BANGLADESH

A. Regulations on Lead Sources

Sources of lead	Relevant legislation/regulation	Government Agencies	Data source
1. Used lead-acid battery recycling	1. Informal ULAB recyclers – "feriwallas" collect and sell used batteries (estimated 1100 informal ULAB sites, putting <1 million people at risk) 2. Illegal recycling of used lead-acid batteries in the open-air is considered to be a major source of lead exposure 3. Currently (as of 2021), there are a lack of vehicle battery recycling regulations and law enforcement agencies do not monitor lead emissions via industrial waste disposal.	a) Bangladesh Department of Environment b) Ministry of Environment and Forest	1. Lead Acid Battery Recycling, Sustainable Environment Management Programme (SEMP) 2. Global Battery Alliance (World Economic Forum), December 2020, "Consequences of a Mobile Future" 3. World Bank: Bangladesh – Rural electrification and renewable energy development project II – environment and social management Framework, 2012 4. UNICEF, 2020, "A third of the world's children poisoned by lead: Bangladesh fourth most-seriously hit in terms of the number of children affected"
2. Standards for lead in food	1. A study by Bangladesh Rice Research Institute (BRRI) showed that one sample of rice collected from industrial field of Narayangonj district have a very high amount of lead (0.242ppm). *2.* There are now regulations on lead in food and environmental sources, such as spices like turmeric, which has already faced rapid recalls in Bangladesh due to high lead levels	a) Ministry of Agriculture b) Ministry of Health and Family Welfare c) Ministry of Local Government, Rural Development and Co-operatives d) Ministry of Law, Justice and Parliamentary Affairs	1. Heavy metal contamination of food in a developing country like Bangladesh: An emerging threat to food safety, 2016, Hezbullah, M. 2. Bangladesh Country Report, Regulatory Framework for Foods

	3. Bangladesh Food Laws, 1967: Unsound or unwholesome food and food unfit for human consumption-Subject to the limitations prescribed under SI. No. 47 of the schedule, any article of food shall be considered injurious to health and unfit for human consumption within the meaning of section 17 of the Ordinance, if it contains the following metal or metalloids more than the tolerance limit.	e) Ministry of Food and Disaster Management f) Ministry of Industry g) Ministry of Environment and Forest	
3. Standards for lead in cookware	1. Most of the cookware, used in South Asian countries (including Bangladesh), is made up of aluminium. 2. Most of the aluminium cookware found in local market of Bangladesh is made of scrap metals. During the analyses it was observed that among the metal released from low grade aluminium pots lead content is high. 3. Regulations to omit lead in cookware have not yet been formulated.	a) Ministry of Industry	1. ESDO report, " Aluminum Cookware: A Major Source of Lead and Other Toxic Metal Contamination in Bangladesh", 2018 2. Semwal, A. D., A. Padmashree, M. A. Khan, G. K. Sharma, and A. S. Bawa. 2006. Leaching of aluminum from utensils during cooking of food. Journal of the Science of Food and Agriculture 86: 2425-2430 3. Is your cookware poisoning you? A look at toxic and non-toxic cookware, accessed: https://embracingimperfect.com/nontoxic/nontoxic-cookware/
4. Standards for occupational exposure	1. Use of Lead Acid Battery in Bangladesh has risen with sharp rise of motor vehicles. As	a) Ministry of Labour and Employment	1. Ahmad, S., 2014, Blood lead levels and health problems of lead acid battery workers in Bangladesh

	result, manufacture of LAB is increasing. Most of the lead used by these industries comes from recycling of LAB. Workers in LAB industry are at risk of exposure lead and thus development of lead toxicity. 2. Bangladesh has a Biosafety Framework, established 2012, but does not specifically mention lead exposure.		
5. Lead in paint	1. 2019: Bangladesh has adopted laws to address lead in paint – there is now a 90-ppm lead limit for decorative paints	a) Ministry of Health and Family Welfare b) Department of Environment c) Bangladesh Paint Manufacturers Association (BPMA) d) Environment and Social Development Organization (ESDO)	1. Lead paint law status interactive map, UN Environment Program accessed: https://saicmknowledge.org/content/lead-paint-law-map
6. Waste generated from mining and smelting	1. Dhaka Division accounts for 45% of Smelting activities, and Bangladesh has 15 jurisdictions which cover common issues in mining laws and regulations		1. Bangladesh: Mining Laws and Regulations, 2021

B. International Agreements

Agreement	Year Ratified
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal	1993
Stockholm Convention on Persistent Organic Pollutants	2007
GHS implementation (Globally Harmonized System of Classification and Labelling of Chemicals)	2017
Minamata Convention on Mercury	2013

C. Blood lead-level monitoring programs

There is currently no routine screening or surveillance system in place in the country to monitor the level of children's lead exposure. Academic studies have monitored smaller samples for a temporary period, but Bangladesh's Government is yet to establish a system to monitor blood lead-levels.

D. Inventory of Toxic Sites

Bangladesh has 294 toxic sites contaminated by lead – for the purpose of this country profile, only the sites contaminated by lead in one of the largest cities – Chittagong- have been listed, but a full list (including the 132 contaminated sites in Dhaka) is available on https://www.contaminatedsites.org/

Site	Province/Region	Details (all data comes from the TSIP website)
1. Lead Battery Works, Elliotganj, Daudkandii, Comilla	Chittagong	This is a small-scale battery breaking and repairing shop. They break and repair these used batteries daily. Pollution of lead is occurring for soil, air and water due to improper way of breaking of lead parts. The toxic pathways are mainly through dermal contact and inhalation of lead dust.
2. Lead Battery Breaking and Smelting Works, Rampur, Muradnagar, Comilla	Chittagong	This is a used lead battery breaking and smelting site, located far away from the village. Lead as well as arsenic dust released during the process causes pollution of air, soil and water in the area. Possible pathways of toxic pollutants are dermal contact and inhalation of dust.
3. Arabi Traders, Used plastic recycling factory, Vinglabari, Debidwar, Comilla, Chittagong	Chittagong	This is a used plastic recycling factory where workers crush different plastic bottles, drums, cans, plastic materials etc. into tiny particles to produce raw materials for plastic products. It produces a bad smell and plastic dust and is a source of toxic metals including lead, that pollutes in soil and air. The people around the area and workers are affected through dermal contact and inhalation/ ingestion of metal dust.
4. Gold Recycling from Jewelry Ashes, Noyakandi Nabipur, Muradnagar, Cumilla, Chittagong	Chittagong	Gold was recycled by recycler in recycling process from jewelry ashes. They have collected jewelry ashes different parts of the country and processed various way to collect gold. The lead dust and arsenic pollutes soil. air water during the gold recycling. The

		people are affected through dermal contact and inhalation/ ingestion of metal dust.
5. Lead Battery Works, Gudirpukorpar, Nurpur, Comilla	Chittagong	This polluted site is consists of several adjacent small scale battery breaking and repairing shops along a row. The hired laborers of the shops break and repair these used batteries daily. Pollution of lead is occurring for soil, air and water due to improper way of breaking of lead parts. The toxic pathways are mainly through dermal contact and inhalation of lead dust.
6. Lead Battery Works, Station Road , Comilla Sadar Upazila, Comilla	Chittagong	This site is the combination of several adjacent small scale battery breaking and repairing shops. The laborers of the shops break and repair these used batteries, releasing lead dust into the air, water, and soil.The toxic pathways are mainly through dermal contact and inhalation of lead dust.
7. Minto Battery Works, EPZ Road, South Chartha, Comilla	Chittagong	It is a lead acid battery breaking and repairing site. They collect old batteries and break them to separate lead parts. They use these parts in other batteries. This process pollutes soil, air, and water with lead. People working and/or living around the site are exposed via inhaling/ingesting of lead dust and via dermal contact.
8. Lead Battery Works, Shaktala, Laksam Road, Comilla	Chittagong	This is a small scale battery breaking and repairing shop. They break and repair these used batteries daily. Pollution of lead is occurring for soil, air and water due to improper way of breaking of lead parts. The toxic pathways are mainly through dermal contact and inhalation of lead dust.
9. Lead Battery Works, Jangaliya Bus Stand, Comilla South Sadar Upazila, Comilla,	Chittagong	This site consists of several adjacent small scale battery breaking and repairing shops. The hired labors of the shops break and repair these used batteries daily. Pollution of lead is occurring for soil, air and water due to improper way of breaking of

		lead parts. The toxic pathways are mainly through dermal contact and inhalation of lead dust.
10. Lead Battery Works, Paduarbazar, Bissoroad, Comilla	Chittagong	This site is the aggregation of several adjacent small scale battery breaking and repairing shops. The labors of these shops break and repair these used batteries. The pollution of lead is occurring for soil for continuation of this type of work day by day. The toxic pathways are mainly through dermal contact and inhalation of lead dust.
11. ULAB breaking & smelting works, Noyonpur, Word no-9, Brahmanbaria Pourosova, Brahmanbaria, Chittagong	Chittagong	The abandoned used lead acid battery breaking and smelting site was transferred into other unknown place about 1 year ago. Local people and law & enforcement agency force them to stop their activities. The battery breaking and smelting processes produces large amount of smoke and metal dust. It is a source of toxic metal mainly lead pollution in soil, water and air. The people are affected through dermal contact and inhalation/ ingestion of metal dust.
12. ULAB breaking and smelting works, BSCIC Industrial area, Nondonpur, Brahmanbaria, Chittagong	Chittagong	This is a used lead acid breaking and smelting works in BSCIC (Bangladesh Small Cottage Industries and Corporation). Toxic metal dusts from the breaking and smelting is polluting air, soil and water. People are affected through dermal contact, inhalation and/or ingestion of metal dust particularly lead.
13. ULAB smelting works, Suhilpur, Nondonpur, Brahmanbaria sadar, Braahmanbaria, Chittagong	Chittagong	The used lead acid battery smelting factory is in rural area where they smelt lead particles. The smoke created from lead smelting contains lead dust and other toxic pollutants. Thus it pollutes air, soil and water of the surrounding area. People are affected through dermal contact, inhalation and/or ingestion of metal dust particularly lead.

E. Scientific papers on lead exposure

(Please contact **info@gahp.net** for information on studies not in the public domain)

Topic	Authors	Year	Title	Abstract/Description
Childhood Exposure/ Environmental Exposure	Kamal Ibne Amin Chowdhury	2021	Child lead exposure near abandoned lead acid battery recycling sites in a residential community in Bangladesh: Risk factors and the impact of soil remediation on blood lead levels	**Background:** Lead is a potent neurotoxin that is particularly detrimental to children's cognitive development. Batteries account for at least 80% of global lead use and unsafe battery recycling is a major contributor to childhood lead poisoning. Our objectives were to assess the intensity and nature of child lead exposure at abandoned, informal used lead acid battery (ULAB) recycling sites in Kathgora, Savar, Bangladesh, as well as to assess the feasibility and effectiveness of a soil remediation effort to reduce exposure. ULAB recycling operations were abandoned in 2016 due to complaints from residents, but the lead contamination remained in the soil after operations ceased. We measured soil and blood lead levels (BLLs) among 69 children living within 200 m of the ULAB recycling site once before, and twice after (7 and 14 months after), a multi-part remediation intervention involving soil capping, household cleaning, and awareness-raising activities. Due to attrition, the sample size of children decreased from 69 to 47 children at the 7-month post-intervention assessment and further to 25 children at 14 months. **Methods:** We conducted non-parametric tests to assess changes in soil lead levels and BLLs. We conducted baseline surveys, as well as semi-structured interviews and observations with residents throughout the study period to characterize exposure behaviors and the community perceptions. We conducted bivariate and multivariate regression analyses of exposure characteristics to determine the strongest predictors of baseline child BLLs. Prior to remediation, median soil lead concentrations were 1400 mg/kg, with a maximum of 119,000 mg/kg and dropped to a median of 55 mg/kg after remediation ($p < 0.0001$). **Results:** Among the 47 children with both baseline and post-intervention time 1 measurements, BLLs dropped from a median of 21.3 µg/dL to 17.0 µg/dL at 7 months ($p < 0.0001$). Among the 25 children with all three measurements, BLLs dropped from a median of 22.6 µg/dL to 14.8 µg/dL

				after 14 months ($p < 0.0001$). At baseline, distance from a child's residence to the nearest abandoned ULAB site was the strongest predictor of BLLs and baseline BLLs were 31% higher for children living within 50 m from the sites compared to those living further away ($n = 69$, $p = 0.028$). Women and children spent time in the contaminated site daily and relied on it for their livelihoods and for recreation. **Conclusion:** Overall, this study highlights the intensity of lead exposure associated with the ULAB recycling industry. Additionally, we document the feasibility and effectiveness of a multi-part remediation intervention at a contaminated site embedded within a residential community; substantially reducing child BLLs and soil lead concentrations.
Childhood Exposure	Forsyth, Jenna E.	2018	Prevalence of elevated blood lead levels among pregnant women and sources of lead exposure in rural Bangladesh: A case control study	**Background**: Prenatal and early childhood lead exposures impair cognitive development. We aimed to evaluate the prevalence of elevated blood lead levels (BLLs) among pregnant women in rural Bangladesh and to identify sources of lead exposure. We analysed the BLLs of 430 pregnant women randomly selected from rural communities in central Bangladesh. Fifty-seven cases were selected with the highest BLLs, ≥ 7 µg/dL, and 59 controls were selected with the lowest BLLs, < 2 µg/dL. **Discussion**: Based on this and other studies, elevated BLLs appear to be a widespread problem in many districts across rural Bangladesh. There does not appear to be a single source of lead exposure in this context that can provide a simple focus for prevention, but rather several sources that require further investigation including lead-soldered cans, agrochemicals, rice grinding, and turmeric. Given the spatial clustering of women with elevated BLLs, prevention efforts could target geographic hotspots of lead exposure. Future case control studies should enrol a sufficiently large population to detect fewer common exposures and to assess the relative importance of each pathway. Although this study does not provide direct evidence, we suspect these exposures are not limited to Bangladesh. We recommend investigations in neighbouring countries across South and Southeast Asia.

Childhood Exposure/ Food Exposure	Gleason, Kelsey and Shine, James P.	2014	Contaminated Turmeric Is a Potential Source of Lead Exposure for Children in Rural Bangladesh	**Background**: During the conduct of a cohort study intended to study the associations between mixed metal exposures and child health outcomes, we found that 78% of 309 children aged 20–40 months evaluated in the Munshiganj District of Bangladesh had blood lead concentrations ≥5 μg/dL and 27% had concentrations ≥10 μg/dL. **Hypothesis:** Environmental sources such as spices (e.g., turmeric, which has already faced recalls in Bangladesh due to high lead levels) may be a potential route of lead exposure. **Methods**: We conducted visits to the homes of 28 children randomly selected from among high and low blood lead concentration groups. During the visits, we administered a structured questionnaire and obtained soil, dust, rice, and spice samples. We obtained water samples from community water sources, as well as environmental samples from neighborhood businesses. **Results:** Lead concentrations in many turmeric samples were elevated, with lead concentrations as high as 483 ppm. Analyses showed high bio-accessibility of lead. **Conclusions:** Contamination of turmeric powder is a potentially important source of lead exposure in this population.
Childhood Exposure	Rodrigues, Ema G. and Bellinger, David C.	2016	Neurodevelopmental outcomes among 2- to 3-year-old children in Bangladesh with elevated blood lead and exposure to arsenic and manganese in drinking water	**Background:** The people of Bangladesh are currently exposed to high concentrations of arsenic and manganese in drinking water, as well as elevated lead in many regions. The objective of this study was to investigate associations between environmental exposure to these contaminants and neurodevelopmental outcomes among Bangladeshi children. **Methods:** We evaluated data from 524 children, members of an ongoing prospective birth cohort established to study the effects of prenatal and early childhood arsenic exposure in the Sirajdikhan and Pabna Districts of Bangladesh. Water was collected from the family's primary drinking source during the first trimester of pregnancy and at ages 1, 12 and 20–40 months. At age 20–40 months, blood lead was measured and neurodevelopmental outcomes were assessed using a translated, culturally-adapted version of the Bayley Scales of Infant and Toddler Development, Third Edition (BSID-III).

				Results: Median blood lead concentrations were higher in Sirajdikhan than Pabna (7.6 vs. <LODμg/dL, p <0.0001) and water arsenic concentrations were lower (1.5 vs 25.7 μg/L, p <0.0001). Increased blood lead was associated with decreased cognitive scores in Sirajdikhan (β = −0.17, SE = 0.09, p = 0.05), whereas increased water arsenic was associated with decreased cognitive scores in Pabna (β = −0.06, SE = 0.03, p = 0.05). Water manganese was associated with fine motor scores in an inverse-U relationship in Pabna. **Conclusion:** Where blood lead levels are high, lead is associated with decreased cognitive scores on the BSID-III, and effects of other metals are not detected. In the setting of lower lead levels, the adverse effects of arsenic and manganese on neurodevelopment are observed.
Childhood Exposure	Kippler, Maria	2016	Elevated childhood exposure to arsenic despite reduced drinking water concentrations — A longitudinal cohort study in rural Bangladesh	**Objectives:** The aim of this study was to evaluate the massive efforts to lower water arsenic concentrations in Bangladesh. **Methods:** In our large mother–child cohort in rural Matlab, we measured the arsenic concentrations (and other elements) in drinking water and evaluated the actual exposure (urinary arsenic), from early gestation to 10 years of age (n = 1017). **Results:** Median drinking water arsenic decreased from 23 (2002–2003) to < 2 μg/L (2013), and the fraction of wells exceeding the national standard (50 μg/L) decreased from 58 to 27%. Still, some children had higher water arsenic at 10 years than earlier. Installation of deeper wells (> 50 m) explained much of the lower water arsenic concentrations but increased the manganese concentrations. The highest manganese concentrations (~ 900 μg/L) appeared in 50–100 m wells. Low arsenic and manganese concentrations (17% of the children) occurred mainly in > 100 m wells. The decrease in urinary arsenic concentrations over time was less apparent, from 82 to 58 μg/L, indicating remaining sources of exposure, probably through food (mean 133 μg/kg in rice). **Conclusion:** Despite decreased water arsenic concentrations in rural Bangladesh, the children still have elevated exposure, largely from food. Considering the known risks of severe health effects in children, additional mitigation strategies are needed.

Childhood Exposure	Hawkesworth, Sophie	2013	[Early exposure to toxic metals has a limited effect on blood pressure or kidney function in later childhood, rural Bangladesh]	**Background:** Chronic exposure to toxic metals such as arsenic and cadmium has been implicated in the development of kidney and cardiovascular diseases but few studies have directly measured exposure during in utero and early child development. **Methods:** We investigated the impact of exposure to arsenic (mainly in drinking water) and cadmium (mainly in rice) during pregnancy on blood pressure and kidney function at 4.5 years of age in rural Bangladesh. The effect of arsenic exposure in infancy was also assessed. **Results:** Within a cohort of 1887 children recruited into the MINIMat study, exposure to arsenic (maternal urinary arsenic, U-As), but not cadmium, during in utero development was associated with a minimal increase in blood pressure at 4.5 years. Each 1 mg/l increase in pregnancy U-As was associated with 3.69 mmHg (95% CI: 0.74, 6.63; P: 0.01) increase in child systolic and a 2.91 mmHg (95% CI: 0.41, 5.42; P: 0.02) increase in child diastolic blood pressure. Similarly, a 1 mg/l increase in child U-As at 18 months of age was associated with a 8.25 mmHg (95% CI: 1.37, 15.1; P: 0.02) increase in systolic blood pressure at 4.5 years. There was also a marginal inverse association between infancy U-As and glomerular filtration rate at 4.5 years (33.4 ml/min/1.72 m2; 95% CI: 70.2, 3.34; P: 0.08). No association was observed between early arsenic or cadmium exposure and kidney volume at 4.5 years assessed by ultrasound. **Conclusions:** These modest effect sizes provide some evidence that arsenic exposure in early life has long-term consequences for blood pressure and maybe kidney function.
Environmental Exposure	Chatham-Stephens, Kevin	2014	[The paediatric burden of disease from lead exposure at toxic waste sites in low and middle income countries]	**Background:** The impact of lead from toxic waste sites on children in low and middle income countries has not been calculated due to a lack of exposure data. We sought to calculate this impact in Disability Adjusted Life Years (DALYs). **Materials and methods:** Using an Integrated Exposure Uptake Biokinetic (IEUBK) model, we converted soil and drinking water lead levels from sites in the Blacksmith Institute's Toxic Sites Identification Program (TSIP) into mean blood lead levels (BLLs). We then calculated the incidence of mild mental retardation (MMR) and DALYs resulting from these BLLs. **Results:** The TSIP included 200 sites in 31 countries with soil (n=132) or drinking water (n=68) lead levels, representing 779,989 children younger

				than 4 years of age potentially exposed to lead. Environmental lead levels produced a range of BLLs from 1.56 to 104.71 µg/dL. These BLLs equated to an estimated loss of 5.41–8.23 IQ points, resulting in an incidence of MMR of 6.03 per 1000 population and 76.1 DALYs per 1000 population. **Discussion:** Soil and water lead levels at toxic waste sites predict BLLs that lower the intelligence quotient (IQ), with the resulting MMR potentially limiting individual- and country-level development. The preventable burden of disease produced by these sites highlights the need for toxic waste sites to be systematically identified, evaluated, and remediated.
Childhood Exposure	Faruque Parvez, Gail A. Wasserman, Pam Factor-Litvak, Xinhua Liu	2011	Arsenic Exposure and Motor Function among Children in Bangladesh	**Background:** Several reports indicate that drinking water arsenic (WAs) and manganese (WMn) are associated with children's intellectual function. Very little is known, however, about possible associations with other neurologic outcomes such as motor function. **Methods:** We investigated the associations of WAs and WMn with motor function in 304 children in Bangladesh, 8–11 years of age. We measured As and Mn concentrations in drinking water, blood, urine, and toenails. We assessed motor function with the Bruininks-Oseretsky test, version 2, in four subscales—fine manual control (FMC), manual coordination (MC), body coordination (BC), and strength and agility—which can be summarized with a total motor composite score (TMC). **Results:** Log-transformed blood As was associated with decreases in TMC [$\beta = -3.63$; 95% confidence interval (CI): –6.72, –0.54; $p < 0.01$], FMC ($\beta = -1.68$; 95% CI: –3.19, –0.18; $p < 0.05$), and BC ($\beta = -1.61$; 95% CI: –2.72, –0.51; $p < 0.01$), with adjustment for sex, school attendance, head circumference, mother's intelligence, plasma ferritin, and blood Mn, lead, and selenium. Other measures of As exposure (WAs, urinary As, and toenail As) also were inversely associated with motor function scores, particularly TMC and BC. Square-transformed blood selenium was positively associated with TMC ($\beta = 3.54$; 95% CI: 1.10, 6.0; $p < 0.01$), FMC ($\beta = 1.55$; 95% CI: 0.40, 2.70; $p < 0.005$), and MC ($\beta = 1.57$; 95% CI: 0.60, 2.75; $p < 0.005$) in the unadjusted models. Mn exposure was not significantly associated with motor function. **Conclusion:** Our research demonstrates an adverse association of As exposure and a protective association of Se on motor function in children.

Environmental Exposure	Hezbullah, Sultana, Chakraborty, S. R. and Patwary, M.	2016	Heavy metal contamination of food in a developing country like Bangladesh: An emerging threat to food safety	This review paper highlighted possible ways of heavy metal contamination of food chain in a developing country like Bangladesh as it is considered an emerging threat for food safety. The review paper was prepared over a period of six months by searching and collecting data of various studies done in Bangladesh from original articles of many national and international journals. Also, data were taken from related review articles of many journals and websites. The review showed that arsenic, cadmium, chromium and lead are the four major threats for heavy metal contamination of food chain in Bangladesh. Pollution of surface water, agricultural soil by unscientific industrial effluent disposal and application of chemical fertilizers, pesticides are the major ways of heavy metal contamination. Consumption of these heavy metals with food above safe limit causes various organ dysfunctions including cancer.
Occupational Exposure	Sk. Akhtar Ahmad	2014	Blood Lead Levels and Health Problems of Lead Acid Battery Workers in Bangladesh	**Introduction:** Use of lead acid battery (LAB) in Bangladesh has risen with sharp rise of motor vehicles. As result, manufacture of LAB is increasing. Most of the lead used by these industries comes from recycling of LAB. Workers in LAB industry are at risk of exposure lead and thus development of lead toxicity. **Objective:** The objective of this study was to measure the blood lead concentration and to assess the magnitude of health problems attributable to lead toxicity among the LAB manufacturing workers. **Methods:** A cross-sectional study was conducted among the workers of LAB manufacturing industries located in Dhaka city. **Result:** Mean blood lead level (BLL) among the workers was found to be high. They were found to be suffering from several illnesses attributable to lead toxicity. The common illnesses were frequent headache, numbness of the limbs, colic pain, nausea, tremor, and lead line on the gum. High BLL was also found to be related to hypertension and anaemia of the workers. **Conclusion:** High BLL and illnesses attributable to lead toxicity were prevalent amongst workers of the LAB manufacturing industries, and this requires attention especially in terms of occupational hygiene and safety.

Occupational Exposure	Mazumdar, Imran	2016	Status of Serum Calcium, Vitamin D and Parathyroid Hormone and Hematological Indices Among Lead Exposed Jewelry Workers in Dhaka, Bangladesh	**Background:** Jewelry utilizes lead either directly or as a base metal. Costume jewelry requires lead before molding and plating the product with valuable metals. Therefore, such ornaments have a great potential to release heavy metals having health hazards. Also, jewelry makers engaged in preparing German silver, an alloy, apply lead in smelting, alloying, rolling and milling silver wires and pieces. The metal is taken up by blood, soft tissues and bone. The biological effects of lead are dependent upon the level and duration of exposure. Lead inhibits three enzymes of heme biosynthesis- δ-amino-levulinic-acid dehydratase (ALAD), coproporphyrin oxidase, and ferrochelatase, impairing heme synthesis and depressing serum level of erythropoietin resulting in decreased hemoglobin synthesis. Lead exposure also affects calcium metabolism and impair the synthesis of Calcitriol. **Discussion:** In the present study, jewelry makers from Dhaka, Bangladesh, were shown to have significantly high levels of lead, protein, albumin, and parathormone in their blood, and significantly high amount of zinc-protoporphyrin and δ-amino-levulinic-acid in their urine. The control group, on the other hand showed significantly higher amounts of calcium (both total and ionized form) Vitamin D_3 and non-activated erythrocyte ALAD in their blood, along with hemoglobin. It might be due to inhibition of 1-α-hydroxylase enzyme in renal tubules. Lead causes nephro-toxicity and inhibits 1-α- hydroxylase enzyme leading to decreased calcitriol synthesis resulting in impaired calcium absorption across gastro-intestinal tract and renal tubules. Low Vitamin D_3 and significantly increased Parathyroid hormone (PTH) in study group has been found.

F. University Actors

University	Contribution
The Department of Geology of the University of Dhaka	The researchers also tested children's blood before and after a multi-phased intervention that involved removing and burying contaminated soil, cleaning area households and educating residents about the dangers of soil lead exposure. Study partners from Dhaka University's Department of Geology and Pure Earth conducted the remediation work.
Stanford University	Chowdhury, K.I.A., Nurunnahar, S., Kabir, M.L., Islam, M.T., Baker, M., Islam, M.S., Rahman, M., Hasan, M.A., Sikder, A., Kwong, L.H. and Binkhorst, G.K., 2021. Child lead exposure near abandoned lead acid battery recycling sites in a residential community in Bangladesh: Risk factors and the impact of soil remediation on blood lead levels. *Environmental Research*, 194, pp. 110.
University of Southern Mississippi	Mitra, K.A., Ahua, E. and Saha, P.A, 2012. Prevalence of and Risk Factors for Lead Poisoning in Young Children in Bangladesh. *Journal of Health, Population, and Nutrition,* 30(4), pp. 235-404.
Department of Government, University of Alabama	Mitra, A.K. et al. 2009. Lead Poisoning: An Alarming Public Health Problem in Bangladesh. *Int. J. Environ. Res. Public Health*, 6(1), pp. 84-95.

G. Local NGOs

Environment and Social Development Organization (ESDO): is a non-profit and non-government organization based in Bangladesh. It is working to spread the message about the need for environmental conservation – to ensure the protection of biological diversity and ecological balance.

H. Blood testing in National Health Surveys

National Health Survey	Bangladesh Health and Nutrition Surveys 2017-2018	Source
Purpose	The sample for the 2017-18 BDHS is nationally representative and covers the entire population residing in non-institutional dwelling units in the country. The survey used a list of enumeration areas (EAs) of the 2011 Population and Housing Census of the People's Republic of Bangladesh, provided by the Bangladesh Bureau of Statistics (BBS), as a sampling frame (BBS 2011). The primary sampling unit (PSU) of the survey is an EA with an average of about 120 households	The DHS Program, Demographic and Health Surveys, Bangladesh 2017-2018 DHS Final Report, accessed here.
Sample Size	For the 2018 round, 20127 female individuals, aged between 15 and 49, were surveyed.	
Blood Sample Testing	Blood samples were taken to measure and evaluate blood pressure, anaemia and diabetes.	
Latest round	2018	
Next round	2021 (ongoing)	