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Environmental contamination in Ghana: Environmental fate and risk assessment of heavy metals and polycyclic aromatic hydrocarbons

(ガーナにおける環境汚染：金属と多環芳香族炭化水素の環境動態とリスクアセスメント)

The growing rate of industrialization in Ghana is gradually leading to contamination and deterioration of the environment and pollution is likely to reach disturbing levels. Samples from Kumasi and Tarkwa, Ghana, were therefore collected to assess the risks due to polycyclic aromatic hydrocarbons (PAHs) and metal exposure. Results of PAH metabolites (OH-PAH) studies in cattle and human urine revealed high concentrations; and 2-hydroxynaphthalene (2-OHNap) was most abundant. The use of naphthalene-containing-mothballs in water purification, drive away insects and/or freshener could have contributed significantly. Exposure to PAHs significantly increases the odds of occurrence of persistent cough (OR = 2.5, CI: 1.33-4.70), persistent headache (OR = 1.89, CI: 1.66-3.36), respiratory tract infection (OR = 46.2, CI: 2.88-742), tachycardia (OR = 3.65, CI: 1.50-8.88) and dyspnea (OR = 4.11, CI: 1.75-9.65) among Kumasi residents. Highest level of urinary 2-OHNap, was detected in a female participant in Manhyia hospital, who reported symptoms of persistent cough, headache, tachycardia, nasal congestion and inflammation, all of which are symptoms of naphthalene exposure. In humans, urinary OH-PAHs were higher in females compared to males; and OH-PAHs concentrations showed a positive association with malondialdehyde and 8-hydroxy-2-deoxy-guanosine indicating lipid peroxidation/cell damage in some residents of Kumasi. Studies of heavy metals/metalloid in Tarkwa raises health concerns (including neoplasm) to residents, especially children, due to metal exposure through consumption of drinking water, foodstuffs, chickens and possibly soils/pica. In both livers and kidneys, As, Cd and Zn were higher female rats compared to males. The strong positive correlation between body weight and Cd levels in organs of wild rats reflects a mechanism of protection against development of osteopenia, although biological effects remains a concern. Pb levels in kidneys could cause intra nuclear inclusion bodies and karyocytomegaly in the proximal tubular cells in 29% of wild rats in Tarkwa; and structural and functional kidney damage in 6%. As levels in kidneys could also cause glomerular swelling in 9% of rats. Principal component analysis showed that wild rats in Tarkwa were exposed to metals through borehole drinking water and soils.