80 YEARS OF LEAD POISONING RESEARCH:
BIBLIOMETRIC SCIENCE MAPPING INFORMING A LEAD-FREE POST-2030 AGENDA

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INTRODUCTION

The adverse health and environmental effects of lead exposure and poisoning are extensively documented, particularly in vulnerable populations such as children and women. Lead continues to be widely utilised in various domestic and industrial products, posing significant risks of acute health effects on a global scale. Lead accumulation in critical organs including brain, liver, kidneys and bones can result in morbidity and mortality, with lead poisoning estimated to cause millions of deaths annually worldwide. To this end, significant progress has been made with the global phase-out of leaded petrol, culminating in its complete elimination in Algeria in 2021. Building on this momentum, efforts have intensified to implement similar initiatives aimed at eradicating lead-based paint. The issue of lead poisoning cuts across several Sustainable Development Goals (SDGs) and disciplines thereby slowing progress towards the 2030 Agenda for Sustainable Development. The SDGs most directly associated with lead toxicity include SDG2 (Zero Hunger), SDG3 (Good Health and Wellbeing), SDG4 (Quality Education), SDG5 (Gender Equality), SDG6 (Clean Water and Sanitation), SDG9 (Industry, Innovation and Infrastructure), SDG10 (Reduce Inequality), SDG 12 (Sustainable Consumption and Production), SDG14 (Life Under Water), and SDG15 (Life on Land).

Lead is present in the air, soil, water, and many products, and can be inhaled or ingested. Several clusters emerged, including those from the medical, agriculture, and engineering fields. Lead paint, contaminated land and soil, lead in food systems, and in solar production came up. Key education-related impacts include learning difficulties in (pre-school) children, while health issues include kidney and liver diseases, pregnancy and fertility concerns, vision disorders, and motor function problems. In agriculture, diseases in poultry and birds (especially chickens), contaminated vegetables, and meat diseases (especially in cattle, sheep, and goats) were flagged, along with effects on fish (especially zebra species) and wildlife.

AIMS & OBJECTIVES

This VOSViewer and CiteSpace-aided bibliometric analysis comprehensively performs science mapping and sensemaking from 26,482 documents retrieved from the Scopus database on 4 January 2025. Keyword co-occurrences, author citations, citation bursts, and co-authorship are among the analyses done, providing the base for policy insights beyond the 2030 Agenda. The bulk of the documents analysed come from medicine, environmental and earth sciences, chemistry and biochemistry, agriculture, and engineering disciplines.

METHODOLOGY

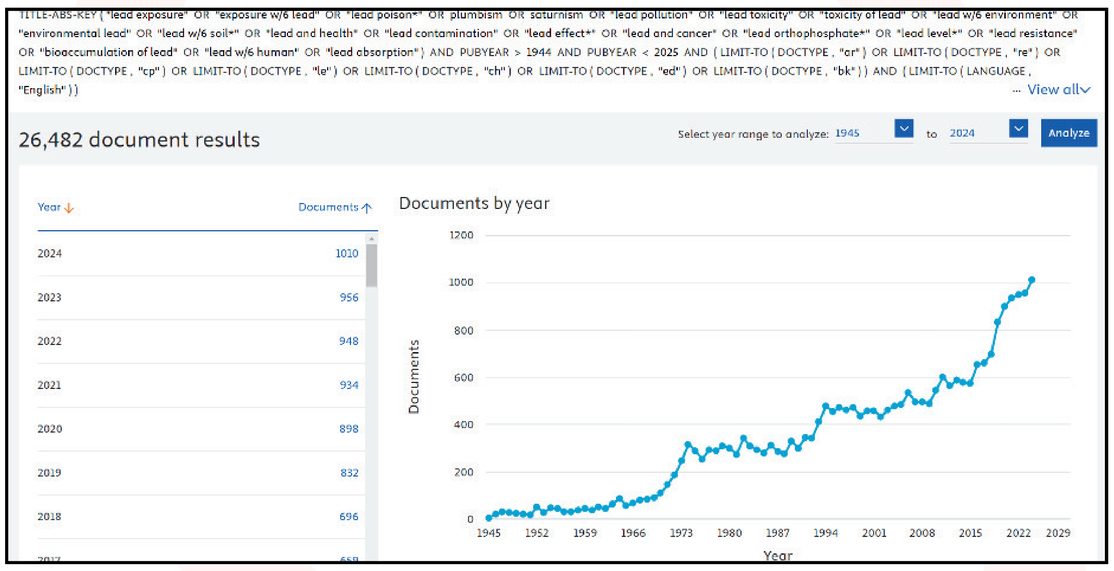

Figure 1: Publication trends 1945-2024

KEY FINDINGS

Engineering concerns centered around water and wastewater treatment, waste disposal, lead paint, and solar energy production (notably lead-free perovskite solar cells). Environmental science raised alarms around biodiversity loss, delayed phase-out of leaded petrol, groundwater and marine pollution, air pollution, pesticide use, and particulate matter. Other critical issues included legislation gaps, other heavy metal poisonings, occupational exposure, and racial disparities affecting Black communities, Hispanic Americans, rural populations, refugees, and immigrants. Despite progress, as of January 2024, 52% of countries—mostly in Africa—had no lead paint regulations. The top five countries in research productivity are the USA, China, India, UK, and Canada. Leading researchers include Hu, Howard (12,153 citations), Lanphear, Bruce P. (8858), Schwartz, Joel (7706), Needleman, Herbert L. (7399), and Bellinger, David C. (6382). The eight most cited journals are Environmental Health Perspectives, Neurotoxicology, Pediatrics, Environmental Research, Chemosphere, Science of the Total Environment, Science, and Nature.

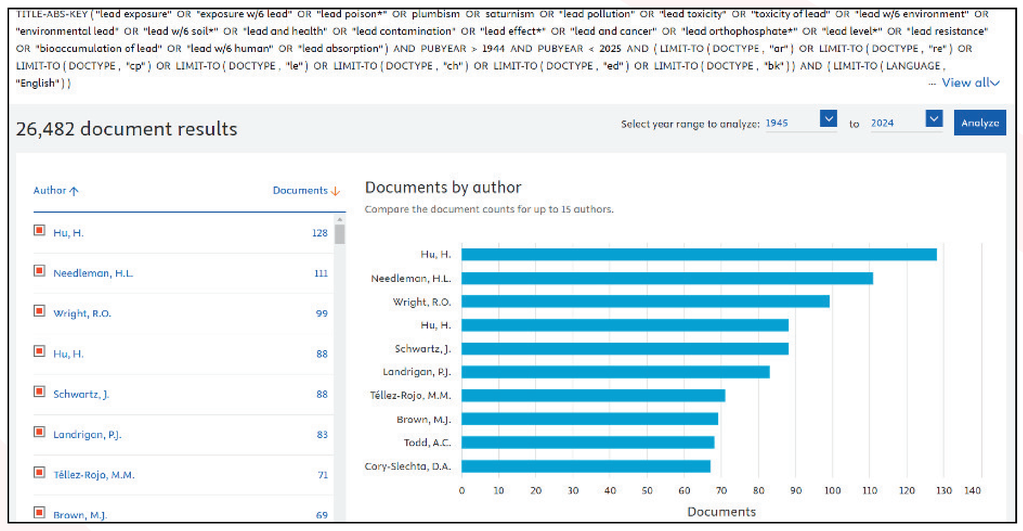

Figure 2: Lead authors in the field by number of publications

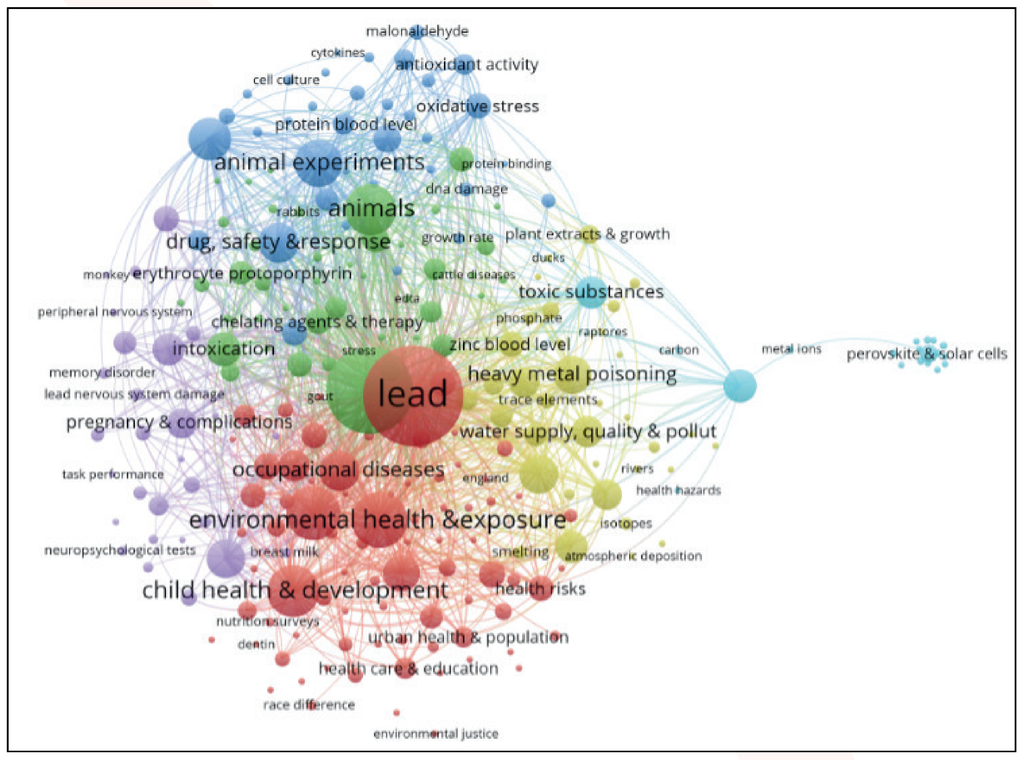

Figure 3: Co-occurrence network visualisation

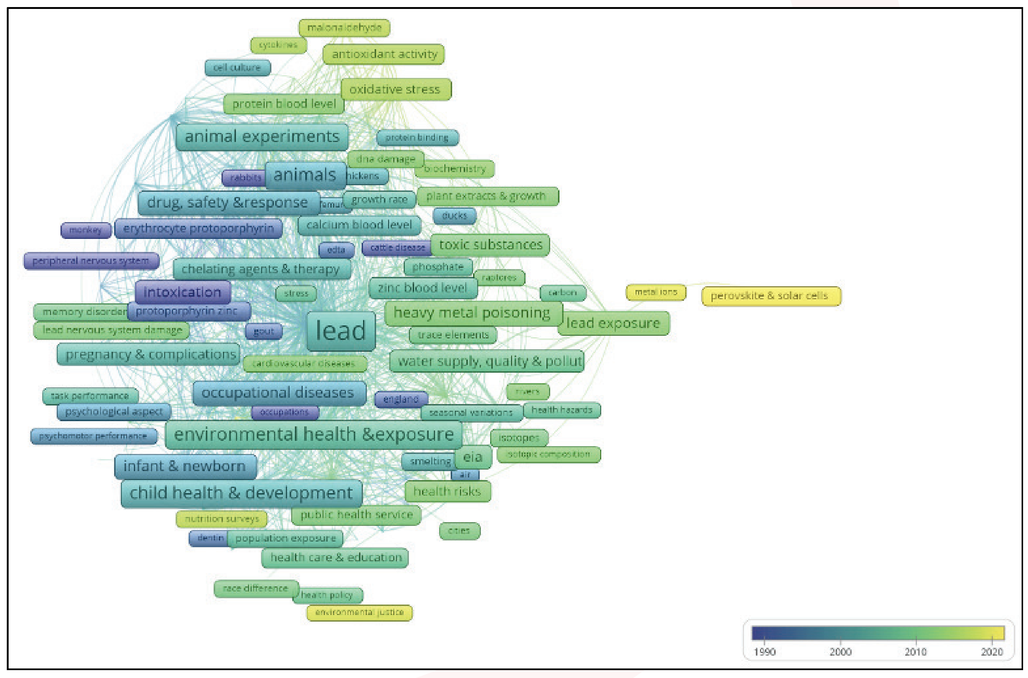

Figure 4: Overlay visualisation showing historical trends in published themes

CONCLUSION

Moving forward, there is an urgent need for a transdisciplinary agenda for universal regulatory regimes on lead paint, lead-free solar perovskite cells, and more research into peripheral lead poisoning affecting humans, animals, and wildlife. Early and/or childhood blood lead level detection must be enforced, especially in low- and middle-income countries (LMICs), particularly across Africa, which remains the epicentre of future work. Although lead poisoning research among migrants and minority groups has advanced in North America, significant gaps remain in developing countries, especially among rural, coastal, and informal urban communities.