Fluoride Signatures in Groundwater and Dental Fluorosis in Permanent Teeth of School Children in Rural Areas of Haryana State, India

V Kumar Garg¹, B Singh²

About 85% of rural population in India depends on groundwater for their domestic needs.¹ Fluoride is a naturally occurring element found in groundwater of various regions of the world. High concentration of fluoride in drinking water may result in fluorosis. The disease is characterized by discolored and mottled teeth (dental fluorosis) or by permanent bone and joint damage (skeletal fluorosis). The fluoride-related problems are closely associated with climate; in tropical regions, people consume more water and are at a higher risk of fluorosis.² Higher fluoride concentration may be found in groundwater, especially in areas with volcanic rocks.³ According to the World Health Organization (WHO), the permissible upper limit for fluoride in drinking water is 1.0 mg/L.⁴

In India, as many as 20 states are affected by endemic fluorosis; there is a wide belt in South of India where the concentration of fluoride is high. Suthar, et al,⁵ reported a fluoride concentration of up to 86.0 mg/L in the groundwater of rural habitations of Bhiwani district. Khaiwal and Garg² reported the fluoride level in the groundwater of Hisar city.

We conducted this study to determine the fluoride concentration in the groundwater of rural areas and the prevalence of dental fluorosis among the school children in Gurgaon district, India. Gurgaon district is in Southeast of Haryana state. It is bounded in North by Union Territory of Delhi, in West by Rohtak district (Haryana), in East by Mohindergarh district (Haryana), and in South by Faridabad district (Haryana). The study area lies between longitudes 76° 40′ and 77° 10′ and between latitudes 27° 37′ and 28° 30′. The villages included in this study were Pataudi, Hailey Mandi and Harsaru in Gurgaon district (Haryana). The water table in the study area varies from 6 to 37 meters. Groundwater is the main water source available to the residents of these villages. Hand pumps are easily installed and extensively used in the study area to pump out groundwater. Groundwater is extracted either by hand pumps or tube wells.

As part of the study, a visual dental fluorosis survey was also conducted among school children of the villages in the study area. Only those school children who had permanent teeth were included in the study.

survey. The dental lesions were scored according to protocol given by Rajiv Gandhi National Drinking Water Mission, New Delhi. The teeth were examined for characteristic mottling and pigmentation, i.e., chalky white discoloration, brownish yellow discoloration and brown-black discoloration on the enamel surface and pitted, and perforated or chipped-off enamel.

Water samples were collected from 30 groundwater sources including manually operated hand pumps and electricity operated tube wells. The fluoride concentration in the samples was determined electrochemically using the USEPA ion selective electrode method. Each sample was analyzed thrice and the results were found reproducible within ±3% error limit.

The fluoride concentration measured in water samples ranged from 0.95 to 2.42 mg/L at Pataudi, 1.90 to 5.20 mg/L at Hailey Mandi and 1.65 to 1.90 mg/L at Harsaru. Almost 94% of samples had a fluoride level higher than 1.0 mg/L—the permissible limit of fluoride in drinking water. This limit may be extended to 1.5 mg/L if alternative sources of water are not available; in the present study, the fluoride level exceeded this limit in 87% of the samples studied.

A total of 650 (445 boys, 205 girls) schoolchildren having permanent teeth was screened for dental fluorosis in the study area. We found that 79.5% of children (357 [80.2%] of 445 boys and 160 [78.0%] of 205 girls) had dental fluorosis. Of these 274 (53.0%) had mild (chalky white discoloration), 215 (41.6%) moderate (yellow brown discoloration), and 28 (5.4%) had severe dental fluorosis (brown black discoloration).

Considering the high concentration of fluoride in the water and the high prevalence of dental fluorosis among school children in the study region, it seems that defluoridation of drinking water is mandatory. People should be provided with alternate water sources for drinking with suitable fluoride concentration.

**Conflicts of Interest:** None declared.

**References**


