IMPACT OF HEAVY METALS EXPOSURE ON THE INCIDENCE AND PROGNOSIS OF CONGENITAL NEURAL TUBE DEFECTS (EMBRYONIC NERVOUS SYSTEM) IN THE MINING AREAS OF KIVU, D.R. CONGO

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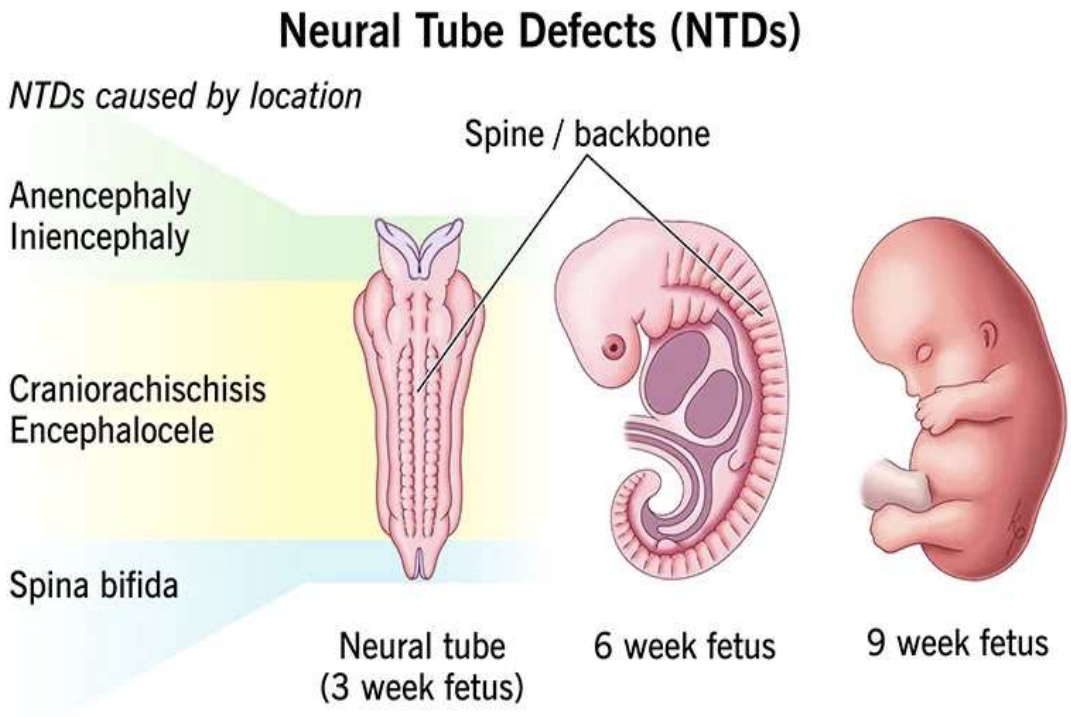
- Pr. Tim Nawrot, Hasselt ;
- Pr. Aimé LUMAKA, UNIKIN;

I. INTRODUCTION

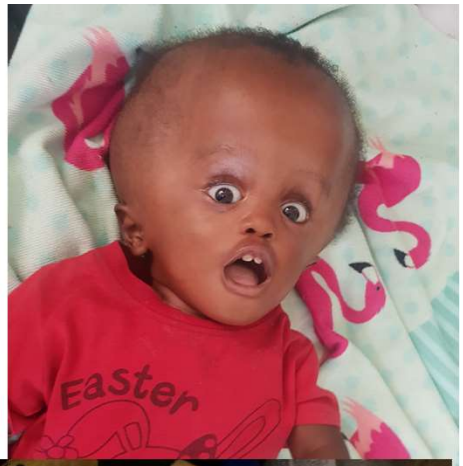
- **Neural tube defects (NTDs)** :

- among the most common congenital malformations ;
- Default of closure of the neural tube ;
- developed very early during pregnancy,
- 2 Common types : Spina bifida and anencephaly.
- Other related forms : hydrocephalus, holoprocencephaly;



I. INTRODUCTION

- Other related forms : hydrocephalus, anencephaly;
- exact etiology remains poorly understood;



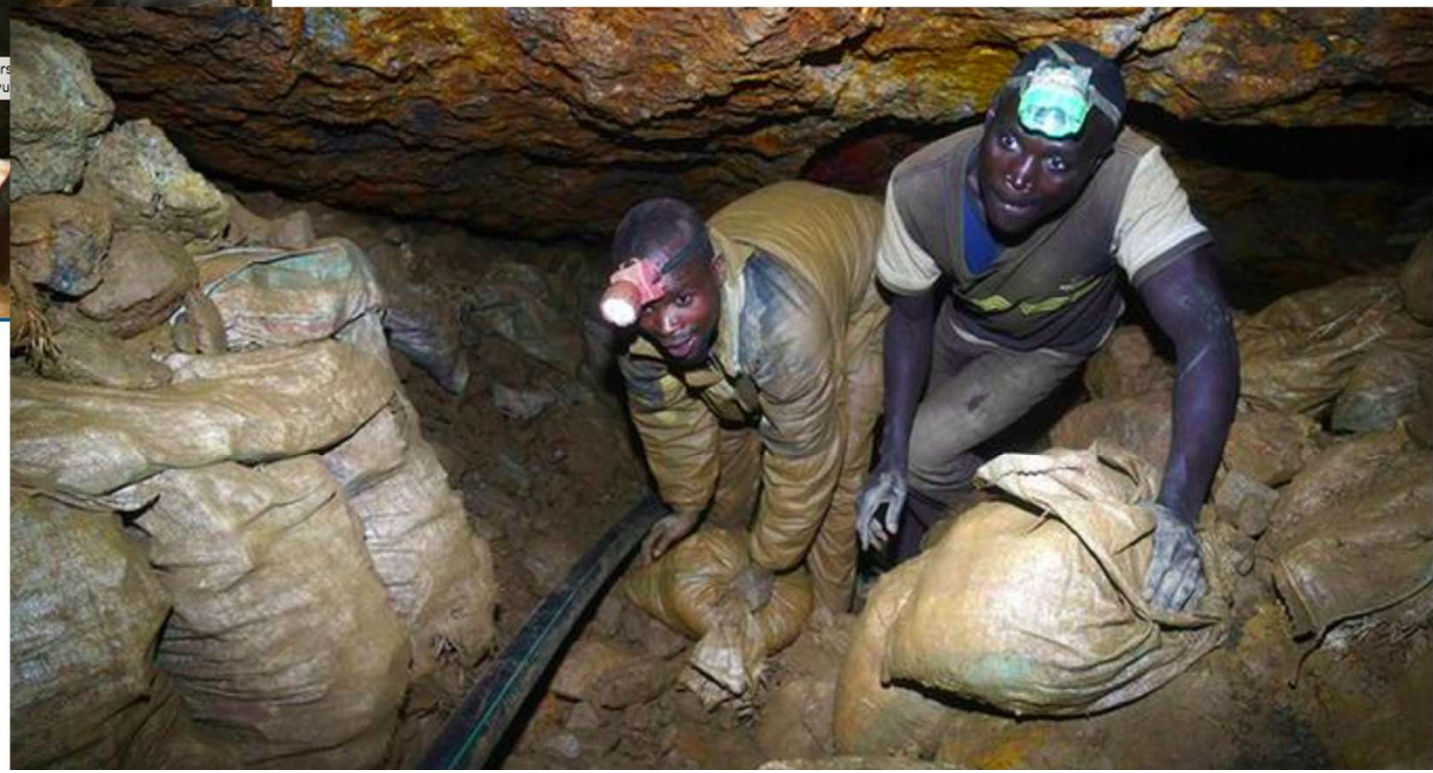
I. INTRODUCTION

- **Six main groups of minerals in DRC :**

1. copper group (copper, cobalt, uranium, zinc, lead, cadmium, germanium) ;
2. the chromium, nickel, diamond group ;
3. the tin group (tin, wolfram, colombo-tantalite, beryl, monazite) ;
4. precious metals (gold, silver, platinum) ;
5. iron and manganese group ;
6. mineral fuels (coal, shale bituminous, oil, gas)

Artisanal sector :

- Main way of mining in South Kivu ;
- More exposion than industrial mining.



II. HYPOTHESIS

- Relationship between environmental exposure and increased incidence of congenital malformations of the central nervous system in Mining areas in South-Kivu.

II. HYPOTHESIS

- **Trace elements and derivatives found in Kivu :** Gold, Mercury, Chromium, Manganèse, Cobalt, Nickel, Copper, Zinc, Arsenic, Selenuim, Niobium, Cadmium, Tantalium, Tungsten, Mercury, Lead) ;

- **Prenatal exposure and developmental effects on Nervous System :**

- Methyl-Mercurium

- Arsenic

- **Nickel**
- **Lead**
- **Lithium**
- **Mangenese**

J. Liu et al. / Journal of Trace Elements in Medicine and Biology 27 (2013) 322–325
Met. Ions Life Sci. 2011, 8, 263–303

II. HYPOTHESIS

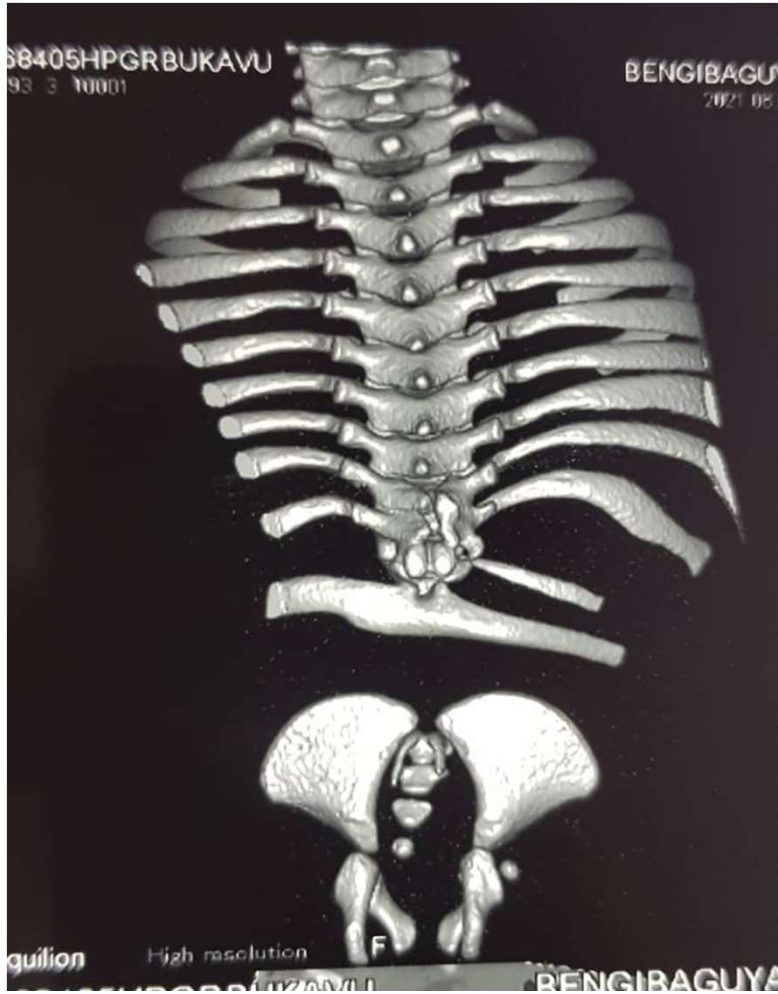
Dorso-lumbar Spina bifida

Malformative hydrocephalus in a young child

Evolutive and no treated hydrocephalus in the childhood.

II. HYPOTHESIS

Spinal dysgenesis with paraplegia

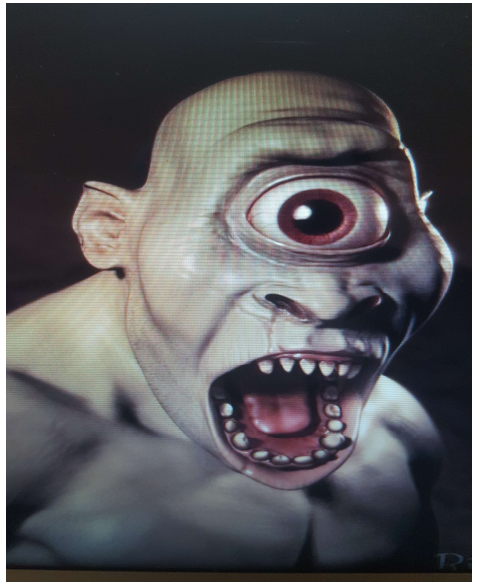


II. HYPOTHESIS

Extremely rare and monstrous malformations : **HOLOPROSENCEPHALY**

Malformation associating:

- A single facial orbital cavity;
- One eyeball or two globes in an eye socket;
- Absence of nasal cavities;
- Presence of a frontal growth (proboscis)



II. HYPOTHESIS

Extremely rare and monstrous malformations found in the mining areas of Kivu (FIZI and MWENGA)

II. HYPOTHESIS

SUSPICIOUS ETIOLOGIES :

- Insulin-dependent maternal diabetes,

- Ethanol;

- Ionizing radiation ;

- Trace elements toxicity ;

- cyto-megalovirus infection,

- Medications :

- **salicylates,**
- **antiepileptic medications,**
- **retinoic acid,**
- **aspirin,**
- **misoprostol,**
- **methotrexate, and**
- **cholesterol-ol-lowering agents.**

PROPOSAL RELEVANCE

- **The proposal will be relevant :**
- **Contributing to the WHO 3rd sustainable development goal (promoting well-being for all ages by 2030).**
- **Elucidating a correlation between the environmental exposure to trace elements in artisanal mining,**
- **Health promotion among artisanal miners in the Kivu ;**
- **Help to formulate clear protocols and regulations of artisanal mining,**

Published case series

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CASE REPORT

Birth Defects Research | Society for Birth Defects Research & Prevention | WILEY

Alobar holoprosencephaly in mining-related areas of the Eastern region of the Democratic Republic of the Congo: A case series

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Abstract

Background: Recent case reports described three cases of holoprosencephaly (HPE) in the area with high mining-related pollution of the southern region of the Democratic Republic of the Congo (DRC). We reported two male neonates with clinically diagnosed HPE in the localities of Fizi and Kitutu, two mineral areas in the Eastern region of the same country (DRC), where artisanal surface mining is predominant with high exposure to radiation and heavy metals from mining.

Cases' presentations: Two newborns from adult and multigravida mothers without pregnancy complication. The birth weights were 3,200 g and 2,500 g, respectively, and the malformations noticed were essentially the single median eye, the absent nose, polydactyly for one case, and proboscis for the other case. They both died a few minutes later after birth.

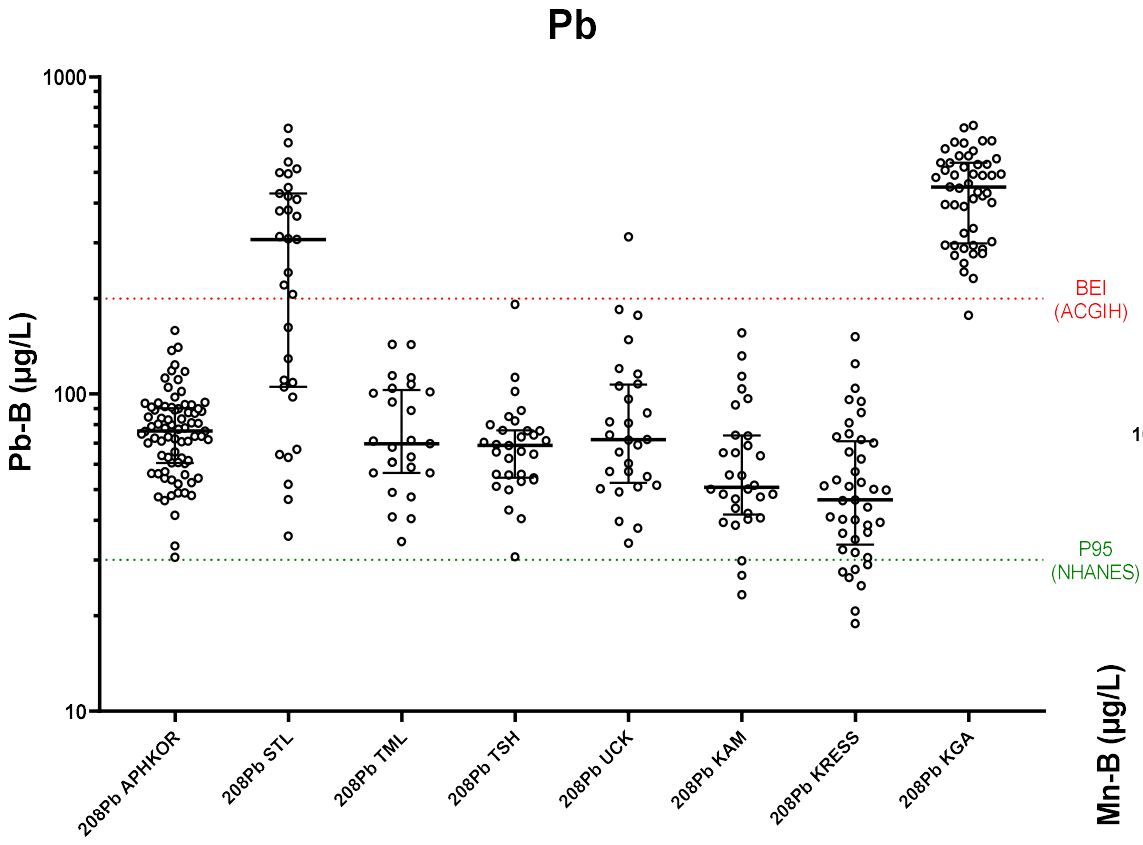
Conclusion: The etiologic factors of HPE remain unknown but seem to be

DRC : 497 mining licenses issued; (min. mines, 2015 report)

PILOT STUDY IN KAMITUGA MINING/ SOUTH-KIVU

KAMITUGA MINING IN SOUTH- KIVU

Dosage of minerals and heavy metals in the blood, urine, dust of mine workers.


Pb
Pb-B (µg/L)
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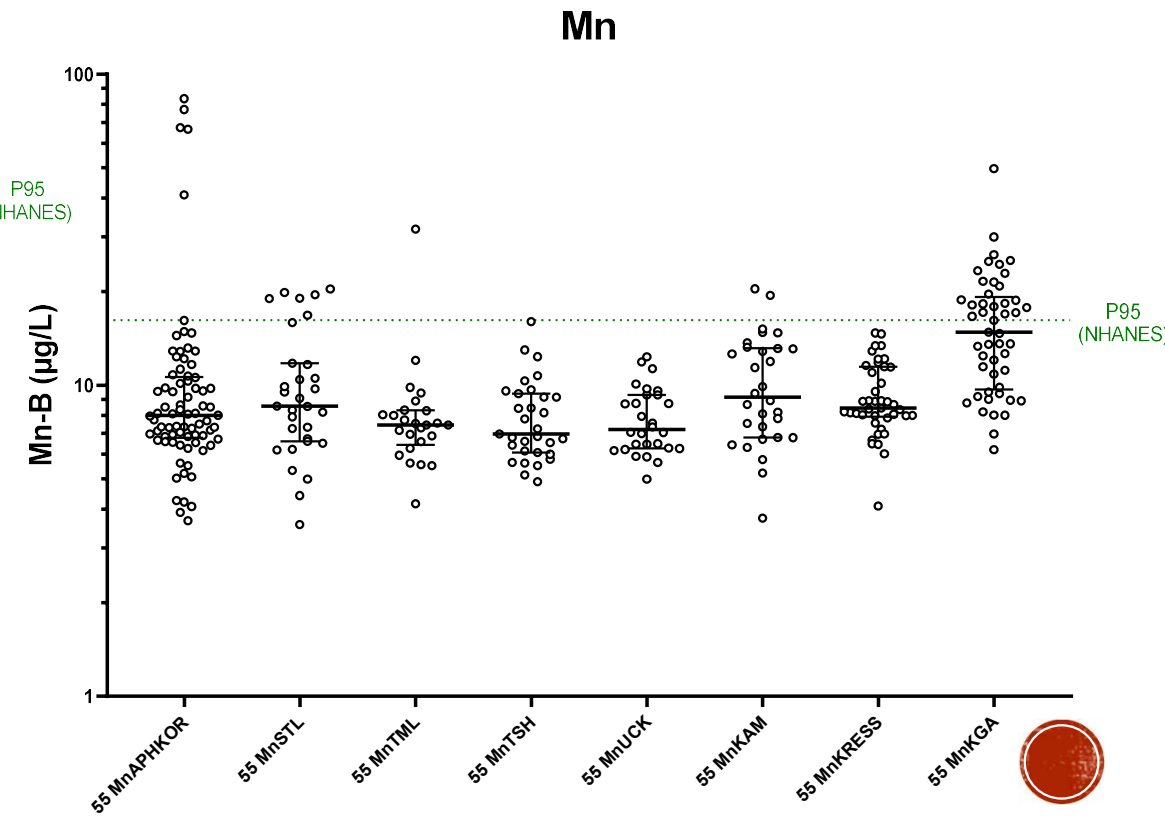
100
10
BEI
(ACGIH)
P95
(NHANES)
208Pb APHKOR
208Pb STL
208Pb TML
208Pb TSH
208Pb UCK
208Pb KAM
208Pb KRESS
208Pb KGA


Mn
Mn-B (µg/L)
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55 MnTML
55 MnTSH
55 MnUCK
55 MnKAM
55 MnKRESS
55 MnKGA

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IV. OBJECTIVES:

1.1. General objective :

- Investigate the relationship between parental exposures and the incidence of neural tube defects ;
- Develop effective strategies to reduce environment exposures ;

2.2. Specific objectives :

- Determine the incidence of NTDs in mining in South-Kivu ;
- Compare the level of minerals in samples of children with NTDs and their parents with others from agriculture areas;
- To identify the chromosomal alterations (mtDNA and telomere length) in parents of children with neural tube defects.

CHRONOGRAM	01/06/2022-30/04/2023	01/05/2023-30/04/2024	01/05/2024-30/04/2025	01/05/2025-30/04/2026
-Research Proposal **-Selection of the research sites and Training of the research team** **-Ethical clearance** **-Data collection and storage of samples** **-Samples analysis in KUL Laboratories** **Doctoral courses (Biostatistics and Epidemiology)** **-Seminars and Conferences** **-Manuscript writing and publications**	- Université Catholique de Bukavu (6 months) - KU Leuven (6 months)			
-Data collection on survival follow up, environmental studies on heavy metals in artisanal mining areas of Kivu **-Manuscript writing and publications** **-Conferences and doctoral courses**		- UCB (6 months) - KULeuven (6 months)		
- Manuscript writing and publications **-Conferences and doctoral courses** - **Surgery of NTD's** - **-Data results presentations and analysis**			- UCB (6 months) - KUL (6 months)	
-Manuscript writing and publications **- Manuscript and thesis writing.** **-PhD Defence**				KU Leuven (6 months)