Universal Journal of Public Health 10(6): 576-580, 2022
DOI: 10.13189/ujph.2022.100604 http://www.hrpub.org

Impact of Exposure to Carbon Monoxide on COHb Levels and Health Problems on Swords and Parking Attendants in A Parking Area at the Bandar Lampung Market, Indonesia

Purbianto Purbianto[1,*], Khayan Khayan[2]

[1]Study Program of Profession, Nursing Major, Politeknik Kesehatan Kemenkes Banten, 42121, Serang, Indonesia
[2]Department of Medical Laboratory Technology, Politeknik Kesehatan Kemenkes Banten, 42121, Serang, Indonesia

Received June 11, 2022; Revised October 21, 2022; Accepted November 14, 2022

Cite This Paper in the Following Citation Styles

(a): *[1] Purbianto Purbianto, Khayan Khayan, "Impact of Exposure to Carbon Monoxide on COHb Levels and Health Problems on Swords and Parking Attendants in A Parking Area at the Bandar Lampung Market, Indonesia," Universal Journal of Public Health, Vol. 10, No. 6, pp. 576 - 580, 2022. DOI: 10.13189/ujph.2022.100604.*

(b): *Purbianto Purbianto, Khayan Khayan (2022). Impact of Exposure to Carbon Monoxide on COHb Levels and Health Problems on Swords and Parking Attendants in A Parking Area at the Bandar Lampung Market, Indonesia. Universal Journal of Public Health, 10(6), 576 - 580. DOI: 10.13189/ujph.2022.100604.*

Abstract Carbon monoxide (CO) pollution to the environment hurts health. The ability of Hb to bind CO is stronger than O_2, which hurts humans in a CO-polluted environment. This condition impacts CO levels in the body and increases with low oxygen levels in the blood. The CO content in the body that exceeds the threshold triggers symptoms of headaches, prolonged fatigue, and even death. This study aimed to determine the effect of exposure to CO in free air with levels of COHb and health complaints on parking attendants and traders in the lower market terminal of Bandar Lampung City. This study used a retrospective cohort design. The population in this study were traders and parking attendants who worked at the Pasar Bawah Terminal in Bandar Lampung City, amounting to 152 people, and parking attendants totaling 35 people divided into two shifts. The sample size is 127 people. Data were taken from measuring COHb levels and using a questionnaire regarding health complaints that respondents often felt. Data analysis used chi-square. The average exposure to CO levels in the market terminal under the basement of the Tanjungkarang supermarket was 23.68 ppm, with the highest level of 25.87 ppm. Most of the respondents are male, aged over 35 years, and have worked for more than three years. Most respondents do not wear masks when working in the exposure area; the COHb level in the blood is above 5%, and most have complaints of health problems. There is a significant relationship between COHb levels in the blood with CO exposure, length of work, and health problems and no significant association with age and habits of using personal protective equipment (PPE).

Keywords Exposure, Carbon Monoxide, Gas

1. Introduction

The development of a city brings positive and negative impacts on the people who live in the area. Urban spatial planning requires proper arrangement to reduce the risk of environmental pollution impacts resulting from activities in urban areas [1]. The market is the leading business center in a metropolitan area, especially in developing countries. Market buildings generally provide parking for visitors' vehicles. Like the market of Bandar Lampung, Indonesia, the parking area is built at the bottom of the market. The parking area under the building, without providing optimal air circulation facilities, impacts the site's health of vehicles in the parking area which will contribute to an increase in air pollution exhaust gases consisting of Carbon Monoxide (CO), Nitrogen Dioxide

(NO_2), Hydro Carbon (NMHC), and Sulfur Dioxide (SO_2). These gases are as indicators of ambient air pollutants [2].

CO gas is a colorless gas and is one of the gases that contribute to air pollution as a result of incomplete combustion of fuel produced by motor vehicles. The chemical compound CO gas in the air when inhaled by humans in excess can cause several health problems such as lowering oxygen levels in the blood, dizziness, and prolonged fatigue and can cause death in exposed humans [3].

The binding of CO gas with hemoglobin in human blood can cause a decrease in the ability of Hb to bind oxygen. If a car is turned on in a closed room such as for 5 minutes, it can cause the person inside to faint [3]. Bachtiar, et al. [4] explained that CO gas in the basement air, which has levels above the threshold value in a closed room, will be very dangerous for people in that environment. CO gas can rapidly increase COHb in the blood with a higher proportion value than the HbO_2 value in a person's breath. The value of Hb's affinity for CO is 210 times that of Hb's affinity for O_2, so it is necessary to measure blood COHb levels for parking attendants and traders in the market terminal under the supermarket basement which is a c, a[5].

The terminal of the down market, which is a combination of the terminal and the market located in the basement of one of the largest supermarkets in Bandar Lampung City, is a strategic place to be visited by traders and buyers because it is located in the middle of Bandar Lampung city. Pasar Bawah terminal is the only terminal in the middle of Bandar Lampung city. Vehicles for passengers, people, and goods, plus vehicles for merchants and buyers, fill the terminal daily. The volume of cars that filled the terminal in 2018 is estimated at an average of 1,500 cars per day. The large volume of motorized vehicles can cause an increase in CO gas levels in the air. People will inhale the accumulation of CO gas in the room in the place, such as traders and parking attendants who are in that place every day. The purpose of this study was to analyze the relationship between exposure to CO gas (Carbon Monoxide) in the air with blood COHb levels and health problems for traders and parking attendants who were in the Pasar Bawan terminal located in the basement of the supermarket.

2. Method

This study uses an observational analytic study with a *retrospective cohort design* where respondents are determined based on their past exposure status and then observed the current output. The research location is at Pasar Bawah Terminal, located in the basement of a supermarket in Bandar Lampung. This research was conducted from April to May 2020. The population in this study were swords and parking attendants totaling 152 people. The sample size in the study was calculated using the Slovin formula, and a sample of 127 respondents were obtained. The sampling method used a purposive sampling method with the criteria of 1) a trader or parking attendant who had worked for more than 1 year, 2) did not smoke, 3) worked more than 8 hours, aged over 30 years, worked 6 days per week. Measurement of carbon monoxide (CO) levels is used to determine CO gas exposure in the basement parking lot. Measurement of carbon monoxide levels used the Impinger tool, carried out by officers from the Tanjungkarang Ministry of Health Poltekkes Laboratory. CO levels in the blood are measured by measuring blood COHb levels. Blood samples researchers took blood samples examined COHb levels from the Tanjungkarang Health Polytechnic laboratory.

The analysis in this study used univariate analysis and bivariate analysis. Bivariate analysis used *chi square.* This research has received ethical approval from the Tanjungkarang Health Polytechnic ethics commission with the number: 084/EA/KEPK-TJK/IX/2020.

3. Results

The research was carried out at the terminal of the down market located in Jalan Raden Intan, Bandar Lampung City, and the location of the terminal of down market in Bandar Lampung City was in the Tanjung Karang City Center. This location is strategic and easily accessible by the community from various corners of the city. The terminal of the down market is passed by all city transportation routes. The terminal of the down market is located in the basement of one of the supermarkets in Tanjungkarang.

Table 1. Results of measuring CO levels in the terminal under Basement of a Supermarket

No	Measurement Location	CO level (ppm)
1	Terminal entrance area	22.04
2	Area for dropping off passengers and parking for motorbikes	25.87
3	Vehicle exit area	23.09
Average CO. level		23.68

Table 2. Distribution of Respondents by Gender, Age and Length of Work of Parking Attendants and Traders at terminal under Basement of a Supermarket

Gender	Number of Respondents Exposed	Percentage
Man	95	74.8
Woman	32	25.2
Age (Years)	**Number of Respondents Exposed**	**Percentage**
<17	25	20
17-35	25	20
>35	77	60
Length of Employment (Years)	**Number of Respondents Exposed**	**Percentage**
< 1 year	17	13.3
1-3 years	45	35.4
> 3 years	65	51.3
Amount	127	100

Measurements of carbon monoxide (CO) gas levels were carried out at three locations in the market terminal under the basement of a supermarket in Tanjungkarang. Measurement of CO gas used the Midget Impinger. Based on Table 1, the measurement of CO gas levels obtained an average of 23.68. The terminal entrance area has a CO gas content of 22.04 ppm. The vehicle entrance area does not stop, so there is no accumulation of exhaust fumes. In the area to drop off passengers and park motorbikes, the CO gas level reaches 25.87. In this area, vehicles stop to drop off passengers, so that in this place, exhaust fumes accumulate and the position of this area is in the middle of the basement so that CO exhaust cannot go directly out of the air. The terminal vehicle's exit area has a CO gas content of 23.09 ppm. In this area, vehicles leave slowly because of the queue of cars outside the terminal, so there is still a slight accumulation of CO.

Table 3. Distribution of Respondents based on the Use of Masks

Habit of Wearing Mask	Number of Respondents Exposed	Percentage
No	95	75
Sometimes	32	25
Keep on wearing	0	0
Amount	127	100

Table 2 shows the characteristics of respondents in this study. Based on Table 2, it can be explained that most of the respondents are male, which is 74.8%, while for age, most of them are over 35 years old, which is 60%. Characteristics of respondents are based on length of work in the market terminal area under the basement of the Tanjungkarang supermarket. Most of them have worked for more than three years, 51.3% either as traders or parking attendants. All respondents work for 10 hours and 6 days a week.

Table 3 shows the distribution of respondents based on the use of personal protective equipment (PPE).

Table 4. Results of Respondents' Blood COHb Measurement

COHb Levels in Blood	Number of Respondents	Percentage
≤ 5%	35	28
≥ 5%	92	72
Amount	127	100

Based on Table 4 above regarding the distribution of HbCO levels in respondents exposed to CO, it can be explained that most of the respondents had Hb levels ≥5% as much as 72%. Most of the parking attendants and vendors at the Pasar Bawah terminal are in the drop off area which is also close to the parking lot, and this area is an area with a high level of CO exhaust, so that people around the place will inhale more CO gas than elsewhere, the HbCO concentration was more than 5%.

Table 5. Distribution of Respondents Based on Health Complaints

Health Complaint	Number of Respondents	Percentage
Exist	98	77
Nothing	29	23
Amount	127	100

Table 5 shows the distribution of health complaints to research respondents, where most of the respondents with a total of 77% stated that there were health complaints. The types of health complaints felt by respondents can be seen in Table 6.

Table 6. Distribution of Respondents by Type of Health Complaint

Health Complaint	Yes	No	Amount
Headache	94 (74.2%)	33 (25.8%)	127 (100%)
Out of breath	16 (12.9%)	111 (87.1%)	127 (100%)
Nauseous	16 (12.9%)	111 (87.1%)	127 (100%)
Dizzy	107 (83.9%)	20 (16.1%)	127 (100%)
Pain in the chest	25 (19.4%)	102 (80.6%)	127 (100%)
Blurred Vision	25 (19.4%)	102 (80.6%)	127 (100%)
Throw up	4 (3.2%)	123 (96.8%)	127 (100%)
Faint	4 (3.2%)	123 (96.8%)	127 (100%)

Table 6 is about health complaints submitted by respondents at the time of the study, namely complaints of dizziness by 83.9% and complaints of headaches by 74.2%.

Table 7. The Relationship between HbCO Levels and CO Levels in the Air, Gender, Age and Length of Work of Respondents

Variable	p
1. CO levels in the air	0.000
2. Age	0.700
3. Length of work	0.040
4. The ability to use PPE	0.128
5. Health Problems	0.000

Results of the chi-square test between exposure to CO gas and HbCo levels in the respondent's blood, a significance value of p = 0.000 was obtained. This means that there is a significant difference between respondents who are in areas exposed to CO with high concentrations and areas exposed to CO with low concentrations (Table 7).

4. Discussion

Carbon monoxide (CO) gas is a gas that has no shape, colour, smell or taste [6]. Carbon monoxide is hazardous for humans because of the solid binding power between Hb and Co to form HbCO. CO is more stable in binding Hb than oxygen. This causes Hb to bind CO more easily than to bind oxygen. CO binds significantly to Hb in the blood rather than oxygen [7,8]. In a room with minimal ventilation, exposure to high CO levels when inhaled by someone without personal protective equipment increases COHb levels [9,10].

CO gas can rapidly increase COHb in the blood, so the proportion value is higher than the value of Hb to O_2 in a person's breathing. The affinity of Hb for CO is 210 times that of Hb for O_2, so in a closed area with high CO levels, it will also contribute to high levels of COHb in human blood [5]. Typically, human blood contains 0.5% COHb levels due to metabolic processes in the body. CO gas is a toxic gas; although inhaled in small amounts, it can cause heart muscle contractions, decreasing the amount of blood circulated throughout the body so that oxygen diffused throughout the tissues will decrease [3].

From the research results, HbCO levels have a relationship with CO levels in the air. High CO in parking areas with minimal ventilation building conditions will increase exposure to parking attendants. CO in the air will enter the body through the respiratory tract. Continuous exposure associated with a long duration of action at low doses can enhance the erythropoietic process with a 4.8% increase in Hbmass. Individual changes in Hbmass correlate with corresponding changes in VO_2max [11].

Referring to the regulation of the threshold value stipulated by the Regulation of the Minister of Manpower of the Republic of Indonesia concerning the threshold value of physical factors and chemical factors in the workplace, the level of CO exhaust gas in the air is 25 ppm [12]. The main danger of CO is its tendency to bind to haemoglobin to produce carboxyhemoglobin (COHb). CO is much more stable in binding to haemoglobin than oxygen; this causes haemoglobin to bind more easily to CO, so the function of oxygen-carrying blood is disrupted. Vital organs such as the brain and heart are organs with the highest metabolic rate, so they are very susceptible to hypoxia and toxic manifestations.

Haemoglobin functions to bind oxygen and is carried to tissues for tissue metabolism, but the binding capacity of Co to Hb is 200-300 times that of oxygen, so that when Hb has bound CO, oxygen will be expelled, so that blood cannot carry oxygen to tissues, resulting in tissue impact and hypoxia will occur. Suppose the COHb level is more than 5%. In that case, it will cause monoxide gas poisoning, which can cause health complaints such as dizziness, nausea, vomiting, increased heart rate, difficulty breathing and even impaired consciousness [13,14].

5. Conclusions

Measurement results of CO (Carbon Monoxide) gas

levels in the terminal of the down market in the Tanjungkarang supermarket basement exceed the threshold, especially in the area where passengers drop off passengers and the motorbike parking lot. The sample of respondents, sworders, and parking attendants had COHb levels of mostly 5%. There is a significant relationship between COHb levels in the blood with CO exposure, length of work, and health problems. The relationship between HbCo levels in the blood was not significant with age and habits of using personal protective equipment (PPE).

Conflict of Interest

The authors declare that there is no conflict of interest.

REFERENCE

[1] L. Ambarwati, R. Verhaeghe, B. van Arem, and A. J. Pel, "The influence of integrated space–transport development strategies on air pollution in urban areas," *Transp. Res. Part D Transp. Environ.*, vol. 44, pp. 134–146, 2016.

[2] N. S. Muhamad Fauzi, M. M. Kasim, and N. H. M. Desa, "Comparison of air pollutants' hazardous levels in selected cities of Malaysia: Entropy method," *Universal Journal of Public Health*, vol. 9, no. 4, pp. 194–200, 2021, doi: 10.13189/ujph.2021.090405.

[3] I. Suharto, "Limbah Kimia dalam Pencemaran Air dan Udara," *CV. Andi Offset. Yogyakarta*, 2011.

[4] V. S. Bachtiar, "Studi Paparan Konsentrasi Gas Karbonmonoksida (CO) Di Lingkungan Kerja Petugas Parkir Dan Polisi Lalu Lintas Di Kota Padang," *J. Dampak*, vol. 10, no. 1, pp. 60–72, 2013.

[5] M. HJ, "Pencemaran Udara dan Pengaruhnya terhadap Gangguan Saluran Pernapasan.[Makalah]." Airlangga University Press, Surabaya, 1997.

[6] X. Yang, M. Wang, C. Tan, W. Lu, and B. Wang, "Pharmacokinetic characteristics of carbon monoxide," *Carbon Monoxide Drug Discov. Basics, Pharmacol. Ther. Potential*, pp. 44–87, 2022.

[7] S. T. Omaye, "Metabolic modulation of carbon monoxide toxicity," *Toxicology*, vol. 180, no. 2, pp. 139–150, 2002.

[8] G. P. Kealey, "Carbon monoxide toxicity," *J. Burn care Res.*, vol. 30, no. 1, pp. 146–147, 2009.

[9] J. A. Raub, M. Mathieu-Nolf, N. B. Hampson, and S. R. Thom, "Carbon monoxide poisoning—a public health perspective," *Toxicology*, vol. 145, no. 1, pp. 1–14, 2000, doi: https://doi.org/10.1016/S0300-483X(99)00217-6.

[10] N. B. Hampson and N. M. Hauff, "Carboxyhemoglobin levels in carbon monoxide poisoning: do they correlate with the clinical picture?," *Am. J. Emerg. Med.*, vol. 26, no. 6, pp. 665–669, 2008.

[11] W. F. J. Schmidt, T. Hoffmeister, S. Haupt, D. Schwenke, N. B. Wachsmuth, and W. C. Byrnes, "Chronic exposure to low-dose carbon monoxide alters hemoglobin mass and V O2max," *Med. Sci. Sport. Exerc.*, vol. 52, no. 9, pp. 1879–1887, 2020, doi: 10.1249/MSS.0000000000002330.

[12] P. R. I. No, "Tahun 2011 tentang Nilai Ambang Batas Faktor Fisika dan Faktor Kimia di Tempat Kerja," *Jakarta: Muhaimin Iskandar*, 13AD.

[13] L. Tang *et al.*, "Binary exposure to hypoxia and perfluorobutane sulfonate disturbs sensory perception and chromatin topography in marine medaka embryos," *Environ. Pollut.*, vol. 266, p. 115284, 2020.

[14] M. S. Rahman and P. Thomas, "Interactive effects of hypoxia and PCB co-exposure on expression of CYP1A and its potential regulators in Atlantic croaker liver," *Environ. Toxicol.*, vol. 33, no. 4, pp. 411–421, 2018.