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# Fluorides in Drinking Water and the Use of Urinary Fluoride Level As Biomaker of Dental Fluorosis in Dharmapuri District of Tamilnadu

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***Asbstract***
***Objective:*** *The Aim Of The Study Was To Show That Urinary Fluoride Level Can Be Used As A Biomarker Of Dental Fluorosis.*
***Material And Methods:*** *A study was conducted in patient attending the dental opd in govt. Dharmapuri medical college and hospital for period of 3 months. The presence and severity of dental fluorosis was evaluated using deans fluorosis index. Urine samples of first morning spot urine was collected in plastic container and urine fluoride concentration was assessed using digital ion select up electrodes at the central lab, gdmch. The body mass index was calculated using height and weight of the individual.*
***Result:*** *The Results Showed That The Urinary Fluoride Level Was High In Those Having Moderate To Severe Dental Fluorosis And The Mean Urinary Fluoride Level Was 33.6±1.57 , With A Minimum Value Of 1.38mg/L And Highest Value Was 7.61mg/L***.**
***Conculsion:*** *Most of the cases had moderate to severe dental fluorosis. Urine fluoride concentration was related to fluorosis severity. Under weight individuals showed greater urine fluoride concentration as well as severe dental fluorosis. Urinary fluoride can be used as a biomaker for dental fluorosis*

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## I. Introduction

High fluoride concentration in the ground water and surface water in many parts of World is of great concern. India is one such region where high concentration of fluoride is present in ground water.High fluorides in drinking water was reported from different geographical regions of Dharmapuri in Tamil Nadu, India. WHO 2008 and BIS 1991 has set a range of available concentration for fluorides in drinking water for a region depending on its climatic condition because the amount of water consumed and the amount of fluoride ingested is being influenced primarily by air temperature.Dharmapuri district forms part of upland plateau region of Tamil Nadu with many hilly ranges and undulating plains. The part of the district between Pennagram and Denkanikottai has hill ranges of Mysore Plateau with chains of undulating hills. The southern boundary of the district is occupied by Shevaroy hill ranges. The plains occupying the Central eastern and Southern parts of the district have an average elevation of 488m above sea level. The plateau region along the Western boundary and north-western parts of the district have an average elevation of 914m above mean sea level.

Dharmapuri is an endemic area of flurorosis, since the main source of fluoride in ground water is the fluoride bearing rocks, possessing rocks bearing minerals that contribute to toxicity of domestic water.[1]

**Hydromorphology**

Aquifers are water bearing layers (or formation) that yield water to wells in usable amounts. The important Aquifer system in Dharmapuri district is constituted by

1. Unconsolidate and semisolidated formation.
2. Weathered and fracture crystalline rocks.[1]

This descriptive study aimed to assess urinary fluoride concentration in community where drinking water contains higher amount of fluorides than recommended.

## II. Materials And Methods

The study was conducted in the Dental OPD in GDMCH, Dharmapuri District which is an endemic area of fluorosis where natural high fluorides in ground water and endemic dental fluorosis have been reported.Participants were individuals attending the Dental OPD of Govt. Dharmapuri Medical College and Hospital who were born and had resided in that area. Written informed consent obtained from all the

participants or by their legal guardian in case they were minors. Fifty patients were selected based on the inclusion criteria.

**Inclusion Criteria**

- Individual who were born and residing in Dharmapuri.
- Individual who can produce sufficient amount of urine.
- Individual who agreed for the study.
- Individual using the same source of drinking water

**Exclusion Criteria**

- Individuals with developmental defects.
- Individual with extrinsic stains.
- Individuals migrating to different regions.
- Individual adopting to alternate source of drinking water.
- Medically/Physically compromised individual.

A questionnaire was admitted to all participant in the study. Diagnosis of Dental fluorosis was performed in day light using Dean's fluorosis index, because it remains popular, for its simplicity and ability to make it compare with numerous early study. In this study assessment of examiner ability of index, Kumar etal showed good to excellent agreement beyond chance in use of index. [8]Anthropometric measure such as weight and height were registered and using this data body mass index BMI and calculated.Early morning spot urine sample were collected in polyethylene container and stored at -20°C until analysis.Urine fluoride concentrations were determined using electronic meter and fluoride specific ion electrodes which was calibrated with fresh serially diluted standard solution. During the measurement ionic strength buffer solution was added to exact sample for analysis. Ion selective electrodes was used for evaluation of urine fluoride concentration for the reason it is automatic analysing system and can be used for estimation of ionic and non-ionic forms. Also it has tremendous tolerance for extraneous ions like sulphates and phosphate and does calibration to give final results in parts/million and most accurate than other methods.

## III. Result

A total of 50 patients were included in this study. In this study there were 24 males and 26 females who were from Dharmapuri district of Tamilnadu state. The water fluoride level here range from 2 -6 mg/dl depending on the source of water source [1]In Table I we see the range of urinary fluoride level and the number of people under each range group. The highest percentage were see in the urinary fluoride range of 2.6 -3.5 mg/l which was about 36% ,followed by the highest range group of 3.6 -8.0. The mean urinary fluoride level was 3.6±1.57 , with a minimum value of 1.38mg/l and highest value was 7.61mg/l.In Table II, we see the percentage analysis of the deans fluorosis index scored. About 44% of the study population had a deans score of 4 which indicates moderate level of fluorosis, followed by 34% of the people having severe fluorosis. Only 2% had very mild fluorosis , that too in the deans score of 2.Table III. shows the nutritional status of the study population . We see that though 50% of the population had BMI in normal range, 34% were underweight with only 16% being overweight.

## IV. Discussion

Chronic fluoride poisoning is a global health problem that occurs endemically in areas where fluoride content is above the optimal level. World Health Organisation (WHO) international standards of 1958 and 1963 refused fluoride for water, claiming that consumption of water with fluoride concentration above 1.0-1.5 mg/dl can result in pathologic changes in teeth causing dental fluorosis (DF) which is characterised by yellow to brown black horizontal lines on tooth surface and chipping of edges. High concentration of fluorides can also produce long term bone damage in children and adults such as skeletal fluorosis[2]. Even intelligent quotient have been associated with fluoride exposure [3]. According to the WHO permissible fluoride concentration limit in drinking water is 1.0mg/l.[4] Dharmapuri district have a fluorides content above the permissible fluoride concentration of 1mg/l.[7]

Fluorides ingested remain for a long time in the human body however approximately 80% of the fluorides entering the body is excreted mainly through the urine, the rest of it is absorbed into the body tissue from where it is released slowly.Excreted fluorides can be monitored by biomarkers of fluorides which are values that serve to identify deficient or excessive consumption and bioavailabilty of fluorides in the body. WHO defines different fluorides marker current-urine plasma, saliva, nails & hairand histological biomarkers (bones & teeth)[6]. Urine fluoride concentration among the biomarkers of fluid expose is generally accepted as best indicators of fluoride exposure[7] because it can be collected non-invasively and systematically, reflects the

burden of fluoride exposure from drinking water. Hence, special attention has been given to it as a biomarker and it is used as an indirect indicator of fluoride intake.

DF was present in almost all the participants of which 88% had moderate to severe fluorosis[10]. Ambient temperature, meters above mean sea level[11] risk practices as direct consumption of boiled water[12] and preparing food with tap water may explain the difference of dental fluorosis prevalence even when concentration of fluorides in water are same.

The dean's fluorosis index was used to evaluate the dentalfluorosis because it remains popular, for its simplicity and ability to make it complex will numerous earlier studies [13][14]. In their study of assessment of examine reliability of index, Kumar etal showed good to excellent agreement beyond chance in use of index [8]. It requires only natural light, no prior drying and cleansing is needed.In the study the fluoride concentration in urine is between 1.38 – 7.6 mg/litre. In Indian group aged between 6-18, the highest UF concentration recorded was 17mg/l when fluoride water concentration was 2.11 mg/l [3]. In other study in Indian population in individuals aged 11-16 years fluoride concentration found in urine samples ranged from 0.9 to 3.25 mg/l well an average of 2.35 mg/l [15]. These valuation might be derived not only from different use and consumption practices of water and other sources of fluorides among population.Water cannot be considered the only source of fluoride exposure. Fluoride iodized salt, certain beverages such as soda & fruit juices and tooth paste are other factors that contribute to exposure.We observed a positive correlation among UF concentration and fluorosis severity these results are congruent with those reported by Jarquin-Yanez et al [10] who found that UF concentration are more elevated in those showing greater fluorosis severity.

Age was significantly associate with DF suggesting that age is protective factor, none the less, this does not imply that DF decreases as age increase Rather these result might suggest that the problem is probably reflecting an increases in consumption of fluorides in new generation that could come from higher concentration of fluoride in water of the zone as suggested by some author who reported that as the depth of water extracted increases the concentration of the element also increases raising the risk of developing DF.The higher prevalence of DF is seen in male children which mat may be associated with greater physical activity that would have increased the consumption of drinking water.[17] But in this present study the gender determination was not done for severity of dental fluorosis.

Rwenyonyi etal[18] who found significant increase in the severity of fluorosis with increasing age in a community with high concentration of fluorides in water, on the other hand underweight children showed greater UF conc.Fluorosis is irreversible, the teeth remains fragile and susceptible to breakage and prosthetic dental treatment that stop tooth destruction are expensive, thus patients and their families often cannot afford them, leading of loss of teeth and consequent effects on the individual quality of life.Some epidemiological studies have indicated that manifestation of fluorosis as more marked among communities exposed to chronic malnutrition[19]. Choulisa etal[20] showed that among participants with poor nutrition, the prevalence of DF increase. Further more in a study by Frigoyen etal[21] in Mexico association between malnutrition and defects in enamel were observed in an area where water contained 2.7mg/l of fluorides.Our study determined not only prevalence of dental fluorosis but also the exposure level and assessment of degree of severity of dental fluorosis.Our results show that the urinary fluoride concentration can be use to predict the severity of DF which affects the quality of life of population studied.Given the potential of adverse health effects that this may produce immediate action are needed to reduce the exposure to this element.

## V. Conclusion

Most of the studied participants had DF and most of the cases were moderate to severe. Positive correlation between fluorosis and UF concentration was observed also nutritional status was associated with severe DF.Fluoride concentration in the water of the population exceeds the permissible limits for human consumption (0.7-1.5 mg/l) owing to potential of adverse health effects of the situation. Hence prompt action would not only reduce dental fluorosis in future generation but would also prevent the prevalence or severity of others alteration that excessive consumption of fluorides can cause.the present study showed that urinary fluoride level can be used as a non-invasive biomarker of body fluoride level.The present work showed the limitation of cross-selection study. For accuracy the using collections should be done over a period of 24 hours.

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**Table I**.Urinary fluoride level in mg/l and percentage in the study population

| | URINARY FLUORIDE level in mg/l | | | |
|---|---|---|---|---|
| | 0-1.5 | 1.6-2.5 | 2.6-3.5 | 3.6 - 8.0 |
| Number of persons | 1 | 11 | 21 | 17 |
| Percentage(%) | 2% | 22% | 38% | 34% |

**Table Ia**. Mean urinary fluoride levels in mg/l

| | |
|---|---|
| Mean urinary fluoride level | 3.6± 1.57 |
| Minimum | 1.38 |
| Maximum | 7.61 |

**Table II.** Deans Dental Fluorosis percentage in the study population

| Deans Fluorosis Index | Very Mild (score of 2) | Moderate (score of 3) | Moderate (Score of 4)u | Severe (score of 5) |
|---|---|---|---|---|
| Number of person | 1 | 10 | 22 | 17 |
| Percentage (%) | 2% | 28% | 44% | 34% |

**Table III.** Nutritional Status of the study population according to BMI

| BMI | Normal 18.5 -24.9 | Underweight <18 | Overweight >25 |
|---|---|---|---|
| Number of persons | 25 | 17 | 8 |
| Percentage % | 50% | 34% | 16% |

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