

# Element of mystery

Half the children in India are poisoned by lead. Why has the country failed to prevent it despite knowing the sources and treatment?

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**F**OR MONTHS before his second birthday in 2007, Vijay Singh (name changed) had frequent bouts of uncontrolled vomiting three-four times a day. He had turned pale and weak. For almost a year, Vijay's parents, residents of Barabanki town in Uttar Pradesh, took him to several medical centres. Finally, a doctor at the district hospital in Faizabad, 100 km away from Barabanki, realised Vijay was severely anaemic and began blood transfusions. Even so, his haemoglobin levels remained dangerously low.

His parents then went to a super-speciality hospital in Lucknow, where doctors conducted several tests like bone marrow analysis and genetic profiling. The mystery prevailed until Vijay's father, Manjit, revealed his source of income—a battery recycling operation at their house.

Manjit would recycle old lead-acid batteries in the basement and sell the products at the ground floor, where the family lived. This means lead could have entered Vijay's body through several ways—the metal can be ingested through mouth, inhaled through the respiratory system or absorbed by the skin, as per the World Health Organization (WHO). After learning about Manjit's occupation, doctors tested Vijay's blood lead level, which was 186 microgrammes per decilitre ( $\mu\text{g}/\text{dL}$ ), much more than the tolerable limit of 5  $\mu\text{g}/$

dL set by WHO.

This was a clear case of lead poisoning. "I read about battery recycling and metal toxicity but I never thought it would happen in my home," says Manjit. He has since shut the operation.

Treatment for lead poisoning involves chelation, in which the patient is given medication that binds with lead molecules and facilitates their excretion through urine. But when Vijay's case was referred to Abbas Ali Mahdi of the department of biochemistry at King George's Medical University, Lucknow, the doctor was hesitant to begin chelation as it can also lead to the loss of essential elements like





tal health non-profit. The report says 275 million children in India record blood lead levels of beyond the tolerable limit of 5 µg/dL. Of these, 64.3 million children's blood lead levels exceed 10 µg/dL.

Adults are also affected by lead toxicity. In July 2022, Union government think tank NITI Aayog and the Council of Scientific & Industrial Research (CSIR) conducted a meta analysis of 89 datasets from 36 studies between 1970 and 2014; its results validate the UNICEF-Pure Earth report. In terms of average blood lead levels among the population, some 23 states exceed the 5 µg/dL margin; levels in the remaining 13 states and Union Territories cannot be determined as there is a lack of research and screening mechanisms to collect data. Bihar (average blood lead level of 10.42 µg/dL), Uttar Pradesh (8.67 µg/dL), Madhya Pradesh (8.32 µg/dL), Jharkhand (8.15 µg/dL), Chhattisgarh (7.46 µg/dL) and Andhra Pradesh (7.14 µg/dL) account for 40 per cent of the population with high blood lead levels (see 'Widespread problem', p20).

Further, a 2016 analysis by the Institute for Health Metrics and Evaluation (IHME), an independent population health research centre at the University of Washington School of Medicine, US, estimates that lead toxicity in India contributes to 4.6 million Disability-Adjusted Life Years (number of years lost due to disease burden) and 165,000 deaths annually.

Lead toxicity is not just a concern in India. The UNICEF-Pure Earth report notes around one in three children worldwide record blood lead levels of over 5 µg/dL. Countries with this burden include Iran, Afghanistan, Yemen, Peru, Vietnam, the Philippines and parts of Central Africa.

## DEBILITATING IMPACTS

The adverse impacts of lead entering the human body have been known since 1920.

iron, zinc and calcium. The university arranged more suitable medication from the

US and Vijay underwent one round of chelation which lasted three-four months. Till today, his blood lead level hovers around 50 µg/dL, but he does not show any obvious signs of lead toxicity like weakness or poor physical growth (see 'What lead does', p22). His nutritional intake has improved, says Mahdi.

## AN ONGOING CRISIS

Lead poisoning is not a new concern. For more than a century, scientists have been aware that the naturally occurring metal has no biological function that can benefit the human body, but can cause devastating physical and developmental impacts.

However, despite the awareness, lead toxicity continues to be a public health concern. Half the children in India report high blood lead levels, reveals a 2020 report by the UN Children's Fund (UNICEF) and Pure Earth, a US-based environmen-

“The Industrial Revolution caused an epidemic of metal intoxication, urging scientists and physicians of that period to study and identify specific symptoms and organ alterations related to chronic lead poisoning,” says a 2012 study published in the journal *Safety and Health at Work* by researchers from Italy.

“Once lead enters the blood stream, it goes directly to the brain, particularly so in children. This is because there is no specific blood-brain barrier for lead that can restrict movement of the metal. During pregnancy, if the woman consumes lead in some form, there is no placental barrier either, so the lead is transferred to the fetus,” explains Thuppil Venkatesh, professor emeritus at St John’s Medical College, Bengaluru.

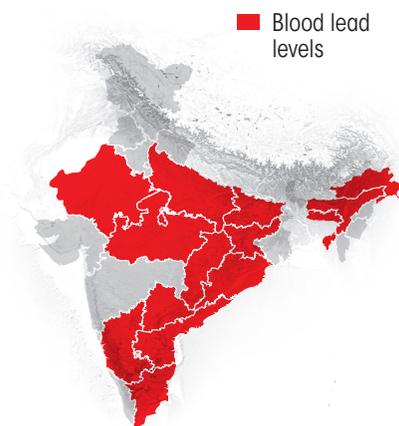
In a newborn, lead poisoning can result in premature birth, low birth weight and slow growth. In children and adults, it can cause anaemia as well as neurological, skeletal and neuromuscular illnesses. The UNICEF-Pure Earth report says children with elevated blood lead levels scored three-five points lower on intelligence tests. This “permanent damage (affects) a child’s brain development and central nervous system, (causing) reduced intelligence, attention deficit disorders and lower educational attainment,” the report notes. This can lead to long-term impacts such as loss of economic productivity.

**PRESENT EVERYWHERE**

Science is clear on the impacts of lead toxicity and research indicates that a significant part of the population is affected. Why then, does the disease continue to remain widespread? In India, it could be due to the fact that lead does not get as much attention as other poten-

**Widespread problem**

Some 23\* states exceed the permissible blood lead level of 5 µg/dL



Note:\* Although there are 23 states with high blood lead levels, the names of only the top 15 are publicly available and have been highlighted in the given map. Levels in the remaining 13 states and Union Territories cannot be determined as there is a lack of research and screening mechanisms to collect data  
Source: “Assessment of Lead Impact of Human and India’s Response”, NITI Aayog and Council of Scientific Research

tional public health concerns. First of all, the country lacks systems to screen populations for possible exposure. India has some 48 national referral centres for lead projects where blood lead levels can be tested, but screening is usually done on a voluntary basis or at health camps by non-profits.

Even if screening occurs, determining the source of exposure is not easy. “In several circumstances, determining the source of (lead) poisoning is challenging since patients may not disclose their history of (lead) exposure, resulting in a late diagnosis. In addition, these situations often go unreported and untreated, or they are merely medicated symptomatically,” notes the NITI Aayog-CSIR report.

Between 1996 and 1999, Venkatesh spearheaded a nationwide study to assess blood lead levels of

23,200 people, 30 per cent of whom were children. More than half the children less than 12 years of age and 40.2 per cent of those above 12 years of age studied had blood lead levels higher than 10 µg/dL. The study identified leaded petrol as a key source. India had already begun phasing out leaded fuel in 1994, first by introducing low-lead petrol and then by mandating use of unleaded fuel in April 2000. Other countries such as the UK took similar steps, which resulted in a decline in deaths associated with lead exposure. But the UNICEF-Pure Earth report says that India, in contrast, has recorded a 21 per cent increase in deaths caused by lead exposure since 1990.

This indicates that there are other sources contributing to lead toxicity. Richard Fuller, founder and president of Pure Earth, explains, “Sources of lead poisoning change from location to location, and there are usually multiple exposure sources in any given place.”

According to the NITI Aayog-CSIR report, some common occupational and non-occupational sources of lead may be present all around people (see ‘Everyday risks’). These include smelting and mining, which lead to a release of lead into the atmosphere risking lives of workers in these industries as well as those who live in nearby areas. The report notes agricultural practices close to smelting and mining industries have also resulted in elevated lead levels in meat, milk and soil.

There are measures to protect workers from toxic metal exposure under the Occupational Safety and Health Administration (OSHA) Regulations. However, since implementation of these norms is voluntary and there is no inspection agency, regulation exists only on paper,

says Venkatesh. Similarly, though the Factories Act, 1948, also has provisions to protect the health and safety of workers, it is difficult to cover all industries.

One lesser-known occupation in the report is “battery work”. “Many developing and under-developing countries have a lack of stringent laws and poor policy implementation, resulting in poor government control over informal recycling sectors...As a result, enormous quantities of (lead)-acid batteries are recovered without using scientific techniques in an unregulated and uncontrolled way,” the NITI Aayog-CSIR report says.

Management of lead-acid batteries came under the Batteries (Management and Handling) Rules, 2001. But enforcement capacity to ensure safe and environmentally sound recycling has been inadequate. “As a result, almost half of the used lead-acid batteries in India are still recycled in informal, uncontrolled and unregulated settings,” says Fuller. Manjit’s battery recycling operation is a case in point.

In 2022, the Union Ministry of Environment, Forest and Climate Change notified the Battery Waste Management Rules, 2022. The new rules aim at reducing share of battery recycling in the informal sector and stress on extended producer responsibility. It remains to be seen whether the government can successfully implement this, says Fuller.

One source that can be seen as both occupational as well as a common hazard is lead-based household paint. This source has been identified much earlier; in 2008-09, Delhi-based think tank Centre for Science and Environment tested paints made by major players of the time and found lead in 23 of the 25 samples tested (see ‘Home truths’,

### Everyday risks

There is potential for lead exposure in several common occupations and products that are used in nearly every household

OCCUPATIONAL SOURCES	Non-Occupational Sources
Battery work	Traditional medicine
Mining	Vehicular exhaust
Glass manufacturing	Contaminated cosmetics and sindoor
Automobile repair	Household storage batteries
Ceramic work	Household paints
Painting	Contaminated spices
Pottery	Effluent from lead-based industries
Smelting	Contaminated soil, dust and water near lead-based industries
Printing work	Food grown in lead contaminated areas
Plumbing	Retained bullets
Soldering	Food stored or cooked in lead-coated vessels
Making lead pipes and plastic	Painted toys

Source: "Assessment of Lead Impact of Human and India's Response", Niti Aayog and Council of Scientific Research

*Down To Earth*, 16-31 August, 2009). In multiple reports in 2007-11, Toxics Link, an environmental non-profit, also found dangerously high levels of lead in paint—140,000 parts per million (PPM)—as against the permissible 90 PPM set by the Central Pollution Control Board. Around this time, the country initiated a phaseout of lead-based paints. But even then, small and medium-scale manufacturers continue to record high levels of lead in their paints; some 31 per cent of household paints had lead concentrations of more than 10,000 PPM, as per information in the NITI Aayog-CSIR report. In 2017, the Centre implemented the Regulation on Lead content in Household and Decorative Paints Rules, but Toxics Link's recent research suggests lead-based

paint is still produced.

Another common source is food. As of now, spices are the only identified sources of lead poisoning, as per experts. In northeastern states, the high moisture content does not allow for turmeric in the region to dry quickly, resulting in a lighter colour. This turmeric is transported to Bihar and West Bengal, where lead is added to the commodity to bring out a deeper yellow colour, says CSIR's Rakesh Kumar.

The Food Safety and Standards (Food Products Standards and Food Additives) Regulations, 2011, says the threshold for lead in food of 10 PPM. However, a 2014 study led by a researcher at KPC Medical College and Hospital, Jadavpur, published in the *International Journal of Current Medical And Applied*

# WHAT LEAD DOES

Lead has no biological function in the body; rather, it can impair physical and developmental growth



## 1. FOETUS

**INTAKE ROUTE**  
Placenta

**EFFECTS\***  
Delay in neurological development  
Premature birth  
Low birth weight

**TREATMENT PROTOCOL**  
Chelation and nutritional intervention for the mother

## 2. INFANTS, YOUNG CHILDREN

**INTAKE ROUTE**  
Mother's milk, inhaled air, skin contact

**EFFECTS\***  
Decreased activity of enzymes that produce heme  
Impaired physical and developmental growth  
Low intelligence quotient

**TREATMENT PROTOCOL**  
Chelation and nutritional intervention

## 3. CHILDREN

**INTAKE ROUTE**  
Inhaled air, skin contact, ingestion

**EFFECTS\***  
Decreased nerve conduction velocity  
Hampered cognitive development and intelligence  
Hearing loss  
Jaundice  
Anaemia  
Encephalopathy  
Impact on vitamin D metabolism if lead is deposited on bones

**TREATMENT PROTOCOL**  
Chelation (Medication that binds with lead and facilitates excretion through the urine); nutritional intervention to ensure that essential elements are not lost from the body

## 4. ADULTS

**INTAKE ROUTE**  
Inhaled air, ingestion, skin contact

**EFFECTS\***  
Decreased activity of enzymes that produce heme, an iron-containing compound crucial for all organs  
Changes in blood pressure  
Damage to renal function  
Fluctuation in sperm count

**TREATMENT PROTOCOL**  
Chelation; nutritional intervention for pregnant women

Note: \*Effects mentioned vary depending on blood lead level Source: Expert comments, World Health Organization

Science notes that among spice samples collected from local markets in Kolkata, "the highest levels of lead was found in chilli powder and turmeric powder, which greatly exceeded the permissible amounts."

There is a need to study the potential presence of lead in other foods, as seen in the case of the Maggi brand of instant noodles. In 2014-15, the noodles marketed by Swiss company Nestlé showed high levels of lead when tested for monosodium glutamate (MSG). The brand was banned for months in 2015, but returned to the market after the company passed health standards.

## HOW TO FIGHT THIS

There are more than 20 occupations and household items that may be exposing people to high levels of

lead, but research to even identify geographical distribution of sources appears to be lacking. Regular screening and testing of lead sources will inform about region-wise prevalence and help tailor interventions, such as "regulations and enforcement, changes in industry practices, training of government officials to assess lead contamination, and changes in public education and consumer behaviour," says the UNICEF-Pure Earth report. For instance, as recycling of used lead-acid batteries risks lead exposure, discouraging informal operations and regulating the sector will help.

The country must also enhance capacity for testing, currently done for blood lead levels. "This test only shows how much (lead) is present in circulating blood and not how much

is stored in the body," says the NITI Aayog-CSIR report. Venkatesh adds that 48 centres around the country are not enough. "We have been asking the government to create facilities for blood lead level screenings at every district hospital," he says.

Next, as seen in Vijay's case, there are gaps in treatment protocols. CSIR underlines the need to train healthcare workers to monitor, detect and treat this condition.

The final tool is public awareness. Rajiv Kumar, former vice chairman of NITI Aayog, says "lead poisoning needs to be a part of the narrative of India's health status. We need to devise strategies on a state level, through regional bureaucracy, local press and vernacular language to have tangible impact." [DTE](#) [@down2earthindia](#)