



CORRELATION OF LEVELS OF LEVELS (PB) IN BLOOD WITH BLOOD PROFILE OF METAL FORGING WORKERS

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ABSTRACT

Metal smelting has the potential to release micro-sized metal particles into the air. One of the metal smelting household industries is the gamelan industry. Brass is the basic material for making gamelan with a lead (Pb) content of 0.46%. In the process of making this gamelan, gamelan craftsmen will have a risk of exposure to Pb particles. Absorbed lead will be transported in the organs of the body as much as 95%, in the blood lead will be bound by erythrocytes and will interfere with the formation of hemoglobin. This study aims to see the relationship between Pb levels and the blood profile of metal forging workers in the gamelan industry, Wirun Mojolaban Village, Sukoharjo. This research is a quantitative, observational study with a sample size of 35 gamelan craftsmen in Wirun Village, Mojolaban Sukoharjo. The examination of Pb levels was carried out at BLK Jogja with GFAAS, while the examination of hemoglobin, leukocytes, platelets, hematocrit, and erythrocytes was carried out in the clinical laboratory. The results showed that there was no relationship between Pb levels in the blood and the number of hemoglobin, leukocytes, platelets, hematocrit, and erythrocytes. Although gamelan craftsmen are exposed to lead, they have not shown any symptoms of poisoning and have no blood disorders.

Keywords: blood profile; lead exposure; metal forging workers

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INTRODUCTION

Metal smelting has the potential to release micro-sized metal particles into the air. Metal smelting in Indonesia is usually carried out by the community on the scale of a home industry, without paying attention to their own safety and the environment, so that the level of emissions and pollution in the work environment becomes high and cannot be controlled.

One of the metal smelting household industries is the gamelan industry. There are many gemaelan-making industries in Wiru Village, Mojolaban District, Sukoharjo Regency. This gamelan is widely ordered from Bali to support the cultural field. The number of owners of the gamelan industry itself in Wiru Village is 5 owners/craftsmen. Each has an average worker of 7-10 people who do work as gemelan forges. The entire gamelan industry is a cottage industry, with simple equipment and minimal protection for the safety and health of the workforce.

The results of the analysis conducted by Supriyanto (2010), on the components of the composition of brass show that brass is a mixed metal containing the main elements, namely

copper (Cu) of 65.493% and zinc (Zn) of 34.506% and other elements including lead (Pb), namely by 0.46% (Supriyanto, 2010). The brass industry uses metal waste which is included in the category of toxic and hazardous waste (B3). The B3 material has the potential to be released into the environment during the smelting process, in the form of metal fumes (fume) or scattering of micron-sized metal particles

Metal particles resulting from smelting enter the human body either by inhalation, subcutaneously or ingestion. One of the dangerous heavy metals that can be released into the air as a result of brass smelting activities is lead (Pb). Pb emissions released into the environment in mining and metal smelting activities reach around 357×10^6 to 857×10^6 kg/year. Pb inhalation is more efficient than ingestion, with an efficiency ratio of 10:1. The efficiency increases with the smaller particle size. Particles with an MMAD size (mass median aerodynamic diameter) greater than 10 μ m are buried in the oropharynx, particles measuring between 5 to 10 μ m enter the middle respiratory tract, while particles measuring between 0.5 to < 5 μ m can enter the bronchioles and alveoli (Zhang et al., 2012). Pb exposure by inhalation generally occurs in those who live close to smelters or those who work in metal smelters (Rodrigues et al., 2009).

Absorbed lead will be transported in body organs as much as 95%, in blood lead will be bound by erythrocytes (Palar, 2008). Exposure to lead bound by erythrocytes will have an impact on disturbances in the blood profile such as inhibition of hemoglobin synthesis which will lead to anemia, causing a shortened life span of circulating erythrocytes (red blood cell tissue) resulting in the stimulation of erythropoiesis (formation of erythrocytes). The cause of the disorder of Pb in heme synthesis causes an abnormally high excretion of metabolism in the urine. Amino Leuvulini. Acid (ALA) and corprophyrin III increase when lead poisoning occurs (Hartin, 2011). This study aims to analyze the relationship between blood lead levels and the number of hemoglobin, leukocytes, platelets, hematocrit, and erythrocytes in Metal Forging Workers in Gamelan Industry, Wirun Mojolaban Village, Sukoharjo.

METHOD

This research is a quantitative, observational study with a descriptive and analytical approach, the research time using a cross sectional approach. The research population is metal forging workers in the gamelan industry, Wirun Mojolaban Sukoharjo Village. Samples were taken randomly without regard to the existing strata in the population with a sample size of 35 workers. Checking blood lead levels is done by taking 3 cc of blood samples inserted in a purple vacuum tube and placed in an ice box and brought directly to the Yogyakarta Health Laboratory, the blood samples at BLK Jogja will be subjected to wet digestion and the Pb levels are read using the GFAAS tool. , while a complete blood count was carried out at the CITO Surakarta Laboratory. The data analysis technique of lead (Pb) levels in the blood with the number of hemoglobin, leukocytes, platelets, hematocrit, and erythrocytes were analyzed using correlation test.

RESULTS

This study involved 35 gamelan industry workers in Wirun Mojolaban Sukoharjo Village, with male gender. The descriptive data is shown in table 1.

Table 1.
Description of the study population

Characteristics	Keterangan (f = 35)	NAB/Kadar Normal
Age (years), mean (SD)	43.86 (10.128)	-
Lead Level (µg/dL), mean (SD)	0.9856 (0.6197)	< 10 µg/dL
Hemoglobin (g%), Mean (SD)	15.1086 (2.1473)	14
Leukocytes (cells/mm ³), Mean (SD)	7240 (2254.434)	4000-11000
Platelets (cells/mm ³), Mean (SD)	236114.29 (79837.62)	150000-450000
Hematocrit (%), Mean (SD)	46.0629 (5.8706)	42-52
Erythrocytes (cells/mm ³), Mean (SD)	5197714.29 (668910.817)	4000000-6200000

Table 1, Pb levels in the blood of gamelan craftsmen indicate that they are still within the normal threshold according to OSHA (Occupational Safety and Health Association) standards where the threshold value for inorganic lead, dust and vapors should not exceed 0.5 ppm (OSHA, 2005). According to the limits for lead levels in the blood according to the Center for Disease Control and Prevention or the CDC (2012) are Adults: < 10 g/dL and children: < 5 g/dL. The levels of hemoglobin, leukocytes, platelets, hematocrit and erythrocytes were still within the normal threshold, although the average hemoglobin level was above the threshold value.

The data obtained were then analyzed for data, the data obtained were tested for normality first with the results shown in the table below.

Table 2.
Shapiro-Wilk . Normality Test Results

Variabel	Df	Sig.
Kadar Pb (µg/dL)	35	0.009
Hemoglobin (g%)	35	0.059
Lekosit (sel/mm ³)	35	0.000
Trombosit (sel/mm ³)	35	0.649
Hematokrit (%)	35	0.050
Eritrosit (sel/mm ³)	35	0.565

The results of the normality distribution test using the Shapiro-Wilk test in the category of blood Pb levels, Leukocytes, and Hematocrit with a significance value of <0.05, it is stated that the data are not normally distributed. Based on the normality test data because there were data that were not normally distributed, the data analysis was continued using a nonparametric correlation test, namely the Spearman's rho correlation test.

Table 3.
Spearman's rho correlation test results of Pb levels on Hemoglobin, Leukocytes, Platelets, Hematocrit, and Erythrocytes

Correlation Test	Signifikasi	Conclusion
Relationship of Pb with Hemoglobin	0.883	No connection
Relationship of Pb with Leukocytes	0.397	No connection
Pb Relationship with Platelets	0.814	No connection
Pb Relationship with Hematocrit	0.639	No connection
Pb Relationship with Erythrocytes	0.547	No connection

DISCUSSION

The results of Table 3 show that there is no relationship between Pb levels with hemoglobin, Pb with leukocytes, Pb with platelets, Pb with hematocrit, and Pb with erythrocytes, with a significance value of each test > 0.05 . The results of the study did not show a relationship between lead levels with hemoglobin, leukocytes, platelets, hematocrit and erythrocytes, this is possible because Pb levels in the blood are still within normal limits and do not exceed OSHA standards, which are no more than $40\mu\text{g/dL}$ for average exposure. 8 hours per day for exposure, so the effects of lead exposure have not been able to affect the abnormality of blood cells in the body. The first effect of chronic lead poisoning before reaching the target organ is a disturbance in hemoglobin synthesis so that hemoglobin levels decrease (Prasetya et al., 2021) (Kurniawan, 2008).

Pb levels more than normal will affect the blood profile shown by research by Mifbakhuddin et al, (2007), the results of research on gas station operators showed that there was a significant relationship between Pb levels in the blood with Hb levels and hematocrit ($p < 0.05$). Gas station operators who have Pb levels above normal have a risk of decreasing Hb levels < 14 , 1.388 times greater than those with normal Pb levels, and Pb levels in blood exceeding normal, have a risk of hematocrit levels $< 42\%$, 1.358 times more greater than the officers whose Pb levels were below normal (Mifbakhuddin et al., 2007).

The results of the determination of Pb levels in the blood are in the low category because Pb is not the main ingredient for making brass metal, only about 0.46% of the total metal making up brass. However, considering the continuous production of brass crafts for a long period of time allows Pb to be exposed to the work environment. As a result, brass craftsmen are very susceptible to chronic Pb exposure (Marianti et al., 2015). Pb levels in the blood were still within normal limits because the results of the 4th observation of the gamelan manufacturing industry showed that the workplace buildings were entirely permanent with adequate lighting and air exchange conditions. Exchange so that it can emit fumes or vapors resulting from metal smelting and smelting furnaces. Although lead levels in the blood are still within normal limits, but with a metallic character that cannot be broken down or broken down. Thus, organisms can only detoxify lead ions by hiding the active constituents in proteins or storing them in intracellular granules in an insoluble form and subsequently excreted in the form of feces or stored in the long term. When lead is ingested or inhaled into our bodies, they bioaccumulate in our systems. Thus they are classified as dangerous. This bioaccumulation will cause biological and physiological complications (Briffa et al., 2020).

The absorbed lead (Pb) is transported by the blood to the organs of the body and as much as 95% of the Pb in the blood is bound by erythrocytes. The hematotoxic effect of Pb is to inhibit the activity of the δ -aminolevulinic acid dehydrogenase (δ -aminolevulinic acid dehydrogenase = δ -ALAD) enzyme in bone marrow erythroblasts and erythrocytes in heme synthesis (Levy, 2006). Exposure to lead bound by erythrocytes will have an impact on disturbances in the blood profile such as inhibition of hemoglobin synthesis. If Lead enters the blood it attaches to erythrocytes, lead is destructive so that lead attached to erythrocytes will cause erythrocytes to lyse/destroy before the time for regeneration. The nature of lead damage is fluctuating according to the intensity of exposure and the time of regeneration of erythrocytes, although on the other hand, continuous exposure will cause lead to continue to enter the blood following blood circulation throughout the body and settle in other organs such as bone marrow and accumulate. adequate nutrition or nutrition is able to play a role in the manufacture of new erythrocytes to replace erythrocytes that are lysed due to lead (Prasetya et al., 2021).

CONCLUSION

There is no relationship between Pb levels in the blood and the number of hemoglobin, leukocytes, platelets, hematocrit, and erythrocytes. Although gamelan craftsmen are exposed to lead, they have not shown any symptoms of poisoning and have no blood disorders.

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