Mercury exposure and lifestyle of native amerindian communities living along the Beni River (Bolivia)

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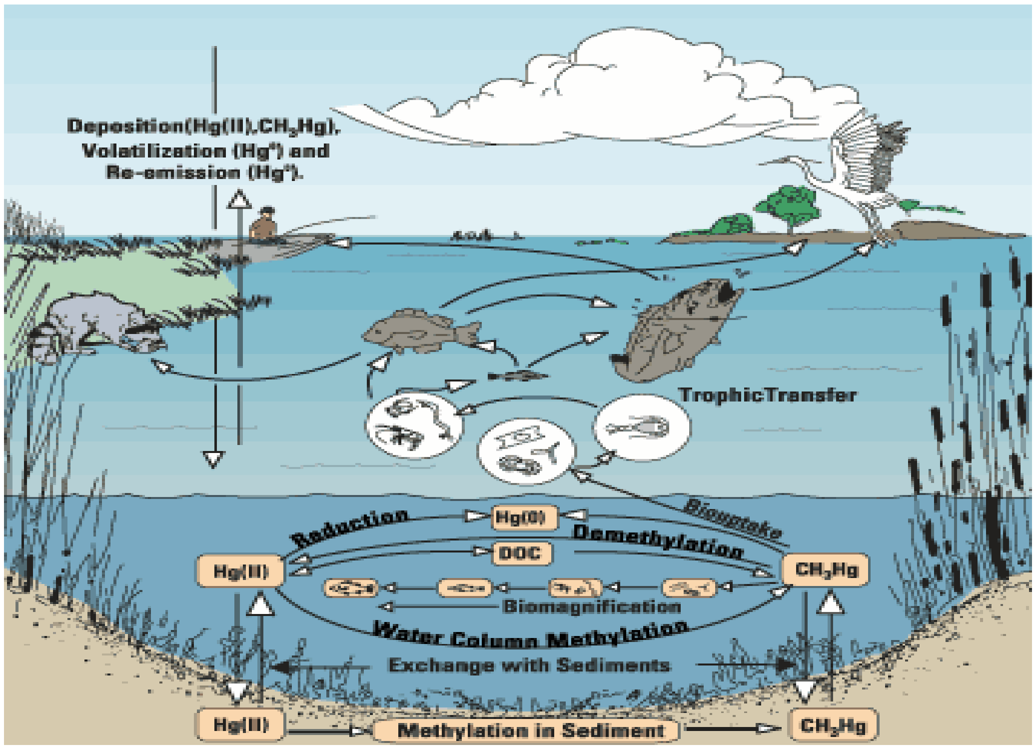
ICMGP 2009, Guizhou, Guiyang China June 7th to June 12th

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

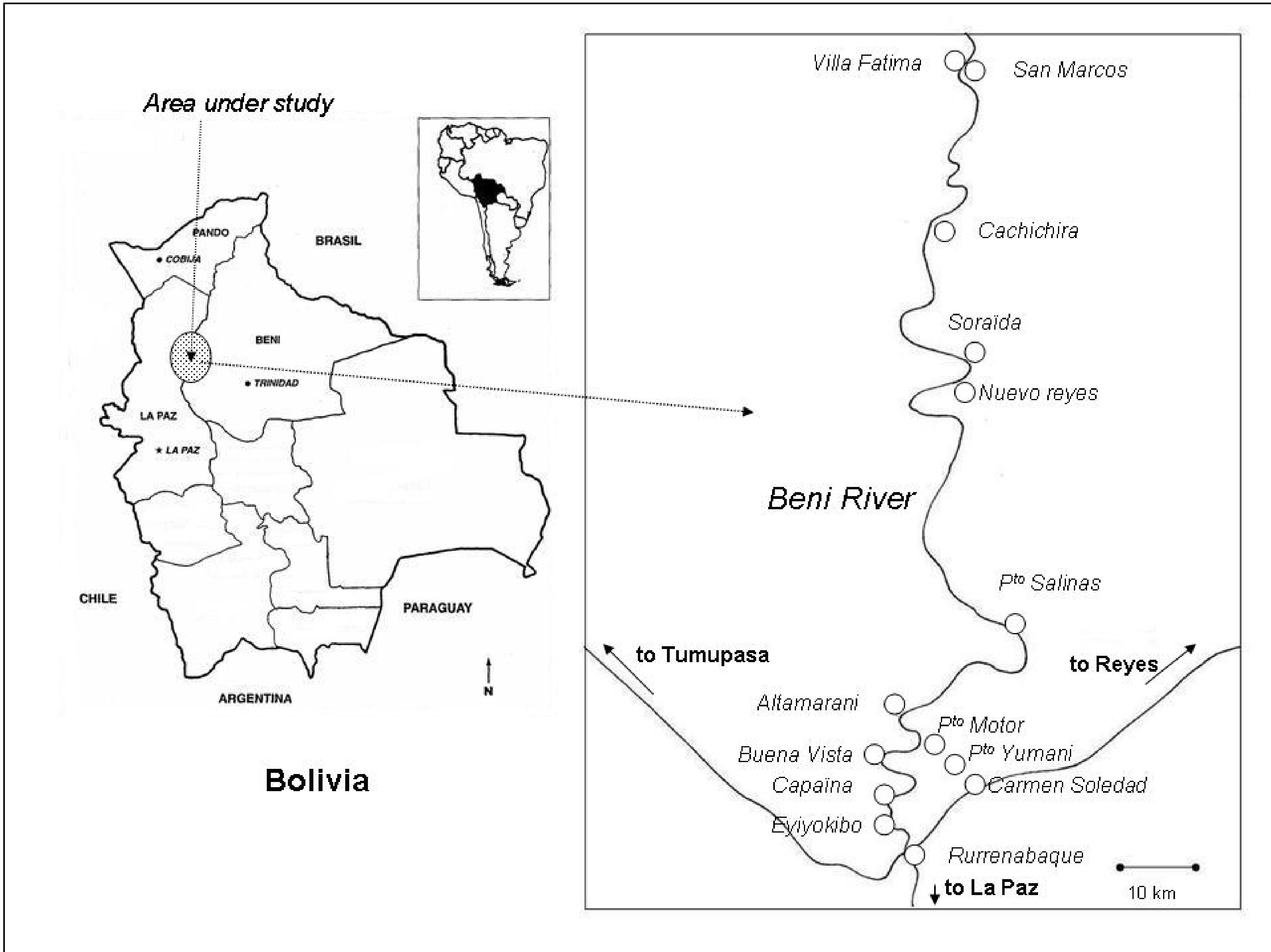
  (importance of fish consumption)
- To analyze possible interaction with the nutritional status of that communities

Study context






Study area



Area under study
PANDO
COBIJA
BRASIL
BENI
TRINIDAD
LA PAZ
LA PAZ
CHILE
PARAGUAY
ARGENTINA
N
Bolivia
Villa Fatima
San Marcos
Cachichira
Soraïda
Nuevo reyes
Beni River
Pto Salinas
to Tumupasa
to Reyes
Altamarani
Pto Motor
Buena Vista
Pto Yumani
Capaina
Carmen Soledad
Eyiyokibo
Rurrenabaque
to La Paz
10 km

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 H_2O Milli Q

Weighing

Mineralization

Digestion

End of digestion

Measurement with atomic absorption spectrometry (PERKIN ELMER 3110)

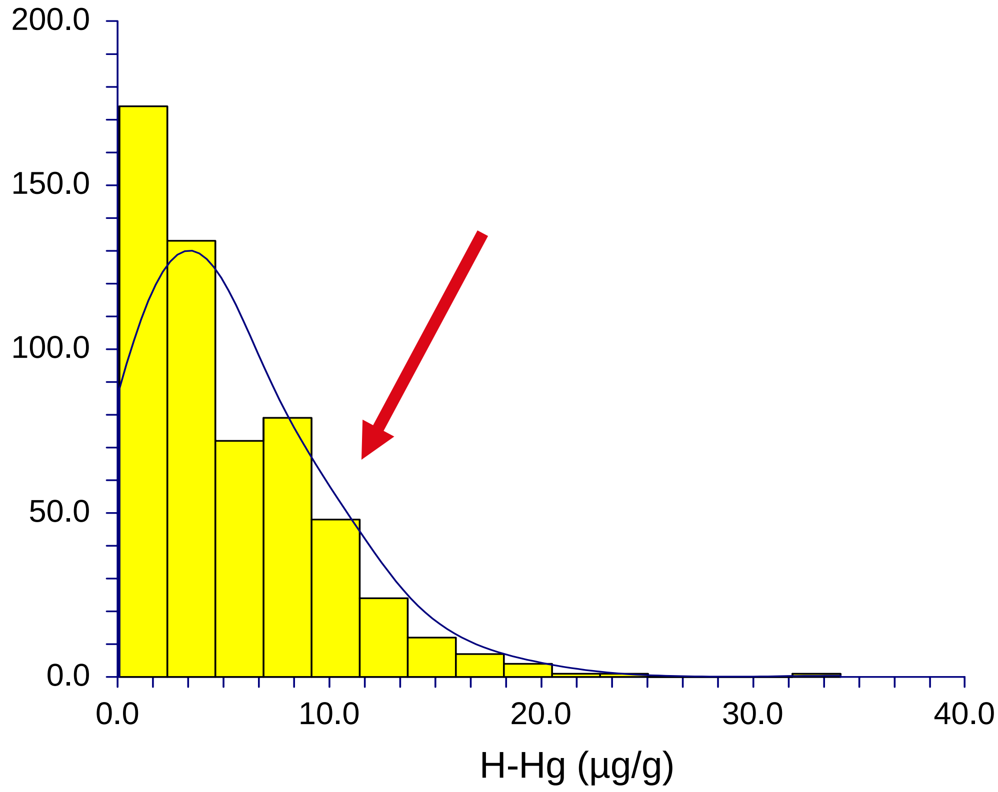
Results

Health characteristics: general

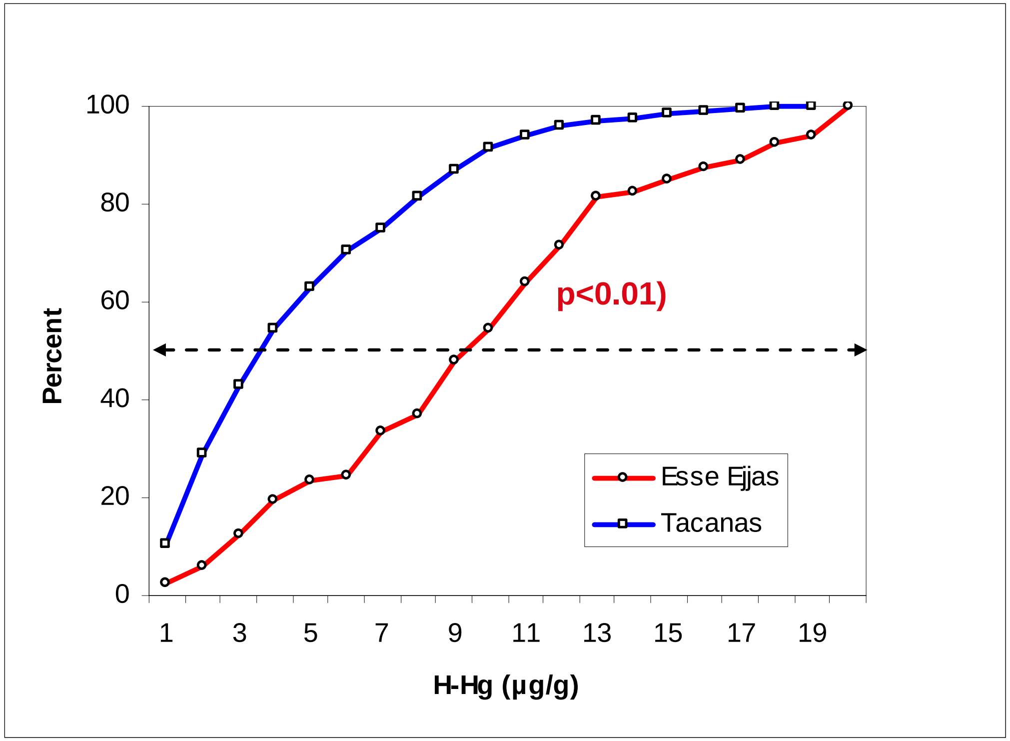
- 70% of mothers gave birth without medical assistance
- High mortality rate
- Anemia prevalence (women): 42 %
- Chronic malnutrition (preschoolers): 41%
- Intestinal parasitism (children): 85%
- Acute infections: 30%

Hair mercury content H-Hg (µg/g)

Group	Median (IC $_{95\%}$)
Overall sample (n=556)	**4.0 (3.6 ~4.4)**
Children (n=393)	**3.9 (3.4 ~4.4)**
Mothers (n=163)	**4.4 (3.5 ~5.4)**
Pregnant (n=18)	**3.3 (1.3 ~3.9)**
Lactating (n=57)	**5.5 (4.4 ~6.4)**
Non-pregnant non-lactating women (n=93)	**4.1 (3.0 ~5.4)**

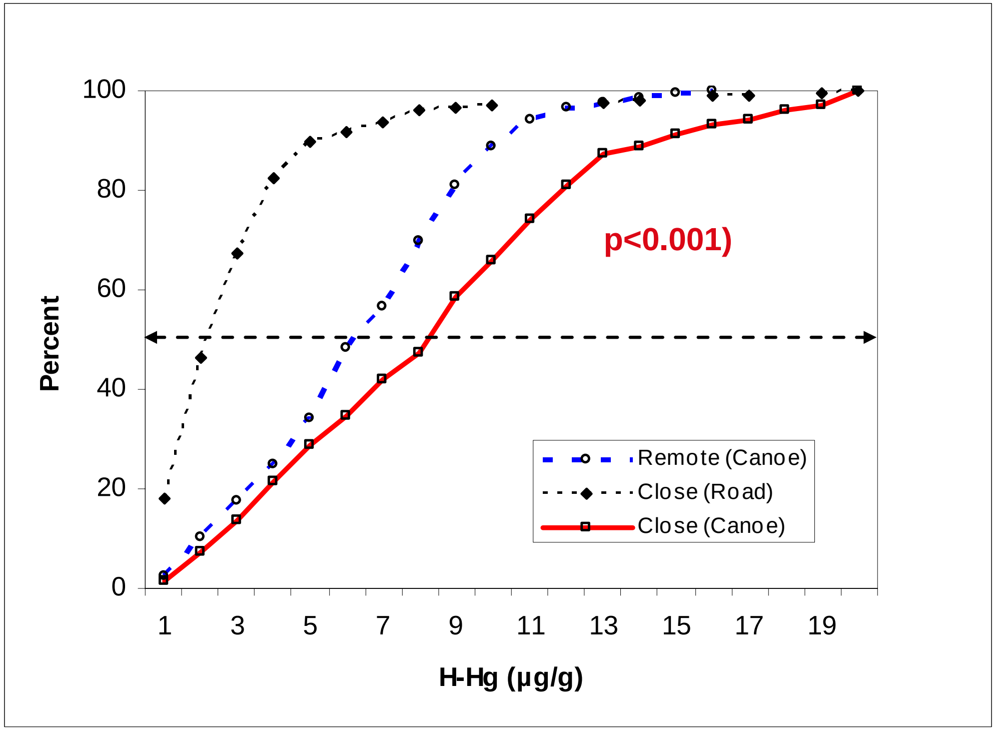


H-Hg and community characteristics (1)



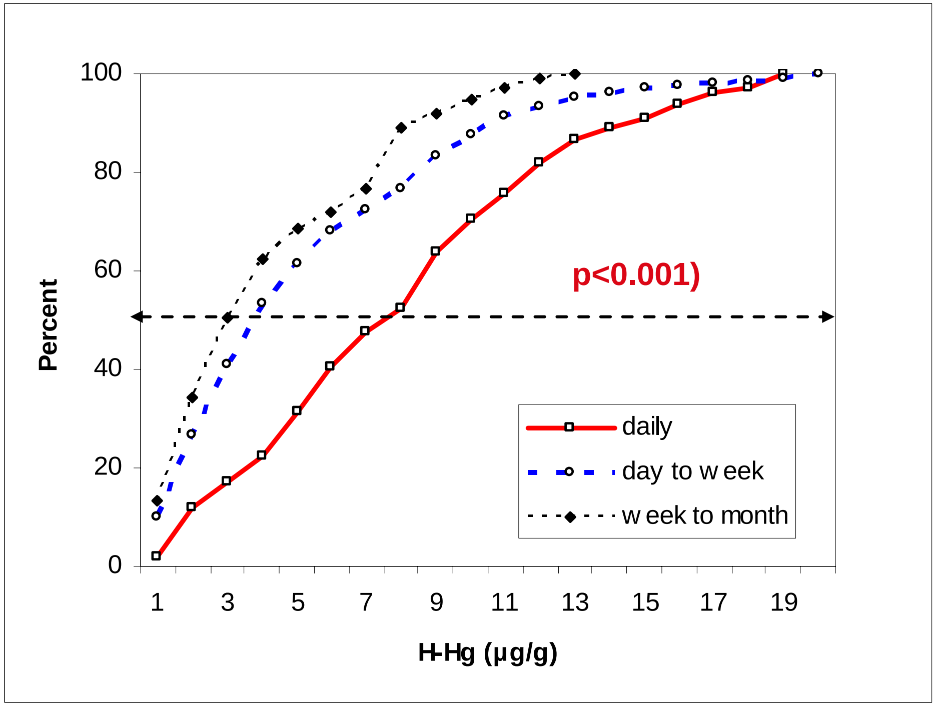
Cumulative distribution of H-Hg according to ethnicity

H-Hg and community characteristics (2)



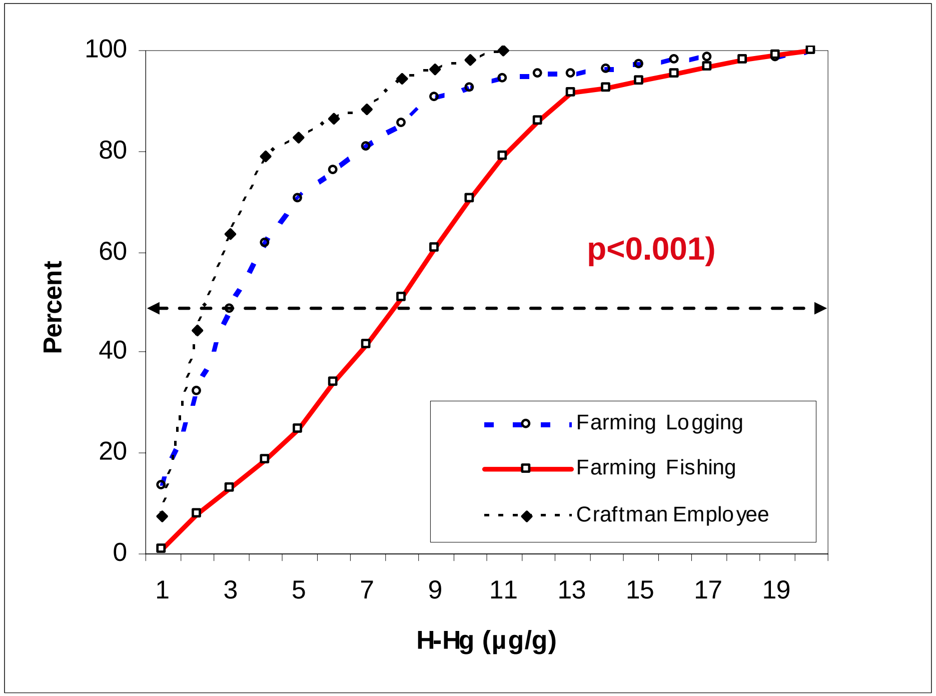
Cumulative distribution of H-Hg according to village accessibility

H-Hg and community characteristics (3)



Cumulative distribution of H-Hg according to fish consumption

H-Hg and community characteristics (4)



Cumulative distribution of H-Hg according to economic activity

Multivariate analysis

- Village accessibility
- Fish consumption

Significant predictive effect

- Ethnicity
- Subsistence activity

No significant effect

Significant interactions between:

- ***Accessibility * Fish consumption***
- ***Subsistence * Fish consumption***

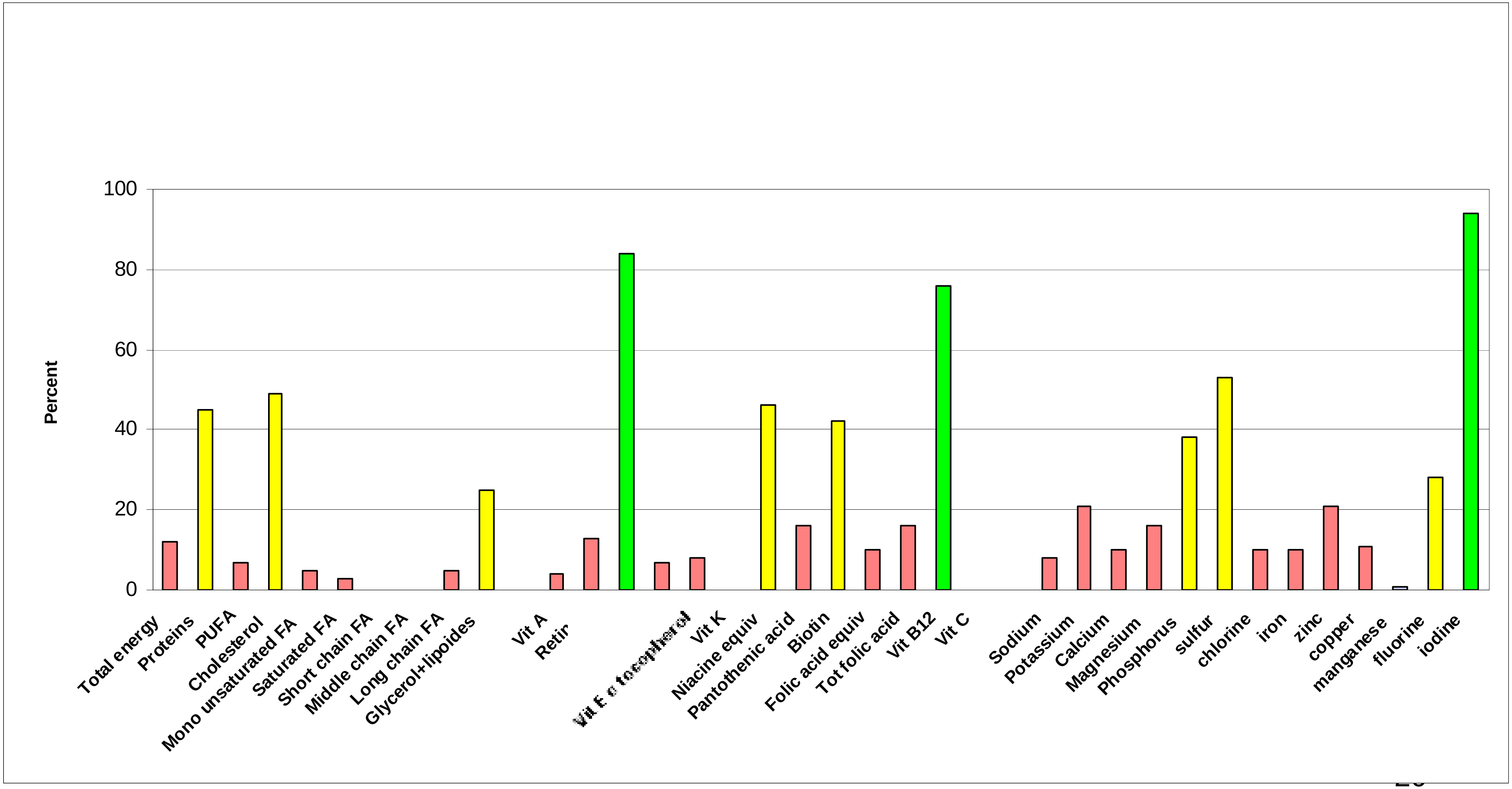
Nature of fish consumed

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

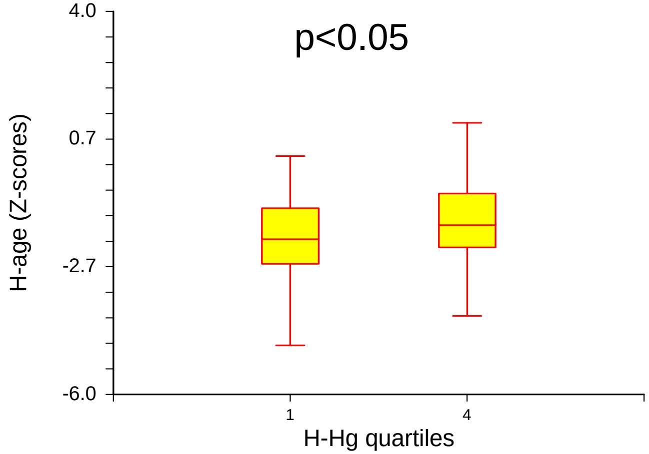
Fish consumed

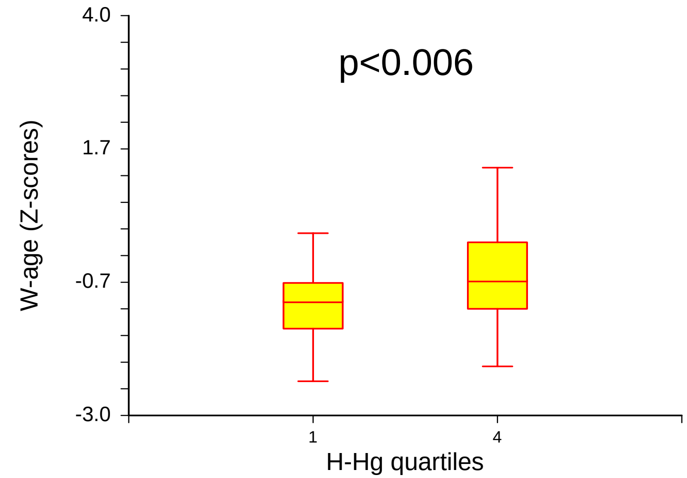
- 63% herbivorous and omnivorous
- 37% piscivorous and carnivorous
- No differences between ethnic groups but
- **Remote communities consumed significantly more carnivorous fish than the others**

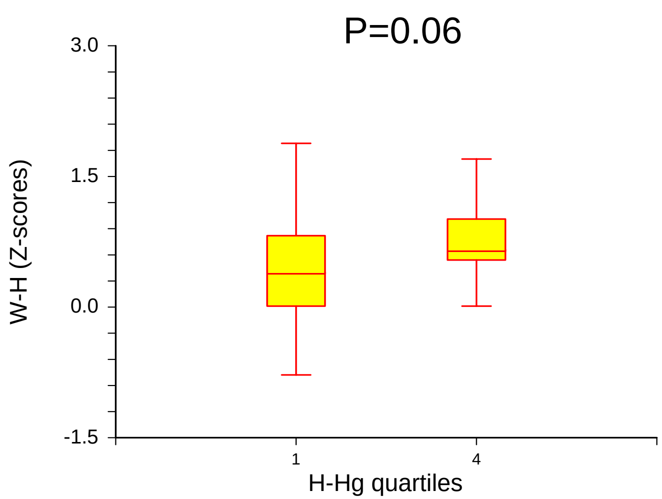
Nutritional importance of fish: percent of energy and nutrients provided by fish

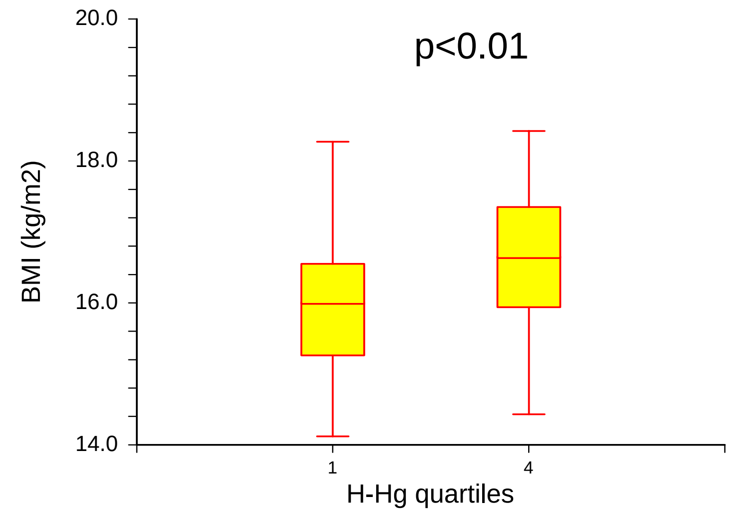


Relationships between H-Hg and anthropometric indices in 5-10-year-old children









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

- To the riverside communities of the Beni River
- To Carlos for his constant devotion to the team
- To the Environmental Quality Laboratory (Ing Jaime Chincherros) of La Paz University
- To our colleagues of the Biochemistry and Pharmacy faculty (Dra Sara Perez, Susana Revollo and Sonia Jimenez)
- To Marc Roulet (2006 †) who inspired and coordinated this program