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Thomsen, Sofie Theresa; Herrera, J. A. R.; Jakobsen, Lea Sletting; Fagt, Sisse; Pires, Sara Monteiro

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Burden of disease of heavy metals in population clusters: towards targeted public health strategies

Sofie Theresa Thomsen

ST Thomsen[1], JAR Herrera[2], L Jakobsen[1], S Fagt[1], SM Pires[1]
[1]Division of Diet, Disease Prevention and Toxicology, National Food Institute, Technical University of Denmark, Kgs. Lyngby, Denmark
[2]Translational Disease Systems Biology Group, University of Copenhagen, Copenhagen, Denmark
Contact: sthth@food.dtu.dk

Background:
Humans are exposed to heavy metals from certain foods, thus specific dietary patterns may lead to high burden of disease (BoD). By identifying diet, lifestyle and socio-demographic characteristics of population groups with highest BoD, targeted preventive strategies can be developed. We aimed at identifying clusters and characteristics of Danish individuals with highest BoD due to food exposure to three heavy metals: methylmercury (MeHg), cadmium and inorganic arsenic.

Methods:
We collected diet, lifestyle and socio-demographic information of 3,946 individuals in the Danish National Survey of Diet and Physical Activity. Occurrence of heavy metals in food was obtained from Danish food monitoring. We applied machine learning self-organizing maps to group individuals according to similarities in diet, lifestyle and socio-demographics, and estimated BoD due to metal exposure in terms of Disease-Adjusted Life Years (DALY). We will present calculation steps of our approach in a tutorial-like way and demonstrate its applicability to other cases.

Results:
We identified 13 population subgroups with distinct dietary and lifestyle characteristics. The estimated BoD varied largely between subgroups, with five subgroups experiencing a BoD > 10 DALY/100,000. The cluster bearing the highest BoD (26.2 (95% uncertainty interval (UI): 10.3, 50.6) DALY/100,000) was significantly different from the cluster with the lowest BoD (5.1 (95% UI: 2.5, 9.2) DALY/100,000) (preliminary). BoD was higher in subgroups with diet and lifestyle considered healthy. Most of the BoD was due to MeHg, particularly in female-dominant subgroups.

Conclusions:
Linking machine learning, exposure assessment and burden of disease metrics, this novel approach identified population subgroups with higher BoD due to exposure to three heavy metals. It can be expanded to estimate BoD of other chemicals, and used to develop targeted preventive strategies to reduce BoD in more affected subgroups.