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Investigating differences in drinking water quality among surface water sources, public taps, and household water storage containers in rural communities in Rwanda

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Water contaminants, including bacteria, trace elements, and/or major anions, can adversely impact public health outcomes. Those most vulnerable to water pollution include pregnant women, infants, and young children. Globally, Campylobacter spp, E. coli, and Salmonella species are significant zoonotic pathogens that cause bacterial infectious diarrhea and gastroenteritis, especially in infants. Bacterial contamination from human and animal waste in water sources also poses health threats especially to vulnerable groups such as infants and young children. To understand potential exposure to contaminants in drinking water at the human-animal-environment interface in rural communities in western Rwanda, we examined water quality in surface drinking water sources, piped water, and household water storage containers. We collected a total of 47 water samples across four sectors in the dry season (July-August) of 2021 and rainy season (February-March) of 2022 in Karongi District. Twenty-one sampling sites overlapped in both seasons, with five additional drinking water sources sampled during the rainy season. We measured basic water quality parameters (pH, temperature, conductivity, Total Dissolved Solids, and salinity) in the field using a portable water quality meter. Using field Colilert test kits, we assessed the presence of total coliform bacteria and E. coli in water samples. We cultured a subset of the rainy season water samples to identify the prevalence of potentially zoonotic pathogens (Campylobacter spp., E. coli, and Salmonella spp.). Water samples were also tested for potential toxic elements, major anions, and metalloids at the UNL Water Sciences Laboratory. Non-metallic compounds and most trace metals across water sources were below the World Health Organization permissible water safety guideline values. However, iron and manganese levels exceeded recommended values across all sample categories. The prevalence of coliform bacteria was highest in surface water samples (100%), followed by household water storage containers (95%). The prevalence of zoonotic pathogen contamination was higher in surface water samples (Campylobacter spp. 89%, E. coli 100%, Salmonella spp. 42%) than in household drinking water containers (Campylobacter spp. 53%, E. coli 42%, Salmonella spp. 0%). No fecal coliform bacteria, Campylobacter spp., Salmonella spp., or E. coli were detected in water samples from public taps. Our results supported our hypothesis that drinking water quality differs significantly among sources. Further research is needed to understand the potential impacts of high iron and manganese levels in drinking water on Rwandan communities. Our study highlights the importance of outreach on bacterial water contamination on public and child health outcomes in rural Rwanda.

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