and non-skeletal fluorosis.

When the fluoride concentration of drinking water above 2 parts per million, skeletal alterations and mottled enamel may occur. Adults should consume no more than 1.5 to 4.0 mg of fluoride per day; children and individuals with renal illness should consume less. Patients with skeletal fluorosis frequently report vague discomfort and paresthesia in the trunk and extremities. Back pain and stiffness, particularly in the lumbar area, then follow in the dorsal and cervical spines.

The primary source of fluoride, which causes teeth mottling, is drinking water. Fluoride and other minerals are enriched in the subsoil structure due to low precipitation rates and unrestricted usage of ground water. Apart from drinking water, the human body also absorbs fluoride from food, drink, pharmaceuticals, dental products (such as mouthwash and toothpaste), sea seafood, cheese, and tea.

2. OBJECTIVES OF THE STUDY

To determine the signs and symptoms of suspected Dental, Skeletal and non- skeletal fluorosis along with the food habits, addictions and use of fluoride containing toothpaste among school students and community people taking water with fluoride concentration above permissible limit in the selected affected region of Varanasi.

3. RESEARCH METHODOLOGY

Due to its endemic state for fluorosis, the Varanasi Region was chosen for the study based on data on water quality from the state government's PHED (Public Health Engineering Department). Varanasi Region were chosen for the study because their hand pumps had high fluoride concentrations (> 20 mg/lit), over the WHO recommendation value of 1.5 mg/lit and the BIS allowed level of 1 mg/lit.

In order to evaluate the prevalence of different dental, skeletal, and non-skeletal manifestations of fluorosis, as well as dietary habits, addictions, and use of fluoride-containing toothpaste among the study population (school children and community), a cross-sectional study was carried out in two schools in Varanasi Region and the nearby community. These two schools in the Varanasi Region were chosen for the study due to the high fluoride content of their drinking water supply.

Prior to the start of the study, ethical clearance was obtained, and 125 students from classes I and IV (6–12 years old) of the previously chosen schools were screened for dental fluorosis and had their sources of drinking and cooking water tested for fluoride and microbiological concentration. The head master gave his or her consent.

Additionally, a house-to-house survey was carried out to identify and raise awareness among the community's fluorosis sufferers. Twenty families, totaling approximately 110 persons, were chosen at random from among the families in the aforementioned villages who had previously gotten their water from a dangerous source.

Following the acquisition of informed consent, the chosen family members were questioned by skilled professionals using a pretested questionnaire to gather general data about their diet, drinking and smoking habits, medical and work histories, and sources of drinking water. A physician who specialized in fluoride treated enrolled research participants clinically to check for signs of fluorosis (dental, skeletal, and non-skeletal). They were classified as fluorosis affected patients based on the clinical examination in accordance with case definitions and diagnostic standards provided by the Fluorosis Research & Rural Development Foundation, New Delhi.

The family members were also encouraged to abide by dietary recommendations and to only use safe water for cooking and drinking. In the future, the fieldworkers would be closely monitoring them. In order to guarantee that the family members' health status was being monitored by the field workers, two field level data collectors and one sample collector were chosen based on their background in carrying out health surveys. The fluorosis specialist educated them to collect water samples and other sociodemographic and health-related data.

4. RESULTS AND DATA INTERPRETATION

Results of study among school children

TABLE 4.1 DISTRIBUTION OF SCHOOL CHILDREN WITH DENTAL FLUOROSIS ACCORDING TO GENDER

Male		Female		Total	
NUMBER OF CHILDRENS	%	NUMBER OF CHILDRENS	%	NUMBER OF CHILDRENS	%
24	44.44	30	55.55	54	43.2

TABLE 4.2 DISTRIBUTION OF SCHOOL CHILDREN WITH DENTAL FLUOROSIS ACCORDING TO AGE

Age in years	NUMBER OF CHILDRENS	PERCENTAGE (%)
6-7	19	35.18%
8-9	21	38.8%
10-11	12	22.22%
>12	2	3.70%
Total	54	100%

54 (43.2%) of the 125 Childrens who underwent screening had dental fluorosis. The majority of students with dental fluorois are between the ages of 6 and 9 (75%) and are predominantly female (55.55%). Of the afflicted youngsters, 72% had early-stage mild disease, 24% had moderate disease, and just 4% had severe disease. The majority of school children from Village, where a piped water supply was recently provided but coverage was insufficient, had moderate to severe dental fluorosis. The majority of school children (43.2%) who had dental fluorosis continued to use their home's tube wells for drinking and cooking water. Five percent came from a dug well, while the remaining thirty percent came from a piped water source. Although the school had a piped water connection, it wasn't sufficient for the amount of children enrolled. The worst of the situation occurs during the summer, when children frequently have to retrieve water from outside the school during school hours.

TABLE 4.3 DISTRIBUTION OF POPULATION IN THE COMMUNITY ACCORDING TO DISEASE MANIFESTATIONS AT VARANASI REGION

Disease Manifestations	Varanasi Region	
	.	%
Dental Fluorosis	**30**	**27**
Lactating / Pregnant mothers	**Nil**	**Nil**
Abortion/Still Births	**Nil**	**Nil**
Skeletal Fluorosis		
a) Touch the chin with the chest (inability)	**15**	**13.6**
b) Bend to touch the toes (inability)	**20**	**18.1**
c) Stretches arm to touch the back of the head (inability)	**10**	**9.1**
NonSkeletal Fluorosis		
a) Pain in the stomach	**20**	**18.1**
b) Bloating or flatulence	**30**	**27.3**
c) Loss of appetite	**35**	**31.8**
d) Constipation followed by diarrhoea	**10**	**9.1**

e) Polyurea/ Polydypsia	**9**	**8.2**
f)Fatigue/Depression	**35**	**31.8**
g) Muscle weakness	**9**	**8.2**
Fluoride Toothpaste	**48**	**43.6**
Consumption of food		
a) Supari	**10**	**9.1**
b) Tobacco	**20**	**18.1**
c) Black lemon tea	**52**	**47.2**
d) Black rock salt	**Nil**	**Nil**
e)Adequate intake of Fruits & Vegetables	**56**	**50.9**
f)Adequate intake of Fish & egg	**42**	**38.1**

Results of Study among Community

In the community, dental fluorosis is 27% prevalent. Male patients in their 40s and 60s made up the majority. 9–18% of the populations had skeletal fluorosis, exhibiting a variety of symptoms. and 8–31% of the group displayed other non-skeletal fluorosis symptoms. It was shown that 47% of people drank black tea and 43.6% of people used dental paste that included fluoride. 38% of people usually consumed fish or eggs, whereas 51% of people consumed fruits and vegetables. In the current study, 18% of the respondents reported using tobacco in any way.

Water testing report

In the District Water Testing Laboratory, which is part of the office of the Executive Engineer, PHED, Government of Uttar Pradesh, about thirty samples of water were taken from household domestic tube wells in the selected region of Varanasi. The samples were tested for a variety of physical and chemical parameters as well as microbiological contaminants. Coliform count estimations were also made.

It was discovered that the dentally fluoridated kids of two schools—one primary and one secondary—were using the water from these tube wells for cooking and drinking.

Two domestic (household) tube wells, were found to have fluoride levels of 20.4 mg/lit and 9.41 mg/l, respectively, out of a total of 30 water samples collected from domestic tube wells. These levels were significantly higher than the permissible limit of 1.5 mg/lit and the desirable limit of 1 mg/lit (BIS). It was discovered that the fluoride values of the other tube wells fell within the usual range.

Remarkably, 16 out of 30, or more than 50% (53.33%), of the water samples taken from these residential tube wells contain E Coli, a sign of water contaminated by microorganisms. Six (20%) of these home tube wells had total coloniform counts of 10 or more per 100 milliliters, suggesting that the water was probably contaminated by feces. A total coliform count of 1–9 was found in 10 (33.3%) water samples. Water samples meant for cooking and drinking should ideally be free of E. Coli. pollution may arise from these

tube wells' proximity to latrines, contaminated water bodies, or other sources of pollution (less than 50 feet or 15 meters), as well as from improper maintenance of these tube wells. It was discovered that the water from two tube wells.

5. CONCLUSION

In the current investigation, high levels of coliforms and fluoride in household tube well water were discovered, associated with an elevated prevalence of dental, skeletal, and non-skeletal fluorosis in the studied population. To address these serious but often overlooked public health issues, it is imperative that the source(s) of fluoride that have been identified be removed by providing home and community filters, that dietary restrictions be followed, that nutritional interventions be made, that people be encouraged to use piped water supplies, and that regular supervision, testing, and monitoring of piped water supplies be conducted.

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