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Associations between Blood Lead Level and Blood Pressure among City Minibus Drivers in Purwokerto City, Indonesia

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Hypertension occurence is increasing in Indonesia. In 2009, the prevalence was 21%. Exposure to lead is well documented as the important risk factor related to the occurence of the disease. In indonesia, leaded gasoline is still being used, and no prohibition was made by the authorities. This lead to increase the risk of people who are exposed to lead pollution in the air to suffer from hypertension, including city minibus drivers. Minibus is used to mass transport in Purwokerto city, Indonesia. This research aimed to examine the association between blood lead level and blood pressure among city minibus drivers in Purwokerto City, Indonesia. The research was observational, cross-sectional study. The respondents were city minibus drivers in Purwokerto city that were not have a history of essensial hypertention in their family and have been work as minibus driver for at least one year. Blood pressure was measured using Hg sphygmomanometer and blood lead level was measured using AAS. Among 300 city minibus drivers, only 54 agreed to be recruited as respondents. Pearson's correlation was used to analyse the data. The result showed that all respondent have blood lead level >20 µg/dL and the mean of blood lead level was high, 49.99 µg/dL, whereas the mean of systole and dyastole blood pressure were 126,67 mmHg and 86,11 mmHg respectively. Hypertension prevalence was 338,89%. Pearson correlation analysis showed that blood lead level has no significant association with both systolic blood pressure (R=0.114; p= 0.413) and diastolic blood pressure (R=0,252; p=0.066). No significant association between blood lead level and hypertension (X^2=2,424, p=0,202, C=0,207).
Keywords: Blood lead level, blood pressure, hypertension

INTRODUCTION

Hypertension is the main cause of cardiovascular diseases. In Indonesia, cardiovascular diseases account for 26,3% dan ranked number two as the cause of death (Glenn *et al.*, 2001; Departemen Kesehatan RI, 2007).

Hypertension is a multifactorial condition, these are genetic and environmental factors. Approximately 30% hypertension cases are related to genetic factor (Glenn *et al.*, 2001). However, Sohaila *et al.* (2006) said that 90% hypertension cases are idiopathic, although it has been well understood that environmental factor has an important role in the occurence of hypertension. One environmental factor that is a risk factor for hypertension is toxic metal (Glenn *et al.*, 2001).

Exposure to toxic metal that is considered to be related to increased blood pressure and hypertension occurence is exposure to lead or plumbum (Pb). Lead exposure remains one of the most important problems in terms of prevalence of exposure and public health impact (Hu *et al.*, 2007).

Most people are exposed to Pb because there are many Pb resourses in the environment. According to *Agency for Toxic Substances and Disease Registry* (ATSDR), the United States of America, one important Pb source in the developing countries is leaded gasoline (ATSDR, 2001). As such, transportation workers, including city minibus drivers are prone to exposed to Pb. This will increasing the risk of hypertension occurence.

WHO established that normal blood lead level for adult is 5-20 µg/dL. However, some research established that low level Pb exposure could increse blood pressure and causes hypertension. Some researches showed that lead blood level between 5 µg/dL to 10 µg/dL results in increased blood pressure and hypertension (Lee *et al*., 2001; Patrick, 2006; Nawrot *et al*., 2002; Chuang *et al*, 2004).

Considering the magnitude of Pb exposure and the high risk of hypertension occurence among city minibus drivers, this research was conducted to examine the the association between lead exposure and blood pressure among city minibus drivers in Purwokerto City, Indonesia.

MATERIAL AND METHODS

Materials needed for blood lead level examination are 7 ml venous blood, disposable syring 10 mL, vaccuettes 10 mL, torniquet, centrufuge, AAS and $PbSO_4$ solution with 2 ppm, 5 ppm, 9 ppm and 15 ppm. Materials needed to measure blood pressure are calibrated sphygmomanometer and stethoscope.

This research was an observational, cross sectional study. Reseach population was 300 city minibus drivers in Purwokerto City. Reseach sample was all city minibus drivers volunteer in Purwokerto City that is agree to be recruited as research respondent. The inclusion criteria for sample are men, has a good nutritional status based on body mass index measurement, do not have essensial hypertention history in their family, have been work as minibus driver for at least one year and agree to be recruited as research respondent with signing the informed consent.

The independent variable was blood lead level and the dependent variable was blood pressure and hypertension, consist of systolic and diastolic blood pressure. The mean of 3 systolic and diastolic blood pressure measurements with 5 minutes interval were collected, all of which were taken by a physician. Respondents were categorized as hypertensive if the systolic blood pressure is ≥140 mmHg and the diastolic blood pressure is ≥90 mmHg. Blood lead level is lead level in the whole blood in µg/dL scale, measured with AAS method (Nash *et al*., 2003; Glenn *et al*., 2001).

Blood samples were obtained by venipuncture. Sampling was done under the supervision of trained medical staff. Care was taken to avoid haemolysis of blood samples, disposable syringes were used and slow transfer to a 10 ml vacuettes Before taking the sample, all respondent were asked to sign informed consent. Minimum time was taken for transport of sample whereas storage was mostly avoided and when required the samples were refrigerated at −4 °C prior to analysis. Almost all samples were analyzed within 8 h after collection. Blood lead concentration was measured by Atomic Absorption Spectrophotometry (AAS) at the Research Laboratory, Jenderal Soedirman University. The assay detection limit was 1.0 µg/dL. Each sample analysis was performed in duplicate, and the mean of both measurements was used in these analyses. All blood lead levels less than 1.0 µg/dL were assigned a value of 0.5 µg/dL (Hu *et al*., 2001).

Detailed information on the volunteers was recorded in the designed questionnaire for this study. Questionnaires are usually used to gather data on health and other factors to ensure that respondent was meet the inclusion and exclusion criteria.

Data were analyse using a computerised statistic program. Univeariate analysis was used to analyse the frequency distribution of research data. In bivariate analysis, Pearson's correlation was used to analyse the association between blood lead level and blood pressure (systolic and diastolic blood pressure). The Chi-square test and contingency coeffisien were used to analyse the association between blood lead level and hypertension occurence. Blood lead level was classified as normal (≤20 µg/dL), high (≥20-40 µg/dL) and very high (>40 µg/dL).

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RESULTS

At the end of research period, 54 volunteers of city minibus drivers were participated on the reseach. All respondent have abnormal or high blood lead level. The minimum blood lead level was 22,18 µg/dL, whereas the maximum blood lead level was 64,51 µg/dL. Mean blood lead level was 45,99 µg/dL, twofold of normal blood level recomended by the WHO. Detail data regarding frequency distribution of blood lead level can be seen in Table 1.

Table 1. Blood lead level among city minibus drivers in Purwokerto

NO.	BLOOD LEAD LEVEL	VALUE
1	Minimum	22,18
2	Maximum	64,51
3	Mean	45,99
4	Median	45,94
5	Standard deviation	10,43

Results of blood pressure measurement are summarized in Table 2. Most respondents have a normal systolic and diastolic blood pressure. The means of both systolic and diastolic blood pressure are still normal. Mean systolic blood pressure was 126,67, whereas mean diastolic blood pressure was 86,11. Pearson's correlation analysis showed that there were no significant association between blood lead level and both systolic and diastolic blood pressure, with R=0.114; p=0.413 and R=0.252, p=0.066, respectively.

Table 2. Blood pressure among city minibus drivers in Purwokerto

NO.	DATA DISTRIBUTION	BLOOD PRESSURE (mmHg)	
		SYSTOLIC	DIASTOLIC
1	Minimum	100	70
2	Maximum	170	120
3	Mean	126,67	86,11
4	Median	120	80
5	Standard deviation	15,54	12,80

The occurenc of hypertension among city minibus drivers in Purwokerto is presented in Table 3. The prevalence of hypertension was 38,89%, higher than that of Indonesian population. However, if compared with data regarding blood lead level where all respondent have high blood lead level, this prevalence is relatively low. Only 38,89% respondents are suffer from hypertension. Hypertension prevalence were higher among those with very high blood lead level. However, statistically there is no signoficant association between blood lead level and hypertension occurence among city minibus drivers in Purwokerto City. The association is very low (X^2=2.424, p=0.202, C=0,207).

Table 3. Hypertension prevalence among city minibus drivers in Purwokerto

NO.	BLOOD LEAD LEVEL	HYPERTENSION		TOTAL
		YES	NO	
1	High	3 (21,42%)	11 (78,58%)	14 (25,93%)
2	Very high	18 (45,00%)	22 (55,00%)	40 (74,07%)
	Total	21 (38,89%)	33(61,11%)	54 (100,00%)

DISCUSSION

This research showed that no significant association between blood lead level and blood pressure. The result also showed that no significant association was found between blood lead level and hypertension. High blood pressure is a multifactorial condition involving both genetic and environmental factors. Family and twin studies indicate that as much as 30 percent of hypertension, a disease defined by high blood pressure, is due to genetic causes. Rare forms of genetic hypertension have different molecular etiologies but a common pathophysiology mediated by abnormal sodium metabolism. Environmental risks for high blood pressure include dietary factors, cigarette smoking, and high alcohol intake, and possibly exposure to toxic metals such as lead (Glenn *et al.*, 2001).

Several epidemiologic studies have suggested a relation between exposure to lead, particularly at blood concentrations less than 40 µg/dl, and small increases in blood pressure, but other studies have failed to find a relation (Chuang *et al*, 2004; Glenn *et al.*, 2001; Lee *et al.*, 2001; Navas-Acien *et al.*, 2007; Patrick, 2006; Nawrot *et al.*, 2002). The conflicting results among studies may be attributed to demographic differences between the populations studied, variation in genetic susceptibility, and limitations of the measures used to define lead exposure (Glenn *et al.*, 2001).

Although statistical analysis revealed that there was no significant associations between blood lead level and blood pressure, this study showed that individu with higher blood lead level tends to have higher blood pressure and the prevalence of hypertension also higher among those with very high blood lead level. However, in this study data about genetic susceptibility and demographic differences in the study population were not measured.

Some studies concluded that genetic susceptibility is an important factor for lead exposure effect on blood pressure and hypertension (Olanaja and Claudio, 2000). According to Vupputuri *et al.* (2003), differences in genetic factor causes black people is more susceptible to the effect of lead exposure than white people. The main genetic factor affected the increased of blood pressure is gene polymorphism. Polymorphism of δ-ALAD gene resukted in differences in lead exposure susceptibility, as 80% blood lead are bind to δ-ALAD (Barbosa Jr. *et al.*, 2005; Lee *et al.*, 2001; Glenn *et al.* (2001). People with δ-ALAD-2 are more susceptible to lead exposure, because δ-ALAD-2 produces protein that is binding Pb more thigh than δ-ALAD-1 (Kelada *et al.*, 2001).

Patient demographic, including age and chronic disease are other important factor that should be examine in the later research. People with occult kidney disfunction, for example, will experience disturbances in lead elimination from the body and usually have higher impact on blood pressure.

In conclusion, although this reseach established that there is no significant association between blood lead level and both blod pressure and hypertension, there is an evidence that people with very high blood lead level tends to have higher blood pressure and hypertension prevalence. As such, workers exposed to lead should be given more attention to monitor the effect of lead on their lead, especially their blood pressure (Oktem *et al.*, 2004).

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