Arsenic occurrence and human exposure in the Main Ethiopian Rift

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Chronic exposure to arsenic (As) in drinking water has been linked to adverse health effects in many parts of the world. This study assesses the relationships between As in drinking water and in urine samples collected from exposed children in the Main Ethiopian Rift Valley (MER), and compares these with As reference levels in urine established in other biomonitoring studies. The groundwater in MER used for drinking is often contaminated with As and other elements including fluoride (F–). The average As concentration in groundwater from the lacustrine sediment aquifer underlying the MER was 25.7±23.3 µg/L (range: 1.5–73.4µg/L; n=67). Forty three percent of the investigated wells exceeded the World Health Organization (WHO) drinking water guideline value of 10µg/L. Arsenic in the groundwater is controlled by oxidizing conditions (mean Eh = +73.3±65), sodium bicarbonate composition, and high pH (>~8). These conditions lead to desorption of As from Iron (Fe) oxides that consequently result in groundwater contamination. Urinary As in samples collected from exposed children (n=164) was also significantly correlated with As concentration in drinking water (R2 = 0.45, p <0.001). Many of these individuals (88%; n=144) had urinary As exceeding commonly used reference levels (e.g., the 15µg/L level from a biomonitoring study in Germany) established in other populations from uncontaminated areas. Finally, arsenic was also detected in cereal samples of maize, wheat, and teff (with mean values of 0.0044µg/g, 0.0044µg/g, and 0.034µg/g, respectively), which are the major cereals consumed in the MER. The health effects of As in the MER are not known at this time; future studies are therefore needed to evaluate the possibility of adverse health effects in this region due to long-term exposure to this well-known contaminant.