An Overview of the Gingival Lead Line in Traffic Officers of Surabaya Capital City Police

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Abstract: Lead exposure in the air comes from the emissions of vehicles, which can damage human health. Exposure to lead will affect the brain, kidneys, and blood. The presence of lead in the body can be seen through a bluish pigmentation in the oral mucosa or gingival lead line. Traffic officers have a high risk of lead exposure which has been demonstrated by the result of previous studies where 96.67% of traffic officers had a gingival lead line. This study aimed to determine the gingival lead line in traffic officers in Surabaya Capital City Police. This study was an descriptive observational study with a cross-sectional approach. The samples in this study were 98 traffic officers, and it used a simple random sampling technique. Data was collected by conducting interviews, intraoral examination, and laboratory tests. All obtained data was analyzed using cross-tabulation and odd ratio measurement with the SPSS program. Gingival lead lines were classified into two categories, i.e. moderate and poor. A moderate gingival lead line was found in 38 respondents, and the remaining 60 were classified as a poor gingival lead line. The results of measurement of the odd ratio (OR) between the gingival lead line and smoking habit, as well as gingival lead line and blood lead level were 3.436 and 1.018, respectively. This showed that a smoking habit and blood lead level were risk factors for a gingival lead line. A gingival lead line was found more in traffic officers who smoked and had excessive blood lead levels.

1 INTRODUCTION

Lead is a heavy metal which may harm human health. The majority of the lead contained in the air is sourced from motor vehicle exhaust fumes (Hasan, 2012). Previous studies found that the lead concentration at Kertajaya street, Surabaya, was 1.621 µg/m3. This shows that lead concentration in the air of Surabaya has exceeded the permissible limit set by the World Health Organization (WHO) of 0.5 µg/m3 (Wahyudi, 2004). According to the Asian Environmental Compliance and Enforcement Network (AECEN), Surabaya is the third most polluted city in Asia following Bangkok and Jakarta (BLH Surabaya, 2009).

Based on the Centers for Disease Control and Prevention (CDC), the limit of blood lead level normally is less than 10 µg/dl, and if the concentration exceeds the limit, it will lead to health problems (CDC, 2014). Health impacts from inhaled lead on the body are chronic. They include symptoms such as dizziness, anorexia, nausea, anemia, motoric impairment, and in poor conditions may cause convulsion, coma, encephalopathy, and renal failure (Anand, 2009).

The impact of lead exposure from air may harm workers, particularly those who work in the street such as drivers of public transportation, street vendors, and traffic police (Pratiwi, 2012). Traffic officers have greater risk of lead exposure than other workers due to the intensity and frequency of vehicles that emit lead being very high, particularly at certain times of high vehicle traffic (Tomei *et al*., 2008).[7] In previous studies, traffic officers who worked at police stations still had a greater risk of lead exposure than police at temporary street police stations (Indonesian: pos pantau) and administrative officers (Setiawan, 2005).

Typical oral manifestation of lead exposure is in the form of a gingival lead line. A gingival lead line may be used as an indicator of lead exposure in humans. It is described as a bluish line in the marginal gingiva due to reactions between sulphur

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ions and circulating lead that produces lead sulphide in the marginal gingiva (De Long and Burkhart, 2007; Stewart and Selesnick, 2011; Khalil, 2009). In previous studies of traffic officers in Semarang, it was found that 29 in 30 people had a gingival lead line (Permatadewi, 2009). Nevertheless, another study of Japanese lead worker found that blood lead level was not associated with a gingival lead line (Araki *et al.,* 2012). Because there are inconsistent results between these studies, further study is necessary to investigate the gingival lead line in traffic officers of Surabaya Capital City Police.

2 MATERIALS AND METHODS

This was a descriptive observational study with a cross-sectional study design. Study samples involving traffic officers of Surabaya Capital City Police met the inclusion criteria. The sample size used in the study was determined by a simple random sampling technique.

Inclusion criteria were the criteria that met the requirements; they were a) more than 1 year of service, b) physically and mentally healthy, c) willing to undergo blood sampling in order to find out their blood lead level, and d) willingness to undergo oral examination and be interviewed about their age, years of service, position, smoking habit, as well as personal protective equipment. Exclusion criteria were the criteria that did not meet the requirements.

The study data collection used three methods including interview, intraoral examination, and laboratory testing. Interviews were performed in accordance with established interview guidelines to obtain some information such as respondents' identity, smoking habit, and personal protective equipment (PPE) used during service.

The intraoral examination was aimed to find out which region of teeth in the maxillary and mandibular anterior had bluish pigmentation on the marginal gingiva. A gingiva lead line was considered as moderate if pigmentation was found in less than three regions of the tooth, and poor if more than three regions of the tooth.

The laboratory test used the Atomic Absorption Spectrophotometry (AAS) method, performed at Balai Besar Laboratorium Kesehatan Surabaya to monitor the blood lead level of the traffic police. The result of the test was classified according to the limit of the normal blood lead level set by the CDC as <10µg/dl.

Data obtained was analyzed using cross-tabulation, chi-square, and odd ratio between gingival lead.

3 RESULTS

The study results showed an overview of the incidence of gingival lead line in traffic officers of Surabaya Capital City Police and involved 98 respondents. Respondent characteristics obtained in this study such as sex, position, age, years of service, and blood lead level can be seen in Table 1.

Table 1. Respondent Characteristics.

Variable	Mean ± SD	Range	%
Age	37.47 ± 9.74	25 - 64	
Years of service	15.75 ± 8.79	2 - 40	
Blood lead level (µg/dl)	14.67 ± 11.2	0–51.49	
Gingival Lead Line	4.11 ± 3.4	0 - 12	
Sex			
Male			85.7
Female			14.3
Position			
Officer on road			50
Staff			50
The use of PPE			
Complete			19.4
Incomplete			80.6

The study results demonstrate that the gingival lead lines found in 38 respondents were classified as moderate, while 60 respondents were classified as poor.

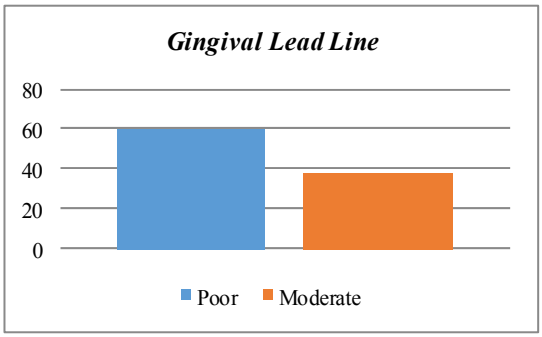

Figure 1. Bar chart of gingival lead line distribution.

The results of the laboratory test were that 41 respondents had a blood lead level of less than 10µg/dl, while the remaining 57 exceeded the limit

of normal blood lead level set by the CDC. From the interview session, we found that 46 respondents were smokers, while the remaining 52 were non-smokers.

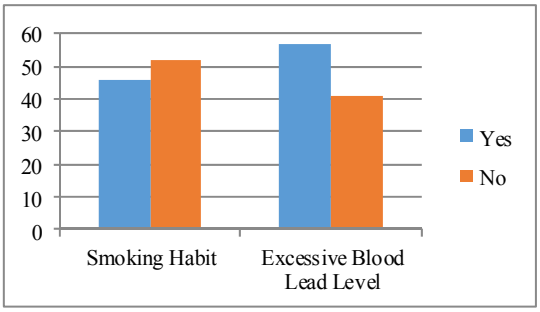

Figure 2. Bar Chart of distribution of interview results

Smoking habit and blood lead level data were compared with the presence of a gingival lead line found in respondents using cross-tabulation (Table 2). In the smoker group, more respondents with both excessive and normal blood lead levels had a poor gingival lead line, and only a few respondents in the non-smoker group had a poor gingival lead line.

Table 2. Distribution of gingival lead line with regard to causative risk factors

		Gingival Lead Line	
		Moderate	Poor
Smoking	Yes	11 (23.9%)	35 (76.1%)
	No	27 (51.9%)	25 (48.1%)
Excessive blood lead level	Yes	22 (38.6%)	35 (61.4%)
	No	16 (39.0%)	25 (61.0%)

The result of the Chi-square test between gingival lead line and smoking habit exhibited a significant result ($p<0.05$), but we found an insignificant result of the Chi-square test between gingival lead line and blood lead level ($p<0.05$). Measurement of the odd ratio for both factors found a significant result (value > 1). This indicated that both factors were risk factors for the formation of a gingival lead line.

Table 3 shows that a poor gingival lead line was mostly found in respondents with an excessive blood lead level and smoking habit. Poor gingival lead lines were least found in those with an excessive blood lead level but who were non-smokers.

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Table 3. Distribution of gingival lead line according to blood lead level associated with a smoking habit.

Excessive blood lead level	Smoking	*Gingival Lead Line*	
		Moderate	Poor
No	No	11 (45,8%)	13 (54,2%)
	Yes	5 (29,4%)	12 (70,6%)
Yes	No	16 (57,1%)	12 (42,9%)
	Yes	6 (20,7%)	23 (79,3%)

4 DISCUSSION

A gingival lead line is an indicator that lead has entered the human body. This is caused by a reaction between circulating lead and sulphur ions released by oral bacteria; therefore, if there is no lead in the body, no gingival lead line will be formed. It presents as a bluish line alongside the marginal gingiva located at the anterior teeth (De Long and Burkhart, 2007; Stewart and Selesnick, 2011; Khalil, 2009).

The result of blood tests showed that the majority of traffic officers of Surabaya Capital City Police have a blood lead level that exceeds the cut-off point set by the CDC. This indicates that traffic officers have a high risk of lead exposure in which high levels may cause health problems (Anand, 2009; Pratiwi, 2012). Excessive blood lead levels in traffic officers may be caused by incomplete PPE use during service. Using complete PPE may reduce the impact of exposure to any substances in the work area. Lead in the air may enter the body through inhalation and skin contact; thus, using a mask, fully covered uniform, eye protectors, head protectors and gloves may reduce contact with lead (Fortoul *et al*., 2009; Aw *et al*. 2007).

From the blood lead level obtained in the study, we did not find any significant difference between those with excessive and normal levels. This is not in accordance with the theory that a gingival lead line is found in people with blood lead levels of more than 50µg/dl. In this study, a gingival lead line could be found in traffic officers with blood lead levels of less than 50µg/dl (Bope, 2013). The discrepancy between the study result and theory may be due to the pigmentation appearing on police's gingiva being caused by high temperature during smoking, therefore stimulating melanin formation (Greenberg, 2008). In addition, gingival lead line formation is influenced by the condition of the oral cavity such as oral hygiene and gingiva. The condition of the oral cavity is considered to

influence the formation of a gingival lead line because sulphur ions that react with circulating lead are released from oral bacteria, particularly periodontal bacteria (Putri, 2010; Izaini, 2010).

There was a big difference regarding the number of respondents with a poor gingival lead line between the smoker and non-smoker groups. Statistical tests revealed a significant difference of the smoking factor in regard to gingival lead line formation. This may be attributed to the fact that smoking can act as a transfer process for lead from the hands into the body via the mouth and may reduce the lungs' clearance mechanism of filtering inhaled lead. Circulating lead will react with sulphur ions on the gingiva and form a gingival lead line.20 Futhermore, smoking may increase pigmentation formation on gingiva (Greenberg, 2008).

According to the odd ratio, we found that smoking and excessive blood lead level are risk factors for gingival lead line formation. A poor gingival lead line was mostly found in traffic police who smoked and had excessive blood lead levels. Gingival lead line formation in the oral cavity is highly influenced by circulating lead; thus, excessive blood lead levels will further increase the likelihood of poor gingival lead line formation (Karita *et al*., 2005). Smoking may worsen the occurrence of a gingival lead line because it can trigger pigmentation on the gingiva. The underlying mechanism of pigmentation or staining on the gingiva remains unclear, but it is thought that chemical compounds in cigarettes are responsible. Moreover, pigmentation is likely caused by high temperature of the inhaled smoke that increases melanin production.

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