KEMAS 18 (2) (2022) 283-288

Jurnal Kesehatan Masyarakat

http://journal.unnes.ac.id/nju/index.php/kemas

Working Period and CO Exposure Relationship with Changes Levels COHb of Bus Station Officer

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Article Info

Article History:
Submitted March 2022
Accepted August 2022
Published November 2022

Keywords:
Carbon monoxide, COHb, traffic safety officer

DOI
https://doi.org/ 10.15294/ kemas.v18i2.35568

Abstract

Carbon monoxide inhaled into the lungs will enter the blood circulation and inhibit the entry of oxygen needed by the body. This gas combines with hemoglobin to form carboxyhemoglobin (COHb). The increase in COHb in the blood will inhibit the function of oxygen transportation and will affect the health of workers. This study aims to determine the risk factors for increasing COHb in Tirtonadi Bus Station Surakarta officers. The research method used analytic observational with a cross-sectional design. The research population was 110 respondents with a purposive sampling technique to get a research sample of 43 respondents. CO levels in the environment were measured by a CO meter, while COHb levels were measured by a spectrophotometer. The research data were analyzed using Spearman rank. Statistical correlation test showed a significant relationship between CO levels in the environment and COHb levels, p-value = 0.000 and r-value = 0.897, and no significant relationship between length of work and COHb levels with p-value = 0.285 and r-value = - 0.167. CO in the environment is related to the COHb level of traffic security officers at Tirtonadi Bus Station Surakarta, and the length of work is not related to the COHb level of traffic security officers at Tirtonadi Bus Station Surakarta.

Background

World Health Organization reported that 7 million people die annually due to air pollution. In Southeast Asia, more than 2 million people die from air pollution. Indonesia ranks number 8 out of 15 countries with the deadliest level of air pollution in the world, with a death rate of 50 thousand people annually (WHO, 2016). After inhalation, CO binds to hemoglobin in erythrocytes, due to its increased affinity, to form carboxyhemoglobin (COHb), which is responsible for cellular anoxia (Roderique et al., 2015; Weaver, 2020)

Carbon monoxide is a tasteless, odorless, colorless, and non-irritating gas formed from the combustion of hydrocarbons (fossil fuels). Binds to hemoglobin with a much greater affinity than oxygen to form carboxyhemoglobin. It causes hypoxia, cerebrovascular ischemia, and myocardial infarction. Carboxyhemoglobin interferes with cellular processes that inhibit aerobic metabolism, Acute toxicity can be fatal, and carbon monoxide toxicity causes many deaths due to accidental exposure. Common sources include motor vehicles, ships, faulty heaters, gas-powered generators, propane

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pISSN 1858-1196
eISSN 2355-3596

stoves, and charcoal grills, and toxicity is a concern when these machines are operated in unventilated or semi-enclosed spaces (Owens, 2006).

Approximately 60% of carbon monoxide levels are produced from human activities, one of which is motor fuel engines that use fossil fuels (Hampson and Hauff, 2008). WHO states that people with heart and lung disease should not be exposed to carbon monoxide gas, increasing COHb levels above 2.5% because people with heart and lung disease are more sensitive to CO exposure. CO exposure of 35mg/m3 for 1 hour and 20 mg/m3 for 8 hours is equivalent to the formation of COHb in the blood. CO exposure causes poisoning and increases occult complaints (Koyuncu et al., 2020). Lorensia, dkk (2019) explained that exposure to air pollution significantly contributes to health, mainly to decreased lung function.

CO gas with hemoglobin (Hb) in the blood can form carboxyhemoglobin (COHb), which can no longer bind oxygen for the needs of cell and tissue metabolism (Kusumah, 2014). Contact between CO gas and humans at high concentrations at 1300 ppm can cause death within half an hour. The ability of hemoglobin in the blood to bind CO gas is 240 times stronger than oxygen. Poisoning due to exposure to CO gas causes workers to experience health problems such as headaches, fainting, and there is a significant difference between police officers working more than two years at busy traffic intersections having blood CO levels 2.5% higher than police officers who work in the office (Nair et al., 2017)

Tirtonadi Bus Station, Surakarta City, is one of the largest and busiest in Central Java. The Tirtonadi Bus Station Traffic Security Officer has duties such as licensing and supervising bus parking facilities, regulating the entry and exit of buses in the Tirtonadi Bus Station area and inspecting public transport buses according to their authority. From the job description and the workplace, the Traffic safety officer at Tirtonadi Bus Station is one of the workplaces at risk of being exposed to carbon monoxide from motor vehicle exhaust emissions.

The initial survey for measuring environmental CO levels found that environmental CO levels at several bus station points were 39 ppm for the east, 10 ppm for the middle, and 27 ppm for the west post. The measurement results have exceeded the required ambient air quality standards. From this description, this study aims to determine the relationship between environmental CO levels and duration of work with CO levels in the blood of Traffic Safety Officers at Tirtonadi Bus Station, Surakarta.

Method

This research uses analytical observational methods that seek out and explain relationships between variables through hypothesis testing. The Cross-Sectional approach method is the study of the dynamics of correlation between risk factors and their effects, by way of approach, observation or collection of data at a time. The population in this study was security and traffic officers at Tirtonadi Bus Station, Surakarta, which numbered 110 people. From the total population, 43 respondents were sampled using the purposive sampling technique. The variable in this study was the level of carbon monoxide in the blood (COHb). The independent variables in this study were the service period of traffic safety officers and the level of environmental CO. The research instrument used a CO meter to measure environmental CO levels, and a questionnaire to determine the characteristics and tenure of the respondent. The data was then analyzed using SPSS version 23.0 with the Spearman correlation bivariate test. Multivariate analysis in this study used multiple linear regression analysis.

Results and Discussions

The position of Surakarta City is quite strategic. The Tirtonadi Bus Station is a transit station from west to east or vice versa so that bus departure lines in all directions, such as Inter-Provincial Intercity (AKAP) and Inter-Provincial City Bus Departure (AKDP). From this strategic position, many public vehicles, especially buses and private vehicles pass through and enter Tirtonadi Terminal. Tirtonadi Terminal is the lifeblood of land transportation in Surakarta City, with an average of 100-112 buses per hour in and out of the terminal. So the CO donated to the environment is quite large. The carbon monoxide (CO) gas level was calculated by the CO Meter instrument. Based on table 1, the average value of carbon monoxide levels is 29.6 ppm, a maximum of 43.6 ppm, and a minimum of 18.05 ppm. COHb level was assessed using a spectrophotometer. Based on table 2, 86% of respondents have COHb levels of more than 2%, and 14% of respondents have COHb levels of less than 2%. The number of subjects who followed the study at the start of the study was 43. Of the 43 subjects interviewed, they were included in the nonsykerlying category, male, and maximum age of 54. While the length of work of respondents in table 1 is 29 years.

Table 1. Distribution of Carbon Monoxide Gas Levels and COHb Levels

Variables	Mean	Std Deviation	Min	Max
CO Gas	29.6	9.98	18.05	43.60
COHb	2.65	0,66	1.3	3.8
Length of Work	10.54	9.35	0,50	29

Source: Primary Data, 2020

Table 2. Characteristics of Ordinal Scale COHb Respondent Data

No	Characteristics	Frequency	Percentage
1	<=2	7	14%
2	>2	36	86%

Source: Primary Data, 2020

The Spearman test in table 3 shows a significant relationship between CO and COHb with a p-value = 0.000 or p < 0.05 and an aid coefficient (r) of 0.897. It indicates a variable relationship level that increases positively in the direction of environment and COHb compared to straight. When CO levels increase, COHb levels will also increase. Spearman's correlation test table showed no relationship between working life and COHb with a value of >0.05 with a correlation coefficient of -0.167. The correlation coefficient is a negative value (-) that provides information about working time and COHb rates are inversely proportional, if the working time increases the COHb rate will decrease.

Table 3. CO Correlation Results in The Environment and Long Work Against CO Levels in the Blood (COHb)

Variables	*P-value*	Correlation coefficient (r)
CO Gas Environment	0,000	0,897
Length of Work	0.285	-0.167

Source: Primary Data, 2020

The test uses multiple linear regression statistical tests to determine whether there is a relationship between environmental carbon monoxide (CO) levels and working life with COHb levels, provided that the results of bivariate analysis have a value of p-value < 0.25. In this study, multivariate tests could not be performed. Because its requirements were not met. Data collection of environmental CO levels was carried out using a CO Meter placed for 10 minutes in each respondent's work area. From the results of research conducted from the measurement of Environmental CO levels, the average environmental CO in the Tirtonadi Bus Station area is 29.6 ppm. The result exceeds the National Ambient Air Quality Standard according to the Government Regulation of the Republic of Indonesia Number 41 of 1999, which is 30,000 g / Nm3, equivalent to 24 ppm. It is due to the increasing inflow and outflow of buses, and a large number of road users due to their activities. Such as the start of school hours for students and working hours by workers. It is also following Annisa, Budiyono and Sulistiyani (2021) stated a relationship between the number of vehicles and the concentration of CO. Where the results of many vehicle tests stop waiting for passengers and start the vehicle engine affect the concentration of CO. Similar research where there is a denser number of buses operating in the bus station area, the higher the level of carbon monoxide gas pollution in the air (Mourali, Mohan and Meerasa, 2018). Raub, et al. (2000) revealed that the CO content released by vehicle fumes, both cars, and motorized vehicles, contained up to 100,000 ppm during heavy traffic.

Based on data from 43 respondents, obtained p-value between Environmental CO levels, and COHb levels is 0.000 and r is 0.897**. The p-value of 0.000 indicates that there is a significant association between environmental CO levels, with COHb levels in the blood and with r of 0.897. It shows a strong association with a positive direction (+). COHb levels in the blood are affected by the concentration of CO in the air and will reach a certain equilibrium. There is a relationship between CO levels in the air and COHb levels in the blood. In the research results obtained the average level of environmental CO is 29.6 ppm, and COHb levels are 2.63%. Research by Herminia et al. (2014) and Veronesi et al. (2017) strengthens these results where there is a relationship between environmental CO and COHb levels where there is a 20% increase in COHb levels from exposure to environmental CO.

Several health complaints such as headaches and fatigue experienced by Tirtonadi Bus Station Surakarta officers have the potential consequences of exposure to CO Gas in the area in the long term. When carbon dioxide gas enters the blood circulation, it will bind to hemoglobin in the same way as oxygen. However, the carbon monoxide bond to hemoglobin is 250 times stronger than the binding of oxygen to hemoglobin. An increase of 1 ppm of carbon monoxide gas is at risk of health problems and resulting in changes in the atmosphere. This result is also reinforced by where workers exposed to CO have various health risks such as increased COHb, risk of coronary arteries, and neurological complications (Bol, Koyuncu and Günay, 2018).

CO gas enters the body and binds to hemoglobin, which acts as an oxygen carrier, causing the cells to be deprived of oxygen, called hypoxia (Gorman, et al., 2003). Signs of CO poisoning are mainly related to the brain and heart, the two organs most sensitive to hypoxia. Some of the symptoms of hypoxia are headache, shortness of breath, increased heart rate, decreased mental ability and sharpness of thinking, weakness, feeling lazy, insomnia (Whincup et al., 2006; R.J. Levy, 2015; Nurullita dan Mifbakhuddin, 2016).

The effect of hemoglobin in red blood cells causes the appearance of a red color in the blood because it can transport oxygen. If hemoglobin binds to carbon monoxide, this reaction is a reaction that cannot return to cause red blood cells to be unable to return to their original state. It results in the ability of hemoglobin to reduce oxygen binding. States that the concentration of carbon monoxide (CO) gas in the air will directly affect the concentration of carboxyhemoglobin (COHb). If the concentration of CO gas in the air remains constant, the concentration of COHb in the blood will reach a certain balance and will remain as long as there is no change in the concentration of CO in the air. After inhalation, CO binds to hemoglobin in erythrocytes, due to its increased affinity, to form carboxyhemoglobin (COHb), which is responsible for cellular anoxia (Roderique et al., 2015; Weaver, 2020).

Data collection of COHb levels by taking blood samples from each respondent. 43 respondents who were willing to take blood samples to be tested using Spectrophotometers. Based on the measurement of COHb levels in the Tirtonadi Bus Station Surakarta Traffic Safety Officer showed that of 43 respondents, 36 had abnormal levels of COHb in the blood (2%) in the range of the results of an examination of COHb levels in the blood was 2.1-3.8%, and seven respondents had normal COHb levels (<2%). The highest COHb rate received by respondents was 3.8%, and the lowest COHb rate was 1.3%, with the average respondent's COHb rate at 2.63%. COHb levels in the blood of 0.5% and 2.01% have no impact on the human body, while COHb concentrations of 3.2% impact the central nervous system in humans (Roth et al., 2011) . L. Zhang et al. (2022) in his research explained that workers who work outdoors or in the field have a greater potential for exposure to air pollution caused by traffic.

Based on research conducted, the average length of work of workers is 10.5 years. With a minimum working period of 0.5 years and a maximum of 29 years. With an average working life of 10.5 years, co-entering the respondent's body will also affect the level of COHb in the blood because the COHb in the blood is acute. The amount of COHb formed depends on the length of exposure to CO Gas. The longer the working life, the more COHb content in the blood, and the more CO is inhaled. But the results obtained from respondents with a working period of 22 years have a COHb level of 1.6%. It is below the standard limit of <2%. While those with a working period of 2 years have a COHb level of 3.8% which means exceeding the normal limit of > 2% (Ekpenyong et al., 2012; Liu et al., 2018) .

Based on research from 43 respondents, obtained p-value between working time with COHb levels is 0.220 and r = - 0.191 which means there is no relationship between years of service and COHb levels in the blood. It can be influenced by other uncontrolled factors in this study such as the use of masks, exercise habits, and food nutrients consumed by respondents at the time of the COHb examination. It is in line with the research conducted that there is no relationship between working life and COHb levels in the blood (Rizaldi, Ma'rufi and Ellyke, 2021). But there is an opinion that the duration of CO exposure affects COHb levels, based on the developed model that exposure between 70 and 120 ppm CO for approximately 4 hours produces COHb levels between 10 and 20% with no symptoms (Raub and Benignus, 2002; Winter and Miller, 1976).

Conclusion

There is a relationship between Environmental CO levels and COHb levels in Tirtonadi Bus Station Traffic Safety officers and no relationship between working time and COHb levels in Tirtonadi Bus Station Traffic Safety officers. The COHb level of the Tirtonadi Bus Station Traffic Safety Officer is 14% of the total number of respondents. They have normal COHb levels.

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