

## Introduction

This pilot study assesses the cumulative effects of dietary exposure to lead (Pb), methyl mercury (MeHg), cadmium (Cd), and inorganic arsenic (iAs), through further analysis of exposure data from national risk assessments (Suomi et al. 2015; Suomi et al. 2020).

- Foodstuffs contain heavy metals in varying amounts; the compounds can be present in the same foods.
- Heavy metals damage organs and body processes in many ways. The most sensitive health effect for Pb and MeHg exposure is cognitive damage, for iAs cancer and for Cd kidney damage. However, iAs and Cd have been reported to also damage neurons.

## Methodology

Cumulative exposure was estimated by using relative potency factors (RPF) derived from literature for the neurotoxic effects of the heavy metals. Pb, with BMDL<sub>01</sub> of 0.50 µg/kg bw/d as determined by EFSA, was the most neurotoxic component of the mixture and its RPF was set as 1, while the others had RPF<1. The RPFs and assumptions are found in (Suomi et al. 2017).

The toxicological data in this study were not directly comparable, with sources ranging from epidemiological studies to animal tests with a different endpoint. Thus, the results are indicative.

The exposure of Finnish children (3 and 6 years) and adults (25 to 64 years) to the dietary mixture was assessed, combining the RPFs and the exposure to the compounds singly:

$$Exp(mixture) = \sum RPF_i * Exp_i$$

## Results

The cumulative exposure (neurotoxic effects) had Pb as main component (Fig 1). MeHg had low contribution as it is only present in fish and seafood. The food groups causing the most exposure (Fig 2) were cereals (grains), drinks, meat&offal and fish&seafood.

The average exposure for 3Y, 6Y and adults was estimated to be 0.43, 0.37 and 0.25 µg/kg bw/d, and the P95 0.60, 0.51 and 0.51 µg/kg bw/d, respectively.

The margin of exposure against the BMDL<sub>01</sub> of Pb is <1 for the highly exposed in all age groups. The exposure to only Pb also exceeds the endpoint for a portion of all age groups, causing burden of disease of 570 DALY/year in Finland (Suomi et al. 2019). Based on the results, the burden of disease from neurotoxic effects of all heavy metals is higher than that of only lead.

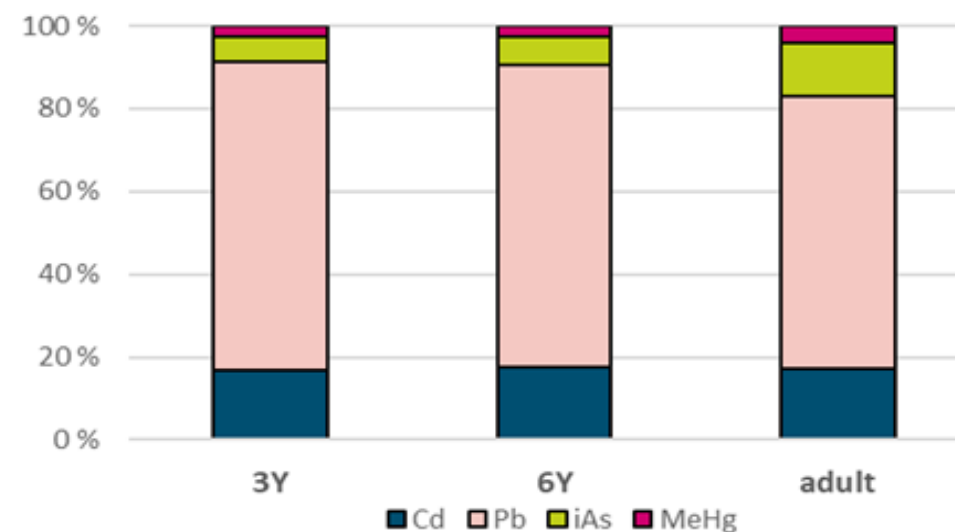


Fig 1. Relative contributions of the heavy metals to the total cumulative exposure in different age groups

### Further information

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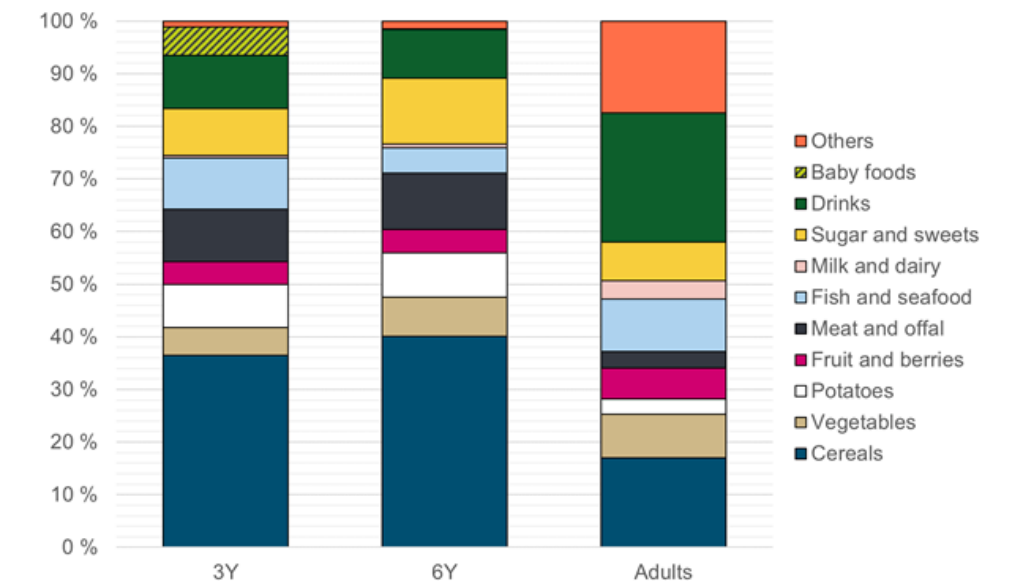


Fig 2. Sources of dietary exposure to heavy metal mixture

## Conclusions

- This pilot study is limited by available toxicological data; thus results are indicative and further research is needed.
- Total neurotoxic effect of dietary heavy metal mixture in real diets is higher than estimated only for lead exposure (i.e. above 570 DALY/year in Finland).
- Grains, drinks, meat and fish contribute the most to exposure to heavy metal mixture, although the concentrations are mostly low to moderate.

### Previous publications cited here

- Suomi et al. 2015 (DOI 10.5281/zenodo.851785)
- Suomi et al. 2017 (DOI: 10.1080/10807039.2017.1314760) and references therein concerning RPFs
- Suomi et al. 2019 (<http://urn.fi/URN:ISBN:978-952-287-797-0>)
- Suomi et al. 2020 (DOI 10.5281/zenodo.3772612)