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Human health risk assessment for potentially toxic metals (PTEs) in Acerra' s area (Campanian Region, Italy)

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Acerra's territory is situated in the Agro Aversano area. It is characterized by considerable anthropogenic pollution, caused by the illegal dumping and burning of waste since the 1990s. This area has also become highly urbanized and it is undergoing continuous changes in land-use patterns. Altogether 60 % of the total area is dedicated to agriculture, cereals, potato, tobacco and vegetables being the main crops, while 20 % of the area is urban and peri-urban. The remaining part is devoted to industrial use. The waste treatment plant, which incinerates mixed municipal solid waste from most of the municipalities around the city of Naples since 2009, is a potential major source of industrial pollution in the area. The aim of this study was to investigate the level of environmental contamination in Acerra and assess the consequential health risks. 178 topsoil samples and 10 food samples (corn and Chicorium endive) were taken within the whole study area. All samples were analysed for 15 elements (As, Be, Cd, Co, Cr, Cu, Hg, Ni, Pb, Sb, Se, Sn, Tl, V and Zn) at Bureau Veritas Analytical Laboratories (Vancouver, Canada) by ICP-MS and ICP-ES after an aqua-regia digestion. We calculated enrichment factors and pollution indexes of the PTEs in soil and vegetables by comparing their concentrations with the regional background level and trigger and action values for residential/recreational and industrial/commercial land use set in the Italian Environmental Law (152/06). We also calculated the soil-to-plant bio-concentration factor for critical PTEs. In the human health risk assessment, we focused on Be, Cu, Pb, and Zn since they were identified as the most critical elements based on the pollution indexes. We drew up a conceptual model to describe the formation of human health risks in the study area and divided it into agricultural, urban and industrial subareas. Considering the land use and environmental conditions, the following exposure routes are relevant in the formation of human health risks: ingestion of soil, dermal intake from soil particles, food consumption (corn and vegetables), and inhalation of soil particles. We used the generic exposure models presented by the United States Environmental Protection Agency (US EPA) to determine the potential average daily dose (ADD) of each critical element. We further calculated hazard indexes (HI) by dividing the exposure route -specific intake rate of each critical element by the corresponding safe daily dose (i.e. reference dose RfD). The results showed unacceptable risks caused by Pb (HIchildren = 6 HIadult = 1,3) in the urban area. We will further conduct a probabilistic risk assessment to find out the probability of these hazards.