Lead Toxicity: The Unbeaten Menace

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Despite it being known for centuries that lead is toxic to man, the uncontrolled hazard continues to affect millions of human lives till date. As per Global burden of disease dataset 2019, nearly 800 million children in world have unsafe levels of lead in body, more than 50% of whom belong to South East Asia [1]. Talking about India alone, we have almost a whopping 275 million kids with elevated lead levels, highest among all countries [1]. Further, India accounts for 26% of global deaths due to lead poisoning, 2,30,000 premature deaths recorded in the year 2017 alone [2]. An increase of 53% and 30% in rates of deaths and disability due to lead poisoning has been reported since 1996-2000 [2]. Over the last five decades, the sources of lead in human life have changed, diagnosis has evolved, and the management has refined but the menace continues unabated.

THE PAST

The study by Sinclair, et al. [3] 50 years back, was conducted to measure blood lead levels in symptomatic children and results compared with the control group. A lead level of 60 µg/100 mL of blood was considered as abnormally high. The study divided the children into three groups, group 1 of 50 children with history of pica with anemia or/and abdominal pain or/and neurological abnormalities; group 2 of 25 children with acute encephalopathy and group 3 of 30 children with diseases not associated to lead poisoning. The authors also checked urinary coproporphyrin and *X*-ray of long bones in children with high blood lead levels. The study results suggested a high mean blood lead level in children with pica (68.1 µg/100 mL) and encephalopathy (79.4 µg/100 mL) when compared to controls (28.7µg/100 mL). Of the total children in each group, 46% and 36% children in pica and encephalopathy group, respectively, showed raised lead levels as against 3.3% children in control group. Abdominal pain in association with pica or encephalopathy was a significant factor. Urinary coproporphyrin levels showed no significant correlation with blood lead levels. The most common sources of lead cited were *surma, sindoor, holi* colors and morning sample of drinking water from tap (lead pipes were used then). Flaking paint as pica was more prevalent in the West, as against mud or white washed walls in India during those times. Other sources quoted in various studies at that time included lead bottles, lead containing medications (especially skin and herbal), adulterated spices, lead foils and glazed pottery. Industrialization was an upcoming cause as an environmental lead contaminant.

THE PRESENT

Fifty years down the lane, a lot has changed but the menace of lead toxicity continues. No lead levels are considered safe but as one of the major revisions made by World Health Organization (WHO) and Centre for Disease Control (CDC), blood levels >5 µg/dL has been labelled as unsafe [3]. In 2021, the Lead Exposure and Prevention Advisory Committee (LEPAC) further recommended CDC to use a blood reference value of 3.5 µg/dL to identify children with high blood lead levels [4].

As per the United Nations Children Fund (UNICEF) and non-profit Pure Earth 2020, a third of the world's children, nearly 800 million, are affected by lead poisoning, of which India accounts for 275.5 million [1]. A loss of up to 5 IQ points has been noted with lead poisoning [5]. Other associated features include reduced attention span, leaning disabilities, behavioral disorders, abdominal pain, anemia and encephalopathies.

Multiple studies have since been done across India, including Delhi-NCR (National Capital Region) regions to assess blood lead levels and its sources in children. In a study conducted in India by George foundation under 'Project Lead Free' in late nineties, 22,000 children were screened for high lead levels (>10 ìg/100 mL), 51% of which were found to be positive [6]. In spite of phasing out of leaded gasoline, considered as one of the major causes of lead toxicity in nineties, children affected with lead toxicity continued to increase [2,7]. In a meta-analysis published in 2018, 31 studies assessing blood lead levels in Indian population were included. The study showed mean BLL of 6.86 µg/dL (95% CI: 4.38-9.35) in children, which is above the safe levels [8].

In a major study conducted in Delhi by the Energy and Resources Institute (TERI) and UNICEF in 2012 [9], 23% of children living along the Yamuna river had lead levels more than 10 µg/dL. The most probable explanation given is contamination of water by dumping of industrial wastes. The food grown in the nearby soil, especially green vegetables like spinach have high metal content. Through this contaminated food and water, lead enters the human body causing various health effects. In another study done in Delhi school children aged 4-6 years [10], it was found that nearly 18% children had elevated lead levels (>10 µg/dL) [10]. The same author conducted a similar study 10 years later in another subset of Delhi school students aged 6-10 years [11], and found 12% of children to have elevated lead levels (>10µg/dL), giving a ray of hope, though the fall could be attributed to many other reasons such as area of study, surrounding industry and less incidence of pica in this age group.

With the phasing out of leaded gasoline, a fall in percentage of children with elevated blood lead levels was expected but the same did not happen, due to rapidly expanding industrialization. In the present scenario, industrialization and its effluents have become the major source of lead contamination of environment. In 2009, a study from Delhi measured the lead loading in household dusts [12]. The geometric mean of dust lead loading for floor and interior window sill samples was found to be 19.7 µg/ft^2 and 75.5 µg/ft^2, respectively. This was much more than the geometric means of same samples checked in US in 2000 and recorded as 1.1 µg/ft^2 and 9.4 µg/ft^2 in floor and windowsill samples, respectively [12].

Among other causes of lead exposure, recent studies have shown a very high level of lead found in paints (especially yellow paint), and artificial jewelry (maximum in pink color), crossing the permissible limits by almost 1000 times. Besides industrial waste (especially lead-based industrial products like batteries), paints and artificial jewelry, other sources of lead exposure include glazed pottery, fossil fuel burning and some healthcare products including herbal medicines [13-15].

THE FUTURE

Pediatricians and health care workers should routinely assess the environmental exposure to lead in their OPD practices. All children with symptoms suggestive of lead levels or with history suggestive of high environmental exposure should be screened for blood lead levels. Those found to have high levels should immediately be removed from the source of contamination. Others should be counselled on the sources of lead exposure and their prevention. Those with iron deficiency should be treated with iron supplementation as lead absorption increases in the presence of iron deficiency. Specific treatment in terms of chelation therapy should only be initiated in high lead exposure (>44 µg/dL), after consultation with an expert and knowing the risks and benefits of the therapy [16].

An urgent need of a government action plan is needed at state and national level to tackle the rising risk of lead poisoning. Joint efforts by policy makers and the people of country can help us to curb this silent killer [17].

Funding: None; *Competing interests*: None stated.

REFERENCES

1. Rees N, Fuller R. The toxic truth: children's exposure to lead pollution undermines a generation of future potential. UNICEF and PURE EARTH; 2020. Accessed on Dec 16, 2022. Available from: *http://www.unicer.org/media/109361/ile/The%20toxic%20truth.pdf*
2. GBD Compare. Institute for Health Metrics and Evaluation; 2020. Accessed on Dec 10, 2020. Available from: *https://www.healthdata.org/data-visualization/gbd-compare*
3. Centre for Disease Control. Blood lead levels in children, CDC. Accessed on Dec 11, 2020. Available from: *https://www.cdc.gov/nceh/lead/prevention/ blood-lead-levels.htm*
4. Blood Lead Reference Value. Accessed on Dec 15, 2020. Available from: *https://www.cdc.gov/nceh/lead/data/blood-lead-reference-value.htm*
5. A third of world's children are poisoned by lead, says UNICEF report. Accessed on Dec 8, 2022. Available at *https://www.downtoearth.org.in/news/health/a-third-of-world-s-children-are-poisoned-by-lead-says-unicef-report-72560.*
6. The George Foundation: Lead poisoning. Available at *http://tgfworld. org/lead.html*. Accessed on 12th December 2022.
7. Sharma S, Mitra P, Bhardwaj P, Sharma P. Blood lead level in school going children of Jodhpur, Rajasthan, India. Turk J Biochem 2021; 46: 393-98.
8. Ericson B, Dowling R, Dey S et al. A meta-analysis of blood lead levels in India and the attributable burden of disease. Environ Int. 2018;121:461-70.

9. Chauhan C. High lead found in 23% children living close to Yamuna: Study. Hindustan Times; Feb 16, 2012.
10. Kalra V, Chitralekha KT, Dua T, Pandey RM, Gupta Y. Blood lead levels and risk factors for lead toxicity in children from schools and an urban slum in Delhi. J Trop Pediatr. 2003 Apr;49(2):121-3.
11. Kalra V, Sahu JK, Bedi P, Pandey RM. Blood lead levels among school children after phasing-out of leaded petrol in Delhi, India. Indian J Pediatr. 2013 Aug;80(8):636-40.
12. Kumar A, Scott Clark C. Lead loadings in household dust in Delhi, India. Indoor Air. 2009;19:414-20.
13. Singh P. Over 73 per cent of paints found to have excessive lead: Study. Times of India; Oct 30, 2015.
14. PTI. Lead content high in children's jewellery found in Delhi: NGO. Accessed on Dec 14, 2022. India Today; July 2, 2010.
15. Jain NB, Hu H. Childhood correlates of blood lead levels in Mumbai and Delhi. Environ Health Perspect. 2006;114:466-70.
16. Pediatric Environmental health Specialty Units. Recommendations on Management of Childhood Lead Exposure A Resource for Clinicians; Updated Dec, 2021. Accessed on Dec 16, 2022. Available from: *https://www.pehsu.net/_Library/facts/PEHSU_Fact_Sheet_Lead_Management_Health_Professionals_9_2021.pdf*
17. ANI. Urgent State and National Level Action Plans needed to tackle lead poisoning in India: Experts. ANI; Oct 11, 2022.