POLICY BRIEF

Childhood Blood Lead Surveillance

Findings and Policy Recommendations

Penguatan Sistem Kesehatan untuk Mengurangi Paparan Timbal

ACKNOWLEDGEMENTS

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KEY FINDINGS

Around **1 in 7 children** (15%) had a **blood lead concentration of ≥5 μg/dL**, the reference value used by World Health Organization (WHO) and the Ministry of Health, Republic of Indonesia to indicate the need for clinical and environmental action.

Higher household income, caregiver education, living in urban areas, and calcium intake are associated with **lower risk of elevated BLLs** in children, while **peeling paint, parental lead-related occupations**, and use of **metal cookware and cosmetic powders are key risk factors.**

More than 20% of tested consumer products, including (1) metal cookware, (2) ceramic foodware (3) plastic foodware, (4) cosmetics, (5) children's and adults' clothing, and (6) toys, contained lead concentrations **exceeding recommended safety limits.**

For every **twofold increase** in **soil lead concentration** measured during home-based assessments, the average **child blood lead level increased by 8%.**

Situation of Childhood Lead Poisoning in Indonesia

Lead is a hazardous chemical that poses a serious threat to child health [1]. There is no safe level of lead exposure; even low-level exposure, when sustained over time, can cause permanent cognitive impairment and hinder child growth and development [2]. In Indonesia, an estimated 8 million children have blood lead levels above the intervention threshold (≥5 μg/dL) [3], largely due to exposure from everyday environments, including informal used lead-acid battery recycling, lead-containing paints, household items, toys, and cosmetics that do not meet safety standards [4,5]. This situation underscores the urgent need for stronger, more coordinated actions to prevent and control lead exposure.

Why Is Childhood Blood Lead Surveillance (BLS) Needed in Indonesia?

To date, Indonesia does not have a national surveillance system capable of routinely and continuously monitoring blood lead levels in children. Given that lead poisoning is chronic and often asymptomatic, blood lead surveillance is critical. In the absence of systematic blood lead data, early detection, estimation of disease burden, identification of high-risk populations, and determination of primary exposure sources remain limited. A robust surveillance system would generate evidence-based data to inform effective, coordinated multisectoral policymaking, support policy evaluation, and enable more timely and targeted prevention and response to childhood lead poisoning.

There is no safe level of lead concentration in blood.

Objectives

1. To assess blood lead levels and estimate the prevalence of blood lead levels ≥5 µg/dL among children aged 1–5 years in six provinces in Indonesia.
2. To evaluate sociodemographic, personal, behavioral, home environment, and occupational risk factors associated with elevated blood lead levels in children.
3. To assess the capacity and feasibility of implementing a future national blood lead surveillance system.

Approach

Study design and sampling strategy

- The BLS study employed a cross-sectional design to describe the current situation of lead exposure risk and blood lead levels among children aged 12–59 months.
- Study locations were selected taking into account regional representation and population distribution, urban–rural characteristics, and local resource readiness.
- Six provinces were selected: South Sumatra, Lampung, Central Java, East Java, Bali, and West Nusa Tenggara (Figure 2).

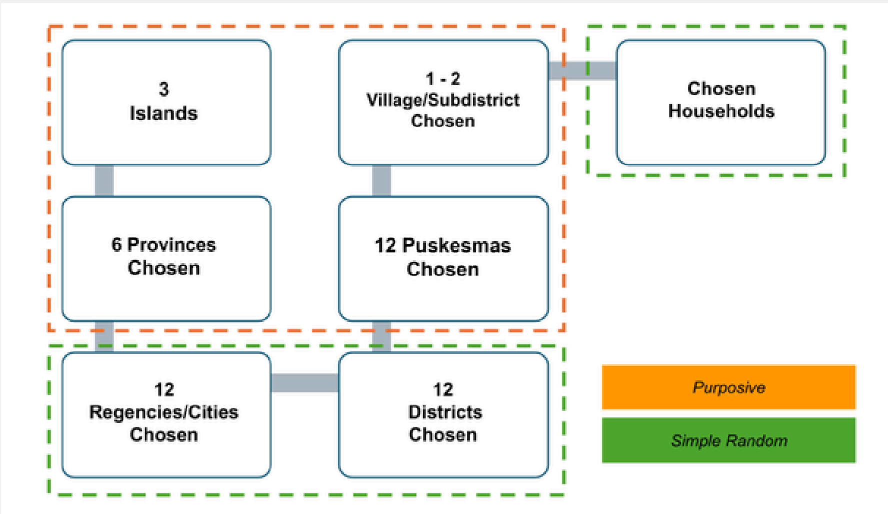

Figure 1. Sampling Strategy

- Regencies/cities and districts were selected through a multistage random sampling based on the population of children aged 12–59 months in urban and rural areas.
- Primary health care centers (Puskesmas) and villages/subdistricts were identified in consultation with local governments, considering access to health facilities and the readiness of BLS implementation teams.
- Children aged 12–59 months were then randomly selected to meet the sample targets and screened against eligibility criteria.

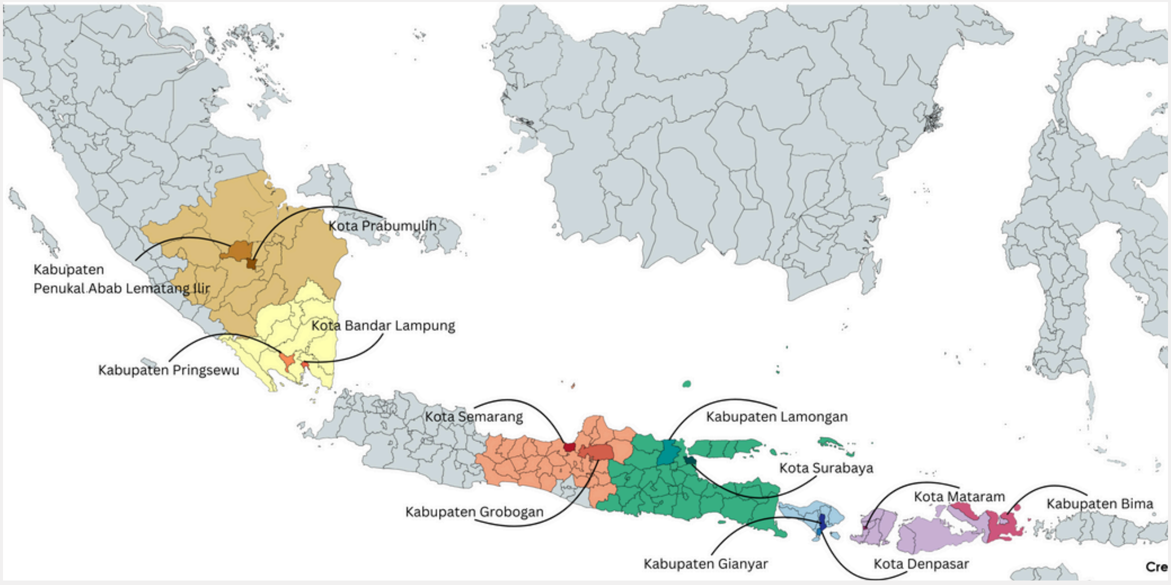

Figure 2. Study Location

Data collection

Blood lead level measurement and household risk assessment questionnaire

- Between April and September 2025, **1,609 children** underwent capillary blood lead testing using portable analyzers.
- Parents/caregivers were interviewed to assess exposure risks related to occupational activities, household vulnerabilities, consumer products, behaviors, nutrition, and sociodemographic characteristics.

Home assessment*

- Subsample of **328 households (20%)** was selected to identify lead exposure in the household.
- X-Ray Fluorescence (XRF) technology was used to measure lead concentrations in soil, dust, clothing, cookware, tableware, toys, paint, and mattresses samples.

Enabling factors and barriers to implement blood lead surveillance

To assess feasibility and capacity to implement BLS, observations were conducted during both the pre-implementation and implementation phases. These observations were complemented by feedback from health workers, cadres, multisectoral subnational stakeholders, and parents/caregivers. The assessment identified enabling factors that supported implementation and barriers that provide lessons for future scale-up.

Figure 3. Health care professionals collect capillary blood for blood lead level testing.

* Home assessment is a series of procedures to identify sources and pathway of exposure of lead, particularly among children.

Summary of Results

Sociodemographic characteristics

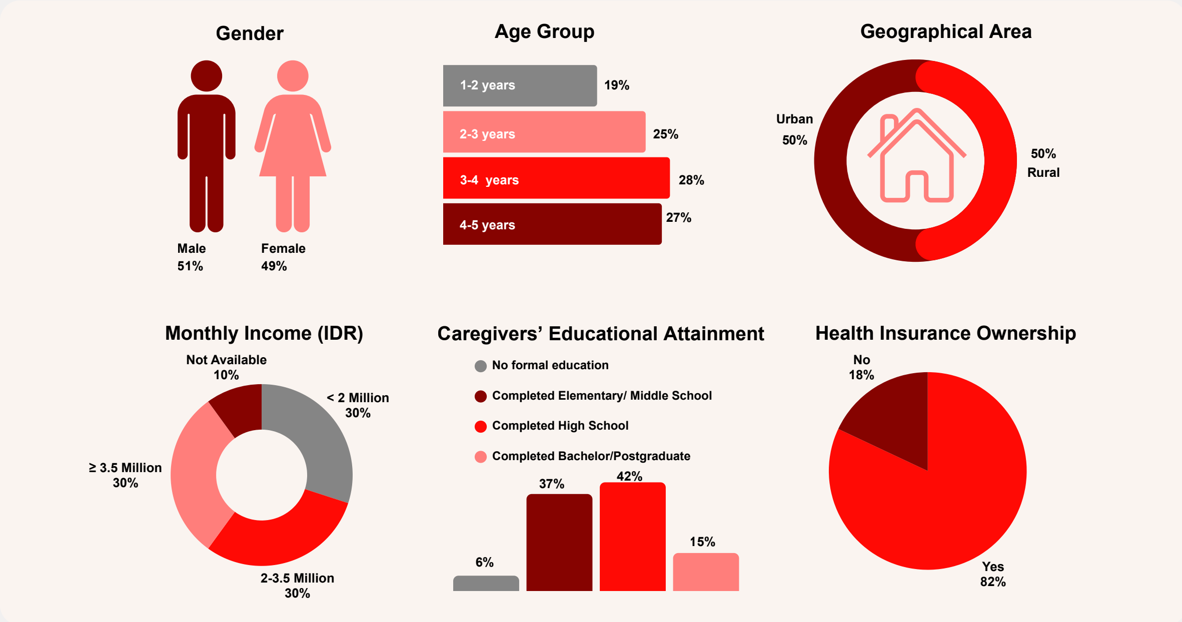

Figure 4. Sociodemographic Characteristics of the Sample (N = 1,609)

Blood lead levels (BLLs)

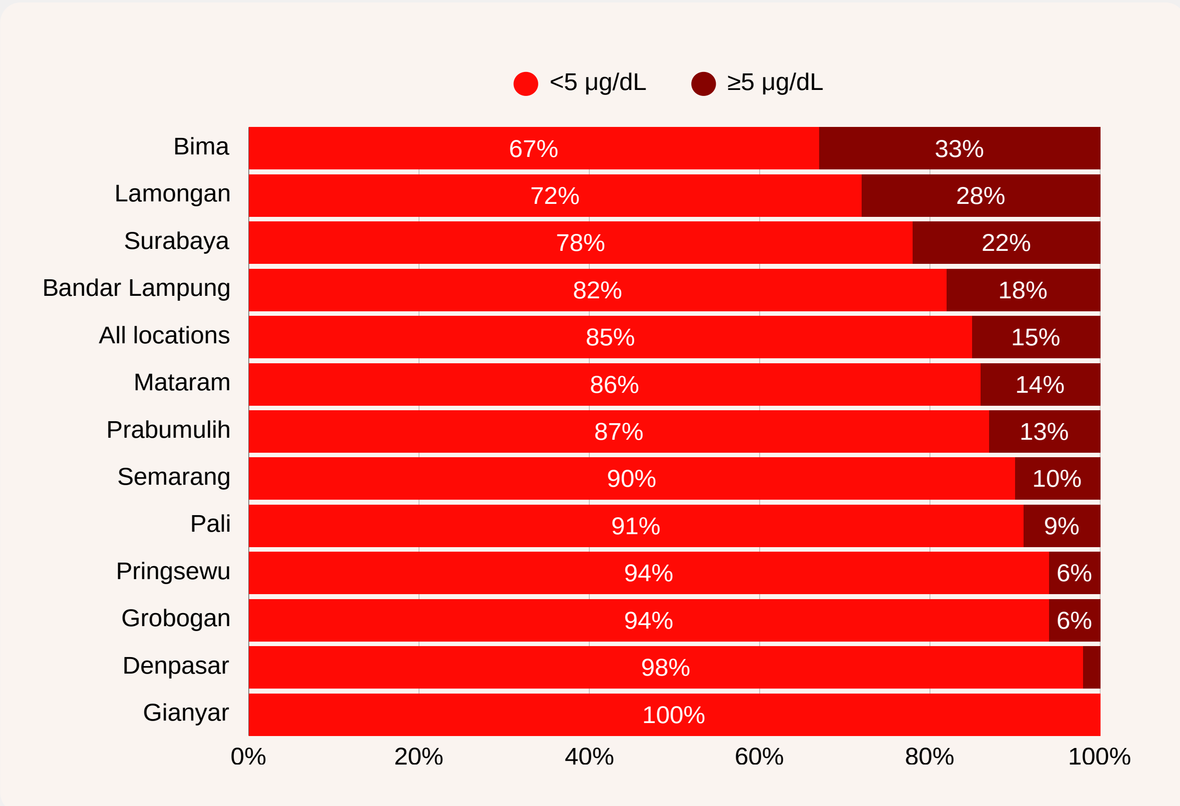

Figure 5. Blood Lead Level Results (N = 1,609)

Risk/protective factors for elevated blood lead levels

Children with **caregivers who have a higher level of education** have up to a **69% lower** likelihood of having **BLLs ≥5 µg/dL**.

Children from **higher-income households** have **7% lower BLLs.**

Children living in houses with **peeling paint** have a **61% higher chance of having BLLs ≥5 µg/dL**.

Children of parents working in lead-related sectors have **7% higher BLLs.**

Children of parents/caregivers who use cosmetic powder have **8% higher BLLs.**

Children living in homes that use **metal cookware** for cooking have **10% higher BLLs**.

Children **consuming calcium supplements** had **lower BLLs**.

Children from urban areas have a **29% lower** likelihood of having **BLLs ≥5 µg/dL.**

Home assessment

Environmental and household samples with lead levels above threshold limits	**Metal cookware (71%)**	**Ceramic (52%) and plastic (20%) tableware**
Cosmetics (34%)	**Children's toys (24%)**	**Children's (21%) and adults' (21%) clothing**

Sample sizes: metal cookware (328), ceramic tableware (199), plastic tableware (278), cosmetics (142), children's clothing (304), adults' clothing (273), and children's toys (322).

Environmental risk factors based on home assessment

For every twofold increase in soil lead concentration, the **mean blood lead levels in children increased by 8%.**

Blood lead surveillance implementation

Enabling factors

- Intensive communication and coordination with national and subnational governments strengthened commitment and implementation support.**
- Pre-survey implementation to test and refine study protocols and BLS standard operating procedures (SOPs) proved essential for maintaining data quality and effective surveillance implementation.*
- Health workers and cadres played a critical role in reaching target populations and increasing community acceptance of blood lead testing.**
- Communicating blood lead test results through culturally appropriate, inclusive communication materials and counseling in local languages improved understanding and promoted household-level lead exposure prevention.**

Figure 6. Health care professionals use communication materials while counseling parents and children about results.

Key barriers

Figure 7. Cadres conducting sampling for recruitment of children for blood lead surveillance.

- The absence of a multisectoral lead control authority and limited supporting subnational policies and regulations.**
- Some children with elevated blood lead levels do not have active JKN health insurance coverage.*
- Inconsistent communication of key messages “there is no safe level of lead exposure” to parents and caregivers, can limit understanding of prevention measures.**
- Access to blood lead testing remains limited, both through portable analyzers and laboratory-based testing, constraining routine monitoring.**
- Children with elevated blood lead levels and malnutrition are not consistently enrolled in routine health monitoring at Posyandu.[a] *
- Essential medicines, such as iron syrup needed for children with anemia and elevated blood lead levels, are not yet widely available at Puskesmas.[b] **

Notes:
* occurred in a limited number of locations or < 6 sites
** occurred in most of locations or ≥ 6 sites
[a] Posyandu: Community-based Integrated health service post for maternal and child health
[b] Puskesmas: Government-run community health center providing primary health care

Policy Recommendations

Strengthen the health system through a national blood lead surveillance program

- Strengthen the capacity of trained health workforce by expanding and upskilling physicians, midwives, and environmental health officers in line with Ministry of Health guidance on clinical, environmental, and community management of lead exposure.
- Enhance laboratory capacity for blood lead level testing and environmental analysis through standardization of equipment and testing methods. Central laboratories should play a key role in capacity building, quality assurance, and oversight of standard operating procedure implementation.
- Integrate routine children's blood lead level screening into the free health check-up program (Pemeriksaan Kesehatan Gratis/PKG) and national health surveys.
- Integrate the blood lead level results and risk factors from this surveillance activity into national public health database so they can inform interventions and policies.
- Expand JKN beneficiary coverage to include children with lead poisoning who require clinical management

Promote multisectoral collaboration

Preventing lead exposure in children requires cross-sector coordination among the industrial, education, environmental, and health sectors, supported by a legal framework, national governance structure, and Coordinating Ministry leadership in implementing the National Action Plan.

Increase surveillance capacity and strengthen interventions to remove sources of exposure

The industrial and environmental sectors are responsible for monitoring sources of lead exposure in water, soil, air, and consumer products (including establishing thresholds for lead in cookware and tableware), overseeing lead-related work, ensuring public disclosure of results, particularly in at-risk areas, and implementing control interventions to protect the environment and health. Evidence-based policies require an equity focus, as the burden of lead exposure disproportionately affects population groups with lower socioeconomic status and educational attainment.

Raise public awareness and knowledge on lead poisoning

Preventing lead exposure requires advocacy to stakeholders and empowering cadres, community leaders, and industry actors through simple, locally contextualized communication materials, delivering consistent messages including lead poisoning prevention and healthy diets through media, health services, and workplaces, and integrating heavy metal issues into school curricula to promote behavioral change.

Scan here for additional resources