



Lead exposure in indigenous children of the Peruvian Amazon

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The Corrientes river basin



- ▶ **Northeastern part of Peru**
- ▶ **Loreto Region**
- ▶ **Extension 425 km**
- ▶ **36 villages (total population: 8000) Achuar, Quichua and Urarina**
- ▶ **oil installations**

Oil industry in the Corrientes

Since 1970

- Environmental impacts

- Discharging of produced waters into the rivers
- disposal of sewage and industrial waste
- frequent oil spills.
- Documented:
 - 1987: high levels of Hg, Cr, TPH, in surface waters.
 - 1998- 2007: oils, fats, TPH and heavy metals
 - 2006- 2009: 158 oil spills , 10 damaged sites

(FECONACO, 2011).




-Health and social impacts

No comprehensive assessment yet.

Continuous communities' demands and protests.

THE CASE

Lead exposure in the Corrientes



2004 -2005

Indigenous leaders and health officials (CENSOPAS) planned first assessment of health impacts

Limitations to assess oil exposure's indicators.
Selection of Pb and Cd

July 2005

Study: Blood lead and cadmium
74 children, 7 communities

THE CASE


Lead exposure in the Corrientes



June 2006

Elevated blood Pb (66%)

Elevated blood Cd(99%)



Attributed
to the
**Oil-related
pollution**

THE CASE

Lead exposure in the Corrientes

October 2006: DORISSA Agreement

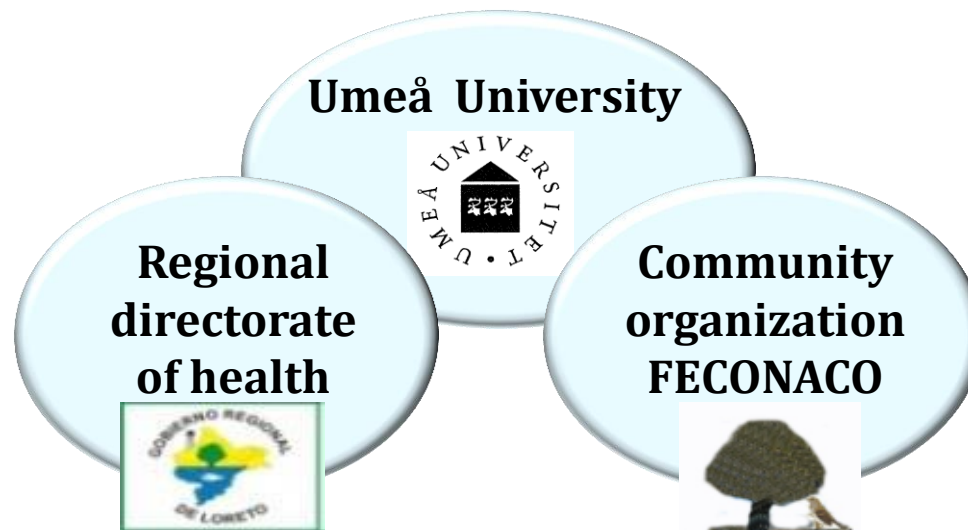


Funding for an independent **study** to clarify the source of heavy metals exposure

THE STUDY

Participatory epidemiological study

January 2008: Collaboration agreement



July 2008: I joined the research team, PhD project

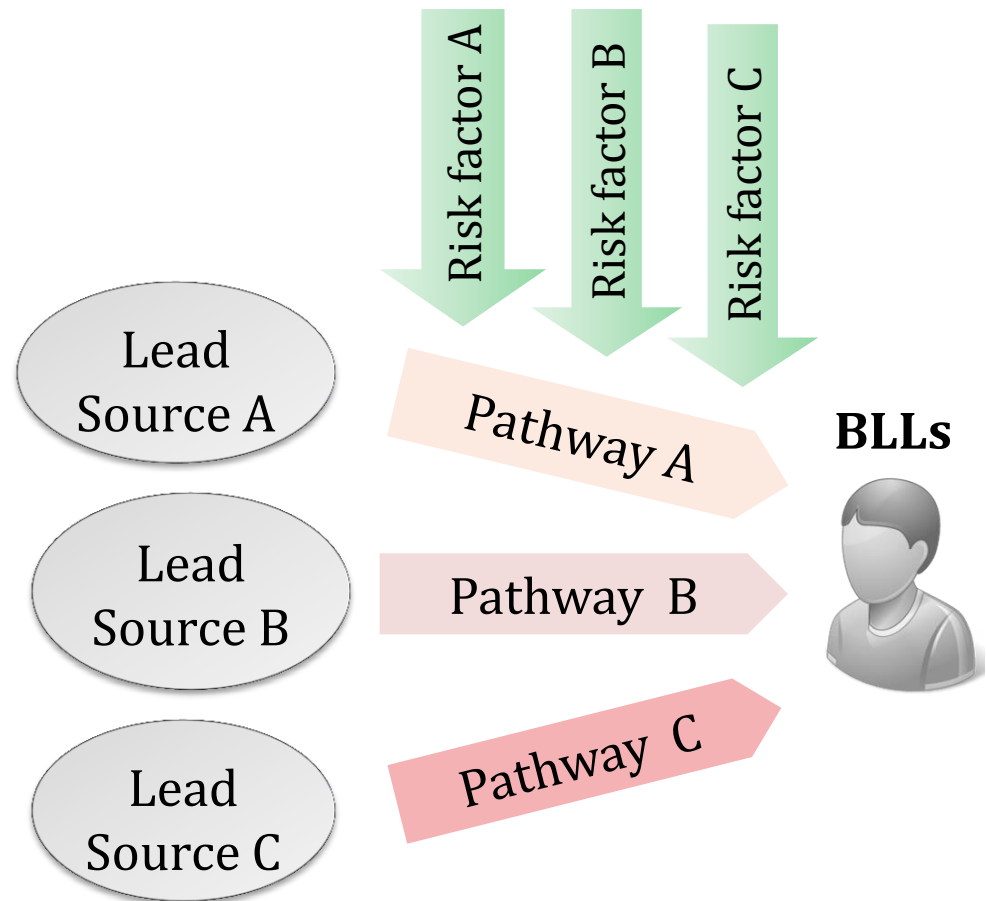
Main objective

To understand the reasons for the elevated BLLs in order to suggest control and prevention strategies

Specific objectives

To determine:

- **sources**
- **risk factors**
- **pathways**



Specific objectives

To understand:

lead exposure



oil activity

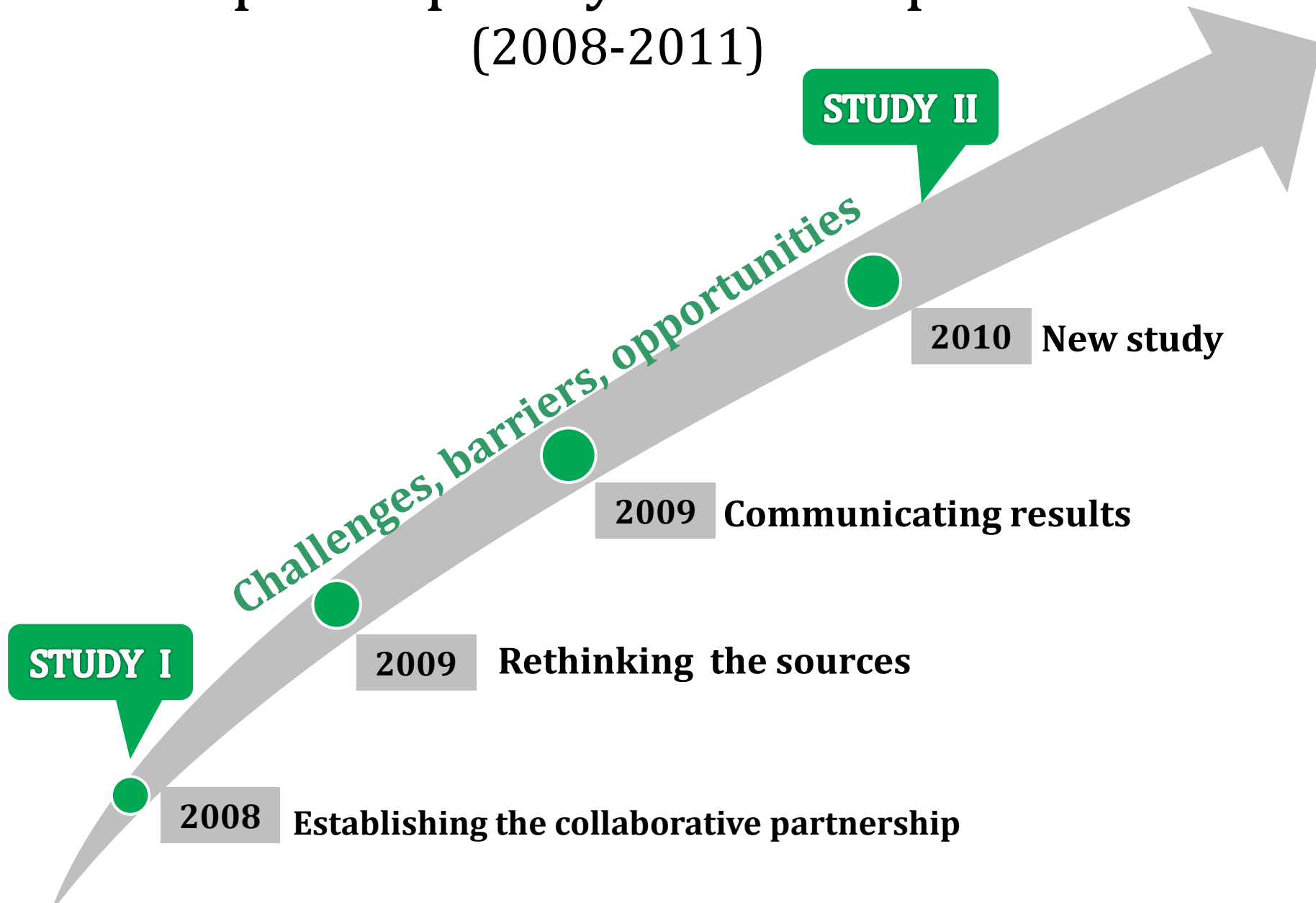
Oil
Activity

?

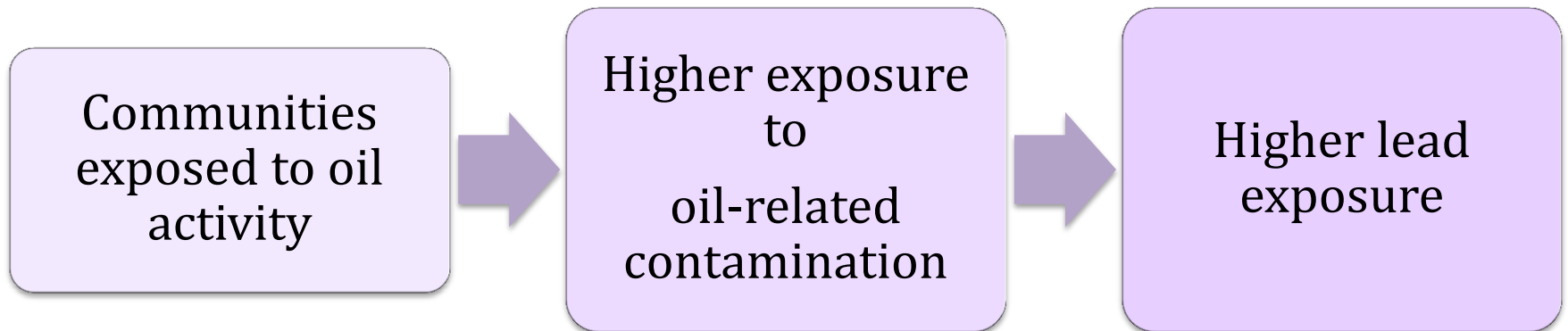
BLLs



The participatory research process (2008-2011)

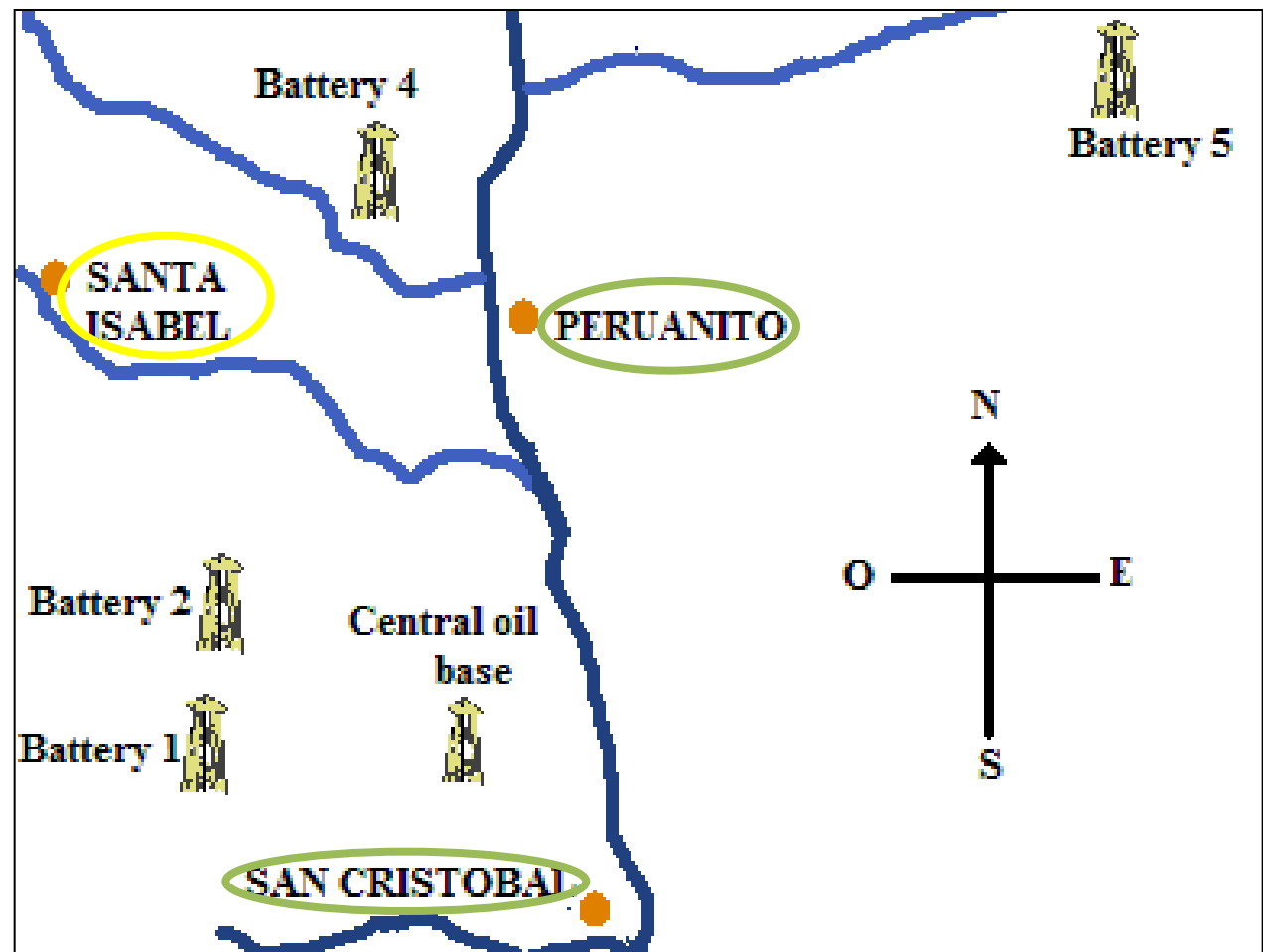


STUDY I



STUDY I

2 villages
exposed
1 village non
exposed to oil
activity



STUDY I

Participants

All residents aged 0-17 years, whose families had lived in the area for the last five years and whose parents authorized their participation

STUDY I

PROCEDURES

1. **Lead population:** BLL in all children 0-17 years using the Leadcare
2. **Lead environment:** water and soil samples in villages and selected dwellings
3. **Risk factors:** Hb levels, anthropometrics questionnaire and risk map


RESULTS STUDY I

Table 4. Demographic characteristics of children in three communities, Corrientes river basin, Peruvian Amazon, 2009.

	San Cristobal	Peruanito	Sta. Isabel de Copal	Overall
n (%)				
Overall	13(5.8)	88(39.8)	120(54.3)	221(100.0)
Sex				
Girls	9 (69.3)	47(53.4)	68(56.7)	124(56.1)
Boys	4(30.7)	41(46.6)	52(43.3)	97(43.9)
Age group				
0-3	6(46.2)	19(21.6)	33(27.5)	58(26.2)
4-6	3(23.1)	21(23.8)	26(21.7)	50(22.6)
7-17	4(30.7)	48(54.5)	61(50.8)	113(51.1)

1. **Anticona C**, Bergdahl I, San Sebastian M. 2012. Lead exposure among children from indigenous communities of the Peruvian Amazon basin. Pan American Journal of Public Health. 31(4):296-302.

RESULTS STUDY I

n	GM BLL ug/dl	BLL \geq 10ug/dl	BLL \geq 5ug/dl
208	8,7 ug/dL	 27.4%	85%

1. **Anticona C**, Bergdahl I, San Sebastian M. 2012. Lead exposure among children from indigenous communities of the Peruvian Amazon basin. Pan American Journal of Public Health. 31(4):296-302.

RESULTS STUDY I

Elevated BLLs

Regardless exposure to oil activity
No \neq in GM BLLs

TABLE 1. Descriptive characteristics and blood lead levels in children from two study communities ($n = 208$) in Corrientes River basin, Peru, 2009

Variable	No.	%	Geometric mean BLL, $\mu\text{g/dL}$	GSD, $\mu\text{g/dL}$	BLL $\geq 10 \mu\text{g/dL}$	
					No.	%
Community of residence						
With oil activity	88	42.3	9.08	3.9	26	29.5
Without oil activity	120	57.7	8.38	4.1	31	25.8

RESULTS STUDY I

Risk factors

Older age: group 7-17 years old has 3,7 times greater likelihood...than the group 0-3 years old.

Boys: 2.12 times more likely than girls of having BLLs $\geq 10\mu\text{g/dL}$

Environmental assessment

Pb levels below reference values

Rethinking ...

RESEARCH VISIT TO PERUANITO

- Group discussions
- Interviews
- Households visits

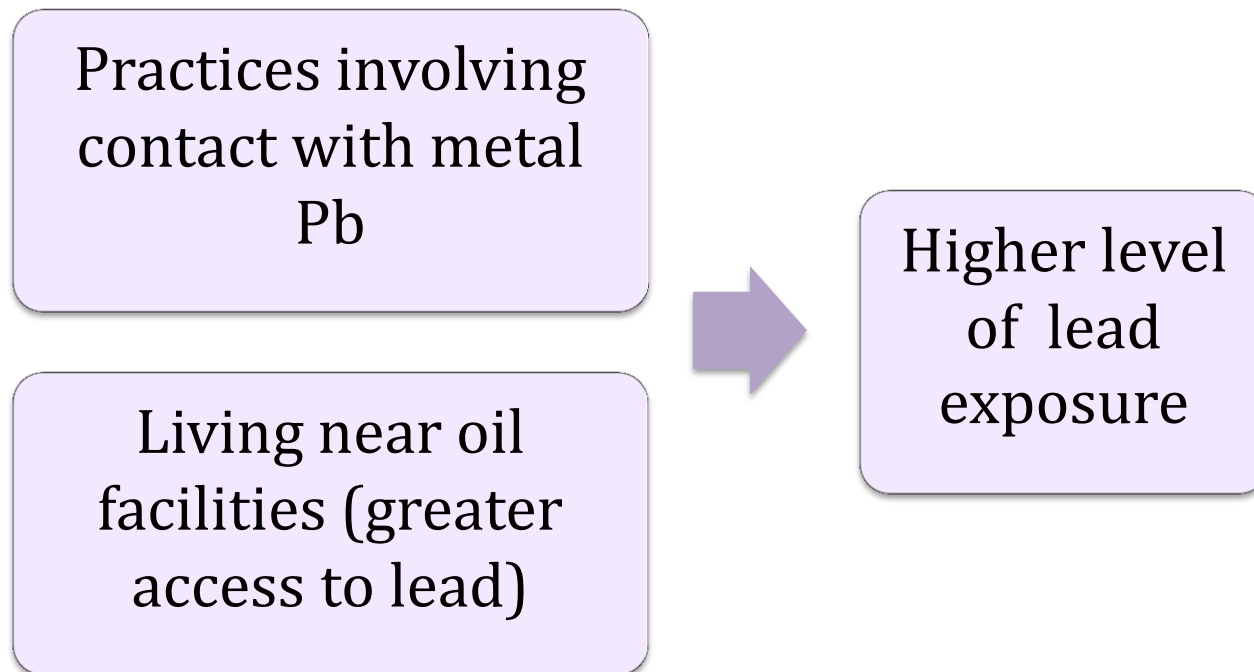


Metal lead for fishing sinkers

- recycling high tension cables from the oil company waste' deposits

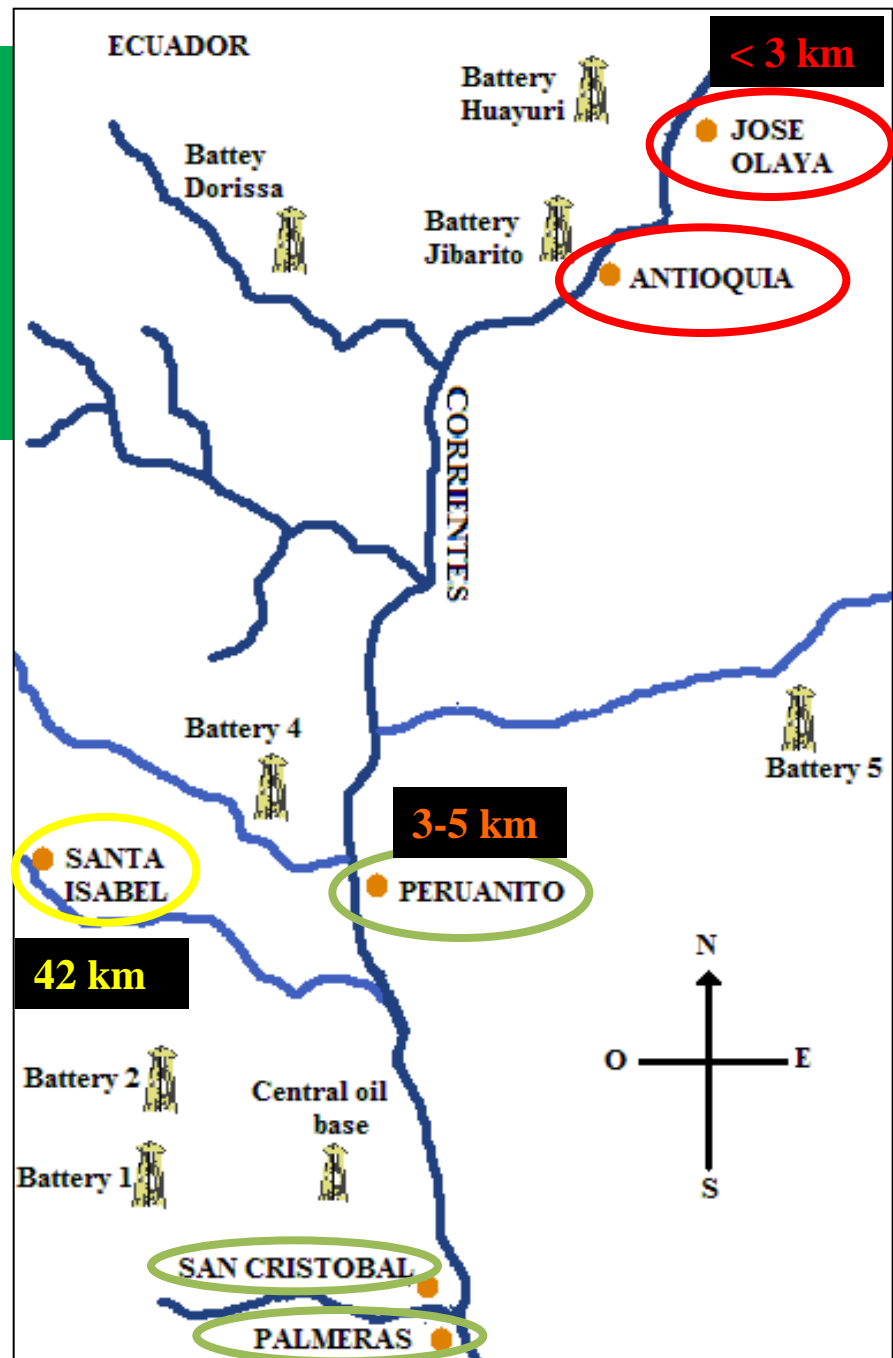
- car batteries, ammunition, vendors

STUDY II



STUDY II

6 villages
≠ exposure
to oil activity



6 communities

geographic
location



history of
oil exposure

→ Distance to
nearest oil
instalation

→ # Oil spills (OS)
from 2006

High exposure: JO 2.5km; 5OS

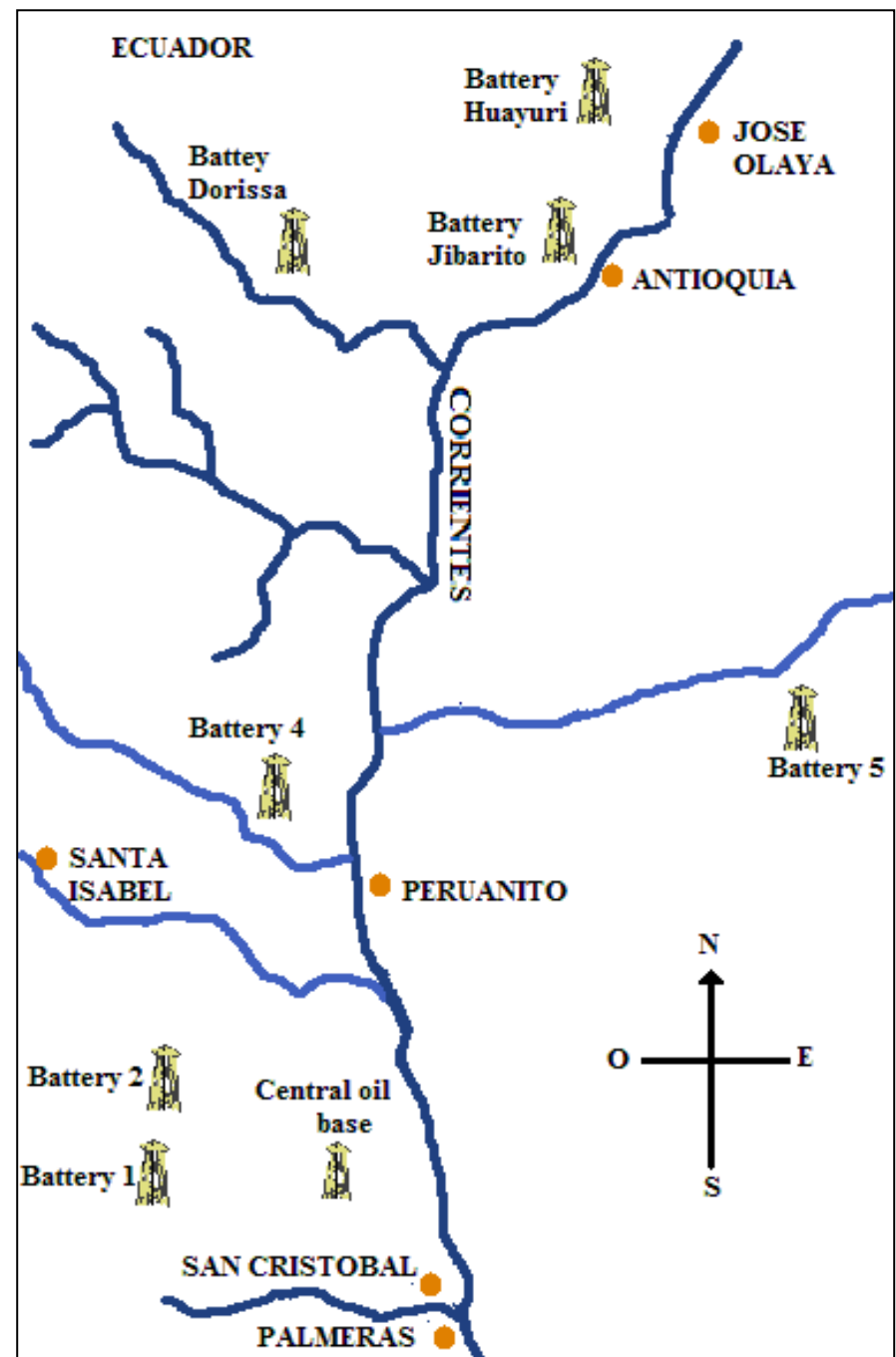
AN 2.5km; 6OS

Medium exposure: PE: 5km; 0OS

SC: 5km; 7OS

PA: 4km; 7OS

No exposure: SI: 42 km



STUDY II

Participants

All children aged 0-17 years, whose families had lived in the area for the last five years and whose parents authorized their participation

STUDY II

PROCEDURES (Similar to study I)

Environmental assessment

- sediments, fish, soil (communities)
- indoor dust, stove ash, foodstuff (dwellings)

Risk factors questionnaire

- activities/practices involving the contact with Pb


RESULTS STUDY II

Table 1 Demographic characteristics of the children tested for blood lead, from six indigenous communities of the Peruvian Amazon, Loreto, Peru, 2010

	<i>n (%)</i>						
	Jose Olaya	Antioquía	Peruanito	Sta. Isabel de Copal	San Cristobal	Palmeras	Total
Gender							
Boys	22 (56.4)	27 (50.9)	40 (48.8)	57 (43.9)	5 (33.3)	12 (44.4)	163 (47.1)
Girls	17 (43.6)	26 (49.1)	42 (51.2)	73 (56.2)	10 (66.7)	15 (55.6)	183 (52.9)
Age (years)							
0–3	8 (20.5)	19 (35.8)	27 (32.9)	41 (31.5)	4 (26.7)	13 (48.2)	112 (32.4)
4–6	11 (28.2)	14 (26.4)	11 (13.4)	27 (20.8)	2 (13.3)	5 (18.5)	70 (20.2)
7–17	20 (51.3)	20 (37.8)	44 (53.7)	62 (47.7)	9 (60.0)	9 (33.3)	164 (47.4)

2. **Anticona C**, Bergdahl I, San Sebastian M. 2012. Sources and risk factors for lead exposure in indigenous children of the Peruvian Amazon, disentangling connections with oil activity. *International Journal of Occupational and Environmental Health* 18(4): 268-277.

RESULTS STUDY II

n	GM BLL ug/dl	BLL \geq 10ug/dl	BLL \geq 5ug/dl
346	7.5 ug/dL	 27%	78%

3. **Anticona C**, Bergdahl I, San Sebastian M. 2012. Sources and risk factors for lead exposure in indigenous children of the Peruvian Amazon, disentangling connections with oil activity. International Journal of Occupational and Environmental Health 18(4): 268-277.

RISK FACTORS

Table 3 Age group-specific multivariate logistic models of OR and 95% CI for BLLs ≥ 10 $\mu\text{g/dl}$ in children from six indigenous communities of the Peruvian Amazon, 2010

	Overall	0–6 years	7–17 years
	<i>n</i> =346	<i>n</i> =182	<i>n</i> =153
Variable	OR (95% CI)	OR (95% CI)	OR (95% CI)
Boys*	3.7 (2.1–6.5)	1.5 (0.6–3.7)	1.2 (0.5–3.4)
Age group 4–6 years [†]	2.9 (1.1–7.5)	NA	NA
Age group 7–17 years [†]	6.9 (1.8–26.2)	NA	NA
Reside in a community with high exposure to oil activity [‡]	2.7 (1.2–6.3)		
Play with pieces of lead	NA	7.2 (2.5–20.2)	NA
Fish \geq three times/week [§]	NA	NA	4.6 (1.2–16.8)
Chew lead scraps	NA	NA	7.8 (2.9–21.3)
Drive motorboat	NA	NA	3.4 (1.0–9.9)

Note: NA: not applicable.

*Compared to girls.

[†]Compared to age group 0–3 years.

[‡]Compared to reside in a community with no exposure to oil activity.

[§]Compared to not fishing.

RESULTS STUDY II

0-6 years

Play with pieces of lead

7-17 years

- Fish ≥ 3 times per week
- Chew pieces of lead to make fishing sinkers

had an increased risk of having elevated BLLs

RESULTS STUDY II

Overall

Living in a community highly exposed to oil activity increased the risk for elevated BLLs

Connection to oil activity

proximity of communities to oil facilities and greater access to lead cables and other wastes

Environmental assessment

Pb levels below reference values

CONCLUSIONS

Sources, risk factors, pathways

**Living in a community
highly exposed to oil activity**

+

**Metal
lead**

**Chewing lead to make
fishing sinkers**



BLLs
7-17 years

Playing with pieces of lead



BLLs
0- 6 years

Connection with oil activity



Proximity to oil battery facilities

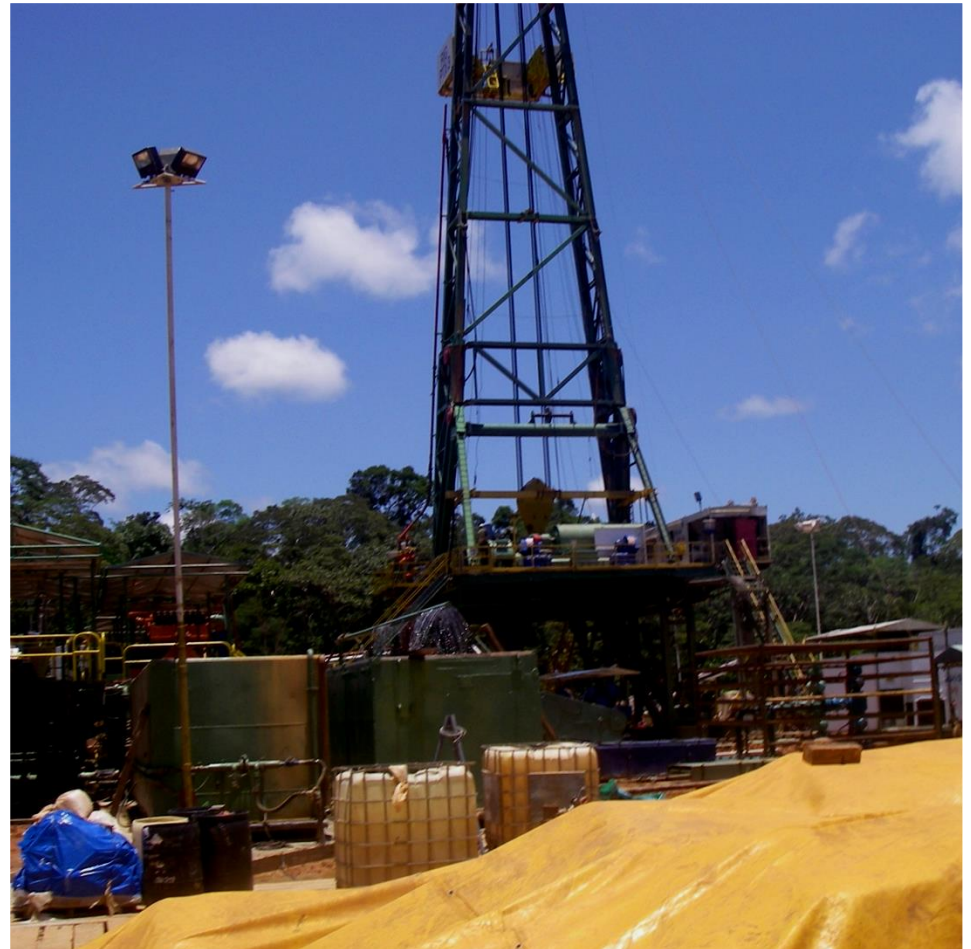
Greater access to metal lead

BLLs



Communities near oil facilities

- Greater access to industrial wastes from which to extract Pb.
- The majority of men work in the company.
- Families keep scraps of lead at home.



Recommendations

A community-based lead control and prevention plan

Introduce substitute non-harmful material(s) for fishing sinkers

Ensure secure containment of the oil company's waste deposits



Thanks....

STUDY II Data collection

- a) **assessment of BLL.** Leadcare system
 - b) assessment of Hb levels. HEMOCUE
 - c) **Risk factors questionnaire** to the heads of all families
 - d) **environmental sampling in communities:**
Sediments, soil, fish (EPA protocol)
 - e) **environmental sampling in selected dwellings:**
Indoor dust,, foodstuff (EPA protocol)
-

Chemical analysis

- Total Pb in all samples by inductively coupled plasma- sector field mass spectrometer (ICPSFMS)
- Modified U.S. EPA method 200.8. Laboratory ALS Scandinavia

Data analysis

Descriptive statistics, bivariate analysis. Logistic regression with GEE