PhD Dissertation Defense

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Residential Mercury Contamination and Exposure in Huancavelica, Peru

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Between 1564 and 1810, nearly 17,000 metric tons of mercury (Hg) vapor were released to the environment during cinnabar refining in the small town of Huancavelica, Peru. Much of this vapor deposited locally. The present study investigated the extent of residential Hg exposure today due to historic Hg contamination by: (1) determining total Hg concentrations in adobe bricks, dirt floors, surface dust, and air in 60 residences and comparing these concentrations across four different neighborhoods; (2) characterizing the species and bioaccessibility of Hg present in residences and evaluating potential exposure risks against international health benchmarks, and (3) characterizing and evaluating personal Hg exposures using total Hg concentrations in hair, total and speciated Hg measurements in residential samples, and self-reported questionnaire data.

Concentrations of total Hg in adobe bricks, dirt floors, and surface dust ranged from 8.00 to 1070 μg/g, 3.06 to 926 μg/g, and 0.02 to 9.69 μg/wipe, respectively, with significant differences across the four neighborhoods. A strong correlation between total Hg concentrations in adobe bricks and dirt floors confirmed that the bricks were likely made on-site.

Although total Hg concentrations in these residential samples were high, less than 10% of the total Hg was found to be soluble and bioaccessible following ingestion. Calculations for various exposure scenarios revealed that bioaccessible Hg concentrations in some households exceed health benchmarks for soluble Hg. The apparent public health threat is much lower when standards are compared against the soluble Hg present, rather than against total Hg. Total Hg concentrations in hair ranged from 0.10 to 3.6 μg/g, similar to concentrations found in the U.S. and lower than concentrations in other populations around the world. Total Hg concentrations in hair were significantly related to gender ($p<0.001$), living in a neighborhood where smelters were previously located ($p=0.021$), smoking status ($p=0.003$), frequency of house cleaning ($p=0.019$), and frequency of fish consumption ($p=0.046$). A comprehensive analysis of residential Hg contamination and exposure in Huancavelica will guide the development and implementation of mitigation and remediation strategies in the community to reduce potential health risks from residential Hg exposure.

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