

URINARY CHROMIUM CONCENTRATIONS IN HUMANS FOLLOWING INGESTION OF SAFE DOSES OF HEXAVALENT AND TRIVALENT CHROMIUM: IMPLICATIONS FOR BIOMONITORING

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In this study, we evaluate the significance of increased urinary chromium concentrations as a marker of chromium exposure and potential health risk. Six human volunteers ingested trivalent chromium [Cr(III)] and hexavalent chromium [Cr(VI)] at doses that are known to be safe but are much higher than typical dietary levels. The following dosing regimen was used: d 1–7, 200 µg/d chromium picolinate (a dietary supplement); d 8–10, Cr(VI) ingestion at the U.S. Environmental Protection Agency (EPA) reference dose (RfD) of 0.005 mg/kg/d; d 11–13, no dose; d 14–16, Cr(III) ingestion at the U.S. EPA RfD of 1.0 mg/kg/d; and d 17–18, postdose. Urine voids were collected throughout the dosing periods and analyzed for chromium. Our findings are as follows: (1) ingestion of 200 µg/d of chromium picolinate yielded significantly elevated urine concentrations such that each participant routinely exceeded background, (2) ingestion of the Cr(VI) RfD (0.005 mg/kg/d) yielded individual mean urinary chromium levels (1.2–23 µg/L) and a pooled mean urinary chromium level (2.4 µg/L) that significantly exceeded background, and (3) ingestion of the Cr(III) RfD yielded no significant increase in urinary chromium concentrations, indicating that little, if any, absorption occurred. Our work identified three critical issues that need to be accounted for in any future studies that will use urinary chromium as a marker of exposure. First, a minimum urinary chromium concentration of approximately 2 µg/L should be used as a screening level to critically identify individuals who may have experienced elevated exposures to chromium. Second, if Cr(III) levels in soils are known to be less than 80,000 ppm and the Cr(III) is insoluble, urinary chromium concentrations are not an appropriate marker of exposure. Third, newer forms of chromium supplements that contain organic forms of Cr(III) must be considered potential confounders and their contribution to residential chromium uptake must be carefully evaluated.

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