Environment, Health and Safety (EHS) challenges in Artisanal and Small-Scale Mining (ASM) in the Southern African Region

Dr Dennis S. M. Shoko

ASM - INTRODUCTION

- ASM largely;
- Informal/extra-legal, poverty driven.
- Remote areas without mineral rights
- Not supervised by Mines, Environment and Finance ministries or any other

INTRODUCTION CONT'D

- Therefore operate without regard to environmental stewardship, far from health care facilities and pay very little attention to any safety procedures and protocols
- Formalisation a panacea?

ASM DEMOGRAPHICS AND MINERALS MINED

Country	Number of ASM)	Minerals Mined	Annual ASM Production as a proportion of national production
Angola	150 000	Chrome, manganese, kaolin, gypsum, quartz, phosphates, granite, marble, fluorite, sulphur and talc	unknown
Botswana	12 000	old soda ash and coal	unknown
Madagascar	500 000	Gold titanium, nickel, chrome, copper, cobalt, ilmenite, rutile, mica, quartz, salt, graphite, zirconium, gemstones, rare earths, marble	unknown
Malawi	40 000	Lime, coal, graphite, granite/black granite, aquamarine, tourmaline, rubies, sapphire, rare earths and amethyst.	Lime 12%
Mozambique	100 000	Gold, rubies, sapphire, amethyst, rutile,marbles, titanium, ilmenite, zircon	Gold 100%
Namibia	10 000	Diamonds, copper, gold, lead, tin, lithium, vanadium, cadmium, zinc and salt	unjknown
South Africa	20 000	Gold, diamond, manganese, chromium, beryllium, titanium, coal	unknown
Tanzania	1 500 000	Gold, lime, salt, aggregates, gypsum, dimension stone, diamond, graphite, soda ash, garnet	unknown
Zambia	50 000	Gold, silver, aquamarine, amethyst, emerald, tourmaline, coal and industrial minerals	Unknown
Zimbabwe	1 500 000	Gold silver, emerald, amethyst, aquamarine, graphite, gypsum, tantalite, chromium, black granite, limestone, and many others	Gold 40-60%

ASM CHARACTERISATION IN SOUTHERN AFRICA

- Illegal and/or informal
- Rush events
- Large numbers
- Antiquated mining and processing methods
- Rudimentary/basic equipment
- Remote locations without services

ASM PRODUCTION PROFILE

- 20% of global production by ASGM
- 60% of Zim gold production in 2021
- 20% diamond and 80% of sapphire
- 26% tantalum and 25% tin
- ASM in Sub-Saharan Africa accounts for an estimated USD 2.1 billion
- Unfortunately, ASM has a deplorable EHS record

ASM AND THE ENVIRONMENT

- Land degradation,
- deforestation,
- surface and underground water pollution,
- air pollution,
- noise pollution,
- dust pollution.

ASM AND HEALTH

- **Process chemicals**
  - **Mercury**
  - **Cyanide**
  - **Mineral acids**

ASM AND HEALTH

- **Poverty and Quality of Life**
  - **Health care**
  - **Nutrition**
  - **Shelter**
  - **Water pollution**
  - **Air pollution**
  - **Drugs alcohol and prostitution**

ASM AND SAFETY

- Large scale mines statutorily regulated while ASM is not.
- Poverty and awareness
- Unsafe mining pits and underground excavations
- Lack of personal protective equipment/clothing - PPE

BARRIERS TO ASM FORMALISATION

- Government - ASM relationship
- Mineral rights
- Financial barriers to entry -
- Poverty

THANK YOU

METHODS Cont'd

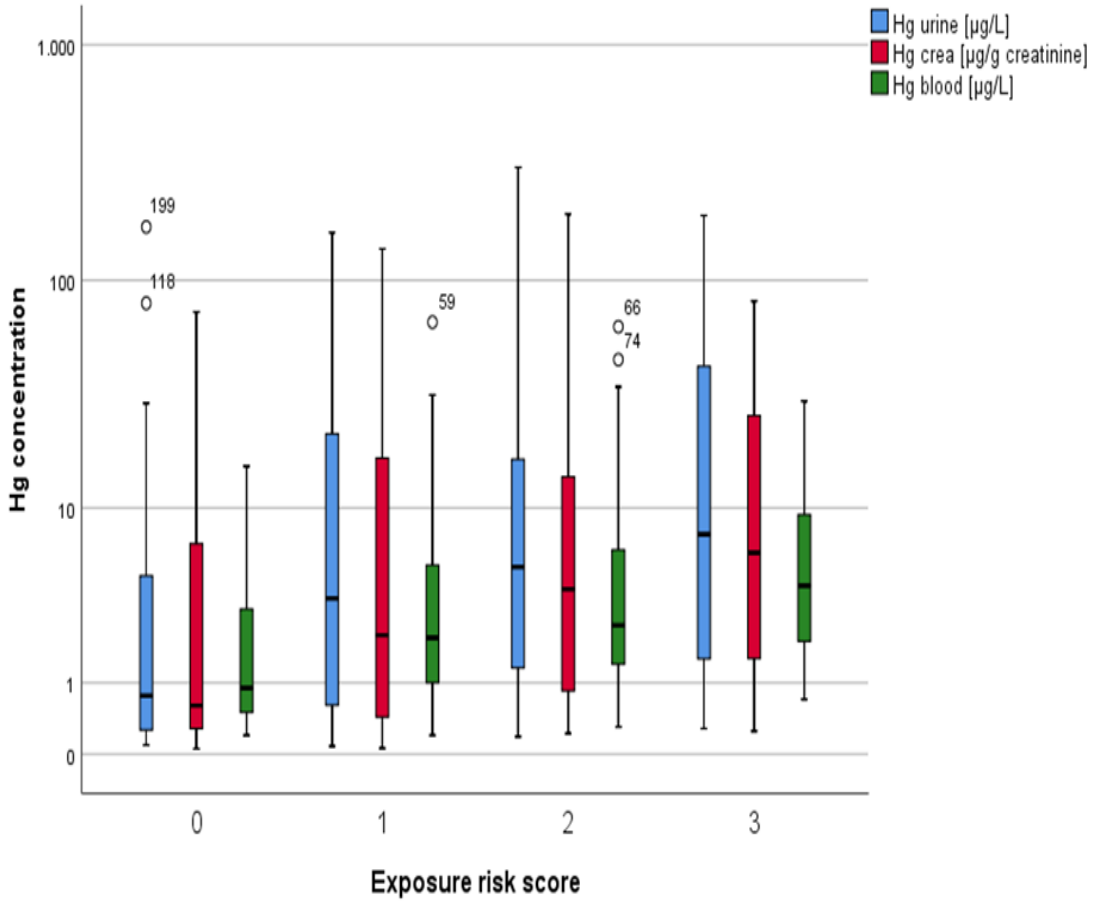
- Spot urine kept at pH 2 for preservation
- Blood samples kept at 4 degrees C
- Direct Hg analysis – DMA 80, AAS
- Urine Hg analysis –Cobus C702 (Jaffe method)

- Detailed methodology – Baeuml et al 2011a

HBM Results

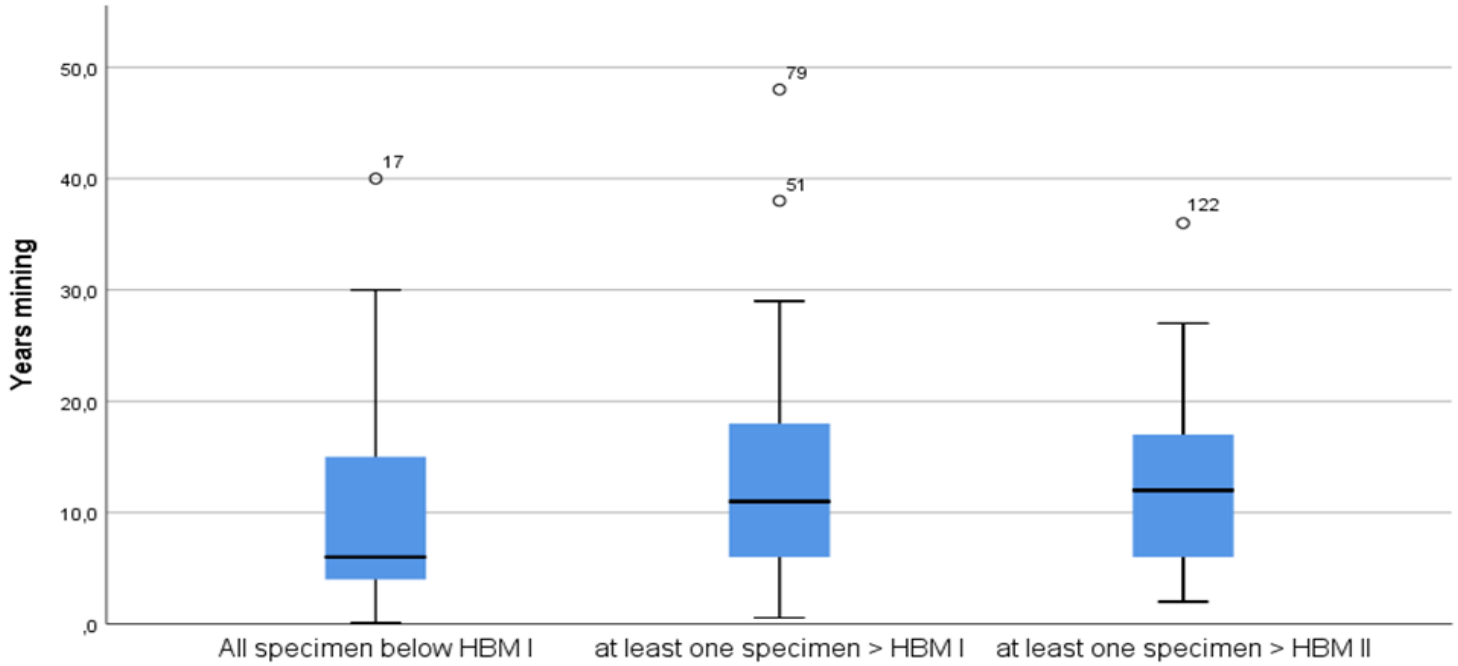
- **Urine median value of total Hg concentration was 4.75 µg/L - ranging between 0.08 to 612.35 µg/L.**
- **The *Mann-Whitney-U* test -significant difference between the median *Hg urine* values between Kadoma (3.53 µg/L) and Shurugwi (6.48 µg/L),**
- **The range in total Hg concentration in blood were 0.20 µg/L and 166.8 µg/L, a median of 2.70 µg/L.**
- **None below detection limit of 0.05 µg/L.**

RESULTS



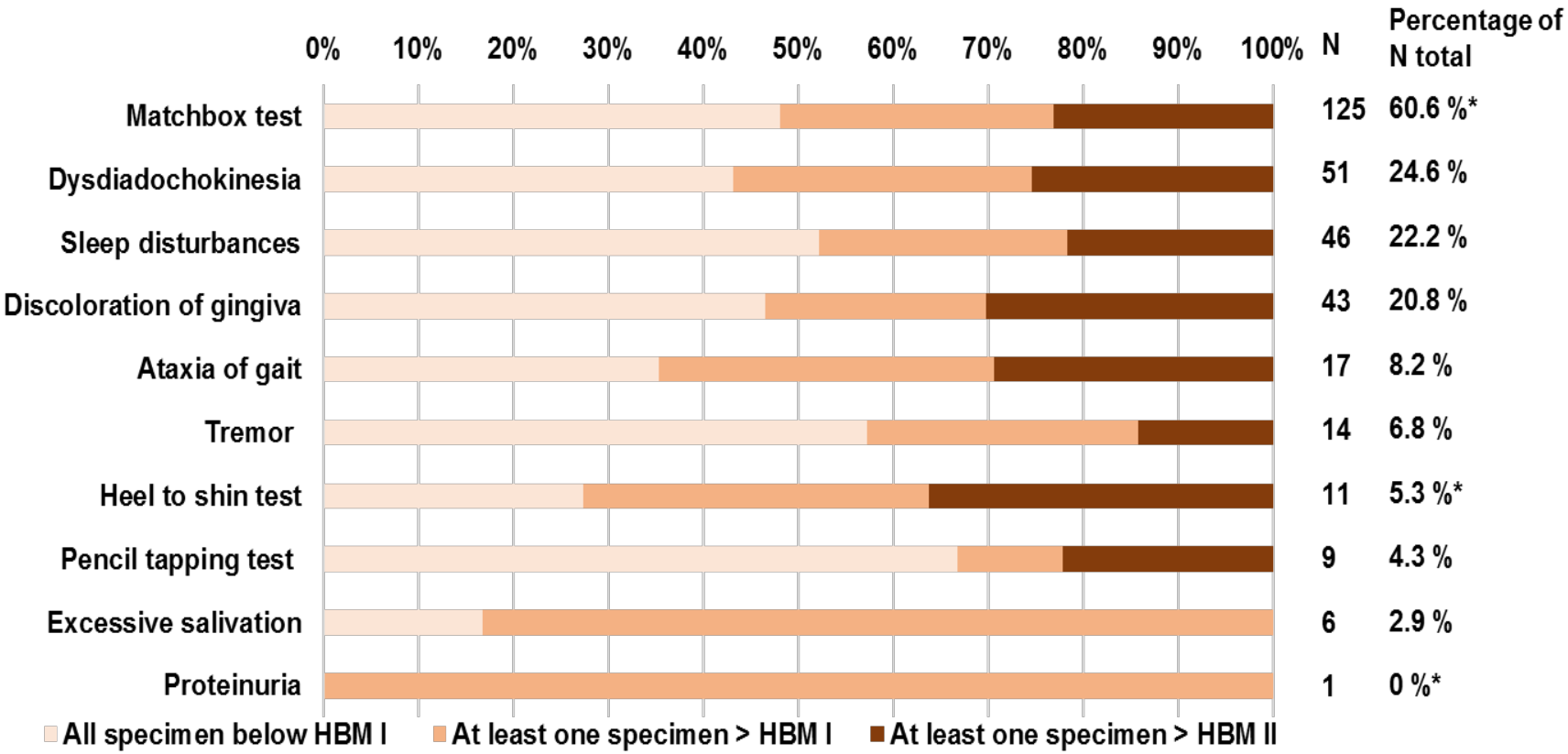
Boxplot with log ranked Hg concentrations for Hg urine, Hg crea and Hg blood by exposure risk

RESULTS Cont'd



Boxplot of years mining across the combined HBM value categories.

RESULTS MSS Cont'd



Stacked bar diagram showing percentage of medical score symptoms and positive test results by combined HBM values. N = number of medical score symptoms and test results. N total = total number of results for each symptom and test: 207. One missing =

DISCUSSION

- Generally higher levels of Hg in Shurugwi compared to Kadoma – lower awareness and higher exposure risks in former

- Dilemma as to location of field sampling; on or off mine sites – contamination vs non miners

WAY FORWARD

- **Immediate and effective switch in gold processing methodology – Borax method**

- **Further and countrywide awareness raising to remove/reduce significant exposure risk factors (retort use, Hg storage, whole ore amalgamation, clothing vectors etc)**

Borax method

- **Time constraint**
- **Ore genesis**
- **Ore mineralogy**