Using Applied Research to Reduce Uncertainty in Health Risk Assessment: Five Case Studies Involving Human Exposure to Chromium in Soil and Groundwater

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In this article, five case studies are presented that involve original research conducted in order to better understand the potential health risks associated with human exposure to Cr(VI) in soils and groundwater. Each study was designed to address a specific data gap, and all of these studies involved the use of human volunteers and/or the study of human biological fluids. The results of this research can be summarized as follows: (1) soil concentrations of approximately 1240 ppm Cr(VI) or less do not elicit allergic contact dermatitis (ACD) in a vast majority of the general population (>99.9%), and soil concentrations much higher than this value are also health protective if the Cr(VI) is not readily bioavailable; (2) exposure to soil concentrations up to 400 ppm total chromium is unlikely to influence urinary chromium levels; (3) the human gastrointestinal tract can reduce ingested Cr(VI) to Cr(III) at concentrations up to 10 mg Cr(VI)/l; and (4) at water concentrations of up to approximately 22 mg Cr(VI)/l, dermal penetration of Cr(VI) is negligible even under extreme exposure conditions. Based on these results, it appears that: (1) ACD is not an appropriate health endpoint for setting health-based soil standards, (2) in many cases, urinary biomonitoring studies are unlikely to be useful in assessing Cr(VI)-related exposures, (3) the USEPA's MCL of 0.10 mg Cr(VI)/l contains a large margin of safety, and (4) systemic uptake of Cr(VI) following dermal contact with water or soil does not occur to a degree that warrants quantitative evaluation in a health risk assessment. The results obtained from carefully designed human volunteer studies generally do not contain the inherent uncertainties associated with extrapolation from animal or in vitro studies. If the work can clearly be performed at no risk to the participants, then consideration should be given to using human subjects in the design and conduct of risk assessment research.

KEY WORDS: *human exposure, chromium, research, risk assessment.*