The Bigger Level Of Blood Lead, The Higher Level Of SGOT and SGPT In Residents Around The Used Battery Recycling Industry

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Abstract: Hazardous materials that need to be watched out for are exposure to lead (Pb) in solder wire from the used battery recycling industry. Pb can cause health problems for workers and the community around the high risk industry. Exposure occurs through inhalation, ingestion or skin because Pb is a multi-media pollutant. Abnormal levels of Pb in the blood have a risk of 1,783 times, can reach toxic levels and cause disturbances in the soft tissues of the liver, characterized by increased levels of SGOT and SGPT in the blood. The purpose of this study was to determine the relationship between blood lead levels and SGOT & SGPT levels in residents around the used battery recycling industry. The number of research samples as many as 40 respondents through the analytical method of observational cross-sectional design approach. Sampling was done by non-probability sampling with purposed sampling technique. The results showed that Pb levels reached 695.90 ug/L exceeds the value of the biological exposure index (IPB). There is a relationship between blood lead levels and blood SGOT& SGPT levels ($p = 0.003$) and ($p = 0.000$) with a strong positive relationship ($r = 0.460$)and ($r = 0.526$). The conclusion is that there is a relationship between blood lead levels and SGOT & SGPT levels in residents around the used battery recycling industry and the greater the blood Pb level, the higher the SGOT & SGPT levels.

Keywords: Blood Lead Levels, SGOT & SGPT Levels

1. Introduction

One of the hazardous materials to watch out for is exposure to lead (Pb) in solder wire or materials being worked on which has the potential to cause negative impacts on human health, both in the short and long term. Pb exposure can occur through the air through the respiratory tract (inhalation), through food, water through the digestive tract (ingestion) and through the skin because lead is a multi-media pollutant (Novi Hidayat, Suhartono, Nurjazuli, 2013). As much as 30-40% of lead absorbed through the respiratory tract will enter the bloodstream. 99% of lead absorbed by the body will be bound to erythrocytes, and 1% spread freely into soft tissues and bones (Lubis dkk, 2013).

The Centers for Disease Control and Prevention (2012) set the permissible level of lead in the blood of children at 10 µg/dL, while according to WHO (1995) normal levels in the blood of adults averaged 10-25 µg/dl. If the lead content is more than 80 µg/dl, it will be harmful to health. Lead levels in the blood rise within a few hours after exposure and will remain high for several weeks afterward so that the length of exposure will affect the increase in blood lead levels and reflect lead levels in the body (Gillis, Arbieva, dan Gavin, 2012).

Lead absorption and accumulation in the body can reach toxic levels. Lead in the blood will be distributed to all body tissues and cause toxic effects on many organ functions. According to (Hariono 2005), the highest lead accumulation in soft tissues occurred in the kidneys, followed by the liver, brain, lungs, heart, muscles and testes. Lead is easy to accumulate and can cause disturbances in the body, one of which is impaired liver function. A person who has abnormal or high blood Pb levels (> 40 µg/dL) has a 1.783 times risk of developing liver function disorders than someone who has low or normal blood Pb levels (< 40 µg/dL). The mechanism of liver damage by lead at a certain level can induce the formation of free radicals and reduce the ability of the body's antioxidant system so that oxidative stress will occur automatically (Fidiyatun, Setiani, dan Suhartono, 2013). Liver disorders can be characterized by increased levels of transaminase enzymes, including Serum Glutamate Oxaloacetate Transaminase (SGOT) and Serum Glutamate Pyruvate Transaminase (SGPT). In the event of cell damage or increased permeability of cell membranes, the enzymes will be released into the extra cellular space and can be used as a means to make a diagnosis (Akbar, 2006).

One source of lead exposure from the battery recycling industry. Lead works as an important medium for storing and supplying electric current in motor vehicles (Pahlawan, S., Keman, 2014). The rapid use of batteries causes battery waste to become a source of pollution problems when discharged into the environment. Efforts have been made to carry out the battery recycling process by small industries, households to large-scale industries to be further processed into pure products and reused as raw materials. The recycling of used batteries produces waste that has the potential to pollute the environment because it contains hazardous and toxic materials, namely Pb metal (Purnawan, 2012) and (Novi Hidayat, Suhartono, Nurjazuli, 2013). Very light Pb material carried through dust is a source of exposure that enters people's homes (Fetronela dkk, 2011).

The results of research by Budiyono et al, (2016) the average length of lead exposure in used battery recycling causes blood lead levels to increase also illustrates the reflection of dynamic continuity between exposure, absorption, distribution, and excretion so that it is an indicator to find out and follow the given ongoing exposure Ardillah, 2016. This is in accordance with the statement of Adi HS, 2001 in Rosmiarti dkk, 2014, that the factors that affect blood lead levels depend on the length of exposure, the longer the exposure the greater the blood lead levels and have a positive effect on increasing levels of SGOT and SGPT blood of workers and communities around the industry.

Kadu Village is a village in the Curug District, Tangerang Regency. This village is a residential area adjacent to the used battery recycling industry which is classified as a large factory that has been fully operational since 1987. To conduct research on industrial workers, researchers have tried to approach but the factory is still not willing, so the research is transferred to residents around the industry. From the results of the preliminary survey by the researchers, it was found that many villagers in the industrial environment became workers in the battery recycling industry. In addition, exposure can also occur from dust entering the houses of local residents settling on floors, furniture and eating utensils. Lead absorption in residents can occur through breathing, digestion through eating utensils and through skin contact. A previous study by (Bobu, Noor, dan Bunawas, 2013), found that the lead concentration in the dust and soil of Kadu Village was well above the predetermined lead standard of 40 µg/ft2. The average lead concentration in the dust samples was between 442 – 558 µg/ft2, while in the soil it was around 505 – 5066 µg/ft2. The concentration of Pb in the air can still be measured at a distance of 600 m from the source of Pb exposure to the environment. This shows that there is lead pollution released in the environment, meaning there is lead exposure to residents around the battery recycling industry. An even more important focus is that every resident around the industry is not aware that continuous lead exposure has a risk of serious disease and can cause disturbances in many soft tissue organ systems such as impaired hematopoietic function, nervous disorders, kidney disorders and liver disorders. For this reason, this study was conducted as an initial step to determine the presence of lead poisoning and impaired liver function so that prevention can be done.

2. Material and Methods

Examination of blood lead levels and SGOT & SGPT levels using ± 5 ml venous blood samples, using a sterile needle and 1 tube holder of EDTA (Ethylene Diamine Tetraacetic Acid). Blood lead levels were measured using Atomic Absorption Spectrophotometer (AAS) and examination of SGOT and SGPT levels by kinetic enzymatic method.

The research design was quantitative with an analytic observational cross-sectional method. The population used is residents around the former battery recycling industry in Kadu Village, Curug District, and Tangerang Regency with a distance of ± 0 to 600 m from the source of exposure. The minimum sample size using the Lemeshows formula is 40. Non-probability sampling is taken using a purposed sampling technique for respondents who meet the criteria, residents around the used battery recycling industry, a distance of ± 0 to 600 m from the source of the used battery recycling industry, minimum length of stay 12 years since the used battery recycling industry started.

3. Ethical clearance

Ethical clearance was obtained from the Health Polytechnic Ministry of Health Jakarta III Ethics Commission Number: KEPK-PKJ3/015/V/2021 and a request for a research permit to the Tangerang District Health Office, Curug District Health Center and Kadu Village.

4. Results

a. Frequency Distribution of Lead Levels in Blood

The results of the study for the distribution of blood lead levels in residents around the battery recycling industry from 40 respondents in table 1.

Table 1. Distribution of Lead Levels in Respondent's Blood

Variable	Minimum	Maximum	Mean	Standard Deviation
Blood Lead Level (µg/L)	91.28	695.90	215.77	129.562

The results of the analysis obtained a maximum lead level of 695.90 µg/L, with blood lead levels already exceeding the biological exposure index reference limit (BEI) > 200 µg/L. A total of 15 respondents with blood lead levels exceeding BEI, can be seen in table 2.

Table 2. Frequency Distribution of Lead Levels in Respondent's Blood

Blood Lead Level*	Frequency (n)	Percentage
≤ 200 µg/L	25	60 %
> 200 µg/L	15	40 %
Total	40	100 %

* Determination of the reference limit value for lead levels in accordance with the Requirements for the Threshold Limit Value for Chemical Substances and Physical Agents and Biological Exposure Indices 2017 which is 200 µg/L.

b. Frequency Distribution of SGOT and SGPT levels

The results of the analysis of blood SGOT levels exceeding the reference value were 7 respondents with a maximum level of 61 mg/dL. While the levels of SGPT are all still within the reference limit with a maximum level of 49 mg/dL and reach the level of alertness, the results can be seen in table 3, table 4 and table 5.

Table 3. Distribution of SGOT and SGPT Levels in Respondent's Blood

Variable	Minimum	Maximum	Mean	Standard Deviation
SGOT Levels in the Blood mg/dL	13	61	25.38	14.598
SGPT Levels in the Blood mg/dL	6	49	19.75	13.893

Table 4. Frequency Distribution of SGOT Levels in Respondent's Blood.

SGOT Levels in the Blood mg/dL*	Frequency (n)	Percentage
Normal (According to Reference)	33	82,5%
High (Exceeds Reference)	7	17,5%
Total	40	100 %

* SGOT reference limit value < 50 mg/dL

Table 5. Frequency Distribution of SGPT Levels in Respondent's Blood.

SGPT Levels in the Blood mg/dL*	Frequency (n)	Percentage
Normal (According to Reference)	40	100%
High (Exceeds Reference)	0	0%
Total	40	100 %

* SGPT reference limit value < 50 mg/dL

SGOT levels that exceed the reference limit and SGPT levels that reach the alert level are not realized by residents around the industry because clinical symptoms have not yet appeared. Residents are also not aware of the increased levels of SGOT and SGPT due to Pb exposure from used battery recycling industry activities.

c. Blood Lead Levels with SGOT Levels in the Blood

The results of the analysis in table 7 showed that blood lead levels exceeding the reference value (> 200 µg/L) had high SGOT levels of 17.5%. Although the SGOT level is still within the reference value, 9 respondents already have lead levels exceeding the BEI reference value with SGOT levels that are close to high (49 mg/dL) which are very dangerous to health.

Table 6. Cross Tabulation of Blood Lead Levels with SGOT Levels in Blood

Blood Lead Level	SGOT Levels in the Blood mg/dL *					
	Normal (According to Reference)		High (Exceeds Reference)		Total	
	N	%	N	%	N	%
≤ 200 µg/L	24	60	0	0	24	60
> 200 µg/L	9	22.5	7	17.5	16	40
Total	33	82.5	7	17.5	40	100

*Methods = IFCC without Pyridoxal Phosphat

d. Blood Lead Levels with SGPT Levels in the Blood

The results of the analysis in table 8 showed that blood lead levels exceed the reference (> 200 µg/L) with SGPT levels are still normal (40%). Although the SGPT level is still within the reference limit, this condition can be dangerous because the lead level is already above the reference limit.

Table 7. Cross Tabulation of Blood Lead Levels with SGPT Levels in Blood

Blood Lead Level	SGPT Levels in the Blood mg/dL *					
	Normal (According to Reference)		High (Exceeds Reference)		Total	
	N	%	N	%	N	%
≤ 200 µg/L	24	60	0	0	24	60
> 200 µg/L	16	40	0	0	16	40
Total	40	100	0	0	40	100

*Methods = IFCC without Pyridoxal Phosphate

e. Correlation Test

The results of the correlation test in table 9 have a relationship between blood lead levels with SGOT and SGPT levels with $p = 0.003$ and $p = 0.000$ ($p < 0.05$). The correlation coefficient of the two has a strong positive relationship ($r = 0.460$ to 0.526).

Table 8. Blood Lead Levels with Blood SGOT & SGPT Levels Spearman Correlation Test

Variable	Blood Lead Level µg/L		
	Frequency (n)	P Value (Sig)	Correlation Coefficient (r)
SGOT Levels in the Blood mg/dL	40	0,003	0,460
SGPT Levels in the Blood mg/dL	40	0,000	0,526

5. Discussion

The blood Pb level exceeds the reference value according to the Threshold Limit Value for Chemical Substances and Physical Agents and Biological Exposure Indices in 2017 which is < 200 µg/L. As many as 40% of all respondents have blood lead levels > 200 µg/L (215.77 µg/L).

The presence and high levels of lead in the blood is influenced by many factors. The modifying factor for residents around the used battery recycling industry obtained from this study to become high risk is the distance from their residence/house to the source of exposure. Lead levels in the air were still detectable at a distance of 600 m from the source of exposure. All respondents have a residence very close to the source of exposure less than 100 meters from the used battery recycling industry. This is a factor in the high levels of lead in the blood in the community around the used battery factory.

Although the used battery processing plant does not always carry out the battery processing process, the pollutants scattered in the air still settle. This occurs due to exposure to airborne particles containing Pb continuously over a long period of time, scattered around community settlements. The very light lead material carried through dust is one of the sources of exposure that enters people's homes, sticks to eating utensils, inhaled through breathing, skin contact and digestion. (Purnawan, 2012), (Novi Hidayat, Suhartono, Nurjazuli, 2013) and (Fetronela dkk, 2011). The results of previous research by Bobu, Noor, and Bunawas, 2013, obtained that the lead concentration in the dust and soil of Kadu Village was far above the predetermined lead standard of 40 µg/ft2. The average lead concentration in the dust sample is between 442 – 558 µg/ft2, while in the soil it is around 505 – 5066 µg/ft2.

The results of previous research by (Fitra, 2015) on workers at CV. Shining Steel Rays lead levels that exceed the threshold. Workers inhale a lot of gases from burning metal continuously from the metal smelting process. Likewise, research by (Tim Mer-C, 2011) on blood samples of the community around the Small Industry Village (PIK) location obtained the results of high levels of Pb. The impact of air pollution resulting from industrial activities of burning lead in PIK, Tegal Regency, and well water for daily needs can be an entry point for Pb metal to be absorbed into the body.

Based on research conducted by Palar, 2008 in Sinuraya, 2017 conducted by several groups of people in America that there are differences in blood lead levels in residents who live close to the source of exposure. The blood lead level of residents who live close to the source of exposure is 227 μg/L while the population who lives far from the source of exposure is only 160 μg/L.

Blood lead levels from this study are quite worrying. It was found that respondents with lead levels reached 696 μg/dL, and some were close to the reference limit value. If continuously exposed to concentrations and for a long time, the body is not able to absorb lead in the blood. Lead in the blood will accumulate to reach toxic levels and cause damage to soft tissue organs such as the liver (Hariono, 2005). Lead is a cumulative, destructive and continuous toxin in soft tissues. High blood lead levels because residents are continuously exposed to concentrations and for a long time, thereby reducing the activity of the body's cellular sub-organs.

SGOT levels in the blood of 7 out of 40 respondents had levels exceeding the reference value > 40 mg/dL. The mechanism of Pb in the blood will cause high levels of SGOT & SGPT starting when Pb enters the body through the bloodstream as much as 95% of Pb is bound to erythrocytes and circulated to soft tissues. Pb compounds turn into Pb2+ which have free atoms so that they will turn into free radicals because they try to complete the outer layer to make it more stable by binding to other molecules from body organs. Pb2+ will bind to lipids from the liver hepatocyte membranes and form lipid peroxides which will cause damage or cell death and damage to the liver, so that the aminotransferase enzymes (SGOT and SGPT) will be released into extra cells and the bloodstream. Examination of SGOT & SGPT levels in the blood can help diagnose certain diseases, such as liver disease (Rosida, 2016) and higher results in SGOT levels can occur due to high levels of lead in the blood of workers. (Fidyatun, 2013).

SGPT levels in the blood in this study, none of which exceeds the reference value limit > 40 mg/dL. Increased levels of SGOT indicate liver abnormalities that are dominated by mitochondrial damage, because SGOT is in the cytosol and mitochondria. Meanwhile, SGPT levels are higher in the cytoplasm of liver cells, so according to research (Nuari, 2016) SGPT is considered more specific for detecting liver disorders than SGOT.

The relationship between blood lead levels with SGOT and SGPT levels in residents around recycling used batteries showed a correlation between blood lead levels with SGOT levels and blood SGPT levels with a pattern that the higher the blood lead level, the higher the SGOT and SGPT levels. This research is also supported by (Ayu Mirarti, Onny, & Tri, 2015) that the increase in SGOT and SGPT values is thought to occur because blood lead levels have exceeded the normal threshold, so that in workers exposed to lead there is a change in liver function values, namely an increase in blood lead levels. SGOT and SGPT. High levels of lead are associated with a 3x increase in liver damage (increased levels of SGPT). Similar research was also carried out by (Fidiyatun et al, 2013) Pb levels in the blood caused the incidence of liver function disorders to be 1.056 times higher than the previous exposure history variable so that there was a relationship between blood lead levels and the incidence of liver function disorders, which was characterized by increased levels of enzymes. SGPT and SGOT. Susiwati and Anggita (2017) state that there is a relationship between the length of time of exposure to pollutants for a long time to liver damage which can be detected by an increase in SGOT and SGPT levels.

Based on the results of research and discussion of several theories and research journals that have been published for the dangers of lead exposure from the used battery recycling industry, it is necessary to have supervision from the local government in the health and environmental health sector. Pb waste from used battery recycling industrial activities is a category of B3 waste. Supervision carried out on the implementation of Government Regulation of the Republic of Indonesia No. 22 Year 2021, concerning the Implementation of Environmental Protection and Management Permits. Supervision that can be carried out through environmental supervision and management efforts (UPL and UKL). The obligation of business actors to be responsible for the management of B3 and non-B3 waste includes the quality of water, air, environmental damage and waste management. Violations of the Government Regulation are in the form of administrative sanctions for revocation of permits based on supervision reports, termination of business permits at the provincial level from the Governor and the Regent for the Regency.

6. Conclusions

The average level of lead in the blood of residents around the used battery recycling industry has exceeded the biological exposure index (BEI) of 215.77 µg/L with the highest level reaching 695.90 µg/L. The highest SGOT level in the residents was 61 mg/dL which had exceeded the normal value, and the highest SGPT level of 49 mg/dL had reached the alert level. There is a relationship between blood lead levels with SGOT and SGPT levels with $p = 0.003$ and $p = 0.000$ ($p < 0.05$). The correlation coefficient between the two has a strong positive relationship ($r = 0.460$ to 0.526) the greater the blood Pb level, the higher the SGOT & SGPT levels.

7. Conflict of Interest

There is no conflict of interest in this research.

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