

Health Implications Associated with Fluorosis in Children Residing in the Low Fluoride Endemic Afflicted Areas of Chittoor District

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Abstract: Dental fluorosis is a serious health problem caused by ingestion of fluoride in excess through water, food and air. Fluoride is a controversial trace element, on the one hand for its widely applied beneficial uses, especially in improving dental health and on the other hand for its toxic effects. Fluoride causes dental fluorosis by damaging the enamel-forming cells, called ameloblasts. The damage to these cells results in a mineralization disorder of the teeth, whereby the porosity of the sub-surface enamel is increased. While the dental profession claims that dental fluorosis is solely a 'cosmetic' effect, and not a health effect, this statement is an assumption and not a fact. Certainly, dental fluorosis represents a toxic effect on tooth cells. The question is whether tooth cells are the only cells in the body that are impacted. As noted by former proponent of fluoridation, Dr. John Colquhoun, "If a poison circulating in a child's body can damage the tooth-forming cells, then other harm also is likely." As noted by Dr. Hardy Limeback, former President of the Canadian Association of Dental Research, "it is illogical to assume that tooth enamel is the only tissue affected by low daily doses of fluoride ingestion." Not only is the prevalence of fluorosis increasing, but so to is its severity.

Keywords: Dental fluorosis; symptoms; associated health implications.

1. Introduction

Fluoride in addition to causing different types of fluorosis also proved to cause various other diseases by being as one of the causative factor. Excessive quantities of fluoride, when deposited in the skeleton, tend to get distributed more in cancellous compared to cortical bone, changes in the bone will then be revealed through radiographs. Maximum ill effects of fluoride obliterate in the neck, spine, knee, pelvic and shoulder joints. Fluoride also affects small joints of the hands and feet [8].

These toxic effects of fluorosis are of two types: 1. Acute Toxicity and 2. Chronic Toxicity

1. Acute toxicity is the result of single massive dose of fluoride. The signs and symptoms are nausea, vomiting, diarrhea, abdominal pain, excessive salivation and lacrimation, pulmonary disturbances, cardiac inefficiency, weakness, paralysis and coma [2]. Typical symptoms of acute toxicity are reduction or loss of appetite, local or general congestion, and sub-mucosal hemorrhages of the gastrointestinal tract [1]; [12]. Such acute responses were recognized when chickens were fed for 10 days on a diet containing 6786 mg F⁻ per kg (as sodium fluoride). Roosters receiving sodium fluoride at 200 mg/kg body weight, twice in 24 hrs, developed gastro-enteritis with oedema of the mucosa of the stomach and upper bowels, subcutaneous oedema, hepatomegaly and atrophy of the pancreas.
2. Chronic toxicity develops due to cumulative effect of consuming relatively high levels of fluoride continuously over several years. One of the manifestations of this type of toxicity is a disease called fluorosis.

2. Review of Literature

2.1. Clinical features

Clinical features of fluorosis include muscular, skeletal dysfunction, arthralgia, arthritis, fixed flexion deformities, restricted movements of joints, stiffness of the spine and sometimes paraplegia. The progression of the disease is very slow and follows the following stages in fig: 1

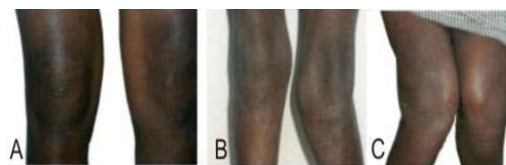


Figure 1 A: Stage I: Swollen joints, pain and rigidity. **B:** Stage II: Deformed but still moving. **C:** Crippled, only moving short and with difficulties and pain

Stage-1:

This is relatively asymptomatic stage. It is usually encountered in young adults whose only complaints are vague pain in the small joints of hands and feet, knee and spinal joints. Quite often such cases may be wrongly diagnosed as rheumatoid arthritis or osteoarthritis, at this stage only radiological examination helps in the diagnosis of fluorosis.

Stage-2:

In this stage obvious stiffness of the spine with limitation in movement is observed.

Stage-3:

By this stage the development of kyphosis is obvious. The subjects experience difficulty in walking and suffer from the following problems: stiffness and limitation of the movements of various joints, especially inability to bend downwards backwards and neck rigidity, the loss of movements is because of the calcification of inter-vertebral

ligaments, which renders the vertebral column rigid. This abnormal calcification also results in narrowing the intervertebral format and spinal canal and compression of vertebral discs. The neurological lesions often encountered in advanced cases of skeletal fluorosis are believed to be due to the above changes. However the recent findings of [9] showed that it could also be due to a direct toxic effect of fluoride on the neurons of smaller nerve fibers.

2.2 Non-Skeletal manifestations caused due to chronic fluoride ingestion include

Neurological manifestations

Neurological manifestations are nervousness and depression, tingling sensation in fingers and toes, excessive thirst and tendency to urinate frequently (polydypsia and polyurea), the control of brain appears to be adversely affected.

Muscular manifestations

Muscular manifestations are muscle weakness and stiffness, pain in the muscle and loss of muscle power.

Urinary tract manifestations

Urinary tract manifestations are urine may be much less in volume, yellow red in colour, itching in the region of axilla

Allergic manifestations

Allergic manifestations are very painful skin rashes, which are peri-vascular inflammations, prevalent in women and children, pinkish red or bluish red spot, round or oval shape on the skin that fade and clear up with in 7-10 days.

Gastro-intestinal manifestations

Gastro-intestinal manifestations include acute abdominal pain, diarrhea, constipation, blood in stool, bloated feeling (gas), tenderness in stomach, feeling of nausea, mouth sores. The complaints with the gastro-intestinal system in endemic areas are now established as early warning signs of fluoride toxicity. Fluoride is known to combine with hydrochloric acid of the stomach and is converted into hydrofluoric acid ($F + HCl = HF + Cl$). Hydrofluoric acid is highly corrosive and hence the stomach and intestinal lining (mucosa) is destroyed with loss of microvillus, which results in poor absorption of nutrients by the body.

It is the observation that excess fluoride ingested exerts twice effects on the stomach destroying the intestinal lining (mucosa) with loss of microvillus which leads to poor absorption of nutrients causing malnutrition [10]; [6]; [7]. Rectification of mucosa and absorption of nutrients takes place upon withdrawal of fluoride sources [11].

3. Materials and Methods

Manifestations are seen in young as well as in adults. The usual complaints of the patients viz., pain in the neck, back, joints and rigidity begin in regions where cancellous bone predominate as it is well recorded that cancellous bone accumulates more fluoride compared to cortical bone. Fig: 2 show three simple physical tests for assessing pain in the joints.

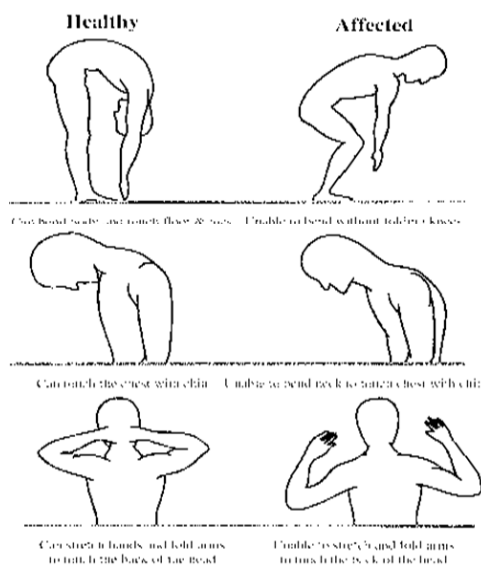


FIGURE 1. The physical test used in the study as a part of the diagnosis of fluorosis.

4. Results and Discussion

Fluorosis which was considered to be a problem related to teeth only can likely be turned to a serious health hazard affecting the body of a person. The other non-visible symptoms of fluorosis being suffered by the individuals were grouped under morbidity symptoms. The percent distribution of children based on the health implications associated to dental fluorosis are presented in table: 1.

The results manifests that pain during chewing is suffered by (86.7 %) highest number of children and the lowest (11.8 %) suffer from knee and joint pains and other symptoms prevalent among children included sensitivity to cold and hot items (41.6 %) and bleeding gums (21.4 %). The reason for this might be due to the histological changes in the enamel mineralization caused as a result of high intake of fluoride containing water. This was evident in a study conducted by [4]; [5] The dental symptoms were more prevalent in the children as the water consumed by them contained low fluoride and is the initial stage of the fluorosis prevalence. When the combination of symptoms are seen pain during chewing and sensitivity to hot and cold food items are suffered by 29.6 per cent and some of the gastro intestinal disorders like acidity, pain in the stomach, indigestion and constipation are seen in combination with other symptoms in 46.5 per cent of the children. This may be due to the fluoride ingestion that destroys the mucosal lining of stomach leading to the poor absorption of the nutrients consumed, causing deprived nutritional status in the children of the present study.

Table 1: Per cent distribution of children according to the prevalence of health implications associated to fluorosis

Clinical Symptoms	Frequency (n)	Percent (%)
Bleeding gums (1)	12	2.1
Pain during chewing (2)	186	33.2
Knee & joint pains (3)	5	0.9
Sensitivity to cold & hot items (4)	15	2.7
Gastro intestinal disorders (5)	35	6.3
1 & 2	17	3.0
1,3 & 5	7	1.3
2 & 3	22	3.9
2, 4 & 5	166	29.6
1, 2 & 3	32	5.7
1, 2, 4 & 5	52	9.3
2,3 & 4	11	2.0
Total	560	100.0

The same was scientifically evident in a study [10]; [6] that Fluoride is known to combine with hydrochloric acid of the stomach and is converted into hydrofluoric acid ($F + HCl = HF + Cl$). Hydrofluoric acid is highly corrosive and hence the stomach and intestinal lining (mucosa) is destroyed with loss of microvillus, which results in poor absorption of nutrients by the body causing malnutrition. The complaints with the gastro-intestinal system in endemic areas are now established as the early warning signs of fluoride toxicity.

5. Conclusion

Dental fluorosis is a public health problem prevalent all over the world. The prevalence of fluorosis is mainly due to the consumption of more fluoride through drinking water. The objectives of this study are to estimate the fluoride exposure through drinking water from people of different age group and to elucidate the fluoride endemic areas through mapping. It is necessary to find out the fluoride endemic areas to adopt remedial measures to the people on the risk of fluorosis. Active steps must be taken to partially defluoridate the water before distribution to reduce the morbidity associated with dental fluorosis in this area. Similar surveys are required in other parts of India to identify areas with high water fluoride content and determine the extent and manner in which defluoridation can be carried out.

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