

ICMGP 2024
CAPE TOWN • SOUTH AFRICA • 21 - 26 JULY

Unraveling mercury species dynamics and potential interactions with selenium: A study in amazonian riverine communities

Juliette Esplugas, Emmanuel Tessier, Gabriel Neves Cezarette, Warren Corns, David Amouroux, Fernando Barbosa Junior, Maïté Bueno, Zoyne Pedrero Zayas



Context

Mercury

Toxic



World Health Organization

Selenium

Essential element

! species and doses

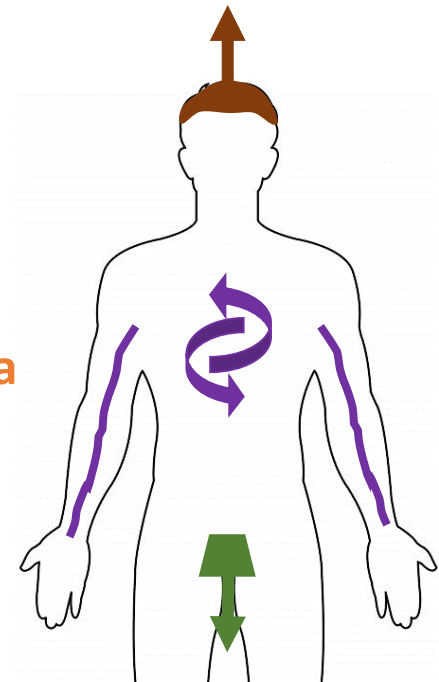
Several chemical forms mostly unknown

Studies have shown the potential protective effect of Se against Hg toxicity

Forms and mechanisms involved are still unknown

Contribute to the understanding of mercury and selenium interactions in humans

Hair
Blood/Plasma
Urine



Amazonian riverside population : a model



Brazil, state of Pará



Σ 1 πΑΚΚΕΑΒ̄ - † Ᾱπ̄ - Ϟε̄ςϞε̄, ΑΔ̄š̄ᾹϞε̄ - π«̄Ϟ̄.

- Hg naturally present in soil
- Biomass burning, dams, deforestation
- Gold mining

Hg

Σ Ϟε̄«̄Ϟε̄† - ≥Ϟε̄š̄† - Ḡ̄Ă̄†̄ Ϟε̄



- High local fish consumption
- 80% of the total protein intake

Hg



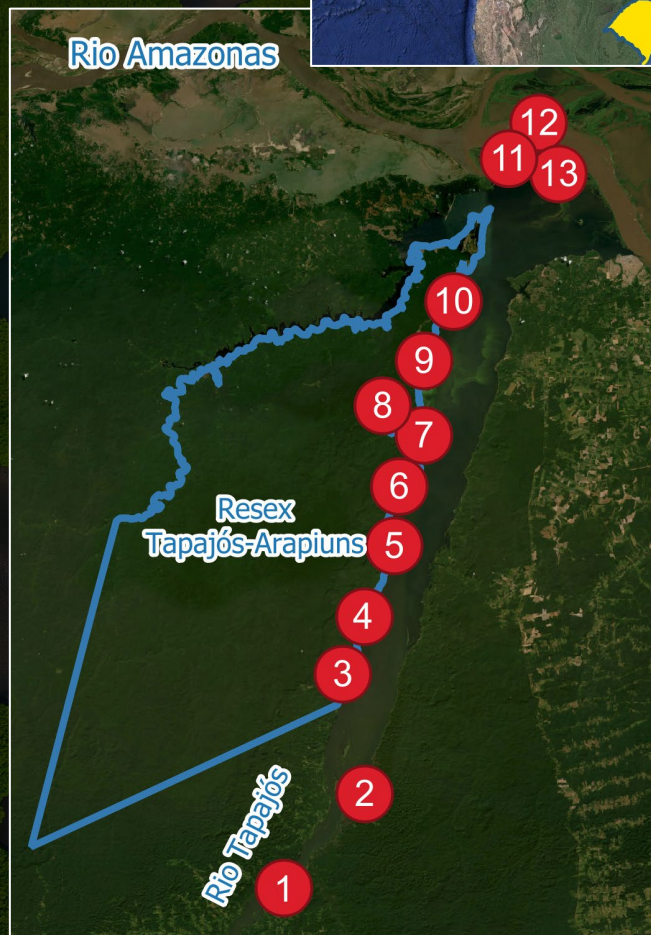
Dietary sources ?



Se

Case of study

Tapajós river Amazon



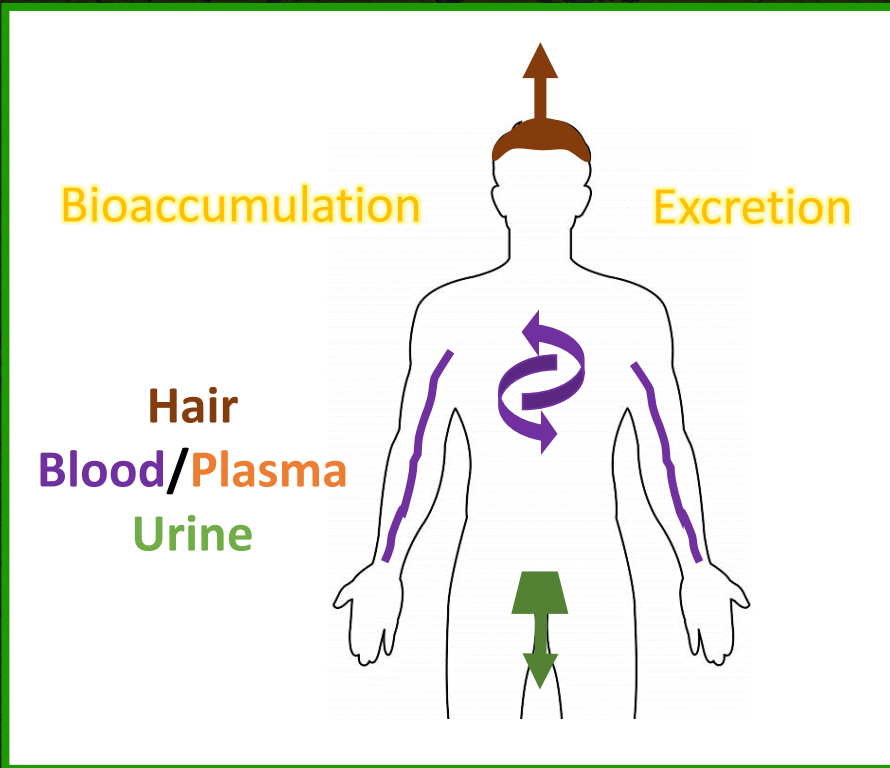
 Oct-Nov 2022 

 n = 1089

62% women

Adults

Tapajós river Amazon



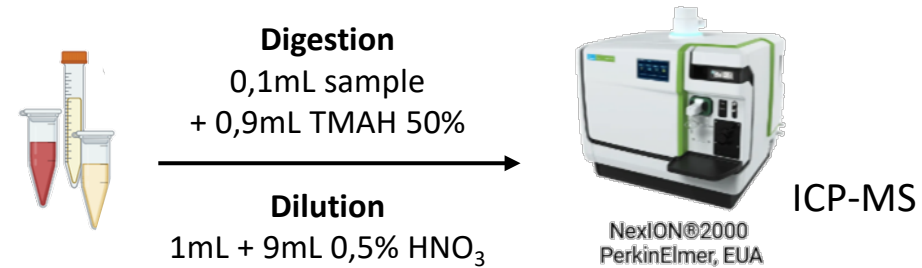
 Oct-Nov 2022 




 n = 1089

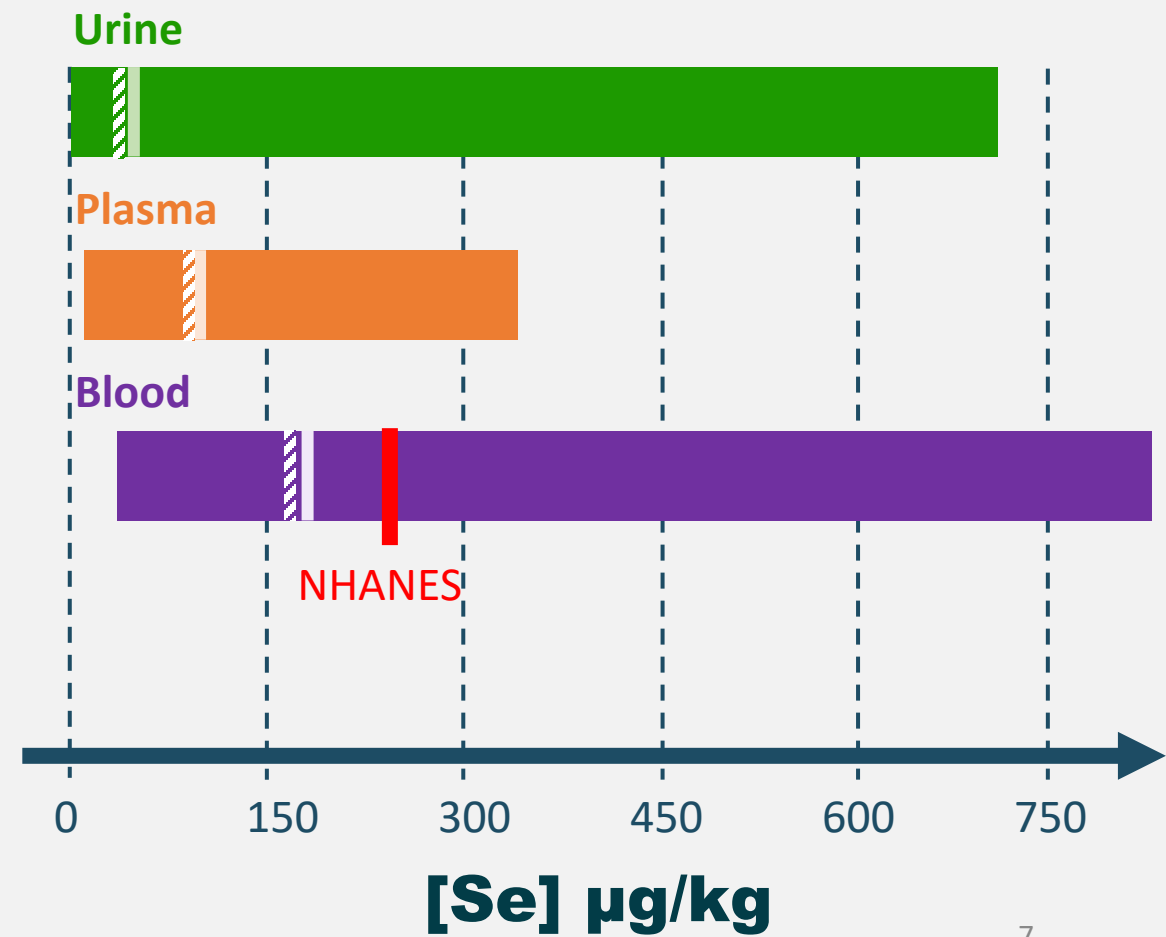
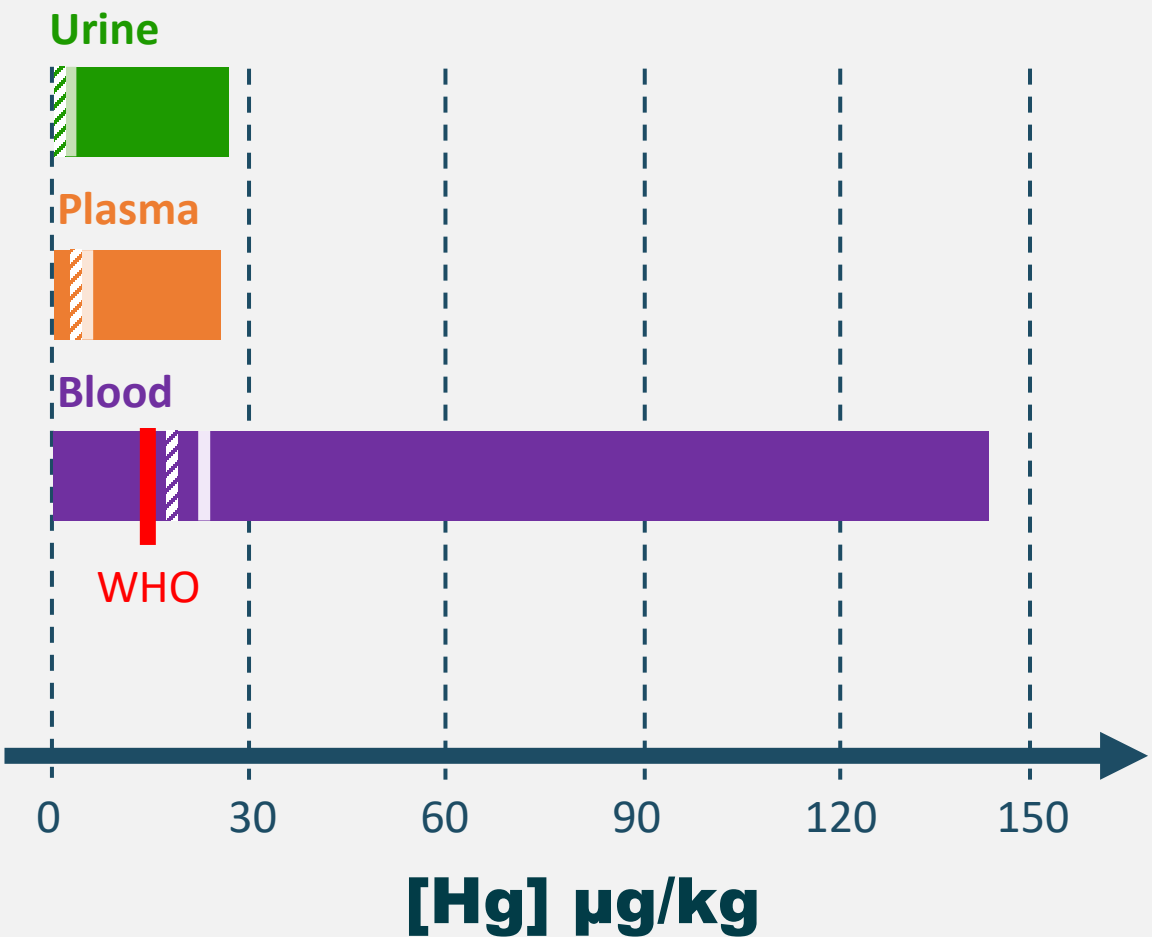
62% women

Adults



Hg and Se levels in humans






 Median
 Mean
 Threshold

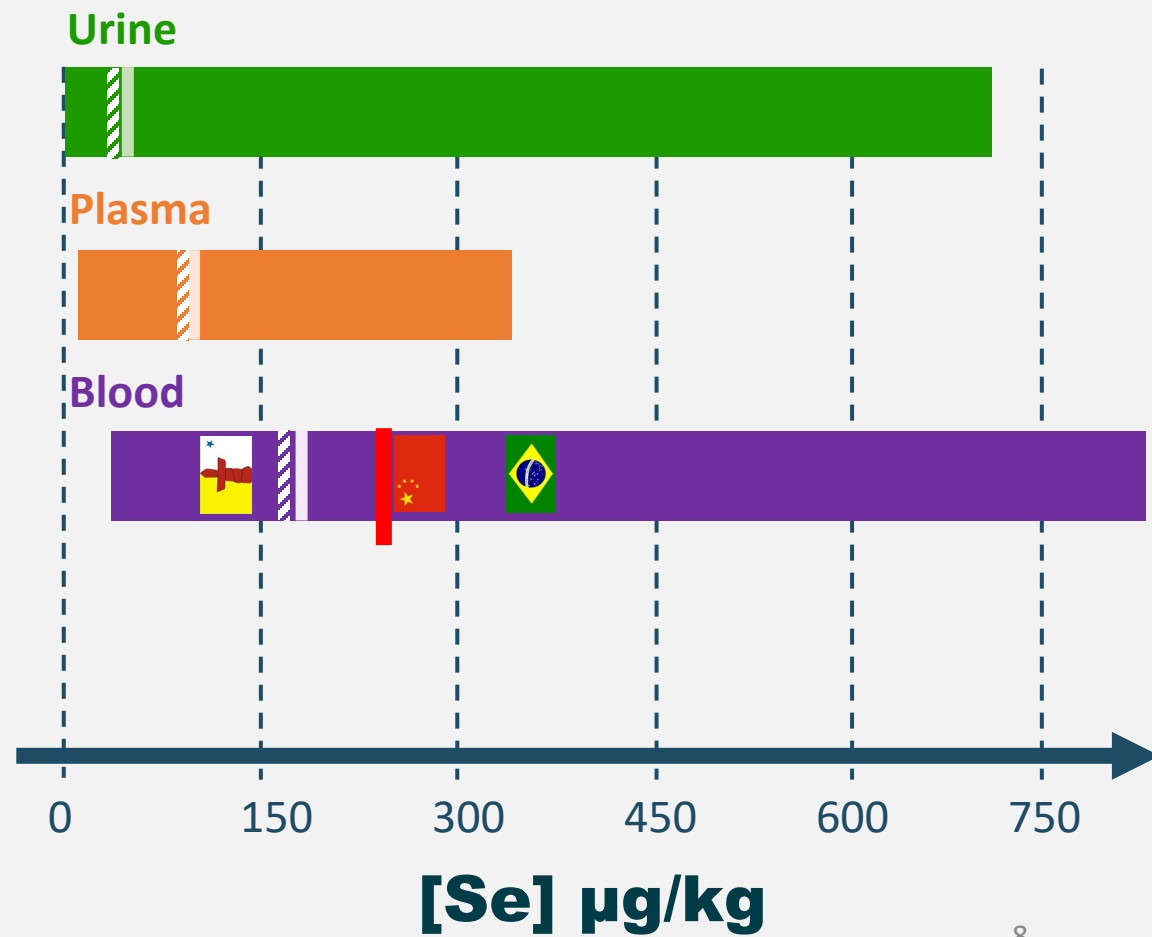
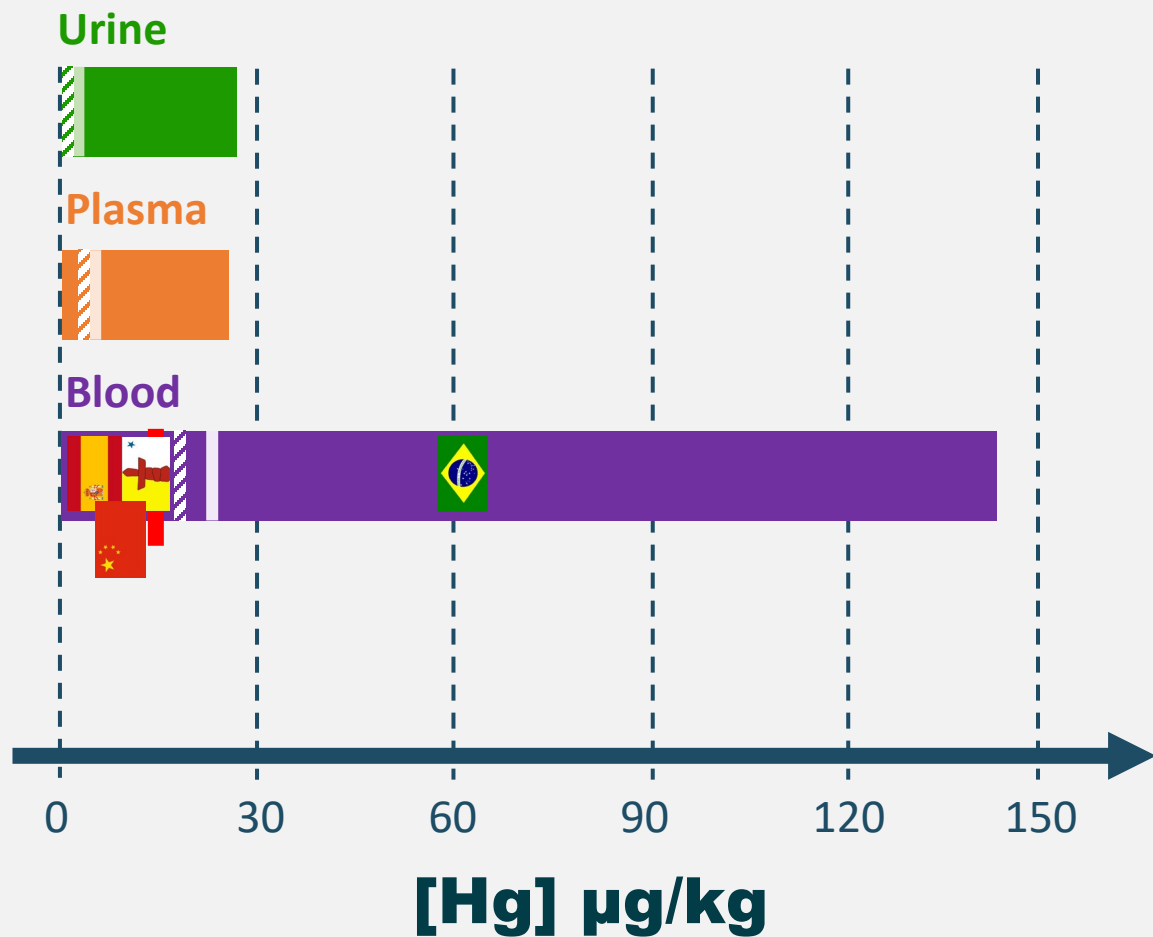


Hg and Se levels in humans

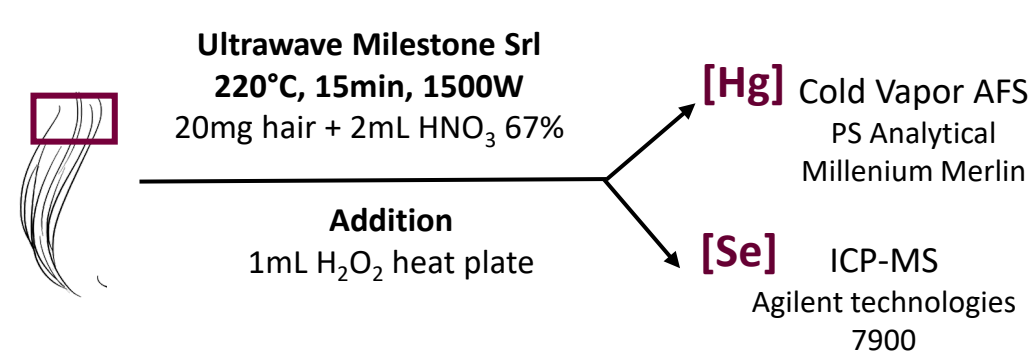
-  Hg contamination
-  Inuit, marine fish
-  Tapajos, river fish
-  Se contamination




- Quiepo-Abad et al. 2019
- Lemire et al. 2016
- Valera et al. 2009
- Fontaine et al. 2008
- Lemire et al. 2011
- Ping Li et al. 2016

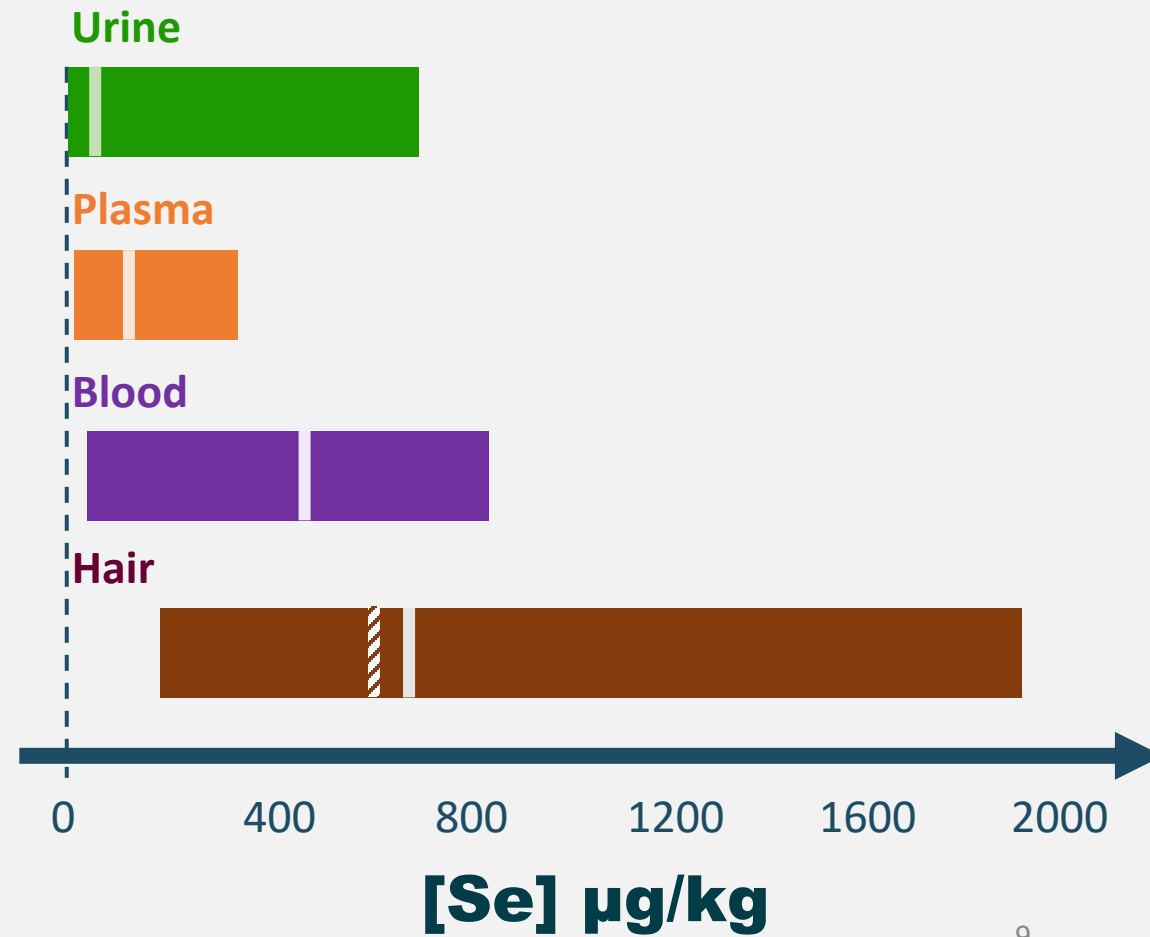
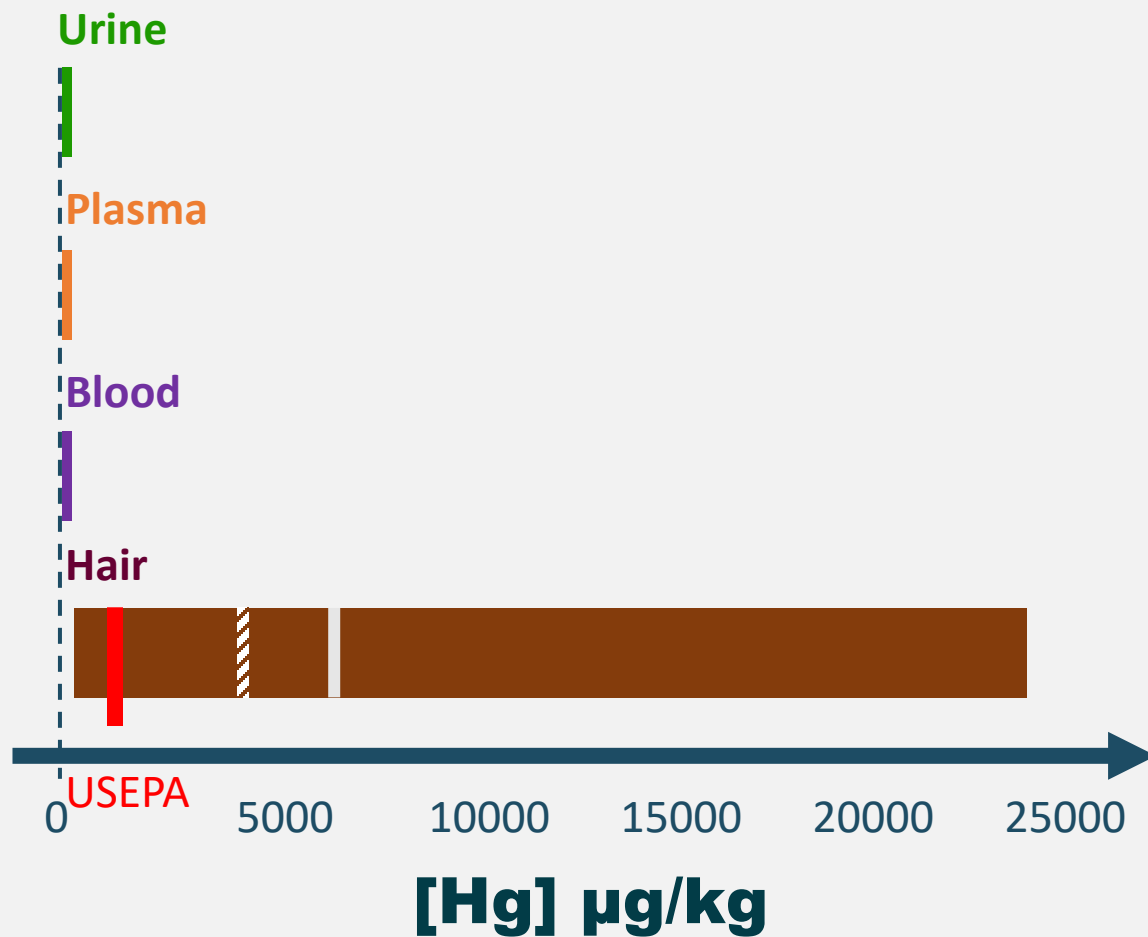
 Median
  Mean
  Threshold



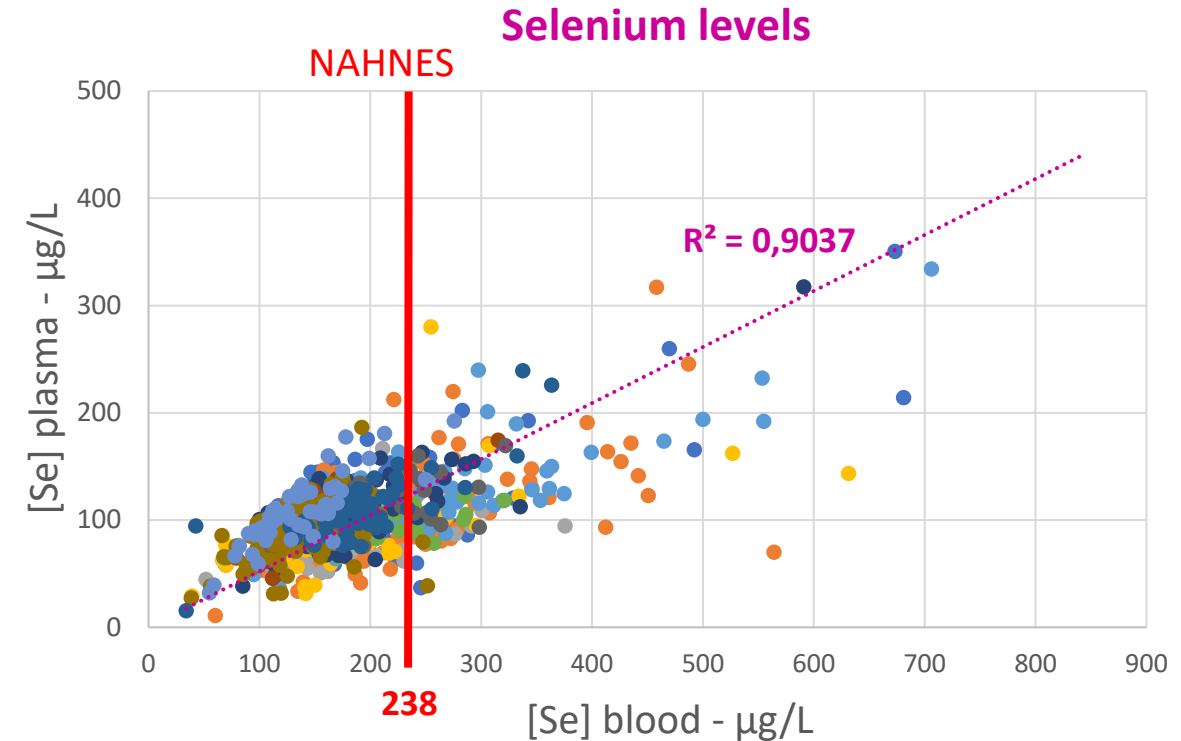
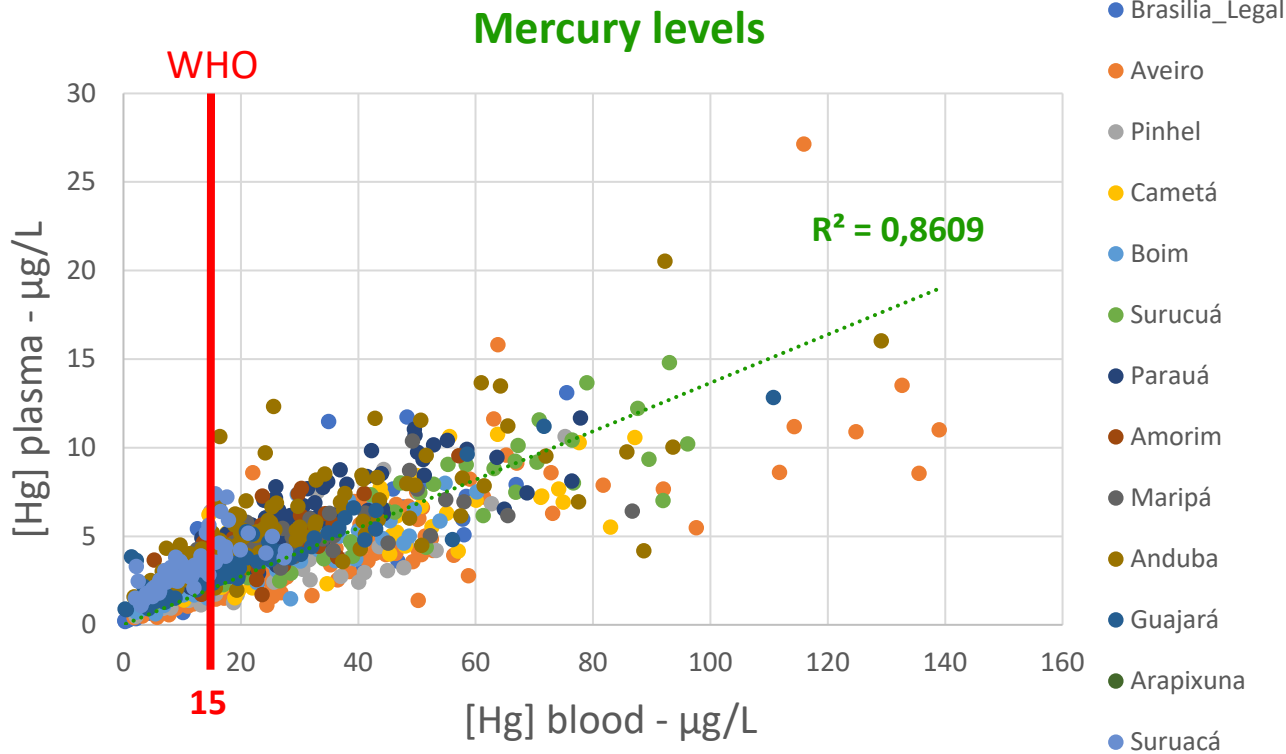
Hg and Se levels in humans



 Median
 Mean
 Threshold



Hg and Se distribution according to communities

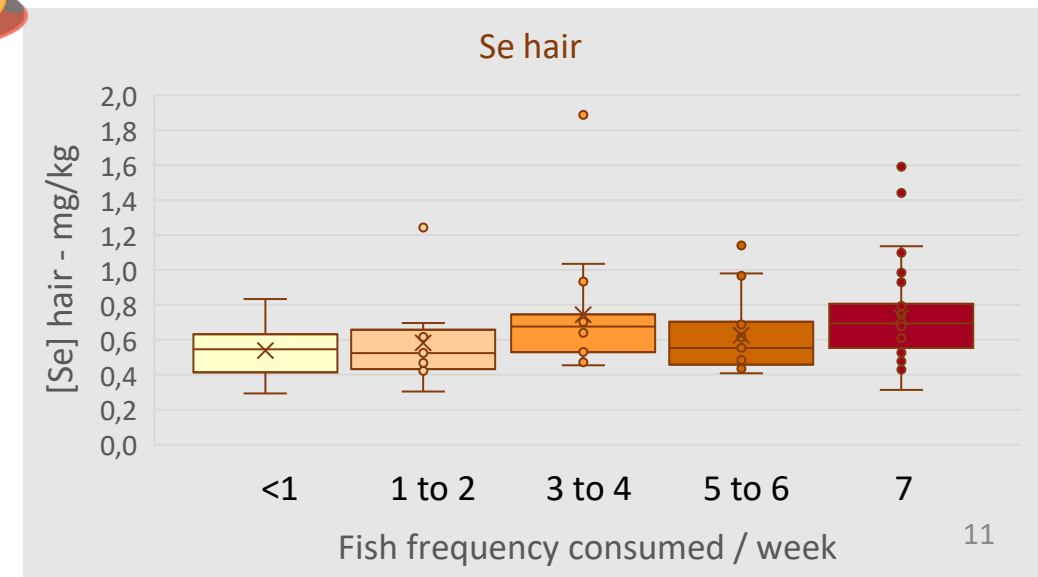
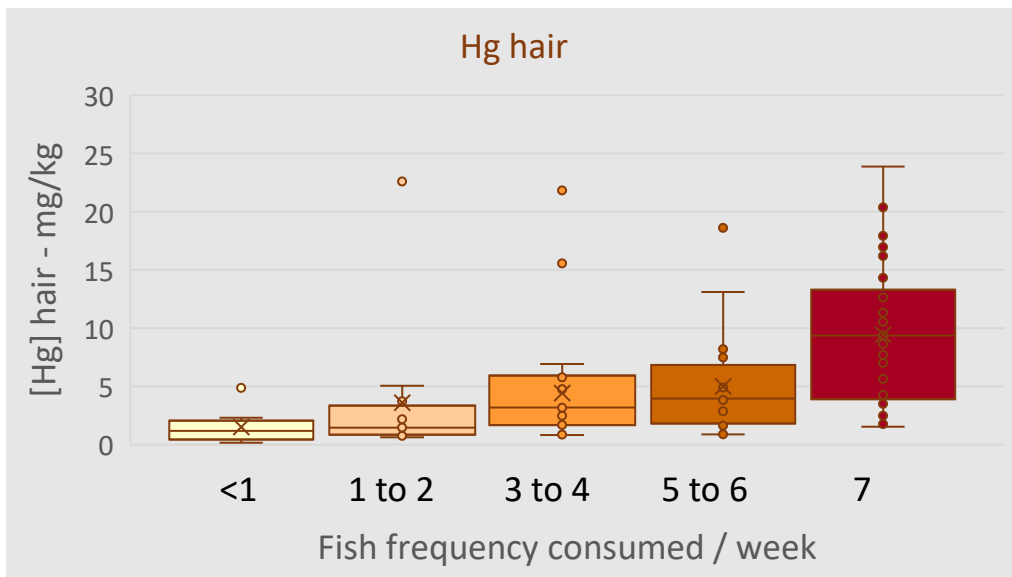
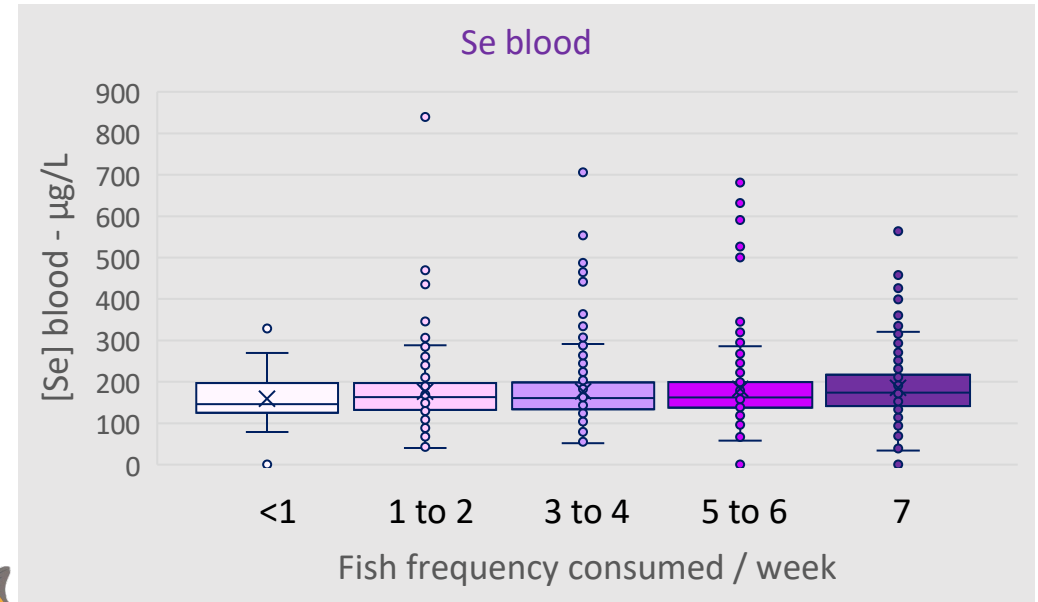
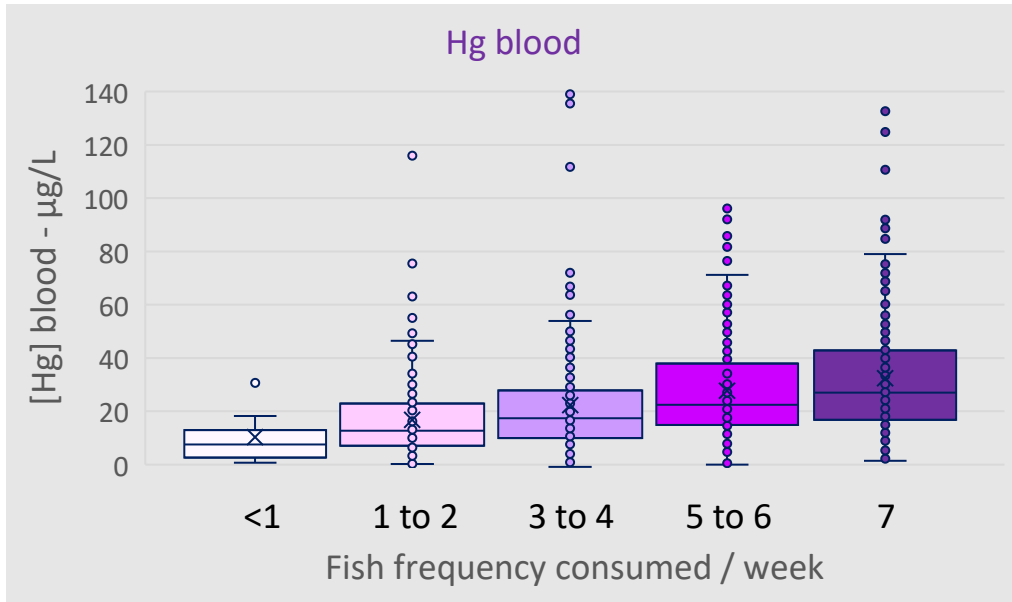


[Hg] blood
65% of individuals > 15 µg/L

→ Homogeneous distribution between communities

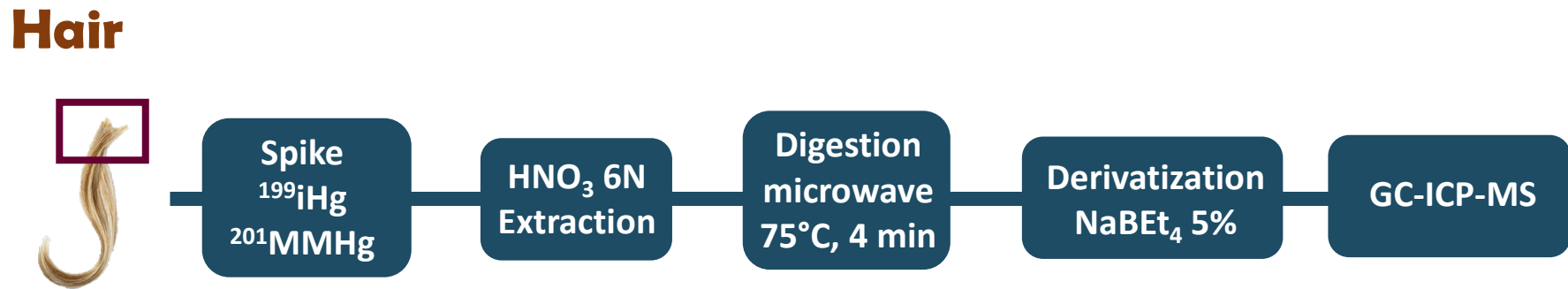
[Se] blood
15% of individuals > 238 µg/L

Hg and Se levels in humans according to fish consumption



Hg speciation GC-ID-ICP-MS

¹⁹⁹iHg
²⁰¹MMHg

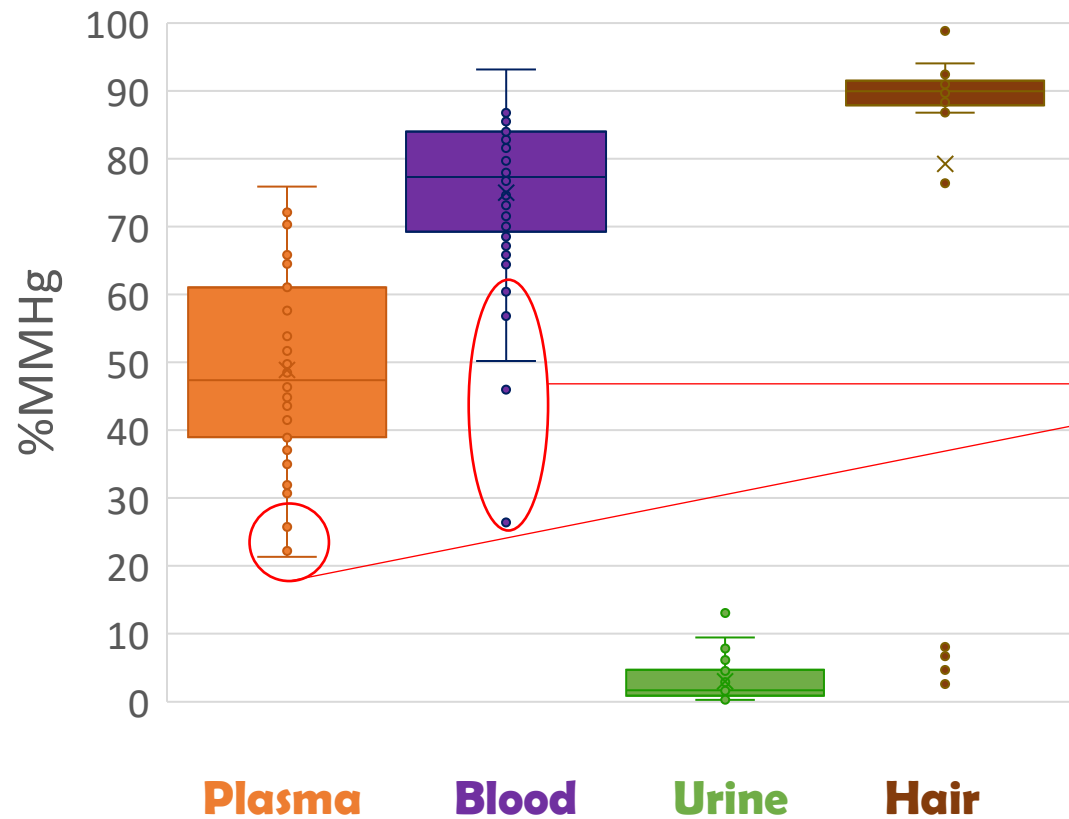


CRMs : DOLT-5 (fish liver), NIES13 (human hair)

[MMHg] and [iHg]

Distribution of Hg species in humans

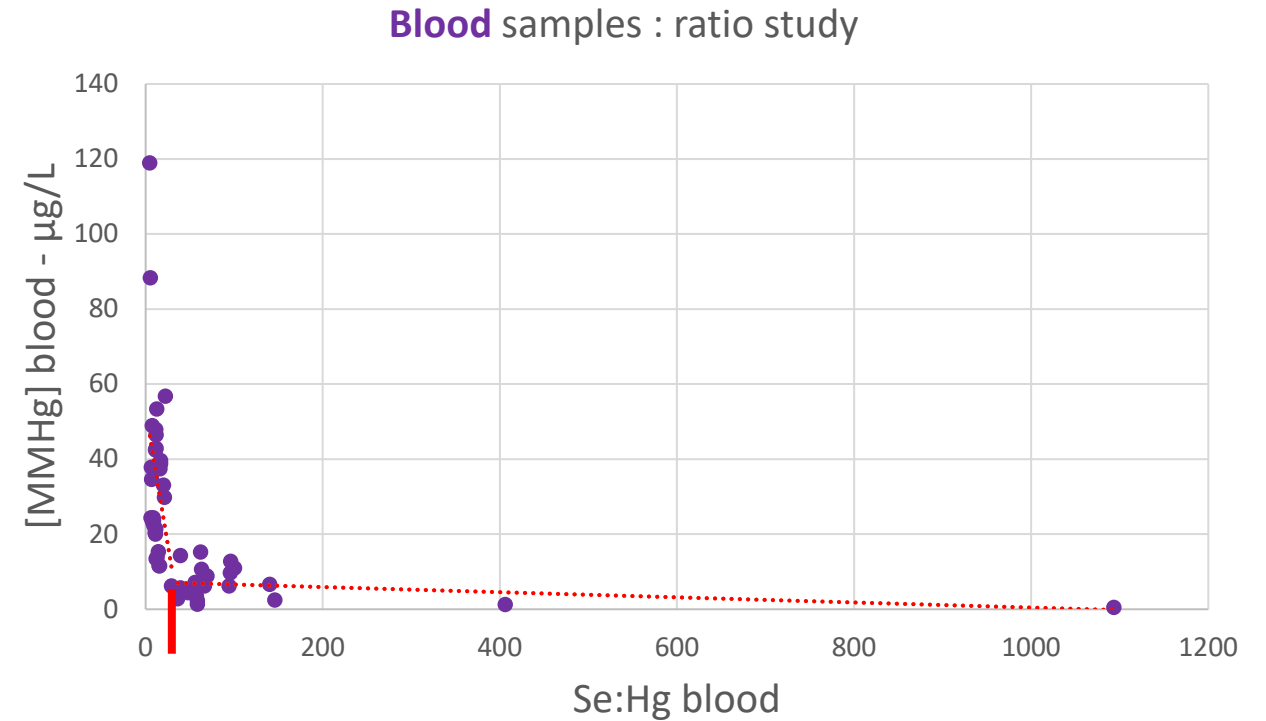
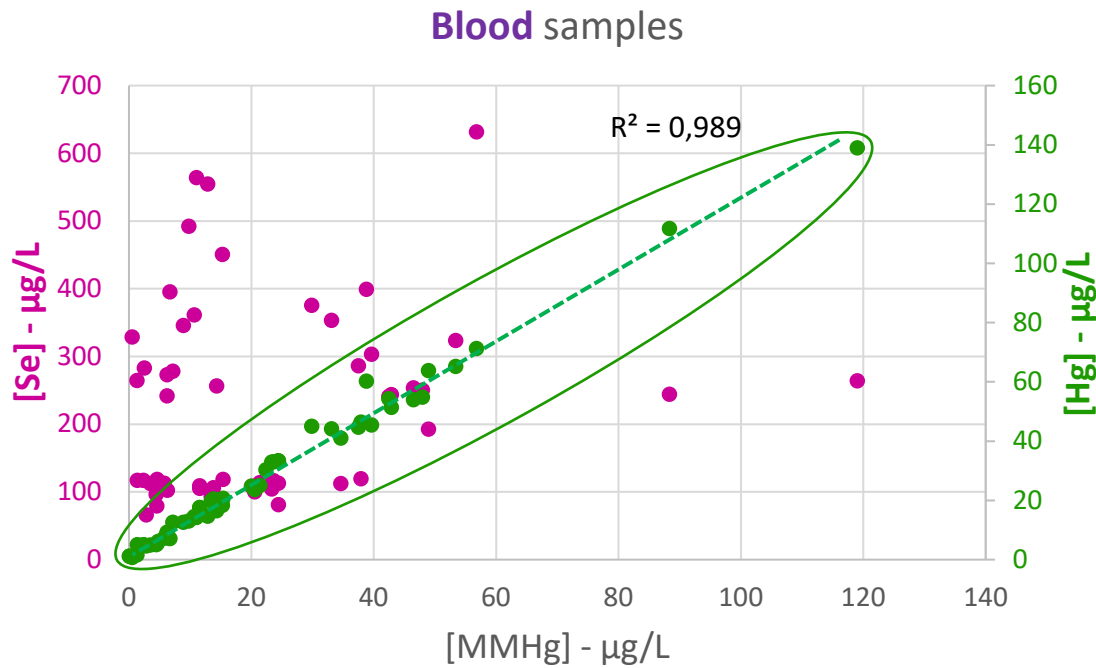
Mean **49 ± 14 %** **75 ± 12 %** **3 ± 3 %** **79 ± 29 %**



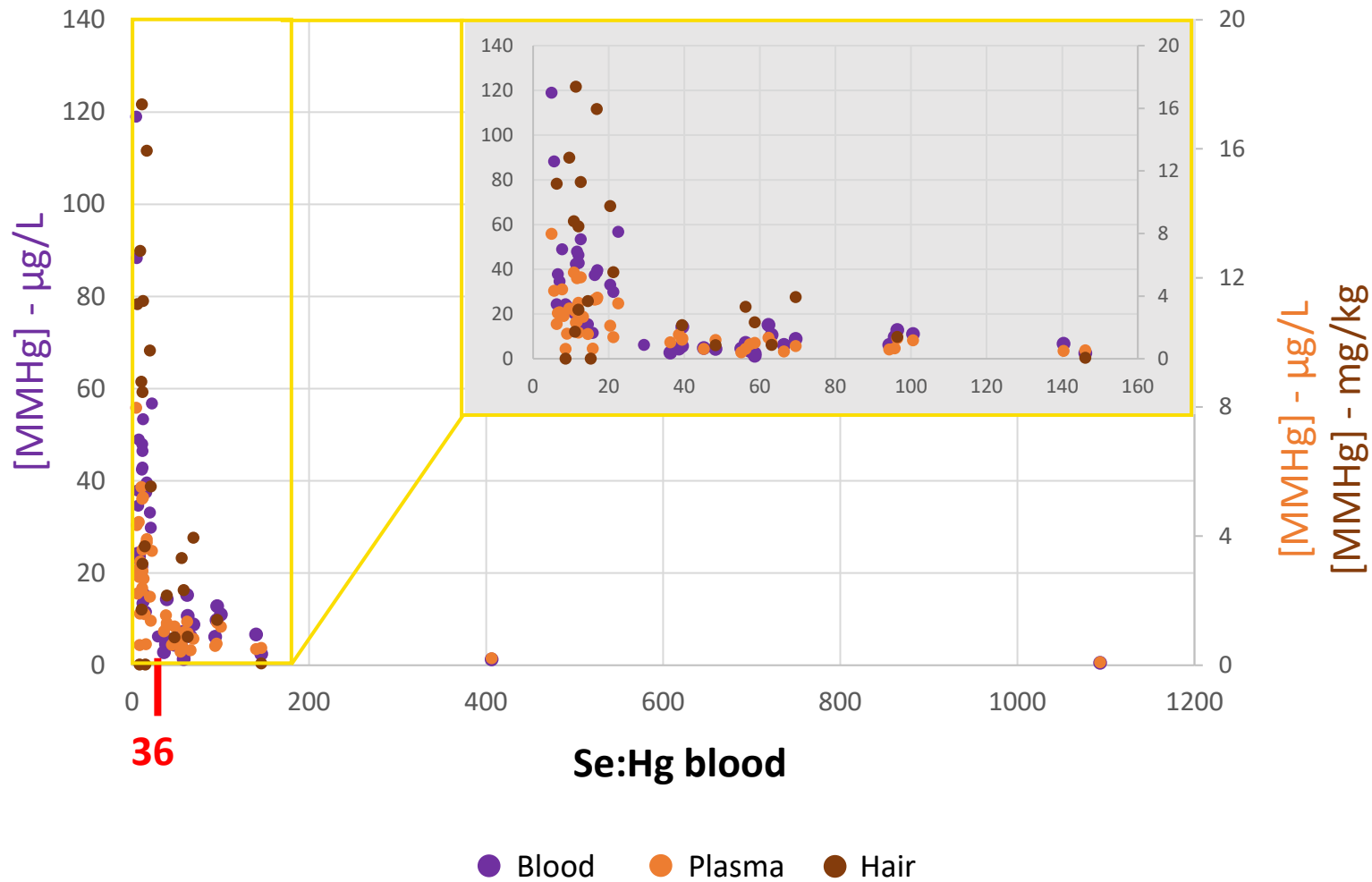
→ MMHg main Hg specie in blood and urine

Extremely low fish consumption individuals

Se effect on MMHg levels in blood

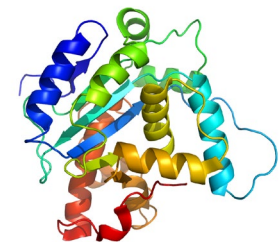


Se effect on MMHg levels in humans



Se:Hg molar ratio in blood:
Key parameter on Hg fate in humans

What Hg and Se species are involved ?



Conclusion

- Hg levels in blood and hair increase with fish frequency consumed
- MMHg levels in blood, plasma and hair decrease when Se:Hg molar ratio in blood increase

Se:Hg molar ratio seems to play an important role in Hg-Se interactions. Above certain threshold (35 in blood), the harmful effects induced by mercury exposure could be attenuated.

Perspectives

- Flood and dry seasons
- Characterization of Hg and/or Se metabolites in humans

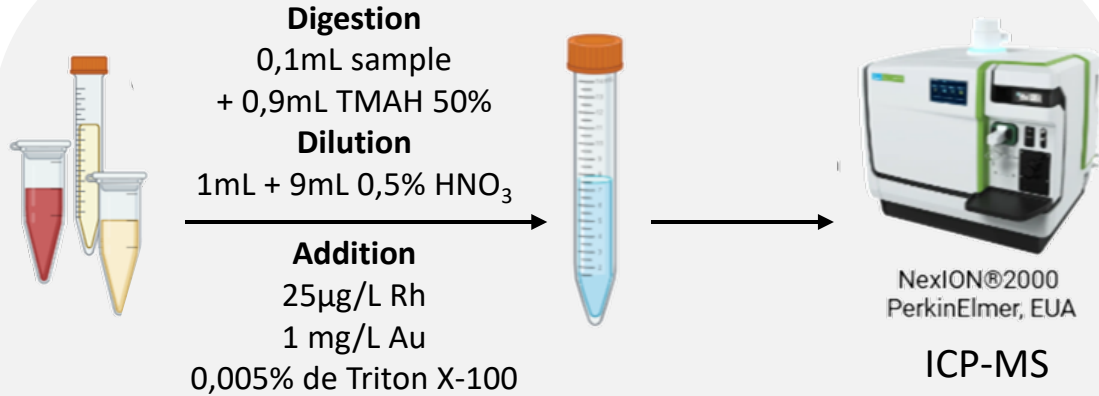


**Thank you
for your
attention**

Juliette ESPLUGAS

Total analysis

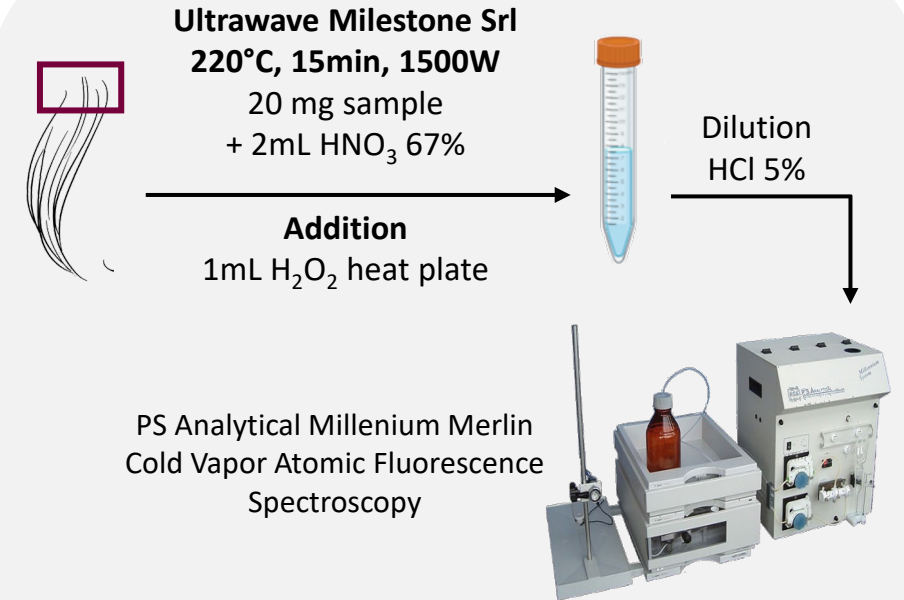
Blood Plasma Urine



Parameters	Conditions
Isotopes	²⁰² Hg; ⁸² Se
Nebulizer gas flow	0,98 L/min
Aux gaz flow	1,45 L/min
Plasma gaz flow	15,00 L/min
Rf power	1350 W
Analogue pulse voltage	1250 W

[Hg] and [Se]




Hair



- Reduction SnCl₂ 3% in HCl 10%
- Detection : 253,7 nm
- External calibration
- LD=0,004 µg/L LQ=0,014 µg/L
- CRM : NIES-13

[Hg]

Hg and Se levels in humans

 Median
  Mean
  Threshold USEPA

-  Inuit
-  General population
-  Hg mining area
-  Se reach area
-  Vaupes gold miners
-  Mining area

- Tian et al. 2011
- Wang et al. 2024
- Li et al. 2012
- Zao et al. 2023
- Calao-Ramos et al. 2021
- R-Villamizar et al. 2023

