

EXTENT OF LEAD EXPOSURE IN MOTHERS AND INFANTS LIVING AROUND A “CLOSED” LEAD MINING AREA, KABWE, ZAMBIA

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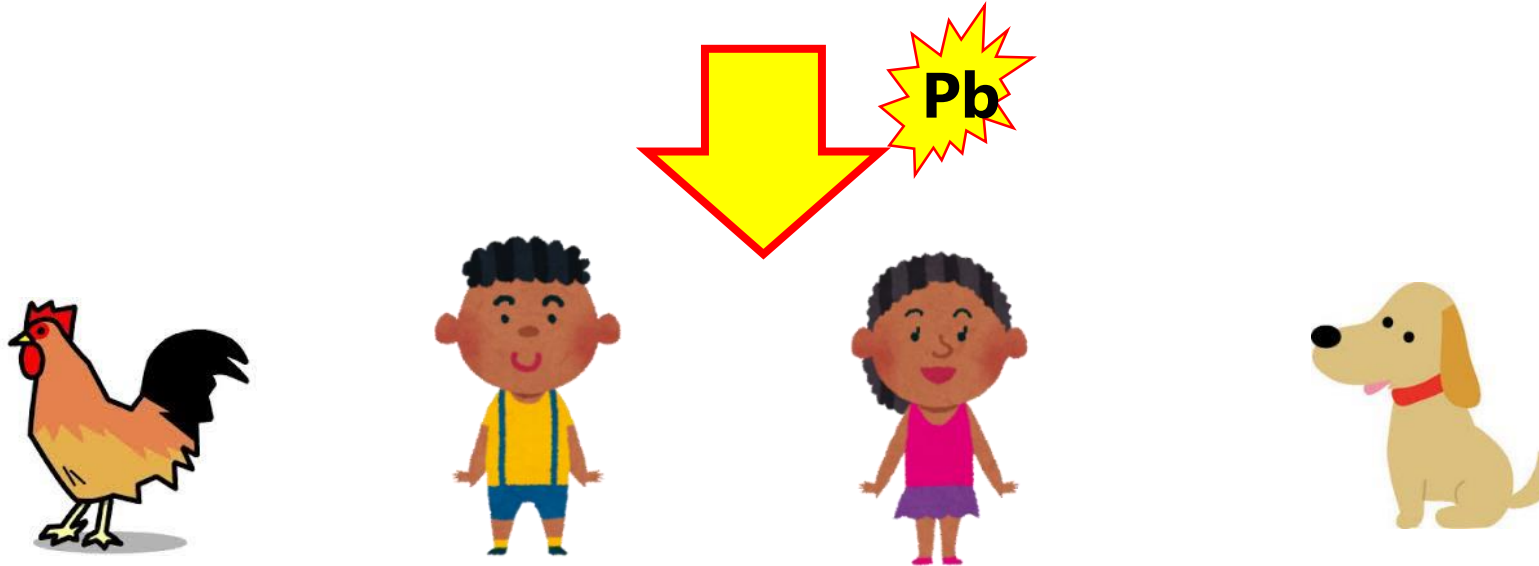
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Lead Poisoning

Lead (Pb)

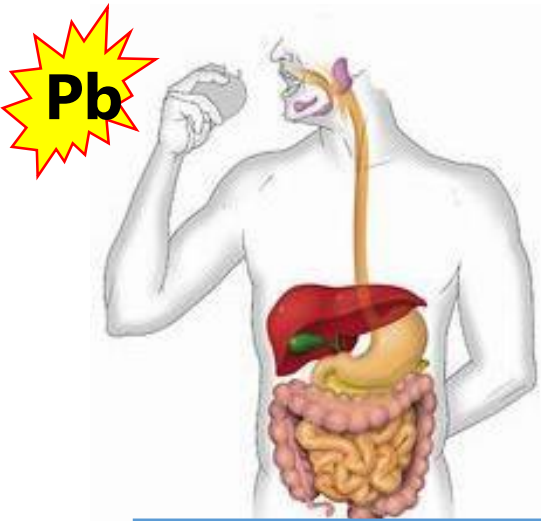


Pb is commonly used for our life

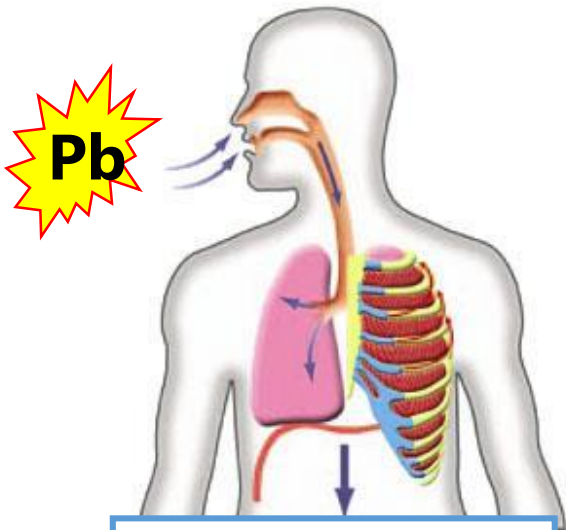


Poisonous to human and animals

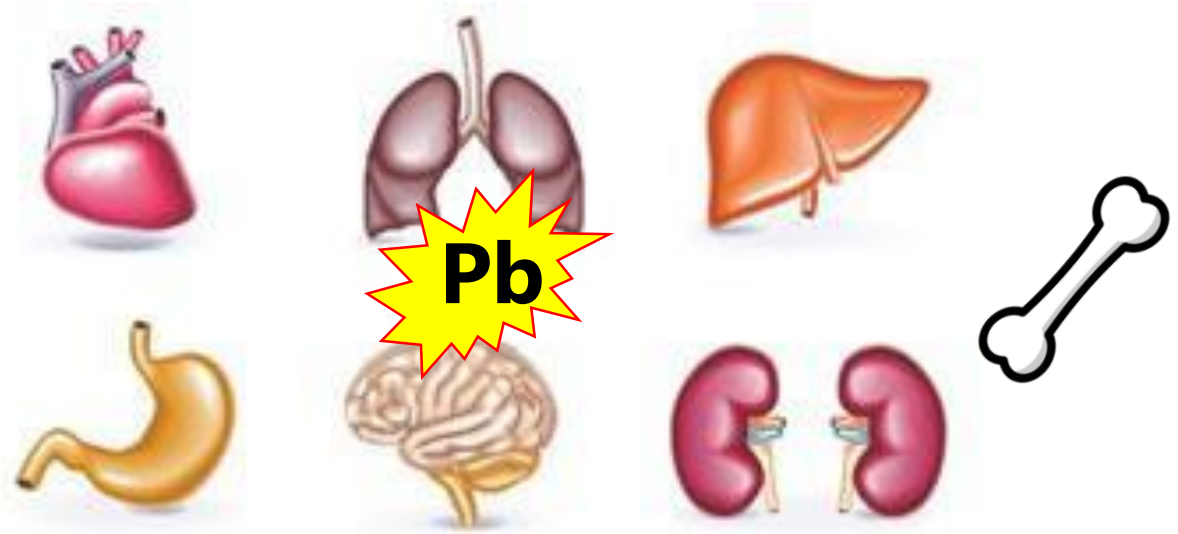
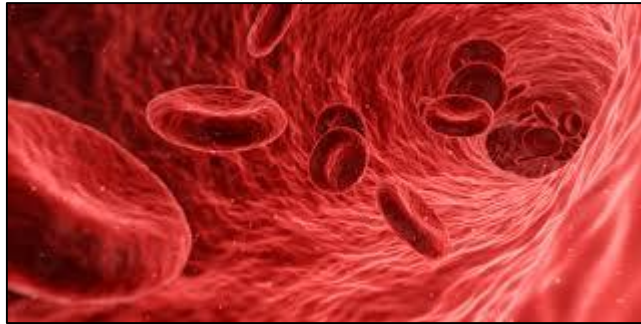
Pb Exposure



Ingestion





Inhalation



Accumulates in soft tissues and bone

Symptom of Pb Poisoning

Children 	BLLs ($\mu\text{g}/\text{dL}$)	 Adults
Death →	150	← Encephalopathy ← Nephropathy
Encephalopathy →	100	← Frank anemia
Nephropathy →		← Male Reproductive Effects
Frank Anemia →	50	← ↓ Hemoglobin Synthesis and Female Reproductive Effects
↓ Hemoglobin Synthesis →	40	← ↓ Nerve Conduction Velocity
↓ Vitamin D Metabolism →	30	← Elevated Blood Pressure
↓ Nerve Conduction Velocity →	20	← ↑ Erythrocyte Protoporphyrin (men)
↑ Erythrocyte Protoporphyrin →		← ↑ Erythrocyte Protoporphyrin (women)
↓ Vitamin D metabolism(?) →		
Developmental Toxicity →	10	
↓ IQ, ↓ Hearing, ↓ Growth	5	
Transplacental Transfer →		

Blood Lead Levels (BLLs)
as indicator of lead poisoning

← **Mortality level: 100 $\mu\text{g}/\text{dL}$**
(For Children)

← **Treated level: 45 $\mu\text{g}/\text{dL}$**

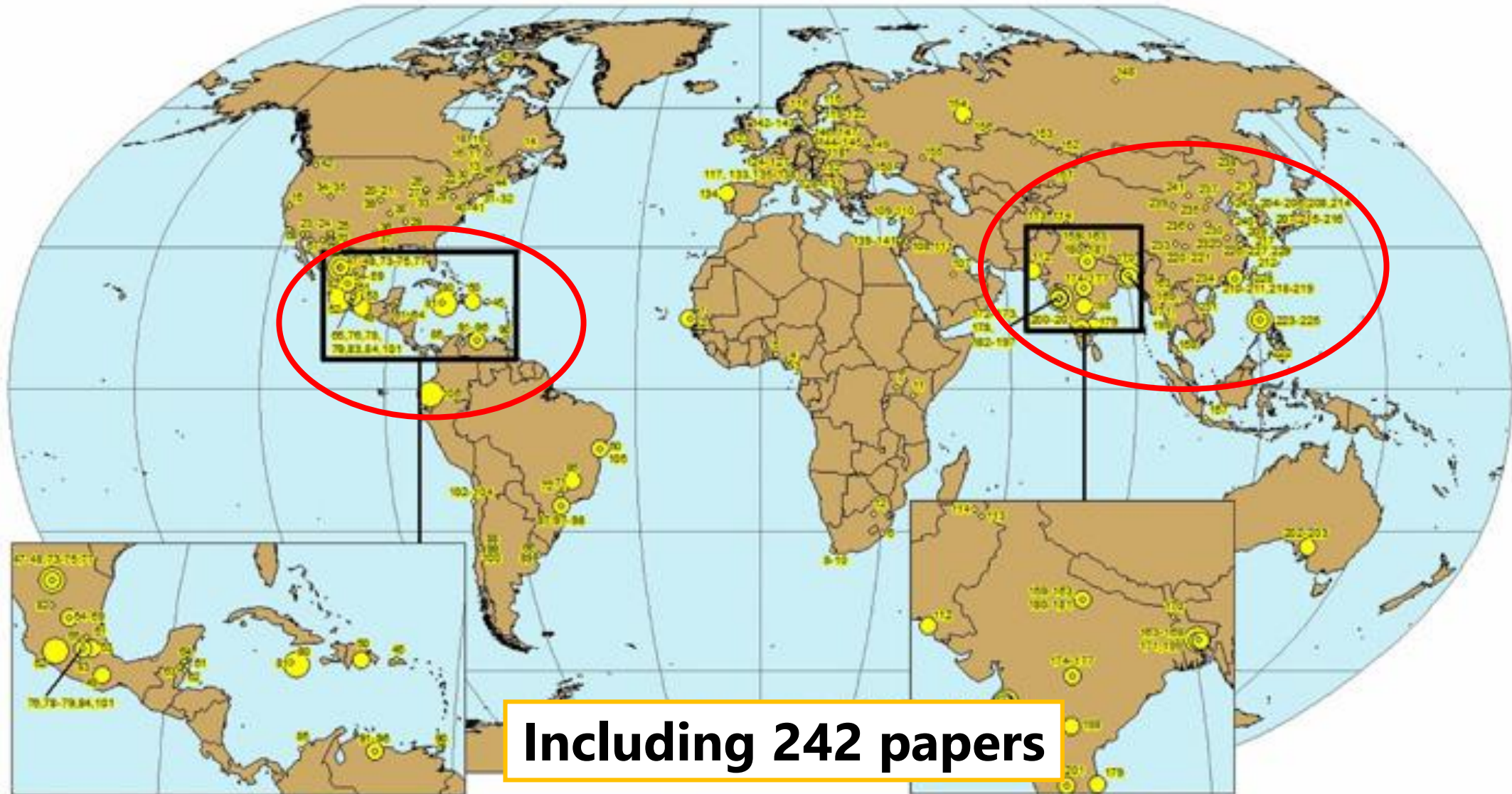
← **Concern level: 5 $\mu\text{g}/\text{dL}$**

Note: ↑ = increased function and ↓ = decreased function.

Source: ATSDR, 1992

Fig. 1. Blood-lead levels associated with adverse health effects.

BLLs in children published from 2000 to 2010

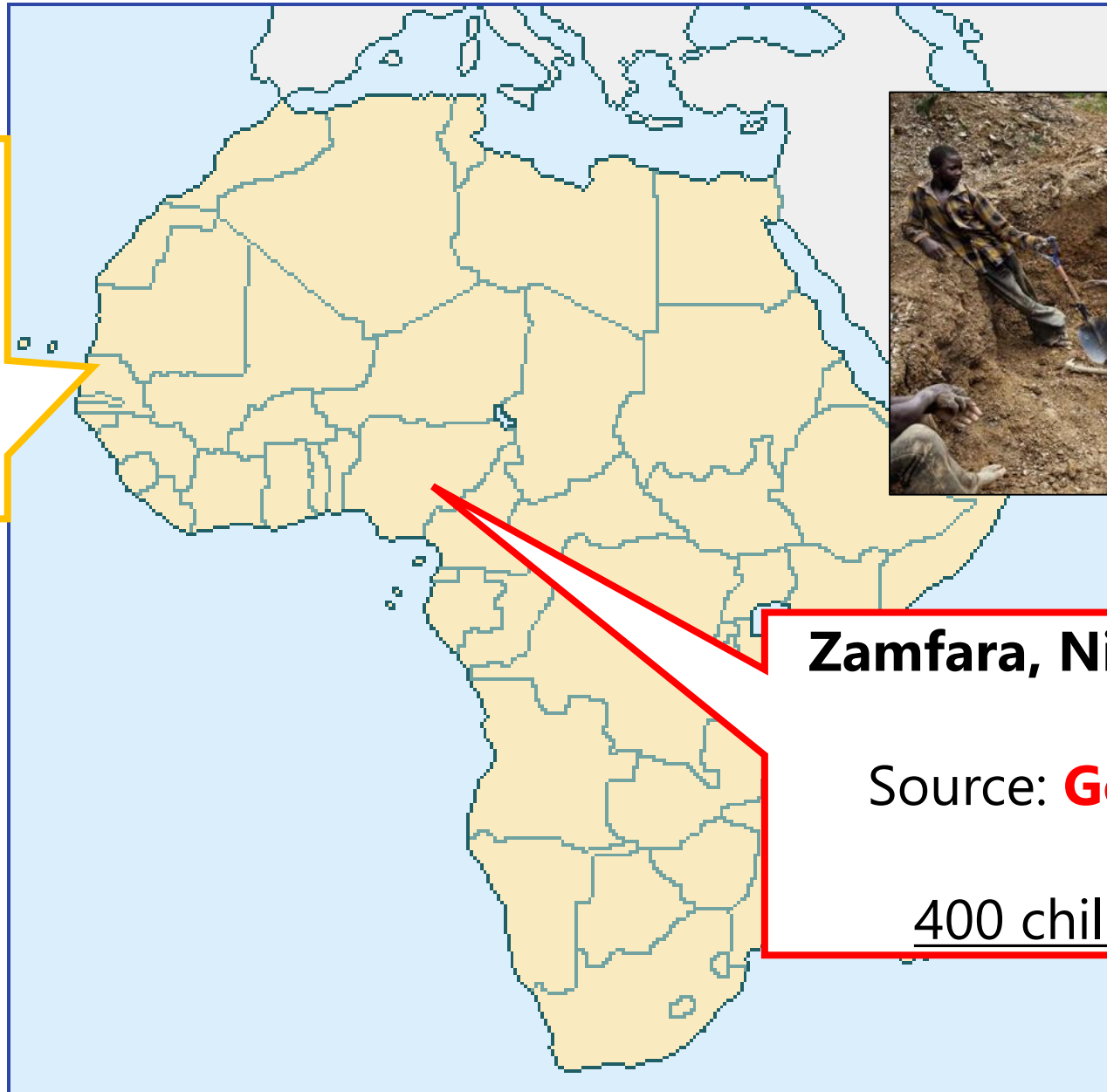


Pb Poisoning Outbreak in Africa

Dakar, Senegal in 2007

Source: **Battery recycling**

18 children died



Zamfara, Nigeria in 2010

Source: **Gold mining**

400 children died



Lead Pollution in Kabwe, Zambia

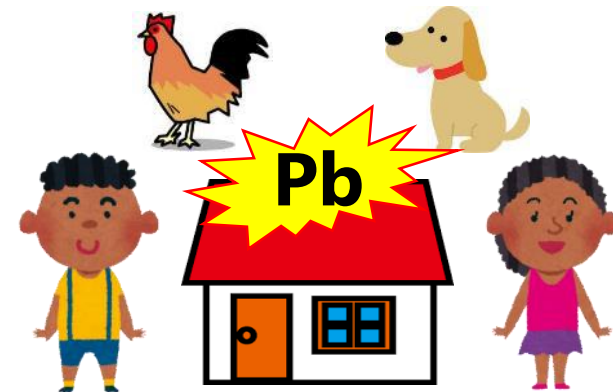
Kabwe, Zambia



- Capital city of the central province
- Pb mining area



Unregulated Mining Activities
for 100 years



Pb spread around mining area

Top 10 World's Worst Polluted Places from 2007



Pb Mining Waste Dump Site in Kabwe

- **Highest Pb concentration more than 50000ppm**

Range: 9 – 51188 ppm

Nakayama et al., Environmental Pollution, 2011

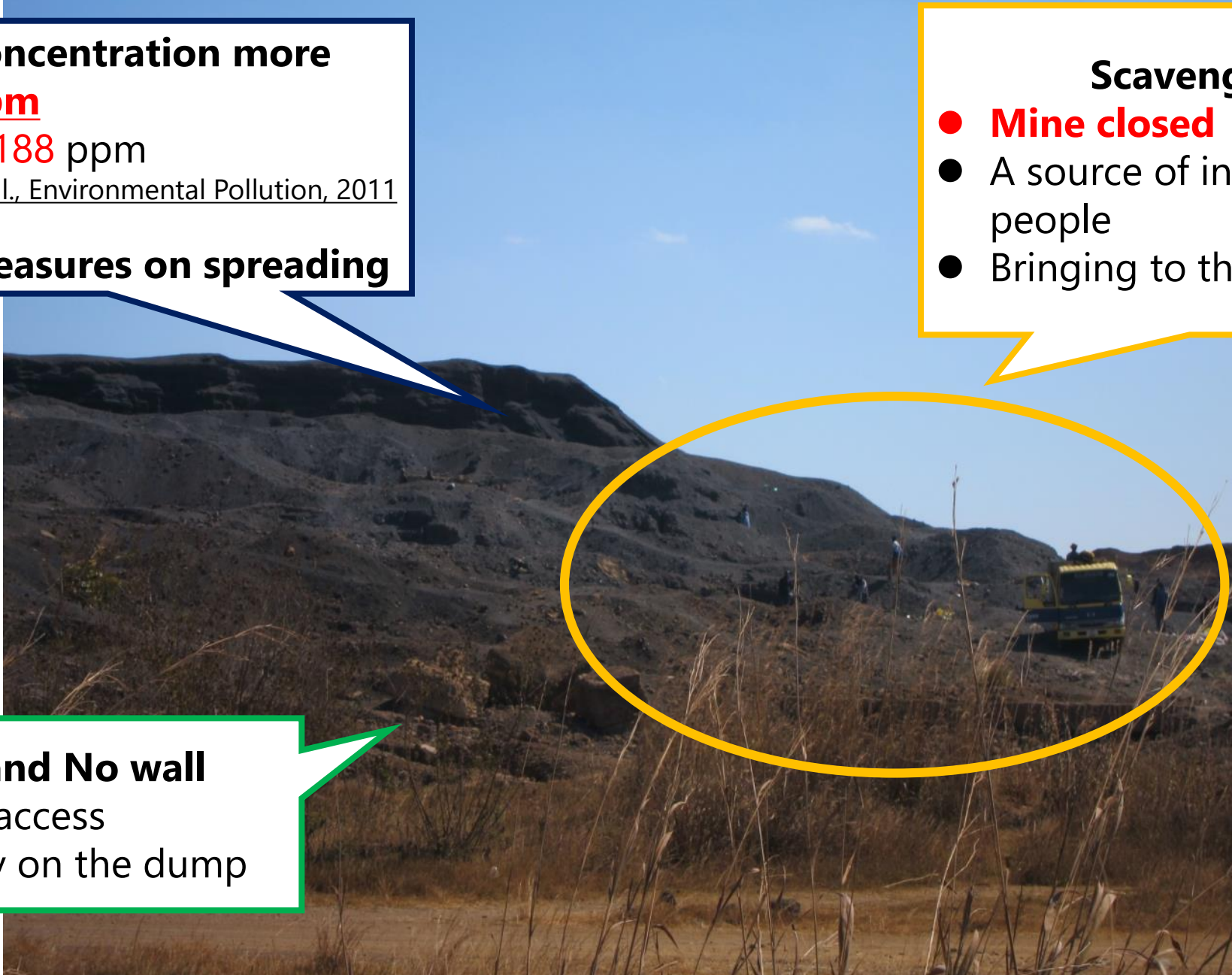
- **No control measures on spreading**

Scavenging ores

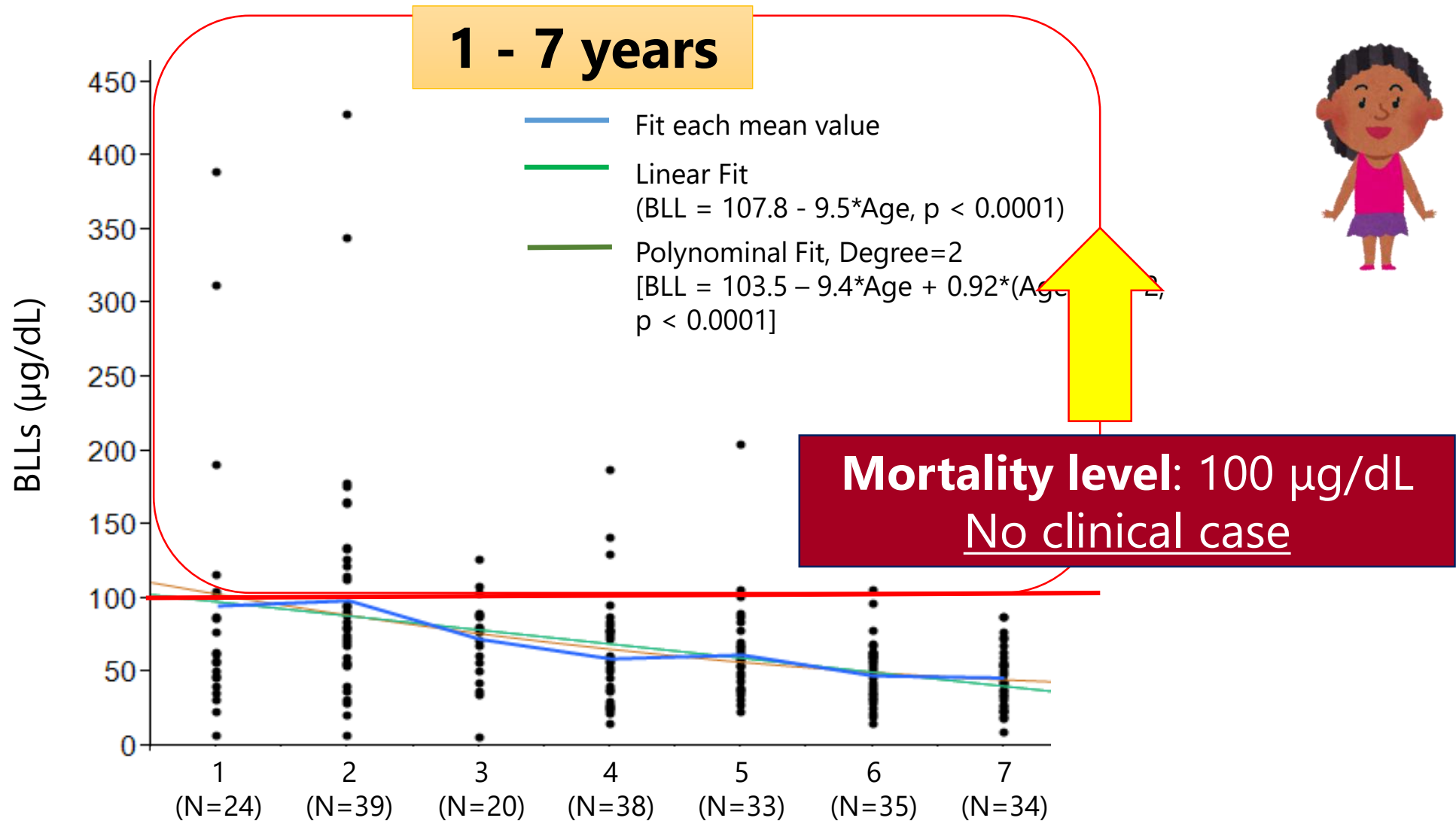
- **Mine closed**
- A source of income for local people
- Bringing to their home garden

No fence and No wall

- Anyone can access
- Children play on the dump



Previous Study: Children in Kabwe



BLLs of all children samples were above **concern level: 5 $\mu\text{g}/\text{dL}$**

Pb poisoning in African countries

Senegal and Nigeria

- Clinical case and children's death

Kabwe

- No clinical case reported

There could be some differences between other cases and Kabwe case

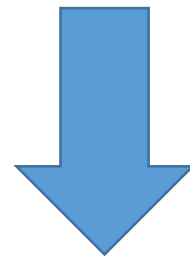
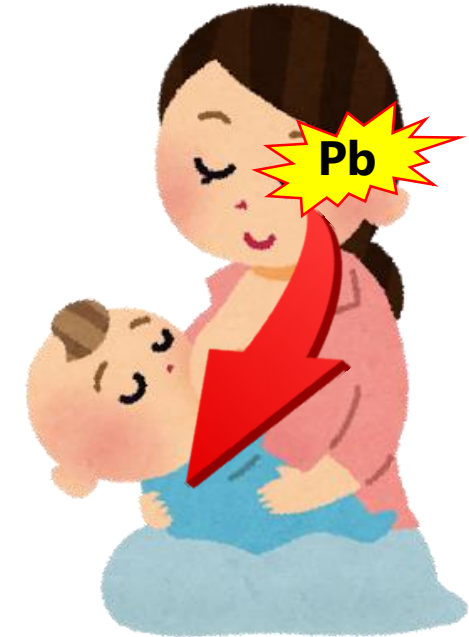
- **Acute exposure**
 - Heavy symptoms

- **Chronic exposure**
 - Exposed through placenta
 - Breastfeeding

Objectives of This Research

Pb Exposure on Infants through Breastfeeding

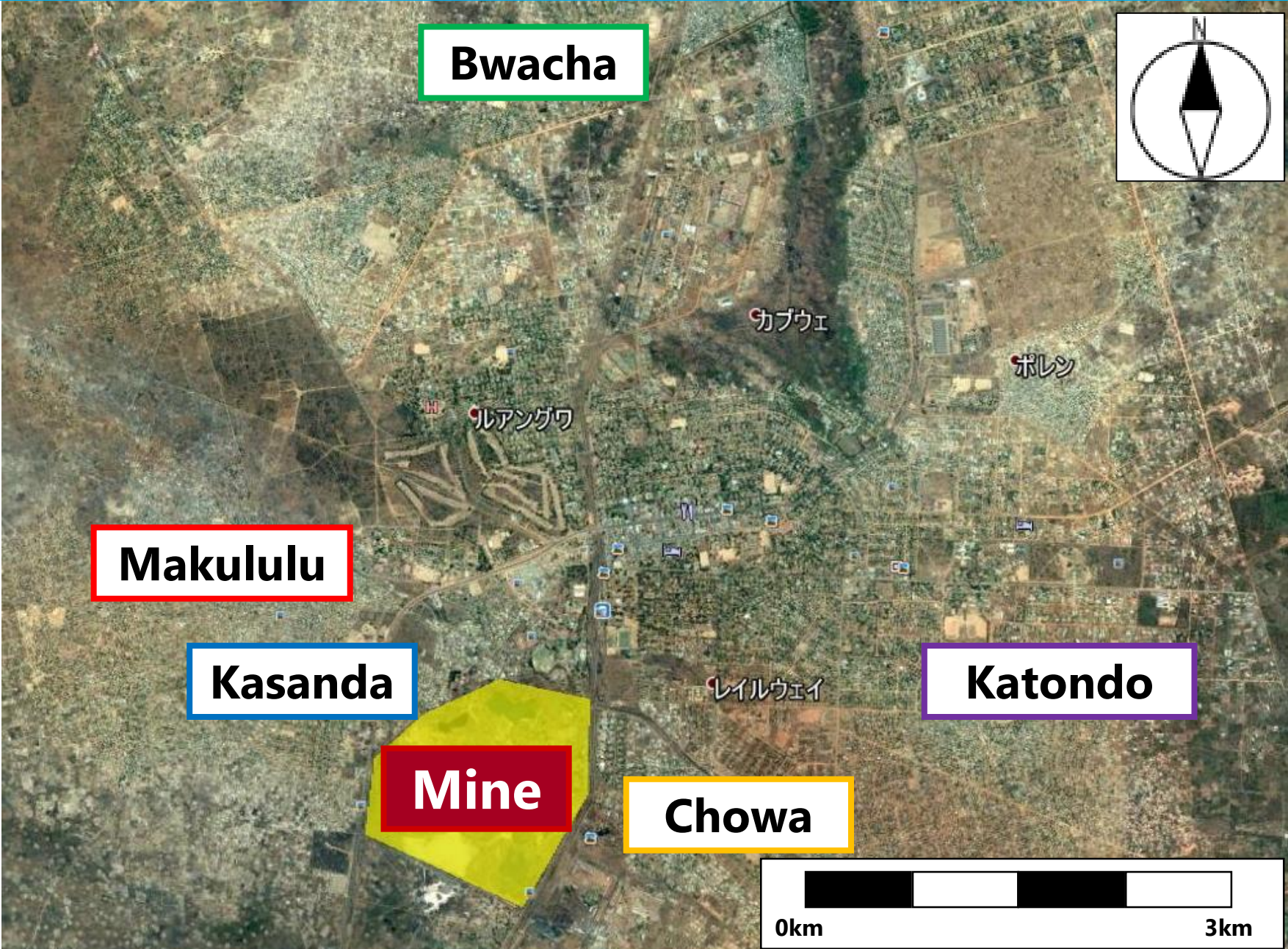
- **Pb can transfer into breastmilk** from maternal blood
- Breastfeeding is considered as one of the sources of Pb **exposure for infants**



Reveal the relationship between Pb exposure on mothers and their infants

Sampling in Kabwe: Mothers and infants

Sampling Site



Sampling

- **Blood samples** were collected from mothers and their infants (below 1 year 6 Months)
- Measuring **Blood Lead Levels (BLLs)** at clinics
 - **LeadCare II** is a portable machine to measure BLLs in the field
 - Limit of range: 3.3 – 65 $\mu\text{g}/\text{dL}$
 - Can **measure above 65 $\mu\text{g}/\text{dL}$** using dilution method



LeadCare® II



Future Plan

Future Plan

- Analyzing lead concentration using **Inductive Coupled Plasma Mass Spectrometer (ICP-MS)** in Japan
 - ICP-MS has higher accuracy than LeadCare II
 - Blood, Breastmilk and Fecal samples
- Questionnaires for mothers were administered
 - **Sociodemographic and Pb exposure** information will be analyzed
- **Monitoring BLLs in mothers and infants regularly from their born**



ICP-MS

Acknowledgement

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