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High fluoride and dental fluorosis prevalence: A case study from Nakuru area, The Kenyan Rift Valley

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Abstract

High fluoride is a major groundwater contaminant in most rural regions in Africa. In areas where people solely rely on groundwater for domestic use, high fluoride has caused several health effects such as dental and skeletal fluorosis. Such cases are highly reported in the Great Rift Valley region. In the Kenyan Rift Valley, Nakuru County is one of the areas known for dental and skeletal fluorosis cases caused by consumption of high fluoride groundwater. Despite the known high fluoride in groundwater, its concentrations in the local aquifers is not well understood.

In this study, fluoride concentrations and distributions in the Nakuru aquifers and its correlation to the status of dental fluorosis affecting the local population was investigated. Groundwater quality data acquired from a water service organization in Nakuru were used to determine fluoride's spatial distribution and association with the physico-chemical parameters in groundwater. Form the health point of view, 170 patients from two dental clinics in the area were screened for the prevalence and severity of dental fluorosis.

The results obtained from the water assessment show a Na-HCO_3 and slightly Na-HCO_3-Cl groundwater type dominated by sodium, fluoride, bicarbonate, chloride, and pH. More than 86% of the boreholes had fluoride levels ranging from 0.5 to 72 mg/l with a mean of 11.08 mg/l, which was higher than the World Health Organization (WHO) recommended value of 1.5 mg/l for safe drinking water. Spatial distribution of fluoride showed the highest concentrations in aquifers in the rift floor and lowest in the escarpments. This variation was attributed to evaporative enrichment, which resulted in high fluoride in the hot rift floor area, and little groundwater resident time resulting in low fluoride in the cool and humid rift escarpments. The results from dental fluorosis study show a high prevalence range of 79.49 to 86.00 %, and a severity of about 3.58 in one of the hospitals. A slightly higher dental fluorosis prevalence was observed in patients with developing dentition (below 14 years of age), while older patients had a slightly higher dental fluorosis severity. This health results shows that, most of the population have mild dental fluorosis in Nakuru area.

The findings of this study highlight a potential of high fluoride concentrations in aquifers on the Rift Valley floor and relatively low in aquifers located towards the rifts escarpments. This high fluoride in groundwater correlated positively with high dental fluorosis cases especially in the young population meaning that there is a potential increase in dental fluorosis cases in the area. This requires serious and urgent attention regarding low-fluoride groundwater prospecting in the rift escarpments and incorporation of defluoridation methods in high fluoride groundwater areas in order to reduce the impact on the population.