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○アブストラクデータ

**Sequential hair mercury in mothers and children from a traditional riverine population of the Rio Tapajós, Amazonia: seasonal changes and natural variability.**

Olaf MALM, José Garrofe DOREA, Antonio Carneiro BARBOSA, José Vicente BERNARDI, Fernando Neves PINTO, Weihe PAL

Riverine populations of the Brazilian Amazon depend on fish for their principals which changes in availability with seasonal fluctuations in the aquatic ecosystem. The Barreiras village is located on the right bank of the Rio Tapajós (Figure 1) 600 km upstream from Belém (State capital of Pará) and around 50 km downstream from Itaituba (an important gold mining and trading area). This is a typical fishing village, depending on subsistence agriculture for starchy foods, and the inhabitants do no work in gold mining activities, unlike many communities in other parts of the Rio Tapajós. A total of 32 married women (age range, 15 to 53y) and their respective children (n=51) were recruited after proper measures to ensure compliance with ethical principles; they participated as volunteers after hearing an explanation of the objectives of the study. They reported high fish consumption (4–14 times a week) with seasonal species preferences (among 15species). From most mothers, hair samples at least 12cm were obtained, thus corresponding to one year of exposure, and several samples were up to 24 or even 30cm. When possible, long hair strands were segmented every 3 cm to represent exposures during 3-month intervals. A total of 340 pieces of hair samples were analysed for both total mercury (THg) and methylmercury (MeHg). Retrospective exposure assessment was conducted from hair concentrations in segments representative of 2years. We report seasonal (high and low waters) and inter-annual changes in THg and MeHg concentrations in hair of fish-eaters from a traditional riverine village on the banks of the Rio Tapajós in the Brazilian Amazon. Ranges of Thg and MeHg concentrations in hair were 1.0–51.0 and 0.5–41.4 ug g<sup>-1</sup>, with means of 12.4 and 10.2 ug g<sup>-1</sup>, respectively. The relative mean value for methylmercury was 80%. There was a significant correlation between mothers and children for both THg ( $r=0.4826$ ;  $P=0.003$ ) and MeHg ( $r=0.5214$ ;  $P=0.004$ ). Mercury concentrations along hair strands of individuals showed significant variation coinciding with seasonal high and low waters. Based on different analytical strategies, our conclusions are: there are seasonal variations in methylmercury exposure which, in turn, is related to the type of fish species consumed.

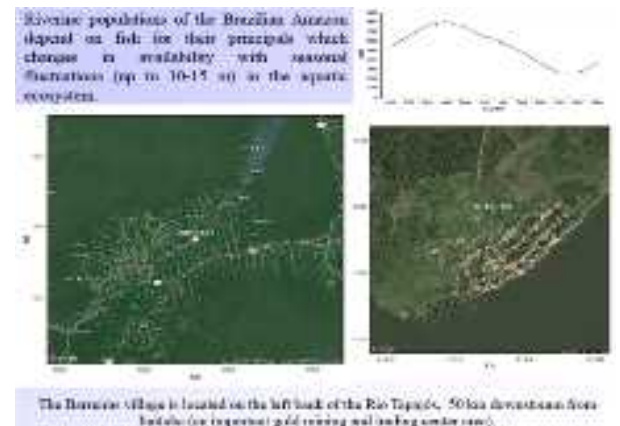
The changes in the aquatic environment impacted fish species availability, which is reflected in the total and MeHg concentrations in hair. The transfer of MeHg from fish to consumers is impacted by water seasons; these populations act as terrestrial ecoreceptors of the natural Hg in the Amazon.

○発表データ

**Sequential hair mercury in mothers and children from a traditional riverine population of the Rio Tapajós, Amazonia: seasonal changes and natural variability.**

Olaf Mielke, José G. Dornas, Adriano C. Barros, Zuzimaida S. Pinto, José V. Damasceno, Iraci V. Souza-Filho, Pál Wáber,  
 / *Low Biomonitoring: EHP, HCVF, CCA, DHP, Fostera, St. de Jussieu, 2004,*  
*Environ Monit Assess, 2004, 94: 1-10*

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 2004-2005



### Introduction

- Environmental mercury exposure was studied by sequential analyses of total mercury (THg) and methylmercury (MeHg) concentrations in hair samples obtained from mothers and their children mainly below 7 years of age in Barro Preto.
- Barro Preto is a small riverine village (around 1000 inhabitants) located on the right bank of the Rio Tapajós, 600 km upstream from Belém (State capital of Pará) and around 50 km downstream from Itaituba (an important gold mining and trading area).
- It is a typical fishing village, depending on subsistence agriculture for starchy foods, and the inhabitants do no work in gold mining activities, unlike many communities in other parts of the Rio Tapajós.

### Introduction

- A total of 52 marital women (age range, 15 to 57y) and their respective children ( $n=51$ ) were recruited after proper measures to ensure compliance with ethical principles. They accepted participated as volunteers after having an explanation of the objectives of the study.
- They reported high fish consumption (4-14 times a week) with seasonal species preferences (among 15 species). From most mothers, hair samples with at least 12cm were obtained, thus corresponding to one year of exposure, and several samples were up to 24 or even 36cm.
- Hair strands were segmented every 1 (2 to 4 cm) to represent exposures during ~3 (2 to 4 mo) months intervals. A total of 340 pieces of hair samples were analyzed for both total mercury (THg) and methylmercury (MeHg).
- A questionnaire was used to record individual family preferences for fish species during dry and the rainy seasons, their weekly ingestion rate and other dietary habits.

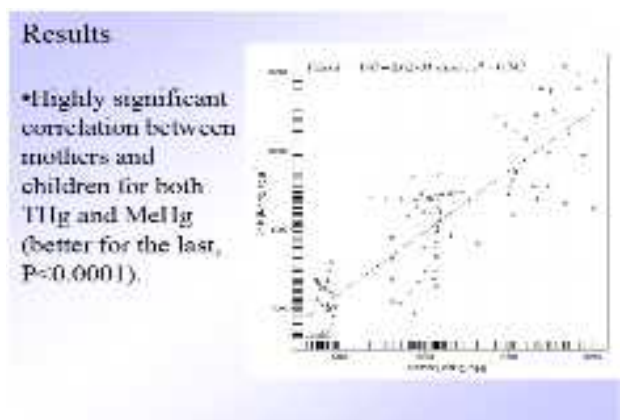
### Methods

#### Chemical Analysis

- The THg concentration was determined by a flow-injection cold-vapor technique with sodium borohydride as a reducing agent (Malm, Pfeiffer, Santos and Souza, 1987; Santos, Malm, Pfeiffer and Cleary, 1999).
- MeHg was extracted by HCl-toluene and measured by gas chromatography with electron capture detector (GC-ECD) (Akagi and Nakamura, 1991; Kikugi, Sôma and Akagi, 1997), at UFPA and Federal University TUC.
- Analytical quality was assured by using certified reference materials (IAEA-485 & 486).

#### Statistical Analysis

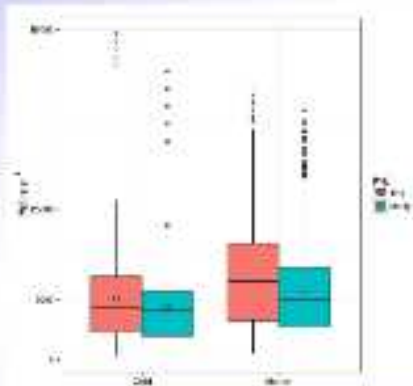
- Data was treated with R-A language and Environment for Statistical Computing 3.1
- Pearson correlation was done with package (corplot)
- Linear Model regression with package (lm)
- For frequencies package (fish)
- For the graphics package (ggplot2)



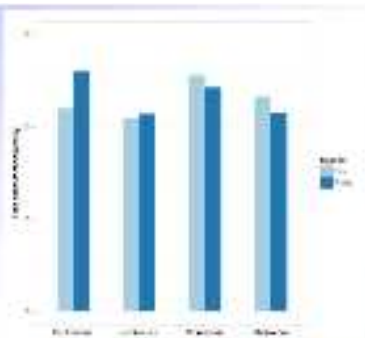
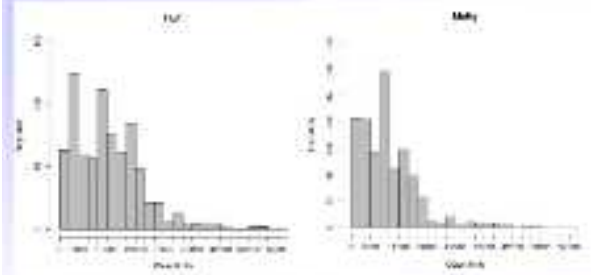
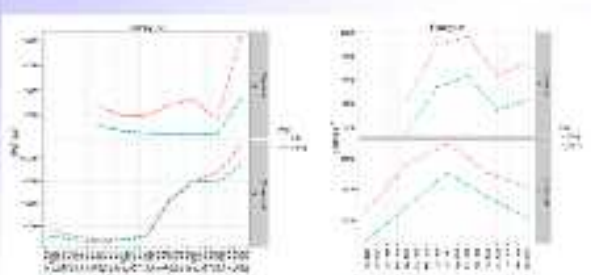
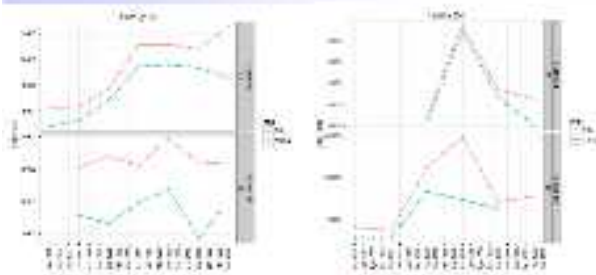
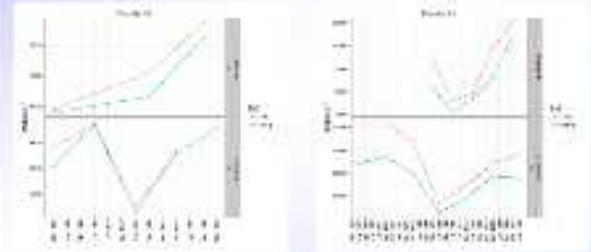
-Ranges and mean (±) value concentrations

THg 0.47–54.36 (17.16)  $\mu\text{g g}^{-1}$

MeHg 0.00–49.07 (9.96)  $\mu\text{g g}^{-1}$



In several families we saw a time lag (i.e. inflexion points in different times) between the child after the mother what could be attributed to different metabolism rates. Different pool of circulating proteins could also participate in this excretion patterns.



Seasonal (high and low waters) changes in fish ingestion species as well as amount consumed that is being reflected in changes in THg and MeHg concentrations in lots of subsistence fish-eaters from the riverine village.

## Conclusions

- Hair-Hg in mothers and respective children are well correlated
- Mothers can represent family fish consumption
- Based on chemical speciation and statistical analysis can also conclude:
  - There are seasonal variations in MeHg exposure possible related to consumed fish species.
  - Variability is quite high, probably influenced by dietary and metabolic factors.
- Differences in functional neurodevelopment outcomes in challenging to assess in subsistence Amazonian populations.

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