

## Evaluation of biomarkers of exposure and effects of mercury using machine-learning methods

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### Abstract

During the EU funded project European Mercury Emissions from Chlor Alkali Plants (EMECAP) we evaluated the exposure to mercury in subjects living close to the mercury cell chlor-alkali (MCCA) plant and in occupationally exposed MCCA workers, compared to controls from the reference areas. Beside urinary mercury as a biomarker of exposure also biomarkers of effect were assessed: albumin, alpha-1-microglobuline (A1M) and *N*-acetyl-beta-d-glucosaminidase (NAG) in urine as indicators of kidney function damage and 8-hydroxydeoxyguanine (8-OH-dG) in urine as an indicator of DNA damage. In addition selenium in urine was analysed because of its known antioxidant protective role.

The dataset consisted of total 269 subjects: 57 chloralkali plant workers, 94 subjects living in 1.5 km diameter from the chlor-alkali plant, and 118 controls living 20 km south of the plant. All subjects completed a questionnaire about the location of their residence and workplace, occupational history including possible exposure to mercury, the number of teeth with amalgam fillings, as well as consumption of various types of fish, smoking habits, consumption of vegetables from their backyard gardens and questions connected to their medical history. Subjects with kidney diseases, diabetes, hypertension or extreme levels of creatinine were excluded from the data analysis.

We used one-way ANOVA to evaluate the differences between the groups in all observed parameters. In order to find associations between the attributes, machine learning methods were used. We used WEKA’s model trees and regression trees, which were validated using 10-fold cross-validation.

Results have shown significantly higher concentrations of mercury and NAG in the urine of chlor-alkali workers and lower concentration of their urinary selenium, compared to the subjects living close to the MCCA and the controls.

Urinary mercury was positively associated with number of teeth with amalgam fillings and negatively associated with age of the subjects and working years in the plant. Associations between A1M and NAG concentrations, teeth with amalgam fillings and urinary selenium were found.