Coal Dust Exposure and Gingivial Lead Line in Coal Miners

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Abstract

Coal dust contains less than 1% lead (Pb). This dust can enter the body through breathing, mouth and skin. Lead contained in coal dust can react with Sulfur and form gingivial leadline. The study was an observational study with cross-sectional design. The research subjects were coal miners in Sambung Makmur Sub-District, Banjar District, amounting to 100 people. The number of samples was calculated by the Slovin formula and obtained 80 people as samples and determined by simple random sampling technique. The sample obtained then determined the value of the gingivial lead line score as done by Sudibyo. The degree of gingivial lead line is assessed based on the score as follows: 0 = no gingivial lead line; 1 = gingivial lead line found in 1-2 marginal gingival anterior teeth labial surface; 2 = gingivial lead line found at 3-4 marginal gingival anterior teeth labial surface; 3 = gingivial lead line at>4 marginal gingival anterior teeth labial surface. In addition, age, working period (tenure), and smoking habits are the variables measured in this study. The data obtained were analyzed using the chi-square test with a = 5%. The conclusion is the incidence of gingivial leadline of coal miners was related to age, tenure, and smoking habits.

***Keywords**: gingivial leadline, lead, coal dust, coal miners*

Introduction

Kalimantan Selatan is one of the provinces in Indonesia which has the largest coal mining with locations spread throughout the region. One of the problems arising from mining is the issue of coal dust which can have an impact on health. This is due to the metal content found in coal dust, namely Fe 36.9%; Si 17.9%; Mo 15%; Al 10%; Ca 8.67%; S 4.7%; Ti 3.65%. Some heavy metal content of less than 1% includes K, V, Cr, Mn, Ni, Cu, and Pb.[1]

Coal dust containing metals can enter the body through breathing, mouth and skin. Furthermore, metals contained in coal dust, especially Lead and Sulfur will accumulate in gum tissue through systemic and local processes, namely direct absorption by the oral mucosa. Lead and Sulfur produce lead sulfate which is deposited in the basement membrane of gum.[2] These deposits provide a picture of the lead line in the gums. Various factors that are thought to influence the occurrence of gingivial lead line, such as working period, age, use of personal protective equipment (PPE), smoking habits, etc.[3]

The working period (tenure) affects the incidence of gingivial lead line, because the working period shows the length of time someone is exposed to coal dust. The longer the exposure time, the incidence of gingivial lead line will bemore severe . Likewise, increasing age causes the detoxification rate to slow down, resulting in a buildup of lead from coal dust. This incident gingivial lead line will be more severe.[4]

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Previous research has revealed that the working period has a relationship with the incidence of gingivial lead line in traffic police.[4] Other studies have also revealed that the workshop workershave a risk of gingiviallead line, because every day they are exposed to fumes that contain lead.[5] Coal miners are a group at risk of developing gingivial lead lines. This is due to his daily exposure to coal dust containing lead and sulfur.However, not many studies have revealed this. Therefore in this study we will examine the relationship of working period, age, and smoking habits to the incidence of gingivial lead line of coal miners.

Materials and Method

The study was an observational study with cross-sectional design. The research subjects were coal miners in Sambung Makmur Sub-District, Banjar District, amounting to 100 people. The number of samples was calculated by the Slovin formula and obtained 80 people as samples and determined by simple random sampling technique.

The sample obtained is then determined by the value of the gingivial lead line score as done by Sudibyo.[6] The degree of gingivial lead line is assessed based on the score as follows:

0 = no gingivial lead line

1 = gingivial lead line found in 1-2 marginal gingival anterior teeth labial surface

2 = gingivial lead line found in 3-4 marginal gingival anterior teeth labial surface

3 = gingivial lead line at>4 marginal gingival anterior teeth labial surface

In addition, age, working period, and smoking habits are the variables measured in this study.The data obtained were analyzed using the chi-square test with a = 5%.

Findings and Discussion

This study involve 80 male who were willing to be sample in the study. The lowest age is 19 years and the highest is 45 years. The existence of gingivial lead line can be seen in Figure 1.

Figure 1. Normal gum looks reddish (a) and gingivial lead line (b)

Gingivial leadline, also called Burtons's Line, is a pigment in the form of gray-blue lines at the border between teeth and gums.[7,8] Leadline occurs due to a reaction between lead and sulfur ions released by the bacterial oral cavity, leading to lead sulfid at the tooth and gingivial surface.[8]

Relationship between age and gingival lead line

The relationship between age and the gingival lead line is presented in table 1. Gingivial lead line is found in>4 marginal gingival anterior teeth labial surfaces. It is found more at the age of 30-45 years.

Table 1. Relationship of Age with Gingivial Lead Line

Age (years)	Gingivial Lead Line Score			
	0	1	2	3
15-30	15%	23.75%	7.5%	6.25%
30-45	7.5%	8.75%	15%	16.25%

Based on the results of the chi-square test obtained p = 0.005 (p <0.05), it was concluded that age wasassociated with the incidence of gingivial lead lines in coal miners. The relationship between age and gingivial lead line caused by in the young age more sensitive to lead activity. It is closely related to organ development and function are not perfect. In the old age the sensitivity is higher, this is caused by the activity of the biotransformase enzyme decreases with increasing age and the resistance of certain organs decreases to the effectsof coal dust containing lead. The older the person, the higher the amount of lead accumulated in the body tissues.

On the other hand, the activity metaloprotein (metal-binding protein) in the oral cavity will slowlydecreasethe activity. This causes lead contained in coal dust can not be transported optimally by metalloproteins. As a result, lead reacts with sulfur in the oral cavity and leadline is formed. The results of this study are in accordance with the study by Vera[9], which states that the age of street vendors in the city of Semarang affects the incidence of gingivial leadline.

Relationship between working period and gingiviallead line

Working period of more than 12 months caused 16% of the study subjects have gingivial lead line at>4 marginal gingival anterior teeth labial surface. The relationship between the working period and the gingivial lead line is presented in table 2.

Table 2. Relationship between Tenure and Gingivial Lead Line.

Working period (month)	Gingivial Lead Line Score			
	0	1	2	3
<3	12.5%	3.75%	1.25%	1.25%
3-6	5%	7.5%	1.25%	1.25%
6-9 9-12 >12	1.25% 2.5% 1.25%	6.0% 2.5% 13.5%	6.25% 1.25% 12.5%	1.25% 2.5% 16.25%

Based on the results of the chi-square test obtained p = 0.000 (p <0.05), it was concluded that the working period of coal miners was related to the incidence of gingivial lead line. The working period shows the length of exposure to coal dust containing lead. Lead as the cause of many lead lines accumulates in gum tissue through systemic processes or local processes, namely direct absorption by the oral mucosa. This lead will only form a lead line after reacting with sulfur ions produced by anaerobic bacteria in the oral cavity.[10] The results of

the reaction are lead sulfate compounds which are then deposited on the gum basement membrane. These deposits provide a picture of the lead line in the gums. Thus, it can be concluded that indirectly the Oral Hygiene Index (OHI) and Gingivitis Index (GI) are important factors that determine the quality of lead line formation because these two factors are closely related to the presence of bacteria in the oral cavity.[11]

Relationship between smoking habit and gingivial lead line

In table 3, the relationship between smoking habits and the incidence of gingivial lead line is presented.

Table 3. Relationship between Smoking Habit and Gingivial Lead Line

Smoking habit	Gingivial Lead Line Score			
	0	1	2	3
Not a smoker	7.5%	10.0%	7.5%	1.25%
Smoker	15.0%	22.5%	15.0%	21.25%

Based on the results of the chi-square test obtained $p = 0.158$ ($p < 0.05$), it was concluded that the smokinghabits of coal miners were not related to the incidence of gingivial lead lines. The standard of cigarettes taken from tobacco, in the handling process often uses pesticides which also contain basic ingredients of lead (Pb).[12] Thus, research subjects who had a smoking habit of Pb levels increased the amount of Pb exposure both from the contents of the cigarette and from coal dust were also sucked. This can worsen the incidence of gingivial leadline.

Conclusion

The results of this study concluded that the incidence of gingivial leadline in coal miners was significantly related with age, working, and smoking habits. Thus, a comprehensive effort is needed to improve dental and oral health.

Ethical Clearance: This research has gone ethical feasibility testing by the Ethical Research Commission of the Faculty of Dentistry, University of Lambung Mangkurat and declared as ethical: no. 28 / KEPKG-FKGULM / EC / IX / 2017.

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Conflict of Interest: The authors declare that they have no conflict interests.

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