LMU KLINIKUM

Toxic Metals Symposium Munich

Program and Abstracts

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Funded by

DFG Deutsche Forschungsgemeinschaft
German Research Foundation

Dear colleagues,

It is with great pleasure that we welcome you to the Toxic Metals Symposium 2025 in Munich.

Over the next two days, we will explore one of the most pressing public health challenges of our time — the global impact of toxic metals such as lead, mercury, cadmium, and others. These substances continue to pose serious risks to human health and the environment, particularly in low- and middle-income countries. From occupational exposure and battery recycling to the environmental cost of the energy transition, this symposium brings together a unique international network of scientists, policymakers, clinicians, and advocates.

We are especially pleased to host this event in the historic St. Vinzenz, a former convent located within the LMU University Hospital at the centre of Munich. With participants joining from all over the world, we look forward to a global exchange of ideas.

Warm regards from the organizing committee,

Stefan Rakete
Stephan Bose-O'Reilly
Dennis Nowak

LMU University Hospital

Melissa McDiarmid
Morando Soffritti
Daniele Mandrioli

Collegium Ramazzini

Welcome Notes

Prof. Dr. Dennis Nowak

Director Institute and Clinic for Occupational, Social and Environmental Medicine, LMU University Hospital, Munich

Dear colleagues,

It is my pleasure to welcome you for this international symposium. I am Dennis Nowak, Director of the Institute for Occupational, Social and Environmental Medicine, and I appreciate your participation in this important meeting.

At our institute, we focus on the interactions between occupational, social, and environmental factors and their influence on health. The topics addressed in this symposium — ranging from mechanisms of toxicity to public health strategies — are central to our work and remain highly relevant as new forms of exposure emerge across industrial and environmental settings.

This meeting has required extensive planning, and I would like to take this opportunity to sincerely thank the team at our institute for the time and effort they have invested in organizing the program.

I would also like to extend my thanks to Professor Thomas Gudermann, Dean of the Medical Faculty, for his support in

hosting this event within the broader academic framework of LMU medicine. Likewise, I am grateful to Professor Francesca Biagini, Vice President for International Affairs and Diversity, for her ongoing commitment to fostering international dialogue and interdisciplinary collaboration — both of which are vital to address global health challenges such as those we are discussing today.

As a relevant example of ongoing challenges with toxic metals, lead remains a persistent concern worldwide. Lead contamination is commonly found in drinking water systems due to old lead pipes, affecting many cities. Here in Munich, which is located in Bavaria, lead pipes were already forbidden in 1875, under the reign of the famous King Ludwig the second. This early action helped to reduce lead exposure in the population, although vigilance and ongoing efforts remain necessary to manage toxic metal exposures in modern environments.

I would also like to acknowledge the valuable role of the Collegium Ramazzini in co-organizing this symposium. Special thanks go to Melissa McDiarmid, President of Collegium Ramazzini, Daniele Mandrioli and Morando Soffritti. The symposium has received funding support by the German Research Foundation (DFG) and the Collegium Ramazzini (CR).

As we gather over the next days to share knowledge, discuss challenges, and explore solutions, I encourage all of us to engage openly and thoughtfully. Let this symposium be a space where expertise and experience come together to advance our understanding and improve public health worldwide. I wish us a productive and inspiring meeting.

Professor Thomas Gudermann

Dean of the Medical Faculty, LMU Munich

Dear participants,

May I extend a warm welcome to you all this morning. I am Thomas Gudermann, serving as the Dean of the Medical Faculty at LMU Munich. In this role, I have the pleasure of working closely with our students, researchers, and staff to support excellence in medical education, research, and patient care. Our faculty is dedicated to contributing to the future of medicine through science, teaching and collaboration across disciplines. It is a privilege to be involved with such a vibrant academic community and to be able to contribute to the training of the next generation of healthcare professionals and medical researchers.

In our own research at the Institute of Pharmacology and Toxicology, we seek to understand how harmful metals and chemicals affect the human body, even down to the level of our cells. Our research has focused on tiny sensors, known as TRP channels, which have been found to act like alarm systems inside our cells. It is important to note that certain dangerous substances have the potential to trigger these alarms and cause stress or damage. We hope that, by understanding how this works, we may be able to find ways to

block these effects and protect people's health. We also study how our bodies handle important minerals like magnesium and zinc, which are essential for staying healthy. It is our understanding, based on the findings of our latest research, that TRPM7 contributes to Cd^{2+} toxicity in pulmonary cells and could serve as a therapeutic target to alleviate the toxic effects of trace metal exposure. Our overarching aspiration is to utilise this knowledge to contribute towards the prevention or treatment of diseases caused by toxic exposures.

It is important to note that toxic metals such as lead, mercury and arsenic can pose serious risks to human health, even at low exposure levels. They are linked to cancer, cardiovascular issues, and cognitive disorders. This symposium will explore how we can better monitor, assess, and reduce these risks, with a special focus on vulnerable populations in low- and middle-income countries, and not only on toxicological and mechanistic issues but also on social aspects of working children and adults in low- and medium-income countries. I am happy that our Institute for Occupational, Social and Environmental Medicine addresses this relevant issue with this international two-day symposium. We are pleased to announce that the agenda will encompass a range of topics, including the health implications of toxic metals, the associated exposure that is increasingly being recognised as a result of the transition towards renewable energy sources, and novel analytical methodologies. We will summarize the reports in an international paper to make our findings accessible for those who cannot attend. The symposium is an opportunity for researchers from around the world to come together. I am delighted to extend a warm welcome to you here in Munich, in this lovely venue.

I wish you the very best of luck with your symposium.

Professor Francesca Biagini

Vice President for International Affairs and Diversity, LMU Munich

Dear participants,

It is a great pleasure to welcome you to this important symposium. My name is Francesca Biagini, and I serve as Vice President for International Affairs and Diversity at LMU Munich. I am honoured to join you today for an event that brings together leading minds to address one of the most pressing global challenges — environmental and occupational health risks associated with toxic metal exposure.

As a professor of applied mathematics, my research has focused on stochastic calculus, probability theory, and mathematical finance — areas that explore the modelling of uncertainty in complex systems. But beyond technical fields, my role at LMU also allows me to support international collaboration and inclusion in academia, which are critical to advancing science and equity worldwide.

This symposium has a particular resonance for me, not only because of its interdisciplinary and global scope, but also for personal reasons. I was born in Italy and began my academic career at the University of Bologna, where I worked as an assistant professor from 1999 to 2005. It was there that I grew as a researcher and educator before moving to LMU Munich as Chair of Financial and Insurance Mathematics. Returning, in a sense, to Bologna today through this symposium is both meaningful and nostalgic.

I am especially pleased that the Collegium Ramazzini, based in Bologna, is co-organizing this event with our Institute of Occupational, Social and Environmental Medicine. The Collegium is named after Bernardino Ramazzini, a fellow Italian and a visionary who is widely recognized as the father of occupational medicine. Centuries ago, Ramazzini boldly drew attention to the health of workers and the impact of their environment long before it became a global scientific concern. His work reminds us that science, at its best, is driven by both curiosity and compassion.

To be part of this gathering — as an Italian, a mathematician, and a representative of LMU — is a privilege. I am confident that this symposium will inspire new connections, new knowledge, and new paths forward in our shared commitment to protecting human health.

Thank you for being here, and I wish you all a stimulating and successful symposium.

Prof. Dr. Melissa McDiarmid

President Collegium Ramazzini

Dear Colleagues,

As President of the Collegium Ramazzini, I too, would like to welcome you to this international Toxic Metals Symposium hosted by the faculty of the LMU Institute and Clinic for Occupational, Social and Environmental Medicine.

The Collegium Ramazzini is an international academy of scientists and physicians from 45 countries who are experts in occupational and environmental sciences and medicine. Included in our number are the hosts of our meeting, Professors Dennis Nowak and Stephan Bose-O'Reilly. We are pleased to co-host this meeting with our LMU colleagues!

Our Collegium takes its name from Dr. Bernadino Ramazzini, an Italian professor of medicine working in Modena and Padua, who, with the publication of his famous treatise, The Diseases of

Workers in 1700, became the ‘father of occupational medicine’. Unconventional, even then, Ramazzini visited the workplaces where his patients labored to see conditions of work for himself. Each chapter of his book described his carefully recorded observations of the tasks performed and maladies of workers in various trades and occupations of that time. These included exposure to metals. He writes of the condition of miners and gilders exposed to metals. Of the gilders he writes, “we all know what terrible maladies are contracted from mercury by goldsmiths, especially by those employed in gilding silver and copper objects. This work cannot be done without the use of amalgam, and when they later drive off the mercury by fire, they cannot avoid receiving the poison fumes…they are subject to vertigo, asthma, paralysis; palsy of the neck and hands, loss of teeth and uncertain gait”.

During the next few days, we will hear again about exposures to amalgam and other toxic metals, still threatening unprotected populations. Inspired by our great teachers of the past, may our time together offer some progress in advancing prevention strategies for present day harms such ‘legacy toxicants’ continue to cause.

As the Italians would say, ‘buon lavoro’ (do good work!).

Dr. Daniele Mandrioli

Secretary General Collegium Ramazzini

Director of the Cesare Maltoni Cancer Research Center of the Ramazzini Institute

Dear Colleagues,

As Secretary General of the Collegium Ramazzini, I am honored to welcome you to the international Toxic Metals Symposium held in Munich on July 4th and 5th 2025.

The Collegium Ramazzini is an international academy of 180 Fellows from 45 countries expert in occupational and environmental sciences and medicine founded by Cesare Maltoni and Irving Selikoff in 1982. The Collegium Ramazzini is named after Prof. Bernadino Ramazzini, author of the "De Morbis Artificum Diatriba", a seminal book printed in 1700 that became a cornerstone for occupation health. It's famous motto "to prevent is better than to cure" cannot be more modern and applicable to the topic of our conference: toxic metals. Bernardino was already discussing in his book the effects of toxic metals such as lead and mercury. And now, 300 years after his publication, we are still

facing similar challenges, to a scale that is widely broader than at the time of Bernardino Ramazzini. The Collegium Ramazzini had published a number of Statements on the topic to call the attention and trigger effective preventive actions on toxic metals, including the ban of leaded gasoline to the reduction of disease and death from Artisanal Small-scale Mining. Prof. Dennis Nowak and Prof. Stephan Bose-O'Reilly from LMU, have been amongst the most distinguished leaders in this field in the Collegium Ramazzini. The Collegium Ramazzini therefore is grateful for the collaboration to LMU and to DFG for its kind support.

I trust this meeting will represent a fundamental step forward for public health and for implementing preventive strategies related to toxic metals.

Thank you all and Welcome to Munich!

Dr. Stefan Rakete and Professor Stephan Böse-O'Reilly

Institute and Clinic for Occupational, Social and Environmental Medicine, LMU University Hospital, Munich

Dear Colleagues,

It is with great pleasure that we welcome you to the Toxic Metals Symposium 2025 here in Munich!

We, Dr. Stefan Rakete and Professor Stephan Böse-O'Reilly are especially pleased to open this international gathering together. Though we come from different professional backgrounds, we share a deep commitment to protecting human health and the environment from toxic metal exposure.

Stefan Rakete is an analytical chemist, passionate about developing innovative methods for detecting toxic metals in human and environmental samples. Stephan Böse-O'Reilly is a paediatrician and Professor for Environmental and Public Health with a focus on preventing disease in children by reducing their exposure to harmful substances such as lead and mercury. Together, we find great value in interdisciplinary collaboration — combining precise analytical science with

public health practice — to create real-world solutions and drive meaningful change.

To all international participants: a heartfelt welcome! Your presence makes this symposium a vibrant and global platform for dialogue, exchange, and progress.

We would also like to express our sincere gratitude to those who made this event possible. Special thanks go to Mrs. Sandra Schwaiger, the dedicated assistant of Prof. Nowak, for her organizational support; to Anne-Marie Pöpper**, our passionate student volunteer, for her help behind the scenes; to Claus Gutknecht, our Ph.D. candidate, for his contributions; and to Michelle O'Reilly and her ensembles, whose music will add a special atmosphere to our gathering. We are also deeply grateful to the DFG (German Research Foundation) and Collegium Ramazzini for their generous funding support.

Thank you all for your time, effort, and commitment. We look forward to a meaningful and inspiring symposium.

Welcome to the Toxic Metals Symposium 2025!

Warm regards,

Dr. Stefan Rakete & Prof. Dr. Stephan Bose-O'Reilly

Programme

Friday, July 4th, 2025

Welcome Ceremony (Moderation: Melissa McDiarmid)

9.00-9.30	Welcome notes	Dennis Nowak	Institute and Clinic of Occupational, Social and Environmental Medicine
		Thomas Gudermann	Dean Medical Faculty LMU Munich
		Francesca Biagini	Vice President LMU Munich
		Musical intermezzo	Maria Ward School Bass Ensemble
		Daniele Mandrioli	Secretary General Collegium Ramazzini
		Melissa McDiarmid	President Collegium Ramazzini
9.30-9.45	Housekeeping	Stefan Rakete	Ludwig Maximilian University (LMU)
9.45-10.15	Keynote: Green transition – future minerals and potential health impacts	Karin Broberg	Lund University
10.15-10.30	Musical intermezzo	Michelle O'Reilly	Maria Ward School Bass Ensemble
10.30-11.00	Who is who in the room	Stefan Rakete	Ludwig Maximilian University (LMU)
11.00-11.30	Coffee break		

Setting the Scene - Exposure to Toxic Metals (Moderation: Morando Soffritti)

11.30-11.45	Occupational exposure to toxic metals	Daniele Mandrioli	Ramazzini Institute
11.45-12.00	The carcinogenicity of metals	Kurt Straif	Boston College & ISGlobal Spain
12.00-12.15	Used lead acid batteries recycling in Africa and India	Anuradha Varanasi & Andreas Manhart	Oeko-Institute
12.15-12.30	E-waste and occupational health in Ghana	Andrea Kaifie-Pechmann	Friedrich-Alexander-Universität Erlangen
12.30-12.45	Artisanal and small-scale gold mining in Sub-Saharan Africa and children's health	Stephan Böse-O'Reilly	Ludwig Maximilian University (LMU)
12.45-13.00	Discussion		
13.00-14.00	Lunch		
14.00	Musical intermezzo	Michelle O'Reilly	Maria Ward School Bass Ensemble
14.05-14.30	Keynote: Toxic metals and global health - Lessons from the lead poisoning pandemic	Phil Landrigan	Boston College

Human Exposure to Toxic Metals in the Global South - Part I (Moderation: Muchtaruddin Mansyur)

14.30-14.45	Southern Africa - One health and toxic metals	John Yabe	University of Namibia
14.45-15.00	Occupational and environmental exposure to lead in Indonesia	Dewi Yunia Fitriani	Universitas Indonesia
15.00-15.15	Occupational metal exposure and health outcomes in the Congolese copper belt region	Paul Musa Obadia	University of Lubumbashi
15.15-15.30	An investigation on the adverse impacts of mineral mining on the environment / Zimbabwe	Brandon Phathisani Sibanda	Enviro recsus Zimbabwe
15.30-15.45	Strategies for protecting people from OSH hazards during brown-field expansion of industrial plants in mineral & metals sectors	Krishna Nirmalya Sen	L&T Construction, Minerals & Metals IC
15.45-16.00	Discussion		

16.00-16.30	Coffee break		

Human Exposure to Toxic Metals in the Global South - Part II (Moderation: Katja Radon)

16.30-16.45	Monitoring lead exposure in Indian children	Yi Lu	Vital Strategies

16.45-17.00	Childhood anemia and malnutrition correlated to lead exposure in Zambia	Tiza Mufune	Ministry of Health, Kabwe District Health Management Team
17.00-17.15	Cognitive functions of pupils around e-waste site in Accra, Ghana	Abigail Serwaa Akoto Bawua	University of Ghana
17.15-17.30	Artisanal and small-scale gold mining and occupational health in the Philippines	Jinky Leilanie Lu	University of the Philippines Manila
17.30-17.45	Lead in spices: evidence from the 100 most populous cities across India	Jenna Forsyth	Stanford University
17.45-18.00	Discussion		
18.00-22.00	Dinner and get together		

Saturday, July 5th, 2025

Toxic Metals in the Northern Hemisphere (Moderation: Dennis Nowak)

8.30-8.45	Toxicology of aluminium	Andrea Hartwig	Karlsruhe Institute of Technology (KIT)
8.45-9.00	Effect of organic food intervention treatment on biomarkers of exposure to lead and cadmium in school children of Cyprus.	Konstantinos C. Makris	Cyprus University of Technology

9.00-9.15	Lead exposure of children in a former mining area in Germany	Lea John	Ludwig Maximilian University (LMU)
9.15-9.30	Mercury exposure via tuna consumption	Adna Alilovic	Institute Jožef Stefan Slovenia
9.30-9.45	Depleted uranium exposure in military populations	Melissa McDiarmid	University of Maryland
9.45-10.00	Military occupational exposure to embedded metal fragments	Joanna Gaitens	University of Maryland
10.00-10.15	Are big lithium batteries a potential health risk due to electro-magnetic fields?	Morando Soffritti	European Foundation Ruberti-Schileo and Ramazzini Institute
10.15-10.30	Exposure to metals during recycling of lithium-ion batteries for electric vehicles	Florencia Harari	University of Gothenburg
10.30-11.00	Discussion		
11.00-11.30	Coffee break		
11.30-13.00	Young researcher's work on toxic metals (E-Poster presentation, Moderation: Stephan Böse-O'Reilly)		
	Mercury released into the environment from the uncontrolled dumping of medical thermometers in hospitals in Cameroon	Samuel Tetsopgang	Association Institute of Total Environment (INTEV)

Diet dependence of mercury exposure in Northern and Southern European populations	Marti Nogués Freixas	IDAEA - CSIC
Artisanal gold mining, mercury and health in Paraguay	Laura Emilce Flores Rodriguez	Hospital de Clínicas Paraguay
Working towards zero lead emissions from the battery recycling industry for a just energy transition in India.	Anuradha Vanasi	Columbia University
Comparative measurements of toxic metals in dust in 66 households and 55 museum institutes with wipe samples and dust traps	Katharina Deering	Ludwig Maximilian University (LMU)
Dynamics of value and power: Organization of the informal e-waste sector in Ghana and its health impacts	Johanna Elbel	Sciences Po
Heavy metals monitoring following the massive use of fire crackers in Dehli	Tushar Joshi	Maulana Azad Medical College India
Biomonitoring of occupational exposure to mercury among dentists in the Fes-Meknes region, Morocco	Imane Bensouda Korachi	Moulay Ismail University Morocco
Metal exposures and biomarkers of liver damage: A systematic review of observational studies	Ibrahim Issah	University of Ghana
Benchmark dose analysis of lead toxicity in wistar rats: identifying critical toxic effects	Dragana Vukelic	University of Belgrade

	From Artisanal Gold to Industrial-Scale Mining: Marine Mercury Contamination Linked to Mining in the Global South	Omar Keshk	GEOMAR Helmholtz Centre for Ocean Research
	Genotoxicity testing with heavy metals – rolling the dice?	Christine Rösch	CFCS-Consult GmbH
13.00-14.00	Lunch		

New analytical tools and other topics (Moderation: Monica Nordberg)

14.00-14.15	"Do No Harm": Understanding and addressing lead exposure in development programs	Rachel Bonnifield	Center for Global Development
14.15-14.30	New analytical approaches to inform exposure assessment and treatment modalities	Don Smith	University of California
14.30-14.45	Microsampling as potential tool for toxic metal assessment	Stefan Rakete	Ludwig Maximilian University (LMU)
14.45-15.00	Criminal Arsenic Poisoning, a Case Study	Syarifah Hidayah Fatriah	Muhammadiyah University of Riau
15.00-15.15	Rapid market screening - lead in consumer products	Aelita Sargsyan	Pure Earth/ University of Valencia
15.15-15.30	Discussion		

15.30-16.00	Coffee break		
16.00-16.30	Keynote: Global burden of health from lead and mercury exposure	Ernesto Sanchez-Triana, Björn Larsen	World Bank
16.30-18.00	Existing policy interventions (Panel Discussion, Moderation: Melissa McDiarmid)		
	Sustainable minerals - wanted!	Benjamin Katz	OECD Centre for Responsible Business Conduct
	Tackling the global burden of lead poisoning	Rachel Bonnifield	Center for Global Development
	Lesson learnt - remediation of lead hotspot areas in Kabwe/ Zambia	Pamela Mwanza	Ministry of Mines
	Moral mining - responsibility of industry - rights of communities	Sophie Turner	Leigh Day
	Lead in gasoline - what we need to learn from a success story	Ernesto Sanchez-Triana	World Bank
	Lithium and Co - future challenges for policies	Karin Broberg	Lund University
18.00	Closing Ceremony	Stephan Böse-O'Reilly	

Abstracts (alphabetical order)

Mercury exposure via tuna consumption

Adna Alilović - Institute Jožef Stefan Slovenia
Adna Alilović is a PhD student at the Department of Environmental Sciences, Jožef Stefan Institute in Ljubljana, Slovenia. Her research focuses on human health risk assessment related to mercury exposure.

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Background
Fish is a valuable source of omega-3 fatty acids, vitamins, and minerals. However, it is also the primary source of mercury (Hg) exposure in the general population, particularly methylmercury (MeHg), which accumulates in large predatory species like tuna. Health risk assessments often assume that all Hg in fish is MeHg and that 95–100% of ingested MeHg is bioavailable. Recent studies challenge these assumptions, suggesting they may overestimate exposure and misrepresent the risk–benefit balance of fish consumption. Fish also contain selenium (Se), which may mitigate MeHg toxicity, though its influence on MeHg kinetics under realistic dietary conditions in humans remains unclear.

Methods/Approach
The present study investigated Hg and Se biomarker changes in humans following controlled tuna consumption. Ten individuals consumed five tuna steaks over five days, six controls abstained from seafood. Total Hg (THg), MeHg, and Se were measured in all steaks. Regular blood and urine sampling enabled tracking of THg, MeHg, and Se kinetics during exposure and elimination.

Results

MeHg comprised an average of 84% (range: 69–98%) of total Hg in the tuna. Se concentrations in steaks were positively correlated with Hg. In exposed individuals, THg and MeHg levels in whole blood, plasma, and erythrocytes increased linearly with dose, peaking after the fifth steak and subsequently declining in a biphasic manner. Urinary THg showed a delayed increase, reaching maximum about one month post-exposure, consistent with ongoing MeHg demethylation. Plasma and urinary Se increased during the exposure, quickly returning to baseline within 10 days post-exposure, while erythrocyte Se remained elevated throughout the study. Correlations between Hg and Se biomarkers in plasma and urine shifted over time, from positive during exposure to negative during post-exposure.

Conclusions and next steps

Despite continuing research, Se-Hg interactions in humans are still not fully understood, and further efforts are needed to unravel the intricate dynamics at play.

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Funding source

ARIS programme P1-0143; ARIS projects: J7-9400 NEURODYS, J7-60123 MultiPart; National HBM Program GA C2715-20-634801; AlpaCem d.o.o. Anhovo fellowship

Cognitive functions among pupils in schools around an electronic waste recycling site at Agbogbloshie in Accra, Ghana

Abigail Serwaa Akoto Bawua - School of public health, University of Ghana. Ghana

I am a trained public health researcher with a keen interest in Occupational and Environmental Health. I specialize in assessing environmental exposures and their potential health effects on vulnerable populations in low-income countries and occupational settings. My expertise encompasses a variety of environmental health issues, including electronic waste pollution, air pollution, water pollution and toxic exposure, climate change, and infectious diseases. I excel at identifying and managing health risks due to environmental factors

All authors and affiliations

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Background

Electronic waste recycling in informal settings, such as Agbogbloshie in Accra, Ghana, releases toxic heavy metals into the environment, posing significant health risks, particularly to children. This study assessed the body burden of metals (lead (Pb), manganese (Mn), cadmium (Cd), chromium (Cr), nickel (Ni), and arsenic (As)) and their association with cognitive function among schoolchildren living near the Agbogbloshie e-waste site, seeking to evaluate the impact of environmental metal exposure on neurodevelopmental outcomes using standardized cognitive assessments.

Methods/Approach

A cross-sectional study was conducted involving 56 pupils from four schools located within a 1 km radius of the e-waste site. Data collection included demographic surveys, biological samples (blood and urine), and cognitive assessments using the Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV). Blood samples were analyzed for Pb and Mn, while urine samples were tested for Cd, Cr, Ni, and As. Multivariate statistical analyses adjusted for confounders such as age, sex, and socioeconomic status.

Results

Results revealed elevated levels of heavy metals, with mean blood Pb levels at 60.43 µg/L and urine As at 21.50 µg/L. Cognitive dysfunction symptoms were commonly reported: 75% of children experienced confusion, 67.9% had poor memory, and 66% had difficulty concentrating. Notably, urinary Cr levels were significantly associated with lower full-scale IQ scores ($\beta = -18.42$, $p < 0.05$) and higher odds of decision-making difficulties (OR = 0.1, $p < 0.05$). No significant associations were found between other metals and cognitive outcomes

Conclusions and next steps

The findings highlight a relationship between neurodevelopmental risks and environmental exposure to heavy metals, particularly chromium, among children living near e-waste recycling sites. This underscores the urgent need for public health interventions to mitigate exposure and protect vulnerable populations. Further research is recommended to explore long-term effects using longitudinal-study and larger sample size and based upon which to develop targeted policies to address e-waste-related health risks

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Biomonitoring of occupational exposure to mercury among dentists in the Fes-Meknes region, Morocco

Imane Bensouda Korachi - Moulay Ismail University Morocco
Imane Bensouda Korachi is PhD student at the Human Epidemiology and Environmental Health Research Team of Moulay Ismail University. Her research work focuses on environmental and occupational exposure in Morocco.

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2. Unit Environmental Hygiene and Human Biological Monitoring, Department of Health Protection, National Health Laboratory (LNS), Dudelange, Luxembourg

Background
Mercury exposure in dental health workers, primarily through the use of dental amalgams, remains a significant concern due to its potential health risks. This study aims to determine occupational exposure levels to mercury and its impact on the health of Moroccan dentists.

Methods/Approach
Urine samples were collected from 34 dentists operating in private dental clinics. 30 healthy non-occupationally exposed individuals were recruited as controls. Mercury concentration in urine (U-Hg) was measured by inductively coupled plasma mass spectrometry. Correlations between amalgam use and U-Hg was determined using Spearman's coefficient (non-parametric test).

Results
The mean urine concentration was 1.2 µg/g creatinine (SD = 1.5, range: 0.18-8.2). U-Hg was significantly higher in dentists compared to controls ($p < 0.05$). Amalgam use correlated significantly with U-Hg ($\rho = 37.50\%$; p-value < 0.03). The U-Hg in our sample was below the Occupational Biological Exposure Indice for Mercury. Several factors contribute to the low levels observed, including the reduced use of mercury in dental procedures, improved compliance with personal

protective equipment protocols, and the shift to encapsulated dental amalgam.

Conclusions and next steps

To the best of our knowledge, this is the first study to identify mercury levels in the urine of Moroccan dentists. Further investigation is needed to assess the impact of this exposure on their health.

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Artisanal and Small-Scale Gold Mining in Sub Saharan Africa and Children's Health

Stephan Bose-O'Reilly - Institute and Clinic for Occupational-, Social-, and Environmental Medicine, University Hospital, LMU Munich Germany
Stephan Bose-O´Reilly, is a professor for Environmental and Public Health at the University Hospital, LMU Munich. He is a pediatrician whose main interest is to prevent children from disease by helping to reduce their exposure to toxic substances, such as lead and mercury. His special interests are introducing micro-sampling methods, transferring knowledge and capacities, and training of scientists and experts to improve children's environmental health.

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Background
Artisanal and small-scale gold mining (ASGM) supports the livelihoods of millions across Sub-Saharan Africa (SSA), including in Ghana, Tanzania, Kenya, Senegal and Zimbabwe. However, the sector is the largest global source of mercury pollution, contributing over 38% of global emissions. Mercury exposure presents acute and chronic health risks, particularly for children, who are highly susceptible due to their developing nervous systems. This study examines the health impacts of mercury exposure on children in ASGM communities across the SSA countries.

Methods/Approach
A review of peer-reviewed literature, national reports, and environmental health assessments was conducted to synthesize data on mercury use in ASGM and its implications for child health. Studies were selected based on relevance to child and maternal health outcomes in proximity to ASGM activities. Biomonitoring data and health statistics were evaluated comparatively.

Results
Children in ASGM areas are exposed to mercury both directly—through

inhalation of vapor during amalgamation—and indirectly, via contaminated food and water. Children living near ASGM sites exhibited elevated mercury levels in blood, hair and urine, with associated cognitive and developmental impairments. Children working as amalgam burners showed clinical mercury intoxication, with children in surrounding communities experiencing significant neurodevelopmental delays. Across all countries, mercury exposure has been linked to increased incidence of stillbirths and adverse birth outcomes among women. Limited access to healthcare, protective equipment, and sanitation compounds these risks.

Conclusions and next steps

Mercury use in ASGM poses a serious threat to child health in Sub-Saharan Africa. Immediate policy attention is needed to eliminate mercury use, strengthen health monitoring, and ensure targeted interventions. Protecting children in mining communities requires coordinated efforts across public health, mining regulation, and community engagement sectors.

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Funding source

World Bank

"Do No Harm": Understanding and Addressing Lead Exposure in Development Programs

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Rachel Bonnifield is Director of Global Health Policy and Senior Fellow at the Center for Global Development, a non-profit, non-partisan, independent think tank based in Washington, D.C. and London, working on issues that affect the poor in low- and middle-income countries and our shared global future.

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Background or Purpose

Roughly half of children in low- and middle-income countries (LMICs) have blood lead levels (BLLs) exceeding the WHO's threshold for clinical intervention, with enormous implications for their health, cognitive development, and long-term life outcomes. Counterintuitively, many development programs that seek to address these same challenges may also inadvertently introduce lead hazards, for example lead acid batteries for energy storage or lead paint in infrastructure.

Content

This presentations consideres the intersection between finance and interventions -- in education, energy, climate, and so forth -- and risks and mitigation opportunities related to childhood lead exposure.

Implications for addressing the issue

Development institutions and funders should ensure a "do no harm" apprach to all cross-sectoral programs to protect against inadvertent resultant lead exposure in intended beneficiaries and communities.

Potential follow-up/actions

Development institutions and funders should ensure a "do no harm" apprach to all cross-sectoral programs to protect against inadvertent resultant lead exposure in intended beneficiaries and communities.

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Open Philanthropy

Green transition – future minerals and potential health impacts

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Prof. Broberg is professor in Occupational and Environmental Medicine, Lund University and professor in Environmental Medicine at Karolinska Institutet, where she has worked with metal exposure, health effects and genetic susceptibility in different settings and populations.

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Background

The Green transition is built on the transition from fossil fuels to green energy and a circular economy to reduce hazardous waste, improve air and water quality, and create healthy jobs and socioeconomic benefits for all. At the same time, the green energy transition is highly dependent on metals. Therefore, in addition to increased mining, states will have to extract more critical raw materials (CRM) from waste, including e-waste, as part of the circular economy. Today, a majority of CRM are extracted in low/middle income countries (e.g. lithium in Chile, cobalt in DR Congo). However, increased mining and recycling may increase human exposure to toxic chemicals. Many metals and organic pollutants in e-waste have been linked to non-communicable diseases such as cancer, cardiovascular, respiratory, neurological and kidney diseases and effects on development, but for many CRM we lack knowledge about human toxicity and new pathways of exposure of the population. In this talk I will present results from ongoing studies on emerging metals linked to the green transition and potential health impacts.

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Swedish Research Council, Swedish Research Councils FORTE, FORMAS

Comparative measurements of toxic metals in dust in 66 households and 55 museum institutes with wipe samples and dust traps

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Dr Katharina Deering works as a scientist at IPASUM LMU and has been working for many years on assessing the risk to employees when handling toxic metals and organochlorine biocides.

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Background
Toxic metals such as arsenic, mercury, and lead have historically been used as preventive and curative conservation agents for cultural and biological collections to protect them from pests and mold. However, these substances pose health risks to staff handling contaminated objects. Monitoring hazardous substances in workplaces is therefore essential. Traditional analytical methods are often costly and resource-intensive. The MUSA project developed a user-friendly, cost-effective testing kit for routine monitoring of dust-borne hazardous substances in cultural heritage settings. To establish baseline levels, house dust from German households was also analyzed as a reference.

Methods/Approach
The study involved 55 museum institutions, each providing 10 wipe samples and 5 dust fall collectors, and 160 households, each with 3 wipe samples and 2 dust traps. To date, 624 wipe samples (531 from museums, 93 from households) and 331 dust traps (269 from museums, 62 from households) have been collected and analyzed. Sampling employed electrostatic cloths for surface wipe samples and dust fall collectors for airborne dust. Target analytes included mercury, copper, arsenic, nickel, cadmium, chromium, and lead. Samples were extracted and analyzed via ICP-MS/MS techniques.

Results
In wipe samples, concentrations of arsenic, cadmium, chromium, copper, mercury, nickel, and lead were significantly higher in museums

than in households. Conversely, in dust traps, levels of chromium, copper, and nickel were significantly higher in households. Notably, lead, arsenic, and mercury levels in household dust exceeded expectations. The higher values in households are probably due to the increased dust generation caused by a higher level of activity and the proximity to traffic routes.

Conclusions and next steps

These findings reveal distinct contamination patterns between museum and household environments. Further research is needed to understand the causes of elevated metal levels in households, which has implications for public health and exposure assessment. Continued investigation will improve monitoring strategies and support safer conservation practices.

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German Federal Environmental Foundation (Deutsche Bundesstiftung Umwelt, DBU)

Dynamics of value and power: Organization of the informal e-waste sector in Ghana and its health impacts

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Johanna Elbel holds a Master's in Public Policy and Global Health and has previously gained professional experience in the politics of global health policy. Her research centers on environmental and occupational health, with a specific interest in the political and commercial determinants of health of mineral extraction and global supply chains.

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Background or Purpose

Ghana's informal e-waste sector sits at the intersection of global waste and recycling
value chains and is central to circular economy narratives. The sector faces severe environmental and health risks, and policy approaches to regulate these risks differ. This study investigates decision-making processes in Ghana's e-waste sector, focusing specifically on the power dynamics that shape policy and its effects on workers' health.

Content

The case study showcases the potential for the sustainable transformation of the
Ghanaian e-waste sector within a multi-stakeholder landscape. These stakeholders are setting up a novel approach to the organization of the e-waste sector and its environmental hazards, which is based on incentive-based mechanisms. In addition, e-waste workers, are returning to the scrapyard Agbogbloshie in 2025 after its destruction in 2021, highlighting resistance to coercive, top-down approaches. Differentiating policy strategies can be identified. The success of policy depends on the recognition of informal e-waste workers, which influences environmental policy compliance and health outcomes.

Implications for addressing the issue

Informal e-waste workers' health can be positively impacted by a strengthened multi-stakeholder e-waste management system that

addresses workers' needs. By strengthening workers' associations and increasing the willingness of workers to join these, the participation and reach of collectors can be ensured. To organize the system in Ghana sustainably, donor dependency must be decreased, potentially by expanding national recycling capacities. General awareness of e-waste as a problem, along with its environmental and health effects, must be improved.

Potential follow-up/actions

Future research on the willingness of workers to shift to the organized sector and on the willingness of the public to participate in collection systems is recommended. Further, a comparison of private versus public initiatives and their different potential to impact occupational and environmental health should be explored to develop best-practice examples.

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Criminal Arsenic Poisoning, a Case Study

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Background
Arsenic poisoning is a severe form of heavy metal toxicity that can be fatal if not diagnosed and treated in time.As a naturally occurring element, arsenic is widely utilized in industrial applications and pesticides, making human exposure possible through ingestion, inhalation, or skin contact.The toxic effects of arsenic stem from its ability to disrupt essential cellular processes, leading to mitochondrial dysfunction, oxidative stress, and cell death. Forensic investigations play a crucial role in identifying arsenic poisoning. This paper explores the mechanisms of arsenic toxicity, clinical symptoms, and forensic approaches in detecting arsenic-related deaths, emphasizing the importance of forensic toxicology in legal investigations.

Methods/Approach
This study reviews existing literature on arsenic poisoning, including its toxicokinetics, clinical manifestations, and forensic detection methods. Information is gathered from toxicological reports, autopsy findings, and exposure investigations to understand the impact of arsenic poisoning on the human body and its role in forensic medicine. Case studies provide real-world insights into the forensic analysis required to confirm arsenic-related fatalities.

Results

Acute arsenic poisoning presents with severe gastrointestinal distress, cardiovascular complications, and neurological dysfunction, progressing rapidly to multiorgan failure and death. Forensic investigations utilize toxicological analyses, autopsy results, and exposure histories to confirm arsenic poisoning as the cause of death. The use of arsenic as a tool for homicide highlights the need for thorough forensic examination to establish cause-of-death findings.

Conclusions and next steps

Arsenic poisoning remains a significant challenge due to its widespread industrial use and potential for intentional misuse. Understanding its toxic effects and forensic detection methods is essential for medical professionals, legal authorities, and public health experts. Proper investigation and toxicological analysis are crucial in identifying arsenic poisoning cases, preventing exposure, and ensuring justice in forensic and legal proceedings. The forensic assessment of arsenic-related deaths reinforces the need for multidisciplinary collaboration in forensic toxicology to uphold truth and legal integrity.

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Occupational and Environmental Exposure to Lead in Indonesia

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Background

Indonesia continues to face a significant public health threat from lead (Pb) exposure, primarily due to informal recycling of used lead-acid batteries (ULABs), unregulated metalworking industries, and widespread environmental contamination. This presentation shares findings from recent field studies that examined both occupational and

environmental pathways of lead exposure in four high-risk communities across Java Island.

Methods/Approach

This cross-sectional study assessed BLL levels in children aged four in communities exposed to used lead-acid battery (ULAB) recycling activities, comparing them to a control area. The study employed a threshold level of 20 µg/dL to identify high BLLs and utilized a sample size of 324 children from exposed sites and 240 from control. Data collection was carried out through questionnaires, laboratory methods, home-based assessment (HBA), and sampling households. Determining BLL, the capillary blood sample was analyzed using LeadCare II which detected BLL ranging from 3.5 to 65.0 µg/dL. This study established a cut-off point for blood lead levels at 20 µg/dL, as heme synthesis is known to be disrupted at this threshold.

Results

Results showed that 29% of the children had BLLs ≥5 µg/dL, with several cases exceeding the LeadCare II analyzer's maximum detection limit of 65 µg/dL. Environmental sampling revealed median soil lead concentrations of 6,582 ppm in exposed areas, well above national and WHO safety thresholds. Determinants of elevated BLLs included parental occupational exposure, use of aluminum cookware and contaminated spices, as well as poor household hygiene practices. A strong association was also observed between paternal and child BLLs, which reinforces the importance of take-home exposure pathways.

Conclusions and next steps

Despite the clear health risks, Indonesia currently lacks a national surveillance or remediation program to address lead exposure. These findings emphasize the need to implement integrated environmental and occupational health policies, targeted risk communication, and scalable biomonitoring and remediation strategies.

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Artisanal gold mining, Mercury and Health. Paraguay

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Background
Artisanal gold mining is considered one of the extractive processes with greater amount of environmental problems, and to human health, it is calculated that for every gram of gold mined, 7 to 30 grams of mercury can be used. The inappropriate use of mercury has neurotoxic effects and systemic in both occupational and environmental exposures.Objectives: Evaluate the health impacts of mercury use in artisanal miners in Yobai pass in the years 2018-2019.

Methods/Approach
Cross-sectional, observational, descriptive study. 99 miners of Paso Yobau were evaluated. A) Occupational clinical history was applied b) Questionnaire of Neurotoxic Symptoms Q 16 c) Mini Mental test d) study tremographic e) Biological Surveillance Mercury in 24-hour urine. The data were analyzed with SPSS 25.

Results
78.2% were male, mean age 34.1 ± 12.9. 62.2% had studies basic. 61.4% handle mercury. The mean years 7.4 ± 5.8 years. 20.2% they had arterial hypertension, abortion 10.1% and congenital malformation in 6.7%. Use of mask in 46.1%, gloves in 40.2%, boots in 17.1%. Trembling fingers 23.2%, nausea and vomiting in 22.8%. Questionnaire Q16 with

disorders of memory 42.4%, change of mood and anger 39.4%, paresthesias 29.2%. Chi: 0.012 in the group that handles mercury. Mini mental Test 39.8% with slight impairment, 15.3% are with moderate deterioration. Mouth ulcers in 27.3%, gingivitis in 13.1%, halitosis in 10.1%, gingival border in 8.1%. Skin lesions 6%, tremor by 33%. The mean Hg concentration 2.21 ± 2.30 ug / 24 hours, 1.1% exceed the value. Those who handle mercury present values equal to and / or above 5 ug / 24 hours, p = 0.006 (Chi Square).

Conclusions and next steps

Multiple social, economic, educational, and labor factors are determining factors of the state of health, for which the integration of the different actors for an adequate system of prevention and health promotion in the Yobai Pass community.

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Ministry of the Environment

Lead in spices: evidence from the 100-plus most populous cities in India

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Jenna is an environmental health researcher affiliated with Stanford's School of Medicine. She currently oversees Project Unleaded, an initiative to address lead poisoning globally through evidence-based approaches. Her team's primary achievement over the past 5 years has been to identify and address turmeric as a key source of lead exposure in Bangladesh. Her work has been featured in The Economist and other outlets. She holds a PhD in Environment and Resources from Stanford University.

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Background
Turmeric and other spices adulterated with lead chromate pigments have been linked with elevated blood lead levels among children and adults across the world.

Methods/Approach
This study evaluated levels of lead and chromium in commonly used South Asian spices—turmeric, chili, cumin, coriander, and mango powder—that have previously been linked to adulteration. We conducted a systematic nationwide sampling of spices across India, collecting all spice types from retail street vendors, as well as turmeric from wholesale bazaars. The sampling covered 104 of the most populous cities and major turmeric production hubs, spanning 19 states and 4 accessible union territories. Samples were measured in triplicate with a calibrated X-ray fluorescence analyzer.

Results
Over 4,000 spice samples were collected; 3,462 from retail street vendors and 1,297 from wholesale turmeric bazaars. Preliminary results indicate that a total of 234 turmeric samples had lead concentrations exceeding the Food Safety and Standards Authority of

India's 10 ppm limit, and the majority also had detectable chromium, indicative of lead chromate adulteration. 90% of the lead-tainted turmeric samples were turmeric roots and only 10% were powder. The median lead level in lead-tainted turmeric samples was 1,410 ppm with a maximum of over 8,000 ppm. None of the other spice types had lead levels above 10 ppm. Thirty-four cities across 10 states exhibited evidence of turmeric adulteration with lead chromate.

Conclusions and next steps

In light of the extremely elevated lead levels found in turmeric, immediate action is needed to stop the addition of lead chromate in India.

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Military occupational exposure to embedded metal fragments

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Background
Evidence suggests that retained metal shrapnel fragments from war-related injuries have the potential to result in long-term systemic metal exposure, thus raising concern about potential target organ effects far from the site of injury.

Methods/Approach
As part of an ongoing medical surveillance program, former military service members who report having an embedded fragment are eligible to complete an exposure questionnaire and submit a urine sample for biomonitoring to assess their overall metal body burden. Urinary concentrations of 15 metals, frequently found in analyzed fragments and/or of toxicological concern, are measured using inductively coupled-mass spectrometry and compared to established reference values.

Results
To date, almost 2,000 participants have submitted an exposure questionnaire and urine sample for metal testing. Findings indicate that less than a quarter of the participants had any metal elevations above established reference values. The most frequently elevated metals include antimony (10.2% of samples), manganese (9.1%), and aluminum (8.6%). In almost all cases, the metal elevation did not exceed a level of health concern.

Conclusions and next steps
In the absence of other known sources of metal exposure, evidence suggests that the fragment may be the source of the elevation. As the

risk of surgical morbidity often precludes fragment removal, these retained fragments can result in decades of sustained metal exposure for these former service members. This underscores the need for continued surveillance to better characterize the exposure and potential health risks.

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Exposure to metals during recycling of lithium-ion batteries for electric vehicles

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Background

Lithium-ion batteries (LiB) are essential for electrification needed to achieve the climate goals, thus large-scale LiB manufacturing and recycling facilities are emerging globally. This pilot study aimed at characterizing metal exposure through air, skin and biomonitoring at a new recycling facility of LiB from electric vehicles.

Methods/Approach

Biomonitoring (blood, plasma and urine) was performed in 16 employees at two time points: baseline (before start of production) and follow-up (four months later). Among these, five workers (from separation and sorting n=3, storage n=1, and maintenance n=1) were selected to perform exposure assessment through air using personal air samplers for inhalable dust, through skin by acid-wipe sampling, and biomonitoring (pre- and post-shift and pre-shift one day later). All samples were analyzed for lithium, nickel and cobalt, by inductively coupled plasma mass spectrometry.

Results

Airborne metal concentrations exceeded occupational exposure limits for all three workers in separation and sorting (work-shift averages, in µg/m3: lithium 17-78, nickel 85-351, cobalt 25-117). Direct reading particle instruments showed high peak exposures of dust during specific work tasks. Inhalable metal concentrations were low among storage and maintenance workers. Nickel (0.002-0.3 µg/cm2) and cobalt (0.001-0.1 µg/cm2) were detected on the hands of the five workers. Among the 16 workers, metal concentrations in blood, plasma and urine were low, similar to those found in the general population.

Conclusions and next steps

Low metal concentrations in biological samples among workers in sorting and separation, where metal dust concentrations in air were elevated, suggest effective use of powered air purifying respirators. Sensitizing metals were detected on skin of all workers, in some cases at ranges that trigger eczema in sensitized individuals. Efforts to reduce metal emissions at the sources are needed.

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Swedish Research Council for Health, Working Life and Welfare (Forte) and Afa Försäkring.

Toxicology of Aluminum

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Dr. Andrea Hartwig is professsor for Food Chemistry and Toxicology at the KIT, specialized on molecular mechanisms of metal toxicology. Furthermore, she is chair of the German MAK commission and thus involved in toxicological risk assessment.

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Background

Aluminum is a naturally occurring element. Major sources of human exposure are food additives, manifold consumer products, such as Al containing antiperspirants, and vaccines. Furthermore, workplace exposure via inhalation of aluminium compounds is of high relevance.

Methods/Approach

The MAK commission has reviewed all available literature, thereby identifying adverse health effects after different routes of exposure and considering different aluminum compounds.

Results

While absorption via the intact skin and the gastrointestinal tract is rather low, inhalative exposure occurring at workplaces, but also in case of respective antiperspirant sprays is of high relevance. Critical toxicological endponts are neurotoxicity, irritation as well as inflammatory responses, depending on solubility and particle size, resulting in differences in local and systemic bioavailability.

Conclusions and next steps

To protect from adverse health effects, different threshold values for Al in air as well as in biological media have been established for different Al compounds. Even though frequently discussed, there is no consistent evidence on the development of breast cancer through the use of aluminum-containing antiperspirants.

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Metal exposures and biomarkers of liver damage: A systematic review of observational studies

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Dr. Ibrahim Issah's research and teaching interests focus on occupational health and safety, environmental exposure assessment, toxic metals, and environmental epigenetics. His work bridges theoretical frameworks and applied field studies, particularly in understanding how occupational and environmental exposures affect human health.

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Background

Exposure to toxic metals is a significant environmental and occupational health concern, with potential implications for liver function. Although individual studies have examined the association between metals exposure and liver damage biomarkers, a comprehensive synthesis of evidence is needed to estimate the overall prevalence, observe trends, and understand the relationship with metal exposures. This systematic review evaluated the association between exposure to metals and key biomarkers of liver damage.

Methods/Approach
This systematic review was conducted following the PRISMA 2020 guidelines and was registered in PROSPERO (CRD42024608273). A comprehensive literature search was performed in PubMed, Scopus, and CINAHL Complete. Studies were included if they were peer-reviewed observational research articles published in English, assessed environmental or occupational exposure to metals, as measured in biological tissues or fluids, and reported any liver damage biomarker (ALT, AST, ALP, and GGT). Quality assessment was conducted using the Newcastle-Ottawa Scale. A narrative synthesis was performed to summarize the findings.

Results
A total of 39 studies met the inclusion criteria. The studies primarily originated from North America, Europe, and Asia, with no studies from Africa. The toxic metals: cadmium (Cd), lead (Pb), mercury (Hg), and arsenic (As) were significantly associated with elevated liver enzyme levels. Most studies identified positive associations between metal exposure and biomarkers of liver injury, with variations based on the exposure levels. Essential metals such as zinc (Zn) and selenium (Se) showed protective effects at physiological levels but contributed to liver dysfunction at high body concentrations. In addition, studies that employed mixture analysis methods, such as Bayesian Kernel Machine Regression (BKMR) and Weighted Quantile Sum (WQS), seem to suggest that the combined effects of multiple metals may exacerbate hepatotoxicity.

Conclusions and next steps
This review strengthens the evidence linking metals exposure to liver dysfunction or damage and underscores the need for targeted regulatory measures to mitigate exposure risks.

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Lead exposure of children in a former mining area in Germany

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Background

The district of Goslar, Germany, is historically shaped by intensive mining activities, resulting in long-term environmental contamination—particularly with lead. While typical background concentrations of lead in soils in Lower Saxony, Germany range between 20–40 mg/kg, parts of Goslar, Lower Saxony, Germany exhibit median values exceeding 1,500 mg/kg. Children are especially vulnerable to lead exposure, mainly through hand-to-mouth contact with contaminated soil and dust during outdoor activities. Even low blood lead levels (BLLs) can adversely affect neurodevelopment.

Methods/Approach

The BLENCA2 study aimed to assess current BLLs among preschool children in Goslar and to identify exposure pathways and regional disparities. Of approximately 1,200 children undergoing school-entry health exams, 310 (26%) participated in the study (Sep 2023 – Jun 2024). Blood samples were analyzed for lead; caregivers completed questionnaires and interviews.

Results

The geometric mean BLL was 23 µg/l, with 51% of children exceeding age-specific German reference values (22 µg/l for boys, 19 µg/l for girls), 24% exceeding age-specific US reference values (35 µg/l) and 13% above the WHO intervention threshold of 50 µg/l. Higher BLLs correlated with elevated soil contamination at children's residential and recreational locations. Risk factors included lack of regular handwashing and passive smoking.

Conclusions and next steps

These findings emphasize the need for structural, environmental, and behavioral interventions to sustainably reduce lead exposure in children in legacy mining regions.

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Heavy metals monitoring following massive use of fire crackers in the city of Delhi

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Abstract
India celebrates Diwali, a major Hindu festival either in late October or early November when deteriorating air quality due to meteorological conditions favours a rise in air pollution. The toxic emissions due to fire cracker use, compound the air pollution pushing it to hazardous levels. Firecrackers may contain potassium nitrate, sulfur, aluminium and salts of arsenic, aluminum, strontium, manganese, and barium. Rising public concern triggered this study involving a total of 707 and 681 residents from 4 residential areas in pre- and post- Diwali period respectively.
Air quality data was obtained from the national grid of monitoring stations. A questionnaire survey was administered. Urine samples were collected for biological monitoring of metals and were analysed with creatinine correction. The mean levels of all heavy metals were significantly higher in the post-Diwali period as indicated by analysis of urine samples. The mean levels of heavy metals lead, copper, strontium, potassium and magnesium were significantly higher in post-Diwali urine samples. Lead is not present in firecrackers and could be due to other sources.

Background
The city of Delhi in India is rated as one of the most polluted city with hazardous poor quality specially in winter months. This time around a major festival is celebrated where there is massive use of fire crackers.

This further aggravates the poor air quality having serious consequence for human health. The rising public concern necessitated this study.

Methods/Approach

This was a field survey that was carried out before and after the celebration of the festival. Urine samples were collected before the onset of the festivities and after the festivities were over. Samples were analyzed with ICPMS with creatinine correction.
Air quality data was obtained from the national grid of monitoring stations.

Results

The air quality had deteriorated in post festivities period as compared with levels before the onset of the festivities. There was significant rise in heavy metal levels as detected in urine samples as confirmed by analysis of these samples in post festival period.

Conclusions and next steps

The study demonstrated that massive use of fire crackers add to the already hazardous air quality. The heavy metals which are contained in some of the firecrackers create an exposure scenario where the levels in post festival period register an increase as compared with the pre festival phase.

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Funding source

The Pollution Board, A government Entity

E-waste and occupational health in Ghana

Andrea Kaifie-Pechmann - Institute and Outpatient Unit for Occupational, Social, and Environmental Medicine Germany
Prof. Kaifie is head of the Institute and Outpatient Unit for Occupational, Social and Environmental Medicine. She focusses in her work on the exposure to hazardous substances in challenging working condititons.

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Background
The rapid expansion of electronic technology has led to a parallel surge in electronic waste (e-waste), posing significant environmental and public health challenges globally. In Ghana, particularly in informal recycling hubs such as Agbogbloshie in Accra, the processing of e-waste has become a widespread livelihood, often carried out under unsafe and unregulated conditions.

Methods/Approach
E-waste workers from the Agbogbloshie recycling site as well as a non-exposed control group was recruited and blood as well as urine samples were taken in different study waves. HPLC-ICP-MS as well as AAS was used in order to determine the blood and urine exposure levels.

Results
E-waste workers showed higher median concentrations of lead as well as inorganic arsenic species in comparison to a control group. More than 80% of the e-waste workers exceeded the acceptable concentration of the sum of carcinogenic inorganic arsenic species (14 µg/L), which was significantly higher in comparison to the control group (70%). The tolerable concentration (40 µg/L) was exceeded in 17.2% of the participants.

Conclusions and next steps
This presentation highlights the urgent need for stricter regulatory

frameworks, improved waste management infrastructure, and targeted public health interventions to mitigate occupational risks.

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From Artisanal to Industrial-Scale Gold Mining: Marine Mercury Contamination in Two Case Studies from the Global South

Omar Keshk - GEOMAR Helmholtz Centre for Ocean Research Kiel Germany

Omar Keshk is a PhD student at GEOMAR Helmholtz Centre for Ocean Research, studying the impact of mining on the marine biogeochemical cycle of mercury. With a background in environmental chemistry, his academic training spans both scientific and social dimensions of pollution, integrating interdisciplinary approaches to understand and address mercury contamination.

All authors and affiliations

From Artisanal Gold to Industrial-Scale Mining: Marine Mercury Contamination Linked to Mining in the Global South

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Background

This study examines mercury (Hg) contamination in sediments from two mining-impacted marine regions. The first site, near the Magdalena River mouth in Colombia might be contaminated with Hg used in artisanal gold mining. The second, in the deep sea near Papua New Guinea (PNG), shows signs of contamination likely linked to mine tailings disposal from the Lihir gold mine. By analyzing total mercury (tHg) concentrations in sediments and porewaters, the study explores Hg behavior across coastal and deep-sea environments. This comparison highlights how mining and sediment characteristics

influence Hg's fate, enhancing the understanding of Hg contamination in coastal and deep-sea ecosystems.

Methods/Approach

Two box cores were collected during expedition MSM112 with RV Maria S. Merian from the Magdalena Canyon, Colombia, and analyzed for tHg. These cores were dated using excess ^{210}Pb profiles to establish a high-resolution sediment chronology. A gravity core from the same area was also analyzed for tHg, with radiocarbon dating underway to refine age models and splicing the cores. At the deep-sea site in PNG, one push core and one gravity core, collected during expedition SO299 with RV SONNE, were analyzed for tHg and trace metals.

Results

In Colombia, tHg concentrations in both box cores have doubled over the past 150 years. The core collected within the river plume exhibited higher tHg levels than the one farther from the delta, indicating the plume as the primary contamination source. At the PNG site, both the push core and gravity core showed increased Hg and trace metals in surface sediments, reflecting potential contamination from mine tailings. tailings.

Conclusions and next steps

Further analyses will determine background tHg levels to calculate a pollution index. An age model and Hg isotope analysis are planned for the PNG samples to confirm whether contamination aligns with tailings disposal over the past 25 years, helping assess environmental risks in both regions.

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Funding source

Base funding from EOMAR Helmholtz Centre for Ocean Research Kiel

Toxic Metals and Global Health - Lessons from the Lead Poisoning Pandemic

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Dr. Landrigan is Director of the Global Observatory on Planetary Health at Boston College, where he and his team generate new scientific knowledge on the health impacts of climate change, pollution, and biodiversity loss – the three great interlinked planetary-scale challenges of our time – and translate this scientific knowledge into evidence-based and ethically grounded actions and policies that will slow climate change, prevent disease, advance social justice, reduce inequity, and save lives.

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Background or Purpose

Lead is an ancient metal that humans have mined, smelted and used for over 5000 years. Lead poisoning has been recognized for 2,000 years and was described in detail by Bernardino Ramazzini. Until the advent of mechanized mining, it was largely a disease of workers.

Content

Since the late 1800s, lead use has increased exponentially. Lead-based paint, tetraethyl lead for petrol, and lead-acid batteries have come to market. Global use continues to rise the world turns increasingly towards electricity. Widespread environmental contamination and extensive human exposure have resulted. Lead poisoning has moved beyond the workplace. Children are at particular risk.

A key development was the recognition that lead can cause poisoning in the absence of symptoms. In children, silent lead poisoning causes lifelong loss of cognitive function, shortened attention span and behavioral disruption. In adults, it increases risk for cardiovascular and renal disease. In 2019, lead was responsible for the loss of 765 million IQ points in children, 90% in low- and middle-income countries (LMICs),

and for 5.5 million deaths among adults. The resulting annual economic losses are estimated to be $6.0 trillion (USD). It is now understood that no level of lead is safe.

Lead poisoning can be prevented by preventing lead exposure and is highly cost-effective. Removal of lead from petrol in the USA reduced children's mean blood lead level by 95%, increased the mean IQ of all children by 5 points, and created an annual economic benefit of $200 billion, an aggregate benefit since 1980 of over $8 trillion. Thanks to work by WHO and UNEP, lead has now been removed from automotive petrol in all countries worldwide.

Implications for addressing the issue

Despite much progress, the lead poisoning pandemic continues. One of 3 every children worldwide has an elevated blood level.

Potential follow-up/actions

We still have much work to do.

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Global health burden from lead and mercury exposure

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Mr. Larsen is an environmental economist/consultant with the World Bank and other international/bilateral/research institutions. Mr. Larsen's primary research interests are environmental health risk assessment, health effect valuation, and benefit-cost analysis in the fields of air pollution and chemicals/toxic substances from over 50 countries in Africa, Asia, Europe, Latin America and the Middle East.

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Background
We estimated the global burden and cost of IQ losses and cardiovascular disease (CVD) mortality from lead due to continued high exposures in low- and middle-income countries (LMICs). We also present blood lead level (BLL) impacts of various exposure sources and initial estimates of benefits and costs of some BLL interventions. Finally we present cognitive and cardiovascular health effects of mercury exposure from artisanal and small-scale gold mining (ASGM), fish consumption and other sources, with focus on Sub-Saharan Africa.

Methods/Approach
Global health effects of lead are estimated from BLL – IQ/CVD functions. Absolute magnitudes of BLL impacts of 10 lead exposure sources are assessed based on a review of 39 BLL source attribution studies. Benefit-cost ratios of BLL interventions are derived by estimating lifetime income gains from avoided IQ losses in children. Health effects of mercury are estimated from Hg – IQ/CVD functions.

Results
The cost of health effects of lead exposure in 2019 is estimated at US$ 6 trillion equivalent to 6.9% of global GDP. Over 90% of the health effects occurred in LMICs from a population-weighted mean BLL of 46 µg/L. Most identified lead exposure sources each contribute on average 5 to 31 µg/L to BLLs. Benefit-cost ratios of BLL interventions range from 2 to > 1000 indicating very large health and economic returns to the interventions. Mercury concentrations in exposed

population groups are causing serious health effects in children and adults.

Conclusions and next steps

Nationally representative BLL and Hg measurements are in much need of being integrated into routine household surveys in LMICs such as in Multiple Indicator Cluster Surveys (MICS) and Demographic and Health Surveys (DHS). BLL and Hg concentration impacts of exposure sources remain inadequately understood in LMICs, with much need for source identification and quantitative BLL and Hg concentration impact assessment in conjunction with BLL and Hg measurement surveys.

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ASGM (Artisanal Small Scale Gold Mining) and occupational health in the Philippines

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Jinky Leilanie LU is a Research Professor at the National Institutes of Health, University of the Philippines Manila. She is also the Chair of the International Commission on Occupational Health- Mining Occupational safety and Health.

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Background
This comprehensive research report covers an overview of the land use in T'boli including mining areas which are the target sites of the study, and proceeds to present the results of the chemical contamination to the environment and community, particularly, mercury as a toxic chemical, using chemical analysis of four environmental media- soil, water, fish and plant/biota.

Methods/Approach
The mercury level in blood of miners and workers was also measured and presented in this report as evidence of possible human toxicity arising from mines exposures. The other hazards widely known and documented in literature including noise, vibration, extremes of temperature, and weather parameters were also measured using certain scientific equipment/ instruments.

Results
Based on German Human Biomonitoring (HBM) values: HBM-I = 0.005 µg/mL; HBM-II = 0.015 µg/mL; 8.13% of the209 blood samples of miners are in category HBM-II needing intervention. 43% are in between HBM -I and HBM-II which calls for confirmation for potential sources. PLANT QS based on Indonesian National Agency of Drug and Food Control Quality Standards (QS) = 0.5 mg/kg, 21.05% was used for plants, and of the 76 plant samples exceeded the standards.Based on the Philippine DENR (DAO-2016-08) General Effluent Standards 2016

Maximum Allowable Limit (MAL) = 0.004 mg/L for release to Class C water bodies, two percent of the 24 water samples exceeded the standards.Of the 30 samples of fish, only one exceeded the FISH MRL based on Philippine National Standards – Bureau of Agriculture and Fisheries Standards 2020 (Fish and fishery products – Tilapia) Maximum Residue Level (MRL) = 0.5 mg/kg. Above threshold limit values were also taken from air monitoring.

Conclusions and next steps

The study has shown results that are not within standard values for air, water, plant, fish, and human blood samples, evidencing the risks to health among small scale miners.

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Monitoring lead exposure in Indian children

Yi Lu – Vital Strategies – New York (USA)

Yi Lu is a senior program manager at vital strategies, New York. She is a collaborative, bilingual environmental epidemiologist with a strong medical background, passionate about global health issues and translating science into policy and practice.

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Background

According to estimates from the GBD study, India accounted for more than half of the total global morbidity and mortality attributable to lead, despite having only 18% of the global population. Based on modeled estimates, over 25 Indian states had average BLLs above 5 ug/dL. However, statewide monitoring and data on lead exposure were not available to verify these estimates. We provide an overview of design considerations and differences in findings from our state-level blood lead surveillance among children in Bihar and Tamil Nadu states in India.

Methods/Approach

We initiated surveillance efforts in two Indian states in collaboration with Pure Earth, local governments, and research organizations. We summarized and compared key components of surveillance approaches, including design considerations and implementation challenges as well as findings from the two states including distribution of lead exposure and potential risk factors.

Results

Approaches to understanding lead exposure among Indian children need to be customized by states due to the large variation in geography, health service delivery systems, existing laboratory capacity, and human resources. We compared sources and risk factors for lead exposure observed across the two states and shared some unique challenges.

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Funding source:
This study was made possible by Pure Earth and GiveWell and was funded in part by the Effective Altruism Global Health and Development Fund, Open Philanthropy, and Affinity Impact.

The effect of an organic food intervention treatment on biomarkers of exposure to lead and cadmium in primary school children of Cyprus: A cluster-randomized crossover trial

Konstantinos C. Makris - Cyprus University of Technology Cyprus
Dr. Makris is a full professor of environmental health sciences applying the concept of the human exposome and its tools to better understand the development and testing of non-pharmacological health interventions towards reducing body burden of environmental chemicals, including metals.

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Background
Food contaminants, such as, pesticides and metals are ubiquitous in the food chain. Studies routinely report on the metals content of organic and conventional food crops. However, comparative human studies on the body burden of metals associated with organic food consumption are currently lacking.

Methods/Approach
The objectives were to i) determine the effectiveness of an organic food intervention in reducing the body burden of urinary concentration of lead (Pb) and cadmium (Cd) and ii) evaluate the association between metal exposures and biomarkers of oxidative damage in primary school children in Cyprus. This study was part of the ORGANIKO cluster-randomized crossover trial, a 40-day organic food treatment to 149 healthy children (10-12 years) in Cyprus. Urinary biomarkers of Pb and Cd were determined using inductively coupled plasma mass spectrometry. Linear mixed-effect regression models were used to account for the effect and duration of the organic food treatment. Multiple comparisons were handled using Benjamini-Hochberg correction.

Results

A time-dependent reduction for creatinine-adjusted Pb during the intervention period was observed (β = -0.021; 95% CI: -0.034, -0.008; p-adjusted = 0.01). A similar trend was observed for creatinine-adjusted Cd, but it was not significant (β = -0.013; 95% CI: -0.026, 0.000; p-adjusted = 0.15). The creatinine-adjusted oxidative damage biomarkers were significantly associated with both metal biomarkers; Pb (8-OHdG: β = 0.388, 95% CI: 0.303, 0.472; p-adjusted<0.001).

Conclusions and next steps

A 40-day organic food treatment reduced primary school children's exposures to Pb over time. More human studies in settings with high food contaminant profiles across common crops are warranted.

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Funding source

ORGANIKO LIFE

Occupational exposure to toxic metals

Daniele Mandrioli – Cesare Maltoni Cancer Research Center, Ramazzini Institute, Italy

Daniele Mandrioli, MD, PhD is the Director of the Cesare Maltoni Cancer Research Center of the Ramazzini Institute, Bologna, Italy. He conducts research on environmental toxicants and carcinogens, including pesticides, plastics, fossil fuels, food additives, ionizing and non-ionizing radiation. Dr. Mandrioli's research on environmental toxicants and carcinogens includes the design and development of bioassays and epidemiological studies, investigations of different molecular mechanisms of toxicity and the analysis of different chemical regulations and their implications for public health. He has been serving as technical advisor for the WHO, ILO, IARC and NIEHS in different working groups, systematic reviews and panels in toxicology and epidemiology. Dr. Mandrioli is the Secretary General of the Collegium Ramazzini, an independent, international academy of 180 internationally renowned experts in the fields of occupational and environmental health.

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Background

According to ILO, every year more than 1 billion workers are exposed to hazardous substances, including pollutants, dusts, vapours and fumes in their working environments. In its recent report "Exposure to hazardous chemicals at work and resulting health impacts: A global review", ILO also included heavy metals in the top 10 chemical occupational exposures identified as priorities.

Methods/Approach

A comprehensive review of the evidence was performed by ILO to better understand the risks posed by hazardous chemicals, including

heavy metals, and to identify measures to protect the health and safety of exposed worker. The Collegium Ramazzini also recently issued a Statement on the occupational diseases caused by artisanal small-scale mining (ASM).

Results

Occupational exposure to heavy metals and their compounds occurs in a wide range of sectors such as construction, mining, electronics and the textiles industry. Heavy metals are metals with a high density that in many cases are hazardous, such as arsenic, cadmium, lead, mercury and hexavalent chromium.

Conclusions and next steps

Globally, heavy metals are a major cause of occupational disease, where up to 33 per cent of ASM miners suffer from chronic metallic mercury vapour intoxication. Up to 100 million children, women and men work in ASM worldwide, mostly in remote rural areas of Low-income and Lower-middle-income countries. Urgent interventions against the grave dangers of ASM are a global occupational health priority.

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Used Lead-acid Battery Recycling in Africa and India

Andreas Manhart - Oeko-Institut Germany

Andreas Manhart is Senior Researcher at Oeko-Institut on raw materials, circular economy and recycling. His work focuses on socioeconomic, technical and regulatory framework conditions and drivers enabling or hindering sustainable raw material cycles. He is engaged in various research and implementation projects in the EU and African contexts with key foci on complex and hazardous waste types such as batteries.

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Background or Purpose

Note: we designed an abstract and split this in 3 sections (the 3 below). We think that this should be one consolidated text-block:
The use of lead-acid batteries is growing in almost all low- and middle-income countries. Due to the high material value of lead and their average lead content of around 60-65%, the batteries are typically collected for recycling. The lead-acid battery recycling landscapes in low- and middle- income countries have developed significantly over the last decade and are now characterized by large, registered recycling facilities equipped with metallurgical furnaces and lead refinery lines. Nevertheless, many of these plants operate at sub-standard in terms of health and safety and pollution control. They are therefore a significant source of lead emissions to the workplace and the environment. This presentation will give insights into lead-acid battery recycling landscapes in selected African countries as well as India.

Content

The use of lead-acid batteries is growing in almost all low- and middle-income countries. Due to the high material value of lead and their average lead content of around 60-65%, the batteries are typically collected for recycling. The lead-acid battery recycling landscapes in low- and middle- income countries have developed significantly over the last decade and are now characterized by large, registered recycling facilities equipped with metallurgical furnaces and lead refinery lines.

Implications for addressing the issue

Nevertheless, many of these plants operate at sub-standard in terms of health and safety and pollution control. They are therefore a significant source of lead emissions to the workplace and the environment.

Potential follow-up/actions

This presentation will give insights into lead-acid battery recycling landscapes in selected African countries as well as India with a view to generate entry points for improvement strategies.

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Depleted Uranium Exposure in Military Populations

Melissa McDiarmid - University of Maryland School of Medicine The United States of America (USA)
Dr. McDiarmid is Professor of Medicine and Director of the University of Maryland, School of Medicine's Division of Occupational and Environmental Medicine. Trained in internal medicine, occupational medicine and toxicology, she was Chief Medical Officer of the U.S. Occupational Safety & Health Administration (OSHA), a position she held for five years. She has authored numerous journal articles on occupational/environmental medicine topics related to heavy metal exposures, healthcare workers, medical surveillance, and occupational cancers.

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Background
Medical surveillance of a group of former Gulf War military service members whose vehicles were struck with depleted uranium (DU) weapons has been carried out since the early 1990s. DU possesses only 60% of the radioactivity of natural uranium, having been 'depleted' of much of its more highly radioactive U234 and U235 isotopes. Therefore, the focus of our surveillance has been on uranium's chemical, heavy metal character, rather than its radiologic toxicity. Due to the surgical morbidity of complete fragment removal, this cohort is managed medically.

Methods/Approach
A comprehensive protocol including detailed health and exposure histories, laboratory studies and exposure monitoring for total and isotopic urine uranium concentrations is conducted biennially, including a comprehensive assessment of health outcomes.

Results
Findings to date reveal the persistent elevation of urine uranium (uU) with a DU isotopic signature, now, more than 30 years after injury, in those with retained shrapnel fragments. Those with an inhalation exposure alone have lower uU results and a natural isotopic signature.

Clinical outcomes related to elevated uranium measures have been extensively explored, focused on but not limited to, known target organs of uranium and other heavy metals including renal, CNS and reproductive systems and genotoxic endpoints. Findings to date revealed few abnormalities in the low (normal) uU sub-group, versus the high uU sub-group, with the exception of impaired bone mineral density (BMD) in the high sub-group. These results will be reviewed in this presentation.

Conclusions and next steps

As the U body burden continues to accrue from in-situ mobilization from metal fragment depots, critical tissue-specific U concentration thresholds may be reached, suggesting the prudence of on-going surveillance.

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Childhood Anemia and Malnutrition Correlated to Lead Exposure in Zambia

Tiza Mufune – Ludwig Maximilian University of Munich Germany

Dr. Tiza Mufune is a District Medical Officer at the Ministry of Health in Kabwe, where he has worked with the co-authors to understand the sources, distribution and effects of lead exposure among affected populations in Kabwe Town, Zambia. He is also a PhD candidate at the Ludwig Maximilian University of Munich – Centre for International Health.

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Background

Environmental lead contamination in Kabwe zambia, is a long standing legacy resulting from mining activities. This presents a serious public health issue, especially among young children. In this study, we sought

to establish the relationship between lead exposure and anemia as well as nutritional status in children living in areas with elevated lead levels.

Methods/Approach

A cross sectional study was conducted among children aged zero to 15 years (n=10,718) residing in four townships. Data on demographic characteristics, anthropometric measurements, blood lead levels (BLLs) and blood hemoglobin (Hb) were collected. Associations were determined using chi square test, and binary logistic regression was conducted. The results are reported as odds ratios (ORs) and their 95% confidence intervals (95% CIs).

Results

The median age was 7.3 years (Interquartile range [IQR] 3.9, 10.7), the median BLL was 22.4µg/dL (IQR 13.9, 34.1) the mean Hb was 12.3g/dL (95% CI: 12.13, 12.36) and the prevalence of anemia was 23.4%. The findings indicated a statistically significant association between younger age and elevated BLL. Makululu Health Center exhibited a substantially higher likelihood of children having a BLL exceeding 45µg/dL compared to Chowa Health Center (OR: 1.76; 95% CI: 1.44, 2.16). Conversely, Katondo Health Center showed a lower likelihood for children to have BLLs above 45µg/dL, compared to Chowa Health Center (OR 0.10; 95% CI: 0.07, 0.16). Furthermore, children with low height for age had a higher likelihood of having a BLL above 45µg/dL, compared to their normal counterparts (OR 1.42; 95% CI: 1.17, 1.71). Similarly, low Hb in children increased their likelihood of having a BLL above 45µg/dL (moderately low Hb: OR 1.52; 95% CI: 1.25, 1.83; low Hb OR 1.96; 95% CI: 1.39, 2.75).

Conclusions and next steps

Children residing near the old lead mine in Kabwe, particularly those with anemia and stunting, should be routinely screened for lead exposure.

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Funding source

Funding source was from the World Bank Group, through the Zambia Mining and Environmental Remediation and Improvement Project

Occupational metal exposure and health outcomes in the Congolese copper belt region

Musa Obadia Paul - University of Lubumbashi The Democratic Republic of Congo

Dr. Musa Obadia Paul is the Chairperson of the Poison Control Centre at the University of Lubumbashi in the Democratic Republic of Congo. A physician and public health researcher, he leads efforts in the study of health effects related to exposure to toxic substances, with a particular focus on heavy metals and environmental pollutants.

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Background

Workplace metal exposure poses significant health risks. We conducted four studies examining its effects: exposure levels in smelter workers, erectile dysfunction in artisanal miners, respiratory health in refinery workers, and behavioral outcomes in child miners, offering a broad perspective on metal-related health impacts.

Methods/Approach

We conducted four cross-sectional studies to assess health risks related to trace metal exposure. We included smelters, samplers, and controls to assess trace metals in blood and urine (ICP-MS). Erectile function, hormone levels, and marital quality were compared between miners and bakers. Respiratory symptoms and spirometry were assessed in refinery workers. In child miners, behavioral screening and urinary metals were compared between miners and farming peers.

Results

Smelter workers showed higher blood cobalt (0.82 µg/L) and lead (190 µg/L) than samplers and controls, and elevated urinary cobalt (10.7 µg/g creatinine), germanium (0.15), and lead (9.51). Artisanal miners had lower IIEF scores (66 vs. 73), lower free testosterone (8.11 vs. 10.52 ng/dL), and greater odds of erectile dysfunction (aOR, 2.6; 95% CI, 1.3-5.3). Refinery workers had high levels of cobalt, arsenic, and

lead; dyspnea was more frequent in lixiviation. Child miners had 4.7 times higher urinary cobalt and 2.6 times more manganese than controls, with more hyperactivity and peer problems.

Conclusions and next steps

Trace metal exposure is high in several occupational groups in the Copperbelt region, with documented effects on sexual, respiratory, and behavioral health. These findings call for urgent occupational and public health interventions to reduce exposure and protect vulnerable groups.

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Funding source

Ares-CUD, Vlir UOS, belgian organisations

Diet dependence of mercury exposure in Northern and Southern European populations

Martí Nogués Freixas - IDAEA - CSIC Spain

Martí Nogues Freixas is a PhD student in Analytical and Environmental Chemistry at the Institute of Environmental Assessment and Water Research (IDAEA-CSIC) in Barcelona, Spain. His research focuses on the analysis of metals, particularly mercury, in various types of samples, including both environmental matrices (fish, sediments, and water) and human biological samples (hair and urine).

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Background

Mercury exposure represents a significant public health issue, particularly through the consumption of contaminated fish. Mercury in hair is used as a biomarker of internal exposure. This study analyzes mercury concentrations in hair samples from two populations: adults from the Metropolitan Area of Barcelona (Catalonia, Spain, n=45) and teenagers from the REPRO_PL birth cohort (Poland, n=80), and compares these data with additional measurements from Menorca (Balearic Islands) and Flix (Catalonia). Significant correlations between hair concentrations and diet using food frequency questionnaires are investigated to identify the exposure sources of mercury in the studied cohorts.

Methods/Approach

Hair samples were collected 1–2 cm from the scalp and pre-treated

with successive washes of hexane, Triton X-100, and Milli-Q water to remove external contamination. Total mercury (THg) was measured using DMA-80, which allows precise determination in solid samples without chemical treatments. Food frequency questionnaires were administered to the families of the participant families.

Results

The median concentrations of THg in the Polish teenagers was 72 µg/kg, ranging from 3.9 µg/kg to 1500 µg/kg. In contrast, the median concentration in adults from Barcelona was 989 µg/kg, ranging from 138 µg/kg to 4424 µg/kg.

Conclusions and next steps

The differences in THg concentrations found between Barcelona and Poland are probably related to fish consumption, since Mediterranean populations have higher intakes than central Europe, in line with previous findings (Smolders et al., 2015). Further analysis is required to confirm these findings, including the determination of larger number of samples and the evaluation of fish consumption.

Smolders, R., et al. (2015). Interpreting biomarker data from the COPHES/DEMOCOPHES twin projects: Using external exposure data to understand biomarker differences among countries. Environmental Research, 141, 86–95.

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Microsampling as potential tool for toxic metal assessment

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Dr. Stefan Rakete is analytical chemist with special interest in the development of innovative methods for toxic metal analysis in human and environmental samples.

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Background
The exposure to toxic metals is associated with many adverse health effects including cancer and neurological diseases. Monitoring of toxic metal levels in biological matrices such as blood is one of the key elements for exposure assessment. However, commonly applied venous blood sampling comes with many disadvantages, e.g., relatively high costs due medical personnel as well as cooling and shipment restrictions. Microsampling-assisted monitoring of toxic metals in blood comes with the promise of simplification and wider availability of exposure assessment. The content of presentation is a brief overview about current microsampling techniques and their applications for toxic metal analysis in blood.

Methods/Approach
The existing literature was reviewed for studies applying microsampling for toxic metal biomonitoring using scientific databases.

Results
Sampling devices such Dried Blood Spots (DBS) or Volumetric Absorptive Microsampling (VAMS) have been used for toxic metal analysis in blood. Major challenges including sensitivity, reproducibility and background contamination of the sampling material were identified. Only a few studies have applied microsampling for biomonitoring of toxic metals to assess occupational or environmental exposure to toxic metals. Furthermore, microsampling methods have yet not been included in regular biomonitoring programs.

Conclusions and next steps

Although the research and use of microsampling-assisted toxic metal biomonitoring is intensifying, standardization and field applicability of these methods still need to be demonstrated. Nevertheless, these tools have the potential support and improve exposure assessment, especially in low- and middle-income countries.

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Genotoxicity testing with heavy metals – rolling the dice?

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Background
REACH regulation (1907/2006 (EU)) demands genotoxicity testing for substances depending on the yearly tonnage band manufactured in the EU. Unfortunately, in vitro genotoxicity testing of metals turns out to be challenging due to methodological limitations and inconsistent predictive outcomes. While standard in vitro assays are designed rather for organic compounds, testing (heavy) metals or metal compounds presents unique challenges due to their chemical properties and interactions with biological systems.

Methods/Approach
Standard bacterial assays like the Ames test often yield false negatives for heavy metals due to the inability of metal cations to permeate bacterial cell walls effectively. The standard in vitro mammalian cell tests demanded by REACH, like the micronucleus test or the chromosome aberration assay, exhibit rather poor specificity and are prone to artifacts. For example, some cell lines are deficient in DNA repair. Also, cell lines do not consider ADME factors: uptake, distribution and metabolism of metals differ fundamentally from organic molecules. Some metals require special transport mechanisms or have an indirect genotoxic effect, which is not well reflected in standard tests.
Genotoxicity testing in vivo does not guarantee unequivocal results, either. Testing at excessively high concentrations, which are unrealistic to achieve in animals and humans under normal physiological conditions, may trigger nonspecific cytotoxicity or stress response. Thus, their outcome may be of doubtful relevance for humans.

Results

Here, as a practical example, the complexity of genotoxicity testing shall be demonstrated based on results obtained with an organometallic compound of copper.

Conclusions and next steps

In conclusion: when genotoxicity testing becomes necessary during REACH registration of your compound containing metals, it is crucial to evaluate any potential pitfalls beforehand and design your testing strategy as specific as possible to avoid producing results that may not accurately reflect the true genotoxic or non-genotoxic properties of your substance.

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Rapid market screening - lead in consumer products

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Background

Lead poisoning remains a major but underrecognized public health threat, particularly in low- and middle-income countries (LMICs). Around the world, lead exposure originates from diverse sources, including everyday household items such as foodware and spices, as well as industrial pollution. This study aimed to investigate whether common consumer goods in LMIC markets contain lead at levels that could plausibly contribute to exposure.

Methods/Approach

In 25 countries, research teams systematically collected and tested 5,007 products—including metal and ceramic foodware, cosmetics, toys, paints, spices, and staple foods—using portable X-ray fluorescence (XRF) analyzers. A subset of samples was tested via ICP-MS laboratory analysis in the USA.

Results

Results revealed that 51% of metal foodware, 45% of ceramic foodware, and 41% of paints exceeded international reference thresholds of lead concentrations. Some traditional cosmetics, such as kohl/kajal, showed extreme concentrations, with lead levels exceeding 600,000 ppm.

Conclusions and next steps

The findings highlight the widespread presence of hazardous products and point to urgent needs for enforcement, consumer protections, and scalable field-testing tools. Rapid Market Screening (RMS) offers a practical, low-cost method to quickly identify high-risk items and inform targeted interventions to reduce lead exposure globally.

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Funding source

RMS was made possible by GiveWell, funded in part by Effective Altruism Global Health and Development Fund, Open Philanthropy, and Affinity Impact

Strategies for safeguarding workers from toxic metals exposure at brown-field mineral & metals projects

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Dr Krishna Nirmalya Sen is the Head of Environment, Health and Safety Dept of Minerals & Metals IC of Larsen & Toubro Limited. He also volunteers as the Chair of OHS Expert Committee of Indian Chamber of Commerce and President of ASSP India Chapter. He is a Fellow of Collegium Ramazzini and Institution of Engineers India.

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Background

Projects related to modernization, expansion and repair in the mineral and metals industry poses significant occupational health and safety (OHS) risks to the workers due to intrinsic nature of the activities and work environments.

Methods/Approach

Challenges posed by brownfield expansion projects require comprehensive, proactive safety frameworks beyond traditional compliance-based approaches. In this paper, efforts made to highlight structured safety framework adopted to ensure safe and healthy workplaces in line with Vision Zero philosophy. The approach encompasses majorly on three main areas, namely, Safe Processes, Competent Workmen and Application of Digital Technologies.

Results

Implementation of integrated strategy for brownfield projects leads to measurable reductions in safety and health incidents, improved compliance, and greater worker wellness through participation and engagement. Adoption of vision Zero principles fostered a culture of accountability and continuous improvement. Collectively, this

integrated approach resulted in smooth handling of complex expansion jobs without compromising safety and health of employees.

Conclusions and next steps

OHS risk management and control associated with construction work of brownfield expansion and modernization of minerals and metals plants, requires multipronged approach. Leadership commitment integrated with establishment of safe processes, workmen competency and technological solution is the way for future.

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An investigation on the adverse impacts of mineral mining on the environment. (A case study of zimbabwe)

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Mr Brandon phathisani sibanda is the environmental scientist at Rusununguko Nkululenko holdings and has assisted the Zimbabwe National Army in its mining projects across Zimbabwe, in an effort to promote environmental rehabilitation and reduce environmental degradation as a result of mineral mining.

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Background or Purpose
Investigating on the polices that are contributing to environmental degradation in zimbabwe. These policies will inturn promote activities that aren't environmentally sustainable and degrade the environment. The role of investors is also in the spot light as they also are part and parcel of the network as they finance the activities, a closer look at the investors it also has to be proven if they are environmentally conscious in nature. The countries legislation on activities that impact the environment is also examined to figure out if they are in line with sustainable environment development. The countries communities is also questionable on the level of environmental awareness as there is also small scale activities in communities that degrade the environment and exposure to toxins.

Content
Zimbabwean environmental legislation.
Investors activities in the country.
Mineral composition of the country.
Small scale mining activities.
Investigation of toxic metals exposure.

Implications for addressing the issue
No direct implications however most of the mining activities are being

done by Chinese nationals hence limited implications on the countries government.

Potential follow-up/actions

Education at community level on the impacts of toxic metals exposure.

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Funding source

Germany research foundation

New analytical approaches to inform exposure assessment and treatment modalities

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Dr. Smith is a Distinguished Professor of Microbiology and Environmental Toxicology at the University of California, Santa Cruz, where he conducts research in environmental health, including exposures and neurotoxicology of environmental agents, exposure pathways to susceptible human populations such as children, the neuromolecular mechanisms underlying neurotoxicity, and the efficacy of therapeutics for the treatment of metal toxicity.

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Background
Accurate assessment of environmental exposures to toxic metals remains the Achille's heel of environmental health studies seeking to determine the adverse health effects those exposures. Further, the identification and validation of exposure biomarkers is fundamental to human toxicology and risk assessment.

Methods/Approach
Over the past decade, we have developed and/or advanced analytical approaches to improve exposure assessment and risk for adverse health effects from a variety of metals, including lead, manganese, and arsenic. For lead, we have advanced stable lead isotope methods to identify exogenous and endogenous sources of exposure to children, adults, and critically endangered wildlife. For manganese, we have developed laser-ablation-inductively coupled mass spectrometry (LA-ICP-MS) methods to determine fetal and postnatal childhood manganese exposure using shed deciduous teeth, and to develop the use of human hair as an integrative biomarker of environmental manganese exposure.

Results
Our studies have shown that 1) lead accumulated in the skeleton poses a significant endogenous source of exposure, potentially stymieing the

efficacy of environmental remediation efforts, and 2) retained/embedded lead fragments, such as often arises as a consequence of non-fatal firearm injuries, produces an endogenous source of prolonged elevated lead exposure that stymies the efficacy of therapeutic chelation treatment to reduce body lead burdens and toxicity. Similarly, our studies with manganese have shown that the adverse health effects associated with elevated manganese exposure in children and adolescents differ depending on pre- vs postnatal exposure windows of susceptibility.

Conclusions and next steps

Altogether, these studies underscore the continued need for the development and advancement of exposure and health effect assessment methods.

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US National Institute of Environmental Health Sciences, UC Santa Cruz, US Veterans Administration

Are big lithium batteries a potential health risk due to EMF?

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Dr. Morando Soffritti, MD, has been Scientific Director of the Ramazzini Institute for 15 years and now is Honorary President. He has been responsible of several research projects to evaluate the carcinogenicity potential of agents to which people may be exposed, including ionizing radiatio, non-ionizing radiation, artificial sweeteners, pestecides, aldehydes, fibre

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Background
Governments are under increasing pressure to accelerate decarbonization and electric vehicles (EV) play a key part in the energy transition. While being operated, EV generate electromagnetic fields. These fields are at extremely low frequency (ELFEMF), 50-60 Hz. From 1979 until now the results of epidemiological research on children living in houses near electricity power lines and on occupational-exposed workers have suggested there is a potential carcinogenic risk from ELFEMF.

Methods/Approach
The objectives of the project were to: 1) assess the qualitative-quantitative carcinogenic effects of 50 Hz MF at various intensity levels (1000; 100; 20; 2; 0 µTesla) using large experimental groups; and 2) assess the capacity of 50 Hz MF to boost the carcinogenic effects of low exposure to known carcinogenic agents such as formaldehyde or gamma radiation. In all studies the treatment at 50 Hz MF started from prenatal life and lasted until natural death.

Results
1) Exposure to MF alone does not induce significant changes in the incidence of the various types of tumors compared to controls, whether in males or females.
2) Compared to controls. Concurrent exposure to low dose formaldehyde (50mg/L/day in drinking water) and to 1,000 µTesla 50

Hz MF for the life span, causes males to have a significant increase in thyroid C-cell carcinomas and lymphomas/leukemias.
3) Compared to controls, exposure to a single dose of Y radiation (0,1 Gy) at 6 weeks of age and to MF lifelong, induces a significant increase of various tumors in male and female rats.

Conclusions and next steps

The results of these studies show that exposure to ELFEMF combined with low exposure to well known carcinogens, such as ionizing radiation or formaldehyde, may increase their carcinogenicity potential and this could be a new health problem for people driving electric cars.

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The Carcinogenicity of Metals

Kurt Straif - Boston College & ISGlobal Spain

Kurt Straif is trained in oncology, occupational, environmental and social medicine, public health and epidemiology. He served as the senior epidemiologist, Head of the IARC Monographs and Head of the IARC Section of Evidence Synthesis and Classification (overseeing the WHO Classification of Tumours, and IARC Handbooks of Cancer Prevention). Since retirement from IARC he continues his work on global cancer prevention at Boston College and ISGlobal, plus a focus on climate change and health.

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Background

The mining of minerals has played a significant role in human history, for human development, but unfortunately also in terms of massive occupational and environmental disasters, from serious injuries and frequent premature deaths among miners to increased cancer risks, long-term environmental pollution in the vicinity of large and small-scale mining activities, and finally in the recycling of precious metals.

Methods/Approach

Over the centuries, and particularly since the second half of the last century, various occupational exposures in mining have been identified as human carcinogens.

Results

This overview will focus on the human carcinogenicity of various metals, building on the evaluations by the IARC Monographs programme, and with an emphasis on the human evidence by exposure to selected metals, specifying the evidence by cancer site.

Conclusions and next steps

Still, new research gaps emerge from the latest consensus evaluations, and new evidence supported the recommendation of some metals for future priority evaluations by the IARC Monographs programme.

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Estimation of mercury released into the environment from the uncontrolled dumping of broken medical thermometers in hospitals in Cameroon, Africa

Samuel Tetsopgang - Association Institute of Total Environment (INTEV) Cameroon

Dr. Samuel Tetsopgang is the President and Co-Founder of Association Institute of Total Environment (INTEV), created and based in Yaounde, Cameroon. INTEV is accredited to UNEP since 2022. INTEV carried out research and advocate before decision makers on toxic chemicals (and precisely heavy metals) on products.

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Background

Mercury is a neurotoxic element. Owning to its unique physical and chemical properties, mercury is present in several daily use devices and will be released into the land and waters after the end of life or through mishandling. There is a permanent usage of mercury thermometers in hospitals and homes because of malaria prevalence in some countries. Then, the accidental breakage of these thermometers will increase the budget of mercury emitted to land and waters. The main objective of this survey was to estimate the quantity of mercury released into the environment through the uncontrolled dumping of broken thermometers in hospitals in Cameroon.

Methods/Approach

In fact, each patient is required to hold a thermometer for any health consultation in Cameroon.
Then a questionnaire was sent out to assess thermometers handled by each medical personnel in respect to categories, total units and broken units during medical consultations. Medical personnel responding to questionnaires comprised assistant nurses (AN), nurses, midwives and physicians. The total of broken mercury thermometers was used to quantity mercury yearly, accidently released into the environment.

Results

This survey indicates that mercury added thermometers are the most common with 2736 units used for a period of a year. Then, there is a yearly disposal of 0.168 to 0.504 Kg of mercury by AN in hospitals in Yaounde. Then, the total national Hg disposed of from the uncontrolled dumping of broken mercury-added thermometers is estimated to 222.52 Kg in Cameroon.

Conclusions and next steps

The total estimation of 0.223 Kg of mercury disposed of in this study is a very small portion of the 2220 tonnes of annual global anthropogenic mercury emissions. Then, this estimation turns out to be significant in the local level since it makes about 8.58 % of mercury use in ASGM in Cameroon.

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Funding source

Funding was received from the Association Institute of Total Environment (INTEV) for field works to carry out this study

Working Towards Zero Lead Emissions From the Battery Recycling Industry For A Just Energy Transition in India

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Anuradha Varanasi is a visiting researcher at Oeko Institute and a freelance science journalist based in Freiburg Germany. She covers climate change and renewable energy and her stories have been published in Atlas Obscura, Popular Science, Inverse, Wired, Cipher News, and other news publications.

Background or Purpose

While India has set an ambitious target of installing 500 gigawatts of renewable energy by 2030, it will need more battery storage than any other country. Lead-acid batteries reign supreme in India for storing electricity because they are 40% to 50% cheaper than lithium-ion batteries. Additionally, the country's thriving three-wheeler electric vehicles industry also predominantly relies on this low-cost technology.

As India's ambitious green energy transition is rapidly underway, the use of lead-acid batteries is growing. However, this rising demand threatens to overwhelm India's unregulated battery recycling sector.

Content

Environmentally unsound lead smelters and battery recyclers — which are the most polluting industry worldwide — are a major source of lead pollution in 23 states across India. Despite that, the Central and State Pollution Control Boards have repeatedly failed to enforce regulations. Children are particularly vulnerable to acute lead poisoning that is proven to cause behavioural and intellectual disabilities. Of the 800 million children with elevated blood lead levels globally, 275 million live in India. Without systemic change, extremely high levels of lead emissions from unsound battery recycling plants will wreak havoc on public health. Intergenerational lead exposures have kept marginalised communities trapped in a cycle of poverty.

Implications for addressing the issue

The Indian lead industry has become a global hub that supplies raw materials to European markets involved in the green energy transition. My research focuses on solutions from successful sector transitions towards well-controlled lead battery recycling (as experienced in

Germany) and evaluating how those solutions could be transferred to developing countries like India.

Potential follow-up/actions

My research project aims to document this environmental justice issue through solutions-oriented news articles. My fieldwork in two Indian states (Bihar and Maharashtra) has enabled me to gather exclusive information on battery waste management systems in India.

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Alexander von Humboldt Foundation

Benchmark Dose Analysis of Lead Toxicity in Wistar Rats: Identifying Critical Toxic Effects

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Background
Although lead (Pb) toxicity has been extensively studied over decades, recent concerns have emerged regarding the effects of chronic low-dose exposure, which may induce subtle and previously underrecognized biological alterations. This study investigates the critical toxic effects of lead (Pb) exposure on various organs and organ systems using a Wistar rat model.

Methods/Approach
The rats were divided into 7 groups of 6 animals, including one control group and 6 experimental groups treated with increasing doses of lead (0.1, 0.5, 1, 3, 7, 15 mg Pb/kg body weight/day) for 28 days. Twenty-four hours after the last dose, the rats were humanely sacrificed, and blood and organs were collected for further analysis. Blood samples were analysed for hematological parameters, biochemical markers, hormones, oxidative stress parameters, bioelements, and Pb content. Organs underwent histopathological examination, and oxidative stress

markers, bioelement levels, Pb content, and brain acetylcholinesterase activity were measured.

Results

The most sensitive toxic effect of lead was a reduction in testosterone levels, with a benchmark dose lower confidence limit (BMDL) of 1.07e-06 mg Pb/kg body weight/day. Other critical effects had BMDLs up to approximately 0.1 mg Pb/kg body weight/day and included a decrease in copper (Cu) levels in blood and liver, inhibition of superoxide dismutase (SOD) in kidneys, and an increase in malondialdehyde (MDA) in the heart, reflecting lipid peroxidation. Elevated total oxidant status (TOS) in the brain and increased zinc (Zn) levels in the testis and pancreas were also identified as critical toxic effects.

Conclusions and next steps

The study highlights the importance of identifying critical toxic effects of Pb and provides insights into its toxicity mechanisms. Our results offer valuable data for human health risk assessment and evaluation of reference points for Pb. Further research will help health professionals make evidence-based decisions and improve environmental safety standards to protect human health and wellbeing.

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Funding source

This research was funded by the Ministry of Science, Technological Development and Innovation, Republic of Serbia through two Grant Agreements with Un

Southern Africa - One health and toxic metals

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Dr. John Yabe is a Senior Lecturer in Veterinary Pathology at the University of Namibia. He graduated with a PhD in Veterinary Pathology (Lead Poisoning) at Hokkaido University, Japan. He has been researching childhood lead poisoning for over ten years and is ranked among the Top 0.05% World Experts on Lead (https://expertscape.com/ex/lead). He is the Regional Coordinator for the JICA-Japan Project on heavy metal contamination in Zambia, Zimbabwe, Namibia, and Botswana (ZA.ZINAMBO Project).

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Background

Southern Africa is endowed with rich mineral deposits, where widespread environmental pollution with toxic metals has been reported. Kabwe town, in Zambia, has a long history of lead and zinc mining and serves as an example of the environmental impact of mining activities. Dense fumes rich in lead, cadmium, etc., polluted the environment in the town, which is ranked among “the ten worst polluted places on earth”.

Methods/Approach

A wide survey was conducted in Kabwe for laboratory screening of blood, milk, fecal, and urine samples in various townships.

Results

Findings from the University of Zambia and Hokkaido University collaborative study (KAMPAI Project; 2016-2022) revealed that animals and humans in communities in the vicinity of the mine were exposed to alarming levels of lead in Kabwe. The study analyzed the extent of lead poisoning and exposure variations among family members in Kabwe. The study also assessed Pb exposure and maternal characteristics on neurodevelopmental (ND) outcomes in children, as well as the clinical

biochemical parameters associated with exposure to multiple environmental metals.

Conclusions and next steps

Following on from studies in Zambia, the researchers are launching a new project in Zambia, Zimbabwe, Namibia, and Botswana (ZAZINAMBO Project), from June 2025 to 2030, to extend the studies on the impact of toxic metals in the Southern African region. This will focus on One Health and Capacity Building.

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Imprint

Printed in June 2025, Munich, Germany

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