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Campine Region

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Modeling human exposure to cadmium and arsenic in the Northern Campine region

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Abstract: The Northern Campine region in north-east Belgium has a long history harboring the zinc smelting industry. In the last decades, increasing environmental and health concerns have resulted in measures to limit or eliminate the heavy metal pollution associated with these activities. A recent study showed a significant correlation between cadmium exposure and lung cancer incidence in the area.

In order to assess the present situation with regards to cadmium and arsenic pollution and human exposure, a large-scale monitoring campaign was set up in participation with stakeholders from the local community and locally active environmental health workers. The campaign involves a population sample of about 1200 subjects in a study area including the municipalities of Mol, Balen, Lommel, Overpelt, Neerpelt and Hechtel-Eksel. Human measurements are available for all participants and environmental measurements were carried out at the homes of 100 individual participants. The participants filled out a questionnaire inquiring about current and past home locations, work and other activities, life style and consumption patterns. In this contribution, we describe the development and implementation of a human exposure model based on these data.

The exposure model aims to capture the transfer and exposure dynamics for the 100 participants with individual environmental measurements and for several subgroups of the population sample. The subgroups are based on relevant confounders like age, home location and smoking behavior.

Several pathways are considered for human exposure to Cd and As. Exposure by inhalation is estimated by combining information on time expenditure within and outside the study area with corresponding metal concentration data. Measurements are available from the monitoring campaign itself and from other sources and literature. Exposure by food and water consumption is calculated based on consumption patterns indicated in the questionnaire and direct measurements in food products. Home-grown versus purchased products are considered separately given the relevance of the local soil cadmium concentration to the concentration in vegetables. Where direct food product measurements were not available for vegetables, previously established models relating soil and plant concentrations are used to estimate the concentration. Other pathways considered are soil ingestion, active and passive smoking and the consumption of water from differing sources. Since urinary cadmium concentrations are a marker for lifetime exposure, the model takes into account the historical exposure. To this end, the model relies on historical data, if available, and on reasonable extrapolations of current consumption and time use patterns.

The model is validated against the biomonitoring data acquired during this campaign. On this basis, it allows to identify the main pathways contributing to human exposure to Cd and As and to refine the focus of possible regulatory guidelines. Also, a sensitivity analysis is performed to identify the impact of specific decisions in the modelling process.

The study was initiated, financed and substantively steered by the Flemish government (Flemish Agency for Care and Health;

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