

Metal Contaminants in River Water and Human Urine after an Episode of Major Pollution by Mining Wastes in the Kasai Province of DR Congo

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Abstract : Background: In July 2021, the Tshikapa river became heavily polluted by mining wastes from a diamond mine in neighboring Angola, leading to massive killing of fish, as well as disease and even deaths among residents living along the Tshikapa and Kasai rivers, a major tributary of the Congo river. The exact nature of the pollutants was unknown. Methods: In a cross-sectional study conducted in the city of Tshikapa in August 2021, we enrolled by opportunistic sampling 65 residents (11 children < 16y) living alongside the polluted rivers and 65 control residents (5 children) living alongside a non-affected portion of the Kasai river (upstream from the Tshikapa-Kasai confluence). We administered a questionnaire and obtained spot urine samples for measurements of thiocyanate (a metabolite of cyanide) and 26 trace metals (by ICP-MS). Metals (and pH) were also measured in samples of river water. Results: Participants from both groups consumed river water. In the area affected by the pollution, most participants had eaten dead fish. Prevalences of reported health symptoms were higher in the exposed group than among controls: skin rashes (52% vs 0%), diarrhea (40% vs 8%), abdominal pain (8% vs 3%), nausea (3% vs 0%). In polluted water, concentrations [median (range)] were only higher for nickel [(2.2(1.4-3.5)µg/L] and uranium [78(71-91)ng/L] than in non-polluted water [0.8(0.6-1.9)µg/L; 9(7-19)ng/L]. In urine, concentrations [µg/g creatinine, median(IQR)] were significantly higher in the exposed group than in controls for lithium [19.5(12.4-27.3) vs 6.9(5.9-12.1)], thallium [0.41(0.31-0.57) vs 0.19(0.16-0.39)], and uranium [0.026(0.013-0.037)] vs 0.012(0.006-0.024)]. Other elements did not differ between the groups, but levels were higher than reference values for several metals (including manganese, cobalt, nickel, and lead). Urinary thiocyanate concentrations did not differ. Conclusion: This study, after an ecological disaster in the DRC, has documented contamination of river water by nickel and uranium and high urinary levels of some trace metals among affected riverine populations. However, the exact cause of the massive fish kill and disease among residents remains elusive. The capacity to rapidly investigate toxic pollution events must be increased in the area.

Keywords : metal contaminants, river water and human urine, pollution by mining wastes, DR Congo

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