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Investigation of spatial distribution of fluoride in drinking water sources in CKDu prevalence areas in Sri Lanka using GIS

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Chronic Kidney Disease of unknown etiology (CKDu) has identified as a significant health burden in rural dry zone areas in Sri Lanka. Fluoride is recognized as a nephrotoxic contaminant which deteriorates the renal functions progressively and the drinking water could be the major source which is responsible for the disease occurrence. Therefore, the present study attempted to investigate the spatial distribution of fluoride in drinking water sources in CKDu prevalence hotspots in Sri Lanka using Geographical Information System (GIS). Triplicated drinking water samples were collected from 30 sampling locations (from dug wells) in each Grama Niladhari Division (GND) including Wewelketiya GND in Anuradhapura district, Ambagaswewa GND in Polonnaruwa district, Naminigama GND in Mathale district and Buddhangala GND in Ampara district (Reference site) in dry season, Sri Lanka (February – March, 2019). Fluoride contents of collected samples were analyzed using ion chromatography (Metrom Eco_IC instrument). Spatial distribution patterns were interpolated using inverse distance weighted (IDW) and spatial autocorrelation (Moran's Index- MI) tools in ArcMap 10.2.2 software. Results indicated that the mean fluoride levels of the collected water samples of Ambagaswewa and Wewalketiya areas were 1.37 ± 0.66 mg/L and 1.26 ± 0.65 mg/L respectively and those results exceeded the Sri Lankan drinking water standards (SLS 614: 2013) (1.0 mg/L) but the mean fluoride levels relevant to Naminigama area (0.82 ± 0.59 mg/L) complied with the SLS standards. Further 80% of the samples in Ambagaswewa GND and 95% of samples in Wewalketiya GND were highly contaminated with fluorides which were exceeded the SLS standard limits. Significantly higher Fluoride concentration levels were shown in Ambagaswewa GND ($P= 0.103$) and Wewalketiya GND ($P= 0.704$) compared to the reference area of the study. As well as fluoride concentration of the reference area was evenly distributed ($MI= -0.005$) in very low levels compared to the selected hot spots. Fluoride distribution were clustered with higher levels ($MI = 0.31$) in Wewalketiya GND, and Fluoride levels were evenly distributed with higher levels in Ambagaswewa GND and Naminigama GND with the Moran's Indices of -0.12 and -0.07 respectively. It can be concluded that fluoride can be one of the risk factors affecting the prevalence of the CKDu. As the people are at a risk with the long-term exposure to the high fluoride concentrations, it is very essential to innovate a proper and affordable drinking water treatment technology for the affected areas and findings of this study can be used as background water quality data in the design process.

Keywords: drinking water, Fluoride, long- term exposure, IDW, CKDu hotspots,

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