Lead Exposure in Africa: A Systematic Review of Prevalence, Sources, Health Impacts, and Research Gaps

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Background

- Approximately 800 million children, or 1 in 3 children worldwide, have blood lead levels (BLLs) exceeding 5 µg/dL, the recommended threshold for action (1).
- Responsible for an estimated 1 million deaths annually and contributes to over 33 million disability-adjusted life years (DALYs) globally in 2021 (2).
- Lead is toxic to multiple organ systems and responsible for (3)
  - 30% of idiopathic intellectual disabilities
  - 4.6% of cardiovascular diseases
  - 3% of chronic kidney disease
- In 2019, lead exposure resulted in an estimated $6 trillion in economic losses worldwide, equivalent to 6.9% of global GDP. (1)
  - Highest in low- and middle-income countries, where losses exceeded 10% of GDP, compared to about 5% in high-income countries.

Aim

- Comprehensively summarize and describe the lead research work that is conducted in countries on the African Continent

Methods

- Design: Systematic review following PRISMA guidelines (4)

Searched databases

PubMed, Scopus, Africanus Index Medicus

Inclusion criteria

Studies published between 2014 and 2024 | Published in English

Search results

Search yielded 347 articles | 209 were identified as duplicates | 1 article was inaccessible | Title and abstract screening excluded 140 articles | Full text screening excluded another 56

Data Extraction and Analyses(n=84)

Conducted by 6 MPH, MD or PhD candidates | Extracted and organized data into Excel | Thematic analyses

Quality Appraisal

Conducted by 3 MPH, MD or PhD candidates | Used the Joanna Briggs Institute tool

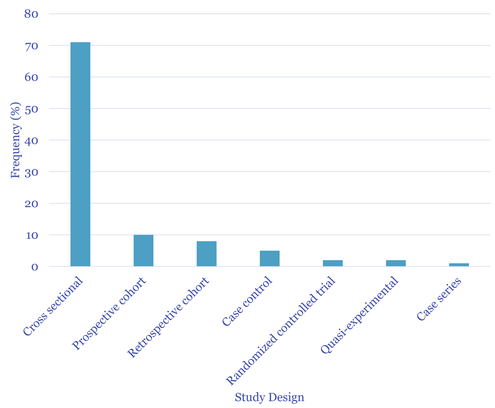
Results

Regional distribution of studies

- Studies Reviewed: 84 studies from 24 African countries

Region	Studies Number (%)	Countries (number)
West Africa	38 (45)	Nigeria (29), Benin (5), Ghana (4)
Southern Africa	21 (25)	South Africa (11), Zambia (9), Zimbabwe (5)
East Africa	11 (13)	Kenya (4), Uganda (3), Madagascar (2), Ethiopia (1), Tanzania (1)
North Africa	9 (11)	Egypt (4), Morocco (3), Libya (1), Tunisia (1)
Central Africa	5 (6)	Democratic Republic of Congo (2), Malawi (1), Cameroon (2)
Total	84 (100)	

Study Design Profile



Focal areas of the studies

BLL measure/EBLL prevalence
- BLL range:0.4 to 116 ug/dL
- Prevalence: 6% to 99.5%

Risk factors of lead exposure
- Proximity to mines/industries
- Geophagia/soil ingestion
- Traditional cosmetics
- Leaded gasoline
- Environmental
- Demographics
- Occupational
- Behavioral

Outcomes of EBLLs
- Children: cognitive impairments, anemia, behavioral issues
- Pregnant women: low birth weight, preterm birth
- Workers: hypertension, kidney damage, neurotoxicity

Prevention and management of EBLLs
- Nutritional adjuvants
- Environmental remediation
- Targeted care
- Chelation therapy

Quality Appraisal

88% of the articles were classified as high quality and 12% as moderate quality.

Table showing some exemplar article and findings

Author (Year)	Summary	Key Findings
Yabe et al. (2015) (Zambia)	*Prevalence-focused*: Assessed BLLs in children near a lead-zinc mine. Used CDC cutoff (≥5 µg/dL).	• **EBLL prevalence**: 76.8% (SD ±12.3%) in children <7 yrs. • **Mean BLL**: 51.1 µg/dL (SD ±18.7) near mine vs. 8.2 µg/dL (SD ±3.1) in controls.
Eneh (2021) (Nigeria)	*Risk factors*: Examined hairdressers' exposure to leaded cosmetics.	• **Risk ratio**: Hairdressers using lead-based products had 3.2× higher BLLs (95% CI: 2.1–4.9) vs. controls. • **Mean BLL**: 17.47 µg/dL (SD ±4.59) in exposed vs. 5.2 µg/dL (SD ±1.8) in unexposed.
Obadia et al. (2018) (DRC)	*Outcomes*: Linked maternal BLL to preterm birth in Lubumbashi.	• **OR for preterm birth**: 2.5 (95% CI: 1.3–4.8) for mothers with BLL ≥5 µg/dL. • **Mean BLL**: 6.66 µg/dL (SD ±3.2) in preeclampsia cases vs. 5.08 µg/dL (SD ±2.1) in controls.
Buerck et al. (2023) (Madagascar)	*Prevention*: Evaluated water pipe remediation in Toamasina.	• **Post-remediation**: 87% of children had reduced BLLs (mean reduction: 4.91 µg/dL, SD ±3.7). • **EBLL (>5 µg/dL) dropped from 96%** (SD=6.3 µg/dL) **to 65%** (SD =3.7 µg/dL).
Mathee et al. (2022) (South Africa)	*Multi-theme*: Analyzed mine-tailings' impact on BLLs in Soweto households.	• **Prevalence**: 42% of children had BLL ≥5 µg/dL near tailings. • **Risk factor**: Living <500m increased BLLs by 2.8× (95% CI: 1.9–4.1). • **Outcome**: 15% of exposed children had developmental delays vs. 4% in controls.

Discussion

Lead research is concentrated in a few countries; many regions remain unstudied.

Lead exposure in Africa remains widespread. Blood lead levels in Africa are higher than in other regions of the world (6% to 99.5% vs 2.5% in the USA (8, 9)

Informal industries and cultural practices drive unique exposure risks, suggesting the need for contextually relevant and culturally tailored interventions.

Almost all the adults with EBLLs were occupationally exposed; implementing occupational safety regulations for both the formal work sector and educational programs for the informal work sector can prevent lead exposure.

No studies focused on screening, and yet screening would provide a more accurate prevalence; it is likely that the prevalence of EBLL is underreported.

The majority of the studies are cross-sectional; investing in geographically inclusive, longitudinal, and policy-relevant research may result in lowering rates of EBLLs.

Limitations

- Inconsistent biomarkers and lab methods reduce comparability
- Exclusion of non-English studies and gray literature

Conclusion

Lead exposure in Africa poses a critical threat to public health, development, and economic productivity. Comprehensive, multisectoral action is needed to prevent exposure, protect future generations, and advance environmental justice across the continent.

References

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