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Pb Exposure to Hair and Nails in The Workers in Basement Parking Lot of Lippo Plaza Mall Yogyakarta

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ABSTRACT

This study was performed in the Lower Ground (LG) basement of Lippo Plaza Mall Yogyakarta. The aim of this study was to provide information on Pb exposure from transportation activity, since Pb in human body to some extent might be toxic or dangerous. The analysis of hair and nails is known to provide useful information about environmental and toxic exposures, they are good bioindicators to detect contaminants in human body. The research was conducted in May 2021 and studied 30 samples of human hair and nails taken from workers who worked inside the basement of parking lot. Hair and finger nail samples were collected from the respondents. Personal characteristics such as age, working duration, background and health conditions of the respondents were recorded. The finger nail clippings were obtained using a stainless steel nail clipper and hair cut by hair scissors. The samples were kept in self-adhesive plastic bag for later analysis which was carried out by Analytical Methods for Atomic absorption Spectroscopy (AAS). The values of Pb concentrations in nail and hair of the subjects were presented as arithmetic mean (ppm) with standard error (±SE) and tabulated to show concentration profile over each parameter. The One-Sample Kolmogorov-Smirnov Test was used to describe the distribution test and and the Mann-Whitney *U* test was used to corelate Pb concentrations from long two perithe groups. The level of significance was set at Pb 0.05. All calculations were performed using statistical packages SPSS (version 21). Respondents with a working period of less than 4 years detected an average Pb of 3.9671 ppm with a Standard Error (SE) of 1.5, an average of 5-8 years of service period of 4.0312 ppm with an SE of 1.6 and an average working period of more than 9 years. The average Pb content was 13.0805 ppm with an SE of 7.1. From these results, it shows that the longer

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the employee's working period, the higher the level of Pb in his nails or hair. The results of the regression test showed that there was no effect of work and the results of measuring Pb levels in nails/hair because the significant value was 0.496> p = 0.05 with R^2: 0.017. The average levels of Pb in the nails and hair of workers working around the basement were security 0.85 ppm, engineers 4.87 ppm, cleaning service 7.17 ppm and parking guards 7.74 ppm. It is recommended to continue rotating employee turnover times with shorter time for parking staff and use masks for cleaning services.

Introduction

Environmental pollution of heavy metals is increasingly. These inorganic pollutants are being discarded in our waters, soils and into the atmosphere. The physiological and biochemical effects of each heavy metal bioaccumulation in humans. (Briffa, Sinagra, and Blundell, 2020). Blood, urine, saliva, nails, and hair is human biomonitoring. It is an essential tool to evaluate chemical exposures (Olympio et al., 2020). Hair and nail as biopsy materials were suggested as more attractive biomarkers in assessing heavy metals environmental exposure (Hussein Were et al., 2008). Human hair can be used as an alternative matrix to detect chronic toxic exposure among occupationally and non-occupationally lead-exposed subjects. Battery manufacturing factory workers was tested. Lead of blood, urine and hair was compared. The result showed the study of hair lead concentration according to workplace showed a significantly higher exposure. Hair is an efficient biological sample to assess lead poisoning especially for chronic exposure. Hair is easy to collect, to handle and gives reproducible results that may be useful in monitoring of exposed workers. (Mariem et al., 2020). As compared to other potential biomarkers of trace elements, nail measurement has certain advantages in clinical research (Ka He, 2011). Human hair and finger nails are therefore recording filaments that can reflect metabolic changes over long period of time and hence furnish a print out of post nutritional event of dietary levels of some of the essential elements. Scalp hair or finger nails are recording filaments that can reflect the extent of environmental pollution (Ndiritu, Wanjau, and Murungi, 2013).

Lead (Pb) pollution has been considered as a major threat for human health due to induction of inflammatory cascades in various tissues. Summarize the literature indicate that lead exposure may cause respiratory, neurologic, digestive, cardiovascular and urinary diseases. (Boskabady et al., 2018). Lead is a naturally occurring element, which can basically be found in the environment in two different chemical forms: as inorganic compounds (oxide, nitrate, halides, sulphide, etc.), which tend to promote the release of the Pb^{+2} cation, and as organometallic species, the so-called alkyl-lead compounds, which are species where organic ligands (methyl, ethyl, etc.) are bound to a lead atom (tetra ethyl lead and tetra methyl lead are the most common, and have been used as fuel additives for decades). Each of these forms may exhibit specific features of poisoning: alkyl lead compounds, due to their lipophilic nature, are able to penetrate the skin and respiratory tract, and predominantly affect

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the Central Nervous System, and inorganic compounds directly enter the bloodstream to be further distributed around the body (Palacios and Capdevila, 2013). Lead pipes, lead in cans, lead in toy, traditional medicine, food, leaded paint, leaded gasoline, leaded industry, cottage industries, burning of waste, lead in cosmetics, traditional medicines applied to skin were the sources of lead exposure. It was indicated that blood lead levels were significantly increased with age, smoking status, and alcohol consumption. Human exposure to lead occurs mainly via digestive and respiratory tracts (Boskabady et al., 2018).

Several researchers have investigated the accumulation of Pb in nails and hair. The exposure of Pb from coal mining activity could be accumulated primarily in the hair and nails. Children hair and children nails in the mining area showed that Pb levels in the hair of exposed respondents in all age categories were above the WHO threshold limits value (≤ 12 μg/g). (Mulyati, Pujiono, and Indah, 2021). The levels of heavy metal in the nail tissues were found to be significantly influenced by both environmental and nutritional factors in a high pollution intensity and heavy industrial activity. The sample got from children nails in urban areas and rural area. The mean levels of heavy metals in children nails in urban areas were found to be higher (27.5±1.8 μg/g Pb and 0.73±0.08 μg/g Cd) than in rural areas (19.7±0.9 μg/g Pb and 0.44±0.06 μg/g Cd) (Hussein Were et al., 2008). The local farmland was seriously polluted by the irrigation of discharged wastewater, atmospheric deposition of flue gas and accumulation of waste residue. the Pb and Se levels of food was effected the hair and urine. The children's PDI (probable daily intake) of Pb and Se were higher than those of adults and seniors (Zhou et al., 2019). Lead in urban car could give human health risk. Vitro methode used to analyzed. the lead in Beijing park soils ranged from 19.0 to 118.2 mg/kg. The reason could be that the soils exposed to anthropogenic pollution such as traffic emissions increase. Human activities had a certain effect on soil Pb in some park (Sun, 2020).

Particulate matter, gases such as ozone, nitrogen dioxide, carbon monoxide, and sulphur dioxide; microbial and chemical volatile organic compounds; passive smoke; and outdoor ambient air are the most common types of air pollutants encountered indoors. The review showed indoor pollutants act as respiratory irritants, toxicants, and adjuvants or carriers of allergens (Bernstein et al., 2008). Indoor dust was more important than soil in terms of human exposure. The high concentration of trace elements on the environmental media and long periods of time the population spends at their households used as media exposure. The soil and indoor dust are the environmental media of human exposure to trace element in the population There were statistically significant association between the trace element concentration in hair/toenails and the estimated chronic daily intake of soil and indoor dust (Beracalusce, 2019).

Most people used vehicles to go everywhere. This is why the use of cars has increased, and this has created parking problems. To overcome these problems, underground car parking was needed. Air circulation inside of the basement usually insufficient, so the air purify equipment must be place in the basement. For most

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underground parking spaces, the main contradiction of sustainable design lies in the lighting and ventilation of underground spaces (Xia et al., 2021). Instrumental monitoring of air quality assessment in parking garages showed elevated PM10 mass concentrations and increased content of carcinogenic heavy metals (Cd, Ni and Pb). Due to poor air conditions, particles, as well as pollutants bound to them, remain longer inside the garage depending on ventilation ineffectiveness. Individual cancer risk values calculated for both heavy metals and PAHs was below the lower limit value of the acceptable range of 10^{-4} to 10^{-6}. Cumulative cancer risk value obtained for Cd, Cr, Ni and Pb was 98% of the total assessed cancer risk. Contrary, cumulative cancer risk value calculated for carcinogenic PAHs was only 2%. Therefore, heavy metals can be considered as the dominant contributors to the assessed cancer risks. According to the instrumental measurements, setting indoor air quality guidelines was needed to reduce health risk (Vicovic et al., 2014). Lippo Mall is a mall in Jalan Solo Yogyakarta. This mall is not too wide if it compared with other malls in Yogya. This Mall has 9 floors, each floor has parking space facilities. Seven floors built above the ground and 2 floors in the basement. The first basement not used in the last 2 years.The second basement called LG Floor. The researched placed in this floor. The basement floor is not only used as a parking space, it is also used as an operational room and a service room. Workers who work in the basement are allegedly directly affected by motor vehicle emissions. This paper talk about relationship between types of workers, length of work and Pb levels in hair and nails.

MATERIALS AND METHODS

Area description

Basement LG Lippo Plaza Mall was used as the research location. The parking space can accommodate 126 passenger cars. The total parking area is 5052 m^2. The main source of pollution in basement parking spaces are emissions from motor vehicles. Motor vehicle emissions produce air pollution are CO (carbon monoxide), NO_2 (nitrogen dioxide), HC (hydrocarbons) and Pb (plumbum) and noise. The LG basement area in Lippo Mall Plaza used as a multi car garage. Average garage condition were temperatur 28,2-30,1°C, air pressure 745.5-749.1 mmHg, humidity 63-73.7% and wind speed 0.1-0.4 m/s. The ambient quality average inside LG Basement Lippo Plaza Mall for 8 hours at 11 Februari 2021 was 0.11 µg/Nm^3 and 13 Februari 2021 was Pb : 0.09 µg/Nm^3. The investigation of lead in basement parking spaces showed acceptable exceeds the Indonesia air quality standard was 2 µg/Nm^3 (Government Regulation of the Republic of Indonesia Number 22 of 2021 concerning the Implementation of Environmental Protection and Management). (Darmanijati et al., 2021).

Sampling

Respondents consist of 30 respondents who work in the Basement. All respondents are male. There were engineers, security guards, parking guards and cleaning services. Parking guard works 2 days in 2 days off. A parking guard stands at the exit on the LG Basement floor. The parking guard watch time is from 10.00 am to 10.00 pm. Security

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works for 24 hours, each person works 12 hours, with shift changes at 12.00 with employee turnover were 4 days in, 2 days off every week. Cleaning service works 8 hours a day. They has working hours from 8.00 to 16.00 and a day off is scheduled every week. Engineers works 8 hours a day. They were a Vendor employee (out sourcing) based on a contract. Employee turnover from 08.00 am to 02.00 pm to 10.00 pm. Lippo Plaza Mall has 7 floors on the ground and 2 basement floors. Cleaning service and security move in different floor every day. Engineers often work in the basement area because most of the servicing equipment is in the basement area.

The questionnaire

Impact identification was carried out using a structured questionnaire. Questionnaires were given to 30 respondents who works in the LG Lippo Mall Basement. The type of data to be identified is the respondent's personal data, user perceptions due to parking activities in the underground parking space. Data is collected through structured questionnaire

Sample collection

Hair and forefinger nail samples were collected from all respondent. Twelve people collected nail samples and 18 people collected hair samples. Personal characteristics included: age, long work, background and health conditions of the respondent. The fingernail clippings were obtained using a stainless steel nail clipper and hair cut by hair scissors. The sample keep in self-adhesive plastic bag for later analysis by Analytical Methods for Atomic absorption Spectroscopy (AAS).

Laboratory procedure

Analytical Methods for Atomic absorption Spectroscopy (Perkin Elmer) 3110 was used.

1. First Step : sample Preparation

Cut segment about of hair/nail about 5 to 10 mm in length and weighing at least 10 mg. Treat each segment separately. Weigh each segment and wash in deionized water on a mechanical shaker and then boil. Transfer the sample to a 100 mL Teflon beaker and digest with a 1:5 mixture of $HCLO_4$: HNO_3 until only a few drops of clear liquid remain. Dilute the sample 1:50 with deionized water.

2. Second Step : Analysis

Determine the concentration of the element of interest using the conditions listed in the "Standard Conditions" section. Standards are prepared by diluting the stock standard solution, described in the "Standard Conditions for Pb", with deionized water. Working standards and a blank solution should be prepared using the same levels used for sample preparation.

Data Analysis

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The values of lead concentrations in nail and hair of the subjects were presented as arithmetic mean (ppm) with standard error (±SE) and tabulated to show concentration profile over each parameter. The One-Sample Kolmogorov-Smirnov Test were used to describe distribution test and the Mann-Whitney *U* test was used to correlate the concentrations between lead concentrations from long work of two groups. The level of significance was set at Pb 0.05. All calculations were performed using statistical packages SPSS (version 21).

RESULT AND DISCUSSION

Respondents consist of 30 respondents who work as engineers, security guards, parking guards and cleaning services. The number of respondents is 30 people consisting of 11 Engineers/Technicians, 6 parking guards, 7 cleaning service people and 6 security guards (Figure 1). Parking guard working hours 2 days in 2 days off. A parking guard stands guard at the exit on the LG Basement floor and the watch time is from 10.00 am to 10.00 pm. Security guards work 12 hours, with shift changes at 12.00. Security watchs for 24 hours and work for 12 hours, 2 shifts per day from 12.00 am to 12.00 pm and 12.00 pm to 12.00 am. Employee turnover 4 days in, 2 days off every week. Cleaning service works 8 hours a day. Working hours are 8.00 am to 04.00 pm. In a week 1 day off is scheduled. Engineers works 8 hours a day and as Vendor employee (out sourcing) based on a contract. Employee turnover is from 08.00 am to 02.00 pm and 02.00 pm to 10.00 pm. Engineers and technicians work for 8 working hours, 07.00 am to 03.00 pm and 03.00 pm to – 11.00 pm. Parking guards work 12 hour shifts from 10.00 am to 10.00 pm and 10.00 pm to 10.00 am.

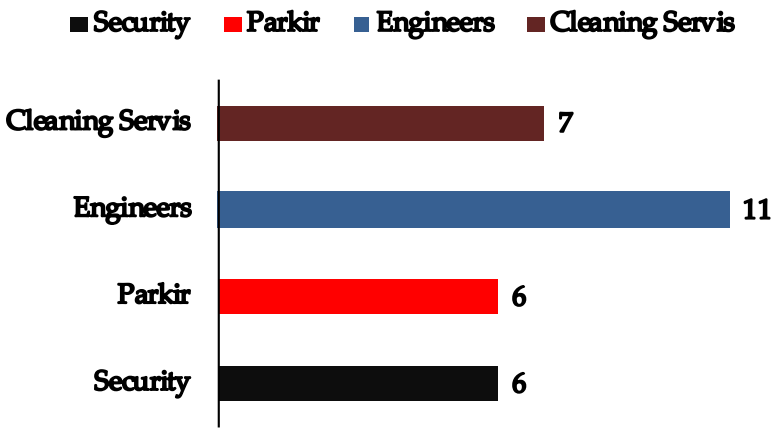

Figure 1. Kinds of job respondents

The age of the respondent can be depicted in Figure 2. Nineteen respondents or 63% of respondents are aged 20-30 years, 26% are aged 31-40 years, 6% are 41-50 years old. Figure 2 shows one respondent or 5% are over 50 years old, 18 respondents or 60% mall for < 4 years, 10 respondents or 33.3% worked for 5-8 years, 2 respondents or 6.7% had worked over 9 years.

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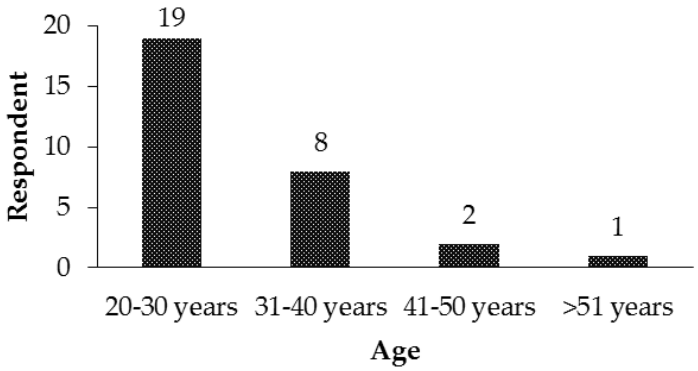

Figure 2. Respondents Age

Figure 3. Length of work respondents

Figure 3 and Table 1 show respondents with a working period of less than 4 years detected an average Pb of 3.9671 ppm with a Standard Error (SE) of 1.5, an average of 5-8 years of service period of 4.0312 with an SE of 1.58 and an average working period of more than 9 years. The average Pb content was 13.0805 with an SE of 7.07. From these results, it shows that the longer the employee's working period, the higher the level of Pb in his nails or hair.

Table 1. Mean concentrations of Pb in fingernail and hair samples from Male subject working in LG Lippo Plaza Mall Basement with respect to age group

Length of work	Pb level in hair/nails (ppm)
< 4 years	3.9671 ± 1,5
5-8 years	4.0312 ± 1,58
>9 years	13.0805± 7,07

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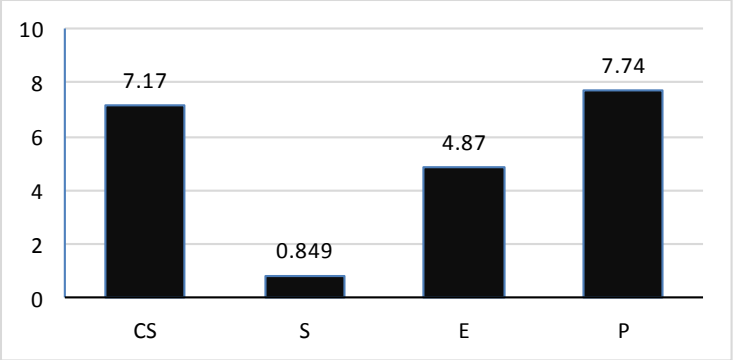

Legenda : CS = cleaning service; S = security guard; E= engineer; P = parking guard

Figure 4. Pb parameter in different job

Figure 4 shows that the average levels of Pb in the nails and hair of workers working around the basement. Security were 0.849 ppm, engineers 4.87 ppm, cleaning service 7.17 ppm and parking guards 7.74 ppm. The results of the regression test showed that there was no effect of work and the results of measuring Pb levels in nails/hair because the sig value was 0.496 > p = 0.05 with R square: 0.017.

From the results of the questionnaire, there were no health complaints from workers in the LG parking space. An engineer told the amount of dust. The parking guards complaint about the heat and water splash when it rains. A parking guard felt dizzy and had a headache and his eyes were red. Security is less likely to be exposed of the dust, the work is not always standby, sometimes walking around the building. Cleaning service, parties affected by dust from their activities are clean, dust can come from anywhere, especially from the floor. The parking guard was clearly exposed to dust directly from the friction of the wheels with the floor on the outside door of the basement. Engineer engaged in electrical and engine repair. Pb acquisition can be from paint or dust exposure at the parking entrance because the room is near the basement entrance. Another possible cause is the use of hair dye by some workers. Some workers use hair dye. Lead exposure can occur through hair dye. Lead concentrations in hair samples with hair dye ranged from 1.85 to 279.9 μg/g and in nail samples (2.69 to 17.77 μg/g). Heavy metal levels (As, Cd, and Pb) measured in hair and nails were significantly increased in participants using Hennablack, Rani-black, Bigen, Vary, Garnier, and Lakme hair dyes compared to the control group. A positive correlation was observed between the As, Cd, and Pb content of hair and nail samples in participants using hair dye groups (Ahmed, et al, 2016). Fine dust, ozone, nitrogen dioxide, carbon monoxide, and sulfur dioxide; microbes and volatile organic compounds; secondhand smoke; and outdoor ambient air are the most common types of indoor air pollutants. The review found that indoor pollutants are a major source of respiratory irritation, toxicity, and allergens (Bernstein et al, 2007). Indoor soil and dust are environmental media of human exposure to elements in the population. There is a statistically significant relationship between trace element concentrations in hair/toenails and estimated chronic daily intake of indoor and soil (Berasaluce et al, 2016). Gradual exposure to Pb in the air can affect health. The average Pb level in the LG Basement parking area is 0.1 μg/Nm3, this figure still meets ambient air quality

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standards. Lead levels in hair and nail samples analyzed for research subjects with > 9 years of work experience exceed the upper limit of 10 ppm (moderate category). This indicates the presence of this metal in the environment and workplace of the subjects and their susceptibility to disease and the dangers of this metal in cases of long-term exposure. More in-depth research is needed on other variables such as smoking habits, use of hair dye and drinking water habits, and others that may cause Pb intake. It is recommended to continue rotating employee shifts with shorter times for parking attendants and using masks for cleaning services. The use of personal protective equipment in the work environment is very necessary. Arranging employee work shifts is important to prevent excessive exposure.

CONCLUSION

Respondents with a working period of less than 4 years detected an average Pb of 3.9671 ppm with a Standard Error (SE) of 1.5, an average of 5-8 years of service period of 4.0312 with an SE of 1.58 and an average working period of more than 9 years. The average Pb content was 13.0805 with an SE of 7.07. From these results, it shows that the longer the employee's working period, the higher the level of Pb in his nails or hair. The results of the regression test showed that there was no effect of work and the results of measuring Pb levels in nails/hair because the sig value was 0.496 > p = 0.05 with R square: 0.017. The average levels of Pb in the nails and hair of workers working around the basement. Security were 0.849 ppm, engineers 4.87 ppm, cleaning service 7.17 ppm and parking guards 7.74 ppm. It is recommended to continue to rotate employee turnover times with shorter time for parking staff and use masks for cleaning services..

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