Comparison of Carboxyhemoglobin (COHb) Levels in the Blood of Active and Passive Smokers in Bulupitu Bus Terminal Workers, Banyumas Regency

Noviani Nur Hayati[1], Kurnia Ritma Dhanti*[2], Retno Sulistiyowati[3], Tantri Analisawati Sudarsono[4]
[1-4] Department of Medical Laboratory Technology, Faculty of Health Science, Univesitas Muhammadiyah Purwokerto, Indonesia
Jl. Raya Dukuh Waluh-Purwokerto Telp. 0281-636751
*Email: kurniard08@gmail.com

ABSTRACT

   Carbon monoxide (CO) is a colorless, tasteless, and odorless gas, but in high concentrations in the blood, it can cause death. One of the CO_2 can come from cigarette smoke. When cigarette smoke is inhaled, the affinity of CO with the blood is stronger than for oxygen, and this will increase the carboxyhemoglobin (COHb) in the blood. Passive smokers who are often near active smokers will inhale cigarette smoke. This study aims to compare COHb levels in the blood of active and passive smokers of Bulupitu terminal workers, Banyumas Regency. This was an analytical observational study with six active and six passive smokers who are terminal workers. All active and passive smokers samples had COHb concentrations above the normal COHb threshold of 3.5%. The measurement results showed the average COHb level of smokers was 5.87%. Determining differences in COHb levels in the blood of active and passive smokers was conducted using the Independent Test (p-value = 0.370). This value shows no significant difference in blood COHb levels in active and passive smokers.

INTRODUCTION

Cigarettes are a type of tobacco product with or using additives. Smoking is a habit that is difficult to stop and can harm the smoker and those around him. An active smoker is someone who smokes and directly inhales cigarette smoke, while a passive smoker is someone who does not smoke but inhales secondhand smoke from other people. Smoking habits are bad for health, especially for the respiratory system. Smoking causes various lung diseases, including Chronic Obstructive Pulmonary Disease (COPD) and lung cancer. The World Health Organization (WHO) (2019) states that lung diseases such as cancer, chronic respiratory disease, and tuberculosis kill more than 40% of smokers worldwide. Based on WHO data (2019), more than 8,000,000 deaths result from direct tobacco use, while around 1,200,000 deaths are experienced by passive smokers.

Smoking is a growing problem in Indonesia and it is difficult to find a solution. According to WHO, Indonesia is the country with the third highest number of smokers in the world, after China and India. Indonesia occupies the first position in Southeast Asia with the number of smokers reaching 62,800,000 smokers (Binita *et al.*, 2016). Every smoker produces smoke that contains various harmful chemicals. One of the chemicals in cigarettes

is carbon monoxide, which can cause hemoglobin desaturation and a decrease in oxygen levels in the tissues that will be distributed throughout the body, including the heart muscle. Carbon monoxide in cigarette smoke is produced by the incomplete combustion of carbon compounds. When carbon monoxide (CO) is inhaled and enters the body in excess, it will inhibit the ability of hemoglobin to bind to oxygen. This is because carbon monoxide has a higher affinity for binding to hemoglobin than oxygen. Inhaled cigarette smoke can increase carbon monoxide levels in the blood (Arifin & Yunasri, 2021).

According to Kumar (2010), smoking causes damage to almost all organs of the body. When cigarette smoke is inhaled, carbon monoxide is absorbed through the lungs and enters the bloodstream. CO will bind to hemoglobin to form carboxyhemoglobin (COHb) which serves as a marker of cigarette smoke absorption. Carbon monoxide will be in the blood for 24 hours after inhaling cigarette smoke, depending on several factors such as physical activity, respiratory rate, and gender.

Bulupitu bus terminal is a type A terminal and the largest terminal in the Banyumas Regency area. Many vehicles and public transportation in the form of buses gather at the terminal. Activities at the terminal last for 24 hours non-stop. Not only passengers, but there are also terminal workers such as bus drivers, terminal supervisors, terminal corps, transport drivers, bus agents, terminal administrators, and terminal traders. The terminal is one of the places that have the potential to generate concentrations of emissions from vehicles. Carbon monoxide is one of the most pollutant substances generated in the environment around the terminal (et al., 2012).

COHb contained in the body can reduce the blood's ability to carry oxygen (O_2) to the body's tissues, resulting in a reduced supply of O_2 to the cells and tissues of the body. High levels of COHb in the blood can cause health problems (Hilyah et al., 2021).

METHOD

This research is an analytic observational type with a cross-sectional research design. The population in this study were active and passive smokers at Bulupitu Terminal, Banyumas Regency. The sample in this study was 12 people consisting of 6 active smokers and 6 passive smokers of Bulupitu terminal workers, Banyumas Regency. Sampling was done by purposive sampling method. The independent variables were active and passive smokers in Bulupitu terminal workers and the dependent variable was the level of COHb in the blood. The type of data is primary data with COHb levels in the blood of the research subjects and the results of the respondent's questionnaire. Subject characteristics were analyzed by univariate test. Processing and analysis of the data used are the Independent Tests, namely to determine the significance between variables.

RESULT AND DISCUSSION

This study aims to determine the comparison of carboxyhemoglobin (COHb) levels in the blood of active smokers and passive smokers of Bulupitu terminal workers, Banyumas Regency. Based on predetermined inclusion criteria with a sample of 12 respondents divided into 6 active smokers and 6 passive smokers. Respondents filled out a research-informed consent sheet to participate in the study and filled out a questionnaire that served as proof of participation in the research and as a source of information on supporting data or data on the characteristics of the respondents. After that, blood was taken and immediately examined for COHb levels with a qualitative test and a quantitative test using a UV-Vis

spectrophotometer at a wavelength of 546 nm. After obtaining the results, the data was tested by the Independent Test.

This study used primary data in the form of questionnaires and COHb levels in the blood of research respondents. Active smokers and passive smokers of Bulupitu terminal workers in Banyumas Regency have the same working hours, namely eight hours per day so all sample respondents have the same length of work.

Table 1. Characteristics of Respondents (Age)

Characteristics of subjects	Frequency	Min	Max	Mean	SD
Age (years old)	12	26	57	36,92	10,031

Based on the results of the study in Table 1, the average age of active and passive smokers at Bulupitu terminal workers in Banyumas Regency is 36.92 years. The youngest active and passive smoking age of Bulupitu terminal workers in Banyumas Regency is 26 years old and the oldest is 57 years old. The age range of the research respondents was 26 to 57 years. This age range is included in the productive age category According to (Kementerian Kesehatan Republik Indonesia, 2016), The productive age category in Indonesia ranges from 15-64 years old. The characteristics of the respondents in this study were identified through interviews in the active smoker group and the passive smoker group in Bulupitu Terminal, Banyumas Regency.

Table 2. Characteristics of Respondents

Variables	Frequency	Percentage (%)
Group of respondents		
a. Active smoker	6	50
b. Passive smoke	6	50
Smoking duration		
a. <5 years	0	0
b. 5-10 years	0	0
c. >11 years	6	50
The number of cigarettes/day	0	0
a. 1-5 cigarettes	0	0
b. 6-12 cigarettes	6	50
c. >12 cigarettes		
Mask at work		
a. Yes	5	58,3
b. No	7	41,7

The criteria for the duration of cigarette consumption in this study were divided into four categories, each category was calculated based on how long they had smoked. Based on Table 2, the duration of smoking in the 6 research respondents was > 11 years with a total consumption of > 12 cigarettes per day, and 6 respondents were passive smokers.

According to Benowitz (2010), nicotine causes addiction and dependence, and smokers usually increase or increase the number of cigarettes smoked every day. Smoking has become a habit and a necessity, nicotine can make it difficult for smokers to stop smoking.

In addition, nicotine can make it difficult for smokers to quit. As a result, smokers will continue to smoke for years.

Based on Table 2 on the use of masks by research respondents, the majority of respondents, namely 7 respondents (58.3%), wore masks at work, and 5 respondents (41.7%) did not wear masks. Active smokers and passive smokers of Bulupitu terminal workers choose not to wear masks as personal protective equipment (PPE) because they feel uncomfortable wearing masks in work and active smokers' environments.

Table 3. COHb Levels

Parameter	Mean (SD) (%)	Median (Min; Max) (%)	Modus
COHb Levels	5,879 (0,9575)	6,100 (4,0; 7,1)	6,5

Based on Table 3, the mean (SD) level of COHb in the blood of the study respondents was 5.879 (0.9575). The smallest COHb level is 4.0% while the largest COHb level is 7.1%. all respondents had COHb concentrations above the normal threshold set by the American Conference of Governmental Industrial Hygienists, namely <3.5%. This is due to the incomplete combustion of carbon compounds in cigarette smoke. A cigarette can produce up to 3-6% CO, while smokers can inhale CO as low as 400 ppm, which can increase blood COHb levels by 2-16%. Carbon monoxide inhaled by active smokers or passive smokers will enter the body through the respiratory tract. When CO gas is inhaled the blood's ability to bind O_2 will decrease because CO is more easily bound by blood than oxyhemoglobin (Hb O_2) so it can cause the formation of COHb. The less O_2 that is circulated throughout the body, the more COHb is formed (Setyo & Handriyono, 2021).

Table 4. COHb Levels Based on Respondent Groups

	Respondent Groups	Frequency	Mean	Std. Deviation	Std. Error Mean
COHb Levels	Active smokers	6	6,140	1,0538	0,4302
	Passive smokers	6	5,618	0,8621	0,3520

Based on Table 4, it is known that the average (SD) blood level of COHb in the active smoking group was 6.140 (1.0538)% while the average blood COHb level in the passive smoking group was 5.618 (0.8621)%. The average COHb level in the blood of active smokers is slightly higher than that of passive smokers with a difference of 0.522%.

Table 5. Independent Test

		Sig.	P Value	Mean Difference	CI 95%
COHb Levels	*Equal variances assumed*	0,647	0,370	0,5217	(-0,7168 – 1,7601)

Based on the statistical analysis in Table 5, the p-sig value was obtained. (2-tailed) of 0.370 (p>0.05), this value indicates that H0 is accepted, which means that there is no significant difference in blood COHb levels in active smokers and passive smokers of Bulupitu terminal workers, Banyumas Regency.

(Khairina, 2019) states that smokers' carboxyhemoglobin (COHb) levels are higher than non-smokers' COHb levels in motorbike repair mechanic workers. Passive smokers with high COHb levels can occur because passive smokers also get exposure to CO gas through cigarette smoke from active smokers. Carbon monoxide is a poisonous gas that is invisible, tasteless, odorless, and does not cause an irritant that cannot be felt by humans. Carbon monoxide has almost the same density as air, so it mixes easily with free air.

Cigarette smoke contains carbon monoxide, which enters the human body through inhalation, which then enters the alveoli and enters blood circulation. Carbon monoxide gas will move from the high-pressure alveoli to the blood vessels with lower pressure from the alveoli (Isnaini, 2013). Carbon monoxide has an affinity 240 times greater than oxygen for binding to hemoglobin. As a result, the ability of hemoglobin to bind oxygen is hampered. CO that has been bound to hemoglobin will form carboxyhemoglobin.

(Rohmah, 2019) stated that there was no significant difference in blood COHb levels between smokers and non-smokers in parking attendants. The surrounding environment affects how carbon monoxide gas spreads in the air. The absorption of carbon monoxide gas in the air is influenced by the surrounding environment. In addition, other factors such as temperature, humidity, and wind speed at these locations that were not studied can affect exposure to carbon monoxide gas (Kurniawati, Nurullita, 2017). Exposure to CO gas can also be caused by vehicle exhaust originating from heavy traffic activities such as the Bulupitu Terminal which is packed with vehicles. This study did not pay attention to these factors and was unable to control for the nutritional status and physical activity of the respondents, which could affect the respondents' COHb levels.

The living environment is one of the factors that can affect COHb levels in the blood. People who live in locations with high levels of CO are more likely to have COHb in their blood (Rahayu & Sudarmadji, 2013). COHb levels in the blood can increase in people who have lived for three years in locations with high levels of CO in the air (Wimpy & Harningsih, 2019).

The limitations of this study were not to review further the factors that can affect COHb levels such as physical activity, diet, length of time inhaling cigarette smoke, and measuring CO gas levels in the air at the study site.

CONCLUSION

Based on the results, it can be concluded that there is no significant difference (p = 0.370) in COHb levels in the blood of active smokers and passive smokers of Bulupitu terminal workers, Banyumas Regency.

REFERENCES

Arifin, D. T., & Yunasri, M. A. (2021). Pengaruh Perokok Aktif Diatas 5 Tahun Terhadap Kadar Hemoglobin Di Kecamatan Panyileukan Kota Bandung. *JIP (Jurnal Inovasi Penelitian)*, *2*(5), 1655–1660.

Fitriana, D., & Oginawati, K. (2012). Studi Paparan Gas Karbon Monoksida Dan Dampaknya Terhadap Pekerja Di Terminal Cicaheum Bandung Study of Carbon

Monoxide Gas Exposure and Its Effect To Workers in Cicaheum Terminal Bandung. *Jurnal Tehnik Lingkungan*, *18*(1), 21–29. https://doi.org/10.5614/jtl.2012.18.1.3

Hilyah, R. A., Lestari, F., & Mulqie, L. (2021). Hubungan Antara Kebiasaan Merokok Dengan Kadar Karbon Monoksida (CO) Perokok. *Jurnal Ilmiah Farmasi Farmasyifa*, *4*(1), 1–5. https://doi.org/10.29313/jiff.v4i1.6649

Isnaini, M. (2013). Pengaruh Kebiasaan Merokok Keluarga Di Dalam Rumah Terhadap Kejadian Ispa Pada Balita. *Skripsi*.

Kementerian Kesehatan Republik Indonesia. (2016). Profil Kesehatan Indonesia 2016. In *Profil Kesehatan Provinsi Bali*.

Khairina, M. (2019). The Description of CO Levels, COHb Levels, And Blood Pressure of Basement Workers X Shopping Centre, Malang. *Jurnal Kesehatan Lingkungan*, *11*(2), 150. https://doi.org/10.20473/jkl.v11i2.2019.150-157

Kurniawati, Nurullita, M. (2017). Indikator Pencemaran Udara Berdasarkan Jumlah Kendaraan Dan Kondisi Iklim (Studi di Wilayah Terminal Mangkang dan Terminal Penggaron Semarang). *Kesehatan Masyarakat*, *12*(2), 19–24.

Rohmah, S. N. (2019). Correlation study of Carbon Monoxide (CO) air exposure level with blood COHb level of Basement Officer in Surabaya Mall. *Jurnal Kesehatan Lingkungan*, *11*(3), 225. https://doi.org/10.20473/jkl.v11i3.2019.225-233

Setyo, G. A., & Handriyono, R. E. (2021). Analisis Penyebaran Gas Karbon Monoksida (Co) Dari Sumber Transportasi Di Jalan Tunjungan Surabaya. *Prosiding Seminar Nasional Sains Dan Teknologi Terapan*, *9*(1), 360–369.

Wimpy, W., & Harningsih, T. (2019). Korelasi Kadar Karboksihemoglobin terhadap Tekanan Darah Penduduk di Sekitar Terminal Bus Tirtonadi Surakarta. *Alchemy*, *7*(2), 53. https://doi.org/10.18860/al.v7i2.7772