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Mercury exposure and lifestyle of native Amerindian communities living along the Beni River

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ICMGP 2009, Guizhou, Guiyang China June 7th to June 12th
Context: Gold mining activity in the foot hill of the Andes

According to L Maurice Bourgoin (2000):

- Extraction of 5 ~10 kg gold/month
  - Use of 250 ~ 500 kg / year of mercury
  - 50 ~ 70 % released into the environment
Background: communities contaminated through fish ingestion

Bio concentration along the aquatic food chain
Objectives of the study

• To document mercury contamination in riverside communities
• To examine associated risk factors risk factors
  (importance of fish consumption)
• To analyze possible interaction with the nutritional status of that communities
Study context
Study area
Subjects and sampling

- Study area: Beni flood plain
- 14000 inhabitants
  - 4000 along the riverside
- 173 mothers and 458 children (<15 yo)
- Ethical clearance
Field procedures

- Informed consent
- Dietary survey

Clinical examination

Anthropometry

Iron deficiency anemia

Parasitological examination

Hair strand cut
Mercury content analysis

Rinsing: EDTA 0.01% and H2O Milli Q

Weighing

Mineralization

Measurement with atomic absorption spectrometry (PERKIN ELMER 3110)

End of digestion

Digestion
Results
Health characteristics: general

- 70% of mothers gave birth without medical assistance
- High mortality rate
- Anemia prevalence (women): 42%
- Chronic malnutrition (preschoolers): 41%
- Intestinal parasitism (children): 85%
- Acute infections: 30%
## Hair mercury content H-Hg (µg/g)

<table>
<thead>
<tr>
<th>Group</th>
<th>Median (IC 95%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall sample (n=556)</td>
<td>4.0 (3.6 ~4.4)</td>
</tr>
<tr>
<td>Children (n=393)</td>
<td>3.9 (3.4 ~4.4)</td>
</tr>
<tr>
<td>Mothers (n=163)</td>
<td>4.4 (3.5 ~5.4)</td>
</tr>
<tr>
<td>Pregnant (n=18)</td>
<td>3.3 (1.3 ~3.9)</td>
</tr>
<tr>
<td>Lactating (n=57)</td>
<td>5.5 (4.4 ~6.4)</td>
</tr>
<tr>
<td>Non-pregnant non-lactating women (n=93)</td>
<td>4.1 (3.0 ~5.4)</td>
</tr>
</tbody>
</table>
H-Hg and community characteristics (1)

Cumulative distribution of H-Hg according to ethnicity

p<0.01)
H-Hg and community characteristics (2)

Cumulative distribution of H-Hg according to village accessibility

$p<0.001$
H-Hg and community characteristics (3)

Cumulative distribution of H-Hg according to fish consumption

p<0.001)
H-Hg and community characteristics (4)

Cumulative distribution of H-Hg according to economic activity

\( p < 0.001 \)
Multivariate analysis

• Village accessibility
• Fish consumption

• Ethnicity
• Subsistence activity

Significant predictive effect

No significant effect

Significant interactions between:
• Accessibility * Fish consumption
• Subsistence * Fish consumption
## Nature of fish consumed

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Common name</th>
<th>Feeding Behavior</th>
<th>Consumption (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Prochilodus nigricans</em></td>
<td>Sábalo</td>
<td>herbivorous</td>
<td>43.5</td>
</tr>
<tr>
<td><em>Leiarius marcocatus</em></td>
<td>Tujuno</td>
<td>piscivorous</td>
<td>11.7</td>
</tr>
<tr>
<td><em>Colossoma brachypomum</em></td>
<td>Pacú</td>
<td></td>
<td>9.1</td>
</tr>
<tr>
<td><em>Pseudoplataystoma fasciatum</em></td>
<td>Pintado</td>
<td></td>
<td>9.1</td>
</tr>
<tr>
<td><em>Astronotus ocellatus o Pygocentrus nattereni</em></td>
<td>Palometa</td>
<td>carnivorous</td>
<td>6.4</td>
</tr>
<tr>
<td><em>Schizodon fasciatum</em></td>
<td>Ruta</td>
<td></td>
<td>3.9</td>
</tr>
<tr>
<td><em>Plagioscian squamosissimus</em></td>
<td>Curbina</td>
<td></td>
<td>3.9</td>
</tr>
<tr>
<td><em>Mylossoma duriventre</em></td>
<td>Jatara</td>
<td></td>
<td>2.6</td>
</tr>
<tr>
<td><em>Brachyplatystoma filamentosum</em></td>
<td>Dorado</td>
<td></td>
<td>1.9</td>
</tr>
<tr>
<td><em>Hoplias malabaricus</em></td>
<td>Benton</td>
<td></td>
<td>1.9</td>
</tr>
<tr>
<td><em>Pimelodus maculatus blochii</em></td>
<td>Griso</td>
<td>omnivorous</td>
<td>1.3</td>
</tr>
<tr>
<td><em>Serubim lima</em></td>
<td>Tahuaya</td>
<td></td>
<td>1.2</td>
</tr>
<tr>
<td><em>Hoplerythrinus unitaeniatus</em></td>
<td>Yayu</td>
<td></td>
<td>0.7</td>
</tr>
<tr>
<td><em>Brycom s.p.</em></td>
<td>Mamuri</td>
<td></td>
<td>0.7</td>
</tr>
<tr>
<td><em>Tripostheus sp o Markiana nigripinis</em></td>
<td>Sardina</td>
<td></td>
<td>0.7</td>
</tr>
<tr>
<td><em>Serrasalmus spp</em></td>
<td>Piraña</td>
<td></td>
<td>0.7</td>
</tr>
<tr>
<td><em>Pseudoplastystoma tigrinum</em></td>
<td>Surubí</td>
<td></td>
<td>0.7</td>
</tr>
</tbody>
</table>
Fish consumed

- 63% herbivorous and omnivorous
- 37% piscivorous and carnivorous
- No differences between ethnic groups but
- **Remote communities consumed significantly more carnivorous fish than the others**
Nutritional importance of fish: percent of energy and nutrients provided by fish
Relationships between H-Hg and anthropometric indices in 5-10-year-old children

- **H-age (Z-scores)**
  - Quartile 1 vs. Quartile 4: p<0.05

- **W-age (Z-scores)**
  - Quartile 1 vs. Quartile 4: p<0.006

- **W-H (Z-scores)**
  - Quartile 1 vs. Quartile 4: P=0.06

- **BMI (kg/m²)**
  - Quartile 1 vs. Quartile 4: p<0.01
Conclusions
1) Mercury exposure

- H-Hg seems relatively low by comparison with other Amazonian areas (ex Tapajos basin): 86% of subjects < 10 µg/g
- But greater exposure of “traditional” and more vulnerable groups of population
  - Isolated
  - Less access to health and schooling facilities
  - Higher consumption of contaminated fish
2) Fish consumption

• Important for the nutritional balance of the diet
  – Macro nutrients (proteins) vitamins and micronutrients (iodine, sulfur…)

• Isolated groups consumed more carnivorous (i.e. Hg contaminated) fish than the others
3) Nutritional status

• H-Hg acts as a bio-indicator of fish consumption

• Positive effect on nutritional indices of school age children
  – Fish consumption is the intermediate link

• Public health: Does the advantage of a fish based diet overcome the risk of Hg poisoning?
Recommendations

- Mercury will not disappear and will continue to bio accumulate unless severe law enforcement is applied
- Fish consumption is very important for certain groups of population
- Advice aiming at reducing consumption of harmful fish should be cautious
- A regular assessment of the Hg content of the most frequently consumed species is required
Acknowledgements

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• To Carlos for his constant devotion to the team
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