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Lead exposure from battery recycling in Indonesia

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Abstract: In Indonesia, more than 200 illegal used lead acid battery (ULAB) smelters are currently operating. Only a few health studies support the finding of lead-related symptoms and diseases among populations living near the smelters. To assess the blood lead levels (BLLs) and potential health impacts among the population surrounding ULAB recycling smelters, we evaluated health effects reported from 2003 to 2013, conducted focus group discussions with lead smelter owner/workers and a group of 35 female partners of smelter owners or workers not actively engaged in smelter work, and retook and measured BLLs. It was found that many children in the areas were having difficulty achieving high grades at school and having stunting or other problems with physical development. The average mean of BLLs increased by almost double in 2015, compared with in 2011. The risk of having hypertension, interference in the ability to make red blood cells in females occurred among 24% of respondents; Elevated blood pressure, hearing loss, and interference in the ability to make red blood cells occurred in 20% of males; Kidney damage, infertility in male, nerve problems, including decreased sensation and decreased ability to move quickly occurred in 13%; Decreased ability to make red blood cells (20%), and; Frank anemia, decreased life-span, coma/seizures were experienced by 22%. The populations living in areas surrounding ULAB smelters are experiencing severe chronic health problems. It is recommended that the smelters must be moved and placed far away from the municipality.

Keywords: blood lead levels; human health effects; used lead acid battery smelters.

Background

Lead is a toxic metal whose widespread use has caused extensive environmental contamination and health problems in many parts of the world. It is a cumulative toxicant that affects multiple body systems, including the neurological, hematological, gastrointestinal, cardiovascular and renal systems. Children are particularly vulnerable to the neurotoxic effects of lead, and even relatively low levels of exposure can cause serious and, in some cases, irreversible neurological damage. Lead exposure is estimated to account for 0.6% of the global burden of disease, with the highest burden in developing regions. Recent reductions in the use of lead in petrol (gasoline), paint, plumbing and solder have resulted in substantial reductions in lead levels in the blood. However, significant sources of exposure to lead still remain, particularly in developing countries. Further efforts are required to continue to reduce the use and releases of lead and to reduce environmental and occupational exposures, particularly for children and women of child-bearing age.

Battery recycling smelters emit lead and other metal particulates into the air which can be carried downwind and deposited in soil. This deposition is important because lead is relatively persistent and immobile in the environment and may accumulate at the soil surface where people may be exposed. In Indonesia, distribution of lead battery trading is spread all over the country (Figure 1) and more than 200 battery recycling smelters have been identified in the past two decades, in which 71 smelters were found in Jakarta greater area where more than 20 million living inhabitants (Figure 2). The Ministry of Environment the Republic of Indonesia and the Joint Committee for Leaded Gasoline Phase-out (KPBB), in 2011, inspected historical household lead smelting sites in several districts in the Jakarta greater area, District of Tegal Central Java and District of Lamongan in East Java, and requested an investigation of lead contamination. Due to the lack of evidence found at that time regarding potential past releases of lead from the smelter sites, no further action was taken. To assess the blood lead levels (BLLs) and potential health impacts among the population surrounding used lead acid batteries (ULABs) recycling smelters, we evaluated health effects reported from year 2003 to 2013, conducted focus group discussions with metals smelter owner/workers and a group of 35 female partners of smelter owners or workers not actively engaged in smelter work, and retook and measured BLLs.
Materials and methods

The methods used in this study involved evaluating health effects reported by Tegal District Health Office from year 2003 to 2013, visiting the sites and observing physical symptoms in selected population, conducting focus group discussions with metals’ smelter owner and workers and a group of 35 female partners of smelter owners or workers not actively engaged in smelter work, retaking and measuring BLLs of 46 samples from cohort population in 2011, and analyzing the BLL samples from 2011 and 2015.

Findings and discussion

Visiting sites and observing the physical symptoms

Situation analysis of metals smelter activities, business and its health impacts had been shared by the local government. It was reported that the environmental pollution in the metal industry has shown high levels in several parameters (1). Dust levels were reported as 5429 μg/m³, which is almost 24 times higher than the threshold level (230 μg/m³). Levels of lead-air (Pb) reached 128,672 μg/m³, compared with a control location with no history of lead content production (2317 μg/m³). Pb-soil concentration in 82 points in Pesarean Village indicates the lowest concentration point at 0 ppm and highest at 398,000 ppm. Half of the samples are above WHO recommendation of 400 ppm (2).

Evaluating health effects

We began by reviewing available information about general prevalence and incidence of diseases reported annually by Puskesmas and District Health Office. The report includes yearly diseases occurrence from 2003 to 2013. The health report was dominated with cases of...
infectious diseases. However, some of the diseases related to the impact of heavy metals (including lead) were also found in a small number, they are wrist drop 1.8% and foot drop 3.3%. We also carried out checks on one family who had engaged in recycling of used batteries over generations (>30 years) and found neurological disorders (such as muscle weakness in the legs and hands) in nearly all family members, BLLs were >30 μg/dL in most of the family members, and mental retardation in two people. A 2014 study by the Ministry of Environment and Forestry (MOEF) in Pesarean Village found 137 asthma cases, 74 cases of skin allergic, 363 cases of respiratory infections, 140 cases of conjunctivitis, and five cases of Down syndrome (3).

Focus group discussion

We conducted focus group discussions in two groups from the study population, one group consisted of 30 male owners and workers of the metals smelters and the second group consisted of 35 female partners of smelter owners or workers not actively engaged in smelter work, and residents living near the metals smelters. It was found that many children of those interviewed were not able to achieve their desired grades at school. Stunting and other physical development delays were common among children in the area of study.

Retaking and measuring BLLs

We begin by selecting purposively 46 people from the 2011 BLLs data provided by the Mer-C and MOEF report. We retook venous blood samples and analyzed the samples using the Leadcare Analyzer II (Magellan Diagnostics Inc., North Billerica, MA, USA) on site. Further analysis was conducted to find out the current status of lead toxicity among the local population (4).

The assessment conducted by Tegal’s local government in 2011 and the Blacksmith Institute in 2015 involving only an adult purposive sampled population, those who work at metal’s smelters and surrounding neighborhoods. The wider and more heterogeneity sampled
population assessed by Mer-C and MOE in 2011, involving 400 children and adults (365 with completed data) were randomly selected. The data revealed that those adults working and living near metals smelters were at high risk of lead exposure. This result indicates exposure to lead is still occurring in Pesarean village. The metals smelters are the only possible sources for the exposure.

The BLLs test was recognized as the fastest and reliable test in describing toxicity of lead in the human body from current environmental lead exposure. The BLLs measurement since 2011 show the lead exposure in the environment is still currently occurring (Table 1). The 2015 findings show the more severe health effects occurred among the population (Table 2). As the metals smelters are the only source of exposure in the area of study, it seems that the metals smelter burns enough number of lead materials.

As the mean BLLs in the cohort population were higher in 2015 (>39.3 μg/dL) than in 2011 (27.9 μg/dL) with no statistical difference (Table 3), it indicated that exposure to environmental lead occurred over time. These results suggest exposure will continue in the near future if no preventative action is taken.

**Conclusion**

The population living near ULABs smelters is at serious risk of chronic health problems. It is recommended that the smelters must be closed or moved away from the municipality.

**References**