



Centro de Investigação em Ciências da Saúde

CICS-UBI



Annual

CICS-UBI

Symposium

Virtual Meeting

1st and 2nd October



P6. MERCURY LEVELS IN BIOLOGICAL MATRICES FROM INHABITANTS OF ESTARREJA, PORTUGAL

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ABSTRACT

Humans are exposed to mercury through several pathways including the consumption of contaminated seafood and ingestion of contaminated house dust. He have previously demonstrated that mercury levels in house dust samples from Estarreja region are amongst the highest reported in Portugal. Here we report the levels of total mercury in different biological matrices from 88 adult individuals from Estarreja (age: 37-83, median: 68). Mercury was detected in all samples analysed, with the highest levels being found in hair (range: 560-4540, median: 1680 ng/g), followed by fingernails (range: 215-1740, median: 844 ng/g), toenails (range: 144-1850, median: 555 ng/g), blood (range: 0.97-18.4, median: 6.70 ng/g) and urine (range: 0.15-5.14, median: 0.61 ng/g). The hair to blood ratio (H:B) varied between 147 and 616, with a median value of 274, which is only 9% higher than the H:B ratio proposed by the World health Organization. The concentrations of mercury in hair were highly correlated with the concentrations in blood ($p < 0.001$, *Pearson r* = 0.871), fingernails ($p < 0.001$, *Pearson r* = 0.735) and toenails ($p < 0.001$, *Pearson r* = 0.639) whereas no correlation between the levels in hair and urine were found ($p = 0.25$, *Pearson r* = 0.208). Similarly, urine levels were not correlated with those found in nails ($p > 0.001$). Such results suggest that a urine levels reflect the exposure to a different form of mercury, reinforcing previous studies that propose urine as a suitable matrix for inorganic mercury whereas blood, hair and nails are suitable matrices for for methylmercury exposure.

Acknowledgements: This work was financed by Labex DRIIHM (PIA), via OHMI Estarreja – International Observatory Hommes-Millieux, tool of CNRS/INEE - National Center for Scientific Research/Institute of Ecology and Environment and Labex DRIIHM, French programme "Investissements d'Avenir" (ANR-11-LABX-0010) which is managed by the ANR. Ana C Sousa acknowledges the financial support from University of Aveiro, in the scope of the framework contract foreseen in the numbers 4, 5 and 6 of the article 23, of the Decree-Law 57/2016, of August 29, changed by Law 57/2017, of July 19 (A.C.A. Sousa).

Keywords: blood, hair, urine, nails, mercury, non-invasive matrices.

Mercury levels in biological matrices from inhabitants of Estarreja, Portugal

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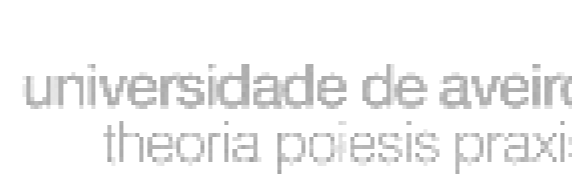
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INTRODUCTION

Mercury

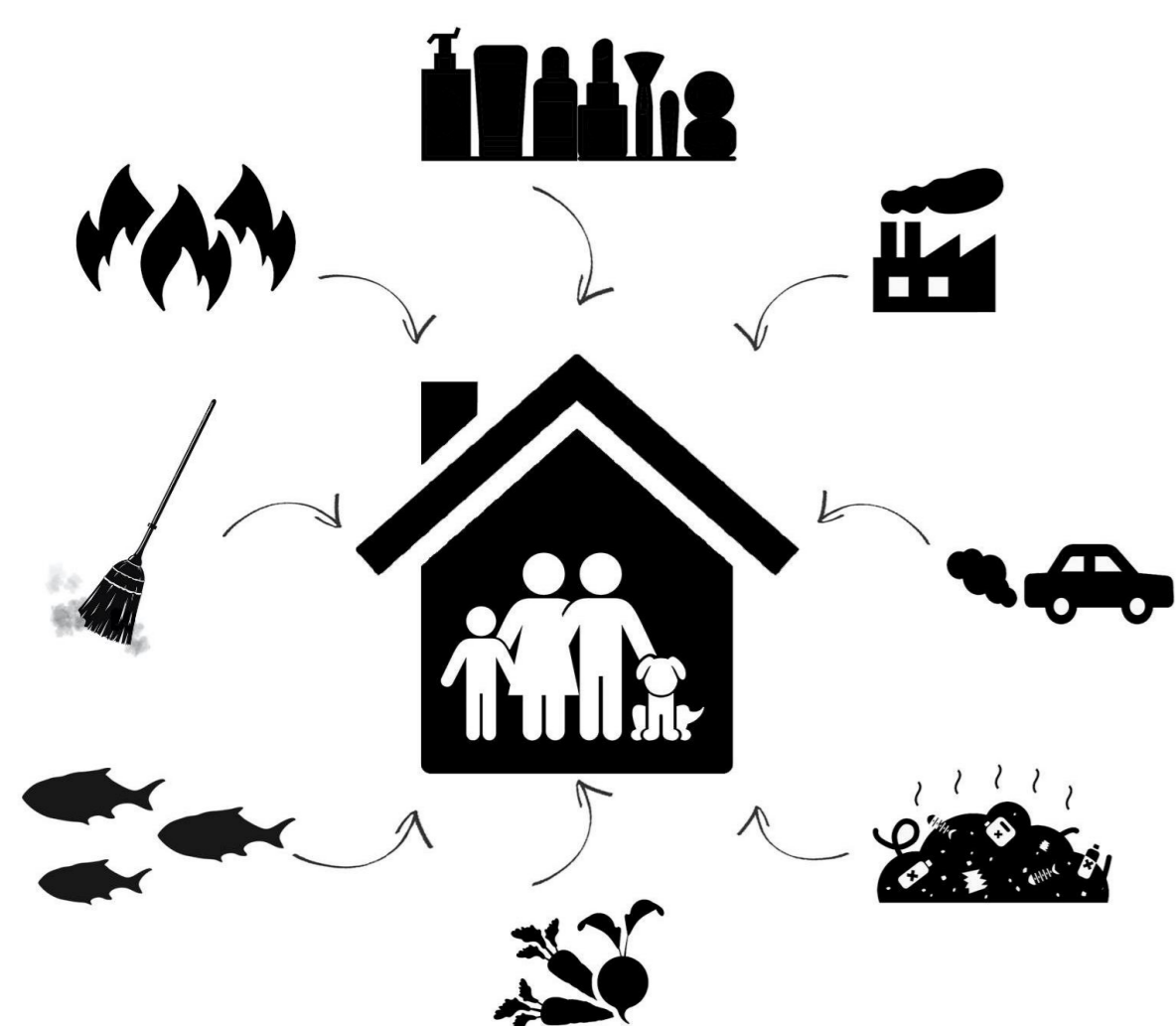


Fig. 1: Potential sources of mercury exposure.

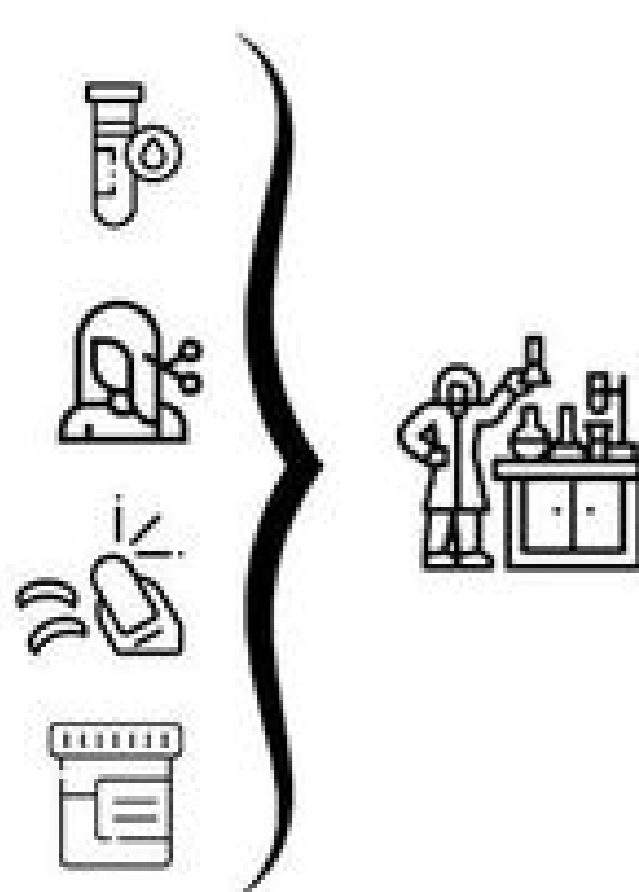
- According to the World Health Organization (WHO), mercury poses serious risks to human health due to its high toxicity [1].
- Human exposure to mercury occurs mainly through the ingestion of contaminated fish. However, recent reports suggest that other sources are also relevant, including house dust [2].
- Mercury levels in house dust samples from Estarreja region are among the highest reported in Portugal [3].

AIM: To quantify the levels of total mercury in different biological matrices collected from Estarreja inhabitants.

MATERIALS AND METHODS

Sample collection and treatment

Samples were collected from 88 adults living in Estarreja.



- Hair was processed in order to ensure greater homogeneity of the sample.
- Nails were sonicated for 20 minutes with 1% Triton X, and dried at 60°C for 24h.
- Blood and urine samples were analyzed without any pre-treatment.

Mercury Quantification

⁸⁰Hg
Mercury

- Atomic absorption spectrometry (AAS) with thermal decomposition and gold amalgamation - NIC-MA-3000 equipment (Nippon Instruments Corporation, Japan).

QA
Quality assurance
QC
Quality control

- Calibration standards (Spectro ECON; Chem-Lab);
- Triplicate analysis of each sample (CV=3.24%);
- Certified Reference Materials (human hair and nails-DB001, blood-Seronorm whole blood L-1 and Urine- Seronorm urine L-1) run every 10 samples. Recoveries varied between 86 and 100%.

RESULTS and DISCUSSION

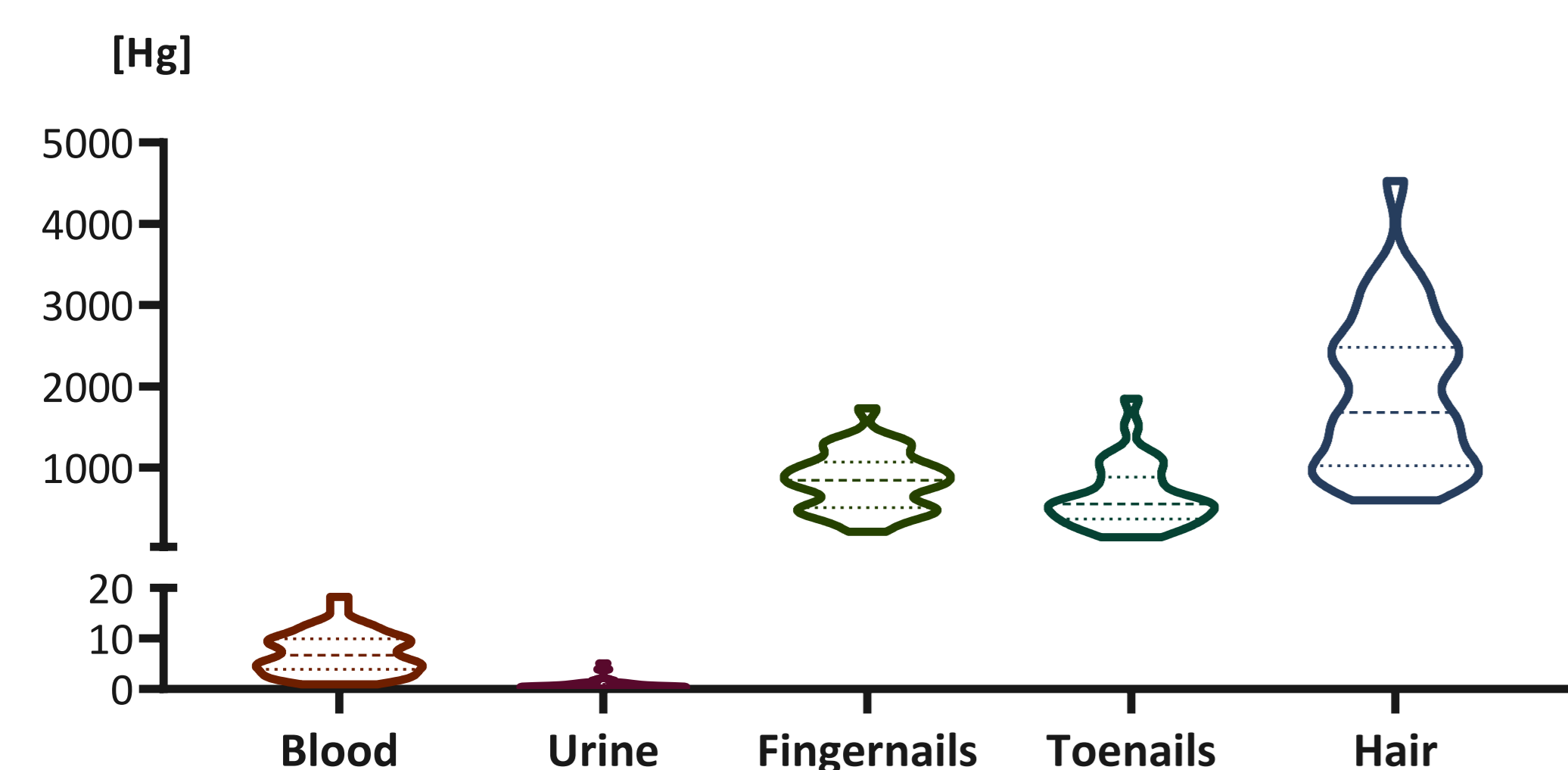


Fig. 2. Mercury concentrations (ng.g⁻¹) in the different biological matrices analysed.

Mercury was detected in all samples analysed:

- Hair (range: 560-4540, median: 1680 ng/g);
- Fingernails (range: 215-1740, median: 844 ng/g);
- Toenails (range: 144-1850, median: 555 ng/g);
- Blood (range: 0.97-18.4, median: 6.70 ng/g);
- Urine (range: 0.15-5.14, median: 0.61 ng/g).

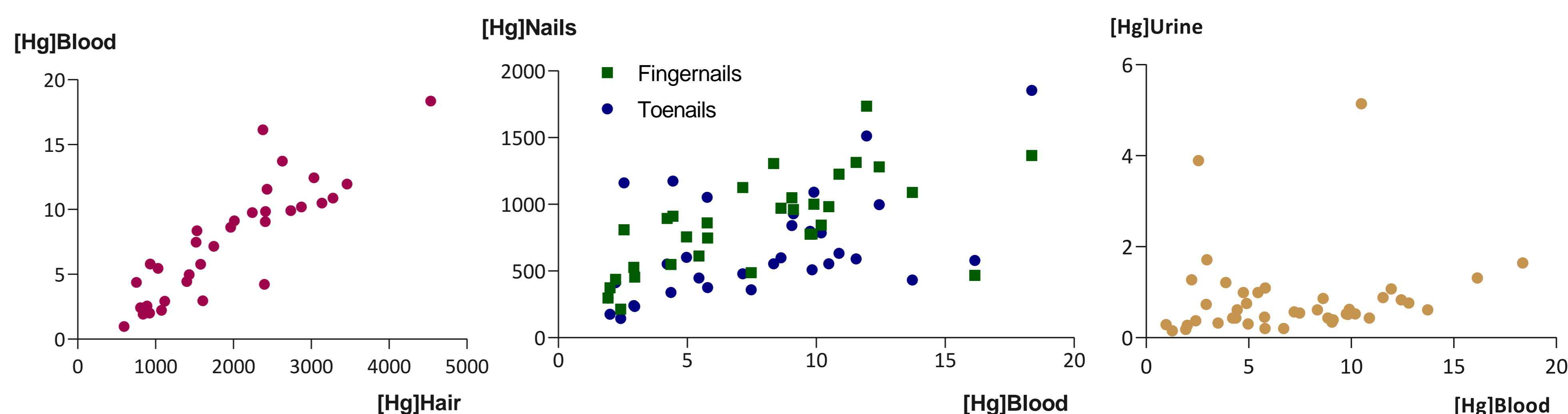


Fig. 3. Relationship between mercury concentrations in the different matrices analysed.

Correlations between mercury concentrations in the different matrices:

- [Hg]_{hair} very strongly correlated with [Hg]_{blood} (Pearson $r=0.871$, $p<0.001$);
- [Hg]_{fingernails} (Pearson $r=0.648$, $p<0.001$) and [Hg]_{toenails} (Pearson $r=0.503$, $p=0.002$) were strongly correlated with [Hg]_{blood};
- [Hg]_{urine} were not correlated with [Hg]_{blood} (Pearson $r=0.136$, $p>0.05$).

CONCLUSIONS

- The obtained results suggest that urine levels reflect exposure to an inorganic species of mercury, reinforcing previous studies that propose urine as a suitable matrix for these inorganic forms, whereas blood, hair and nails are suitable matrices for the evaluation of methylmercury exposure.

ACKNOWLEDGMENTS

The authors thank all the volunteers that kindly provided samples. Financial support provided by: Labex DRIIHM (PIA), via OHMI Estarreja – National Observatory Hommes-Millieux, tool of CNRS/INEE - National Center for Scientific Research/Institute of Ecology and Environment and Labex DRIIHM, French programme "Investissements d'Avenir" (ANR-11-LABX-0010) which is managed by the ANR. A.C. Sousa acknowledges the financial support from University of Aveiro, in the scope of the framework contract foreseen in the numbers 4, 5 and 6 of article 23, of the Decree-Law 57/2016, of August 29, changed by Law 57/2017, of July 19. R. Barros acknowledges the financial support from the Grant "Bolsa Conceição Barbas, SPEDM".

REFERENCES

- UNEP (2013) Mercury time to act, vol. 1, 8.;
- UNEP, (2013) Global Mercury Assessment 2013, p. 42, 2013;
- Sousa et al. (2014) Cur Org Chem 18, 2181