

Manuscript received November 10, 2020; revised March 3, 2021; accepted April 21, 2021; date of publication April 28, 2021;
Digital Object Identifier (DOI): 10.1109/ijahst.v1.i1.1

Analysis of COHb Levels in Blood Using the Hinsberg-Lang Method and the Conway Diffusion Cell Method to Public Transport Drivers on Joyoboyo Street in Surabaya City

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“This work was supported in part by Department of Medical Laboratory Technology, Health Polytechnic Ministry of Health Surabaya”

ABSTRAK Carbon monoxide is a gas that is odorless, colorless and tasteless and is potentially toxic to human health. Carbon monoxide levels in the blood can be analyzed by the Hinberg-Lang method and the Conway diffusion cell method. The purpose of this study was to analyze COHb levels in the blood of city transportation on Jalan Joyoboyo, Surabaya City, which were exposed to carbon monoxide gas by spectrophotometry using the Hinberg-Lang method and the Conway diffusion cell method. The type of research used was a quantitative descriptive study which was carried out in October 2022 - April 2023 at the toxicology Laboratory Medical Laboratory Technology Department, Poltekkes Kemenkes Surabaya. The sample used is 30 city transport drivers taken with predetermined criteria. The results and conclusions of this study indicate that when examining COHb The results of this study showed that COHb levels using the Hinsberg-Lang method obtained the highest levels of 4.9% while for the lowest levels of 3.2%, the examination of COHb levels using the conway diffusion cell method obtained the highest levels of 0.64%, while the lowest level is 0.34%. It can be concluded that there is a significant difference in blood COHb levels using the Hinsberg-Lang method and the conway diffusion cell method.

INDEX TERMS Carbon Monoxide, Hinberg-Lang, Conway diffusion cell

I. INTRODUCTION

In today's modern era, developments in the economy and technology are taking place rapidly. This is felt by the increasing number of means of transportation owned by the people of Indonesia. The increasing number of means of transportation in the form of motorized vehicles results in increased air pollution [1]. The estimated percentage of the largest air pollutants from transportation sources in Indonesia is in CO gas, which is 70.50%, then HC gas accounts for 18.34%, and the rest comes from other gases [2]. In big cities, for example, Jakarta has an annual average CO concentration of 2,280 $\mu\text{g}/\text{Nm}^3$ [3] and Surabaya City has an annual average CO concentration of 1,740 $\mu\text{g}/\text{Nm}^3$ [4]. One group that has a high risk of direct exposure to carbon monoxide gas is city transportation drivers. CO exposure can come from motor vehicle emissions that are accidentally inhaled by city transportation drivers while waiting for passengers on the side of the road [5]. On the streets of Surabaya there are still city transportation that stops on the side of the road to wait for passengers such as

on Jalan Ahmad Yani, Jalan Wonokromo, Jalan Margomulyo, and Jalan Joyoboyo [6].

Based on research [7] shows that Jalan Joyoboyo, which is one of the monitoring point zones of the 6 zones studied, produces an average CO concentration above 30,000 $\mu\text{g} / \text{Nm}^3$ per hour, which means it exceeds the ambient air quality standards in Government Regulation of the Republic of Indonesia No. 41 of 1999. With the large volume of vehicles passing by and the location on the highway, it is possible that city transportation drivers who are stopping on the side of Jalan Joyoboyo are exposed to CO gas.

Carbon monoxide is an odorless, colorless and tasteless gas and has the potential to be toxic which is harmful to human health (8). CO gas that enters the body through the respiratory system will bind to hemoglobin to form COHb. The bond between CO and hemoglobin occurs at the same speed as between O₂ and hemoglobin, but the bond for CO is 245-300 times stronger than O₂. So CO gas and O₂ will compete to bind to hemoglobin, but unlike O₂ which breaks away from hemoglobin more easily, CO binds to hemoglobin longer [9]. According to the Occupational Safety and Health

Administration (OSHA), COHb levels are still within normal limits of no more than 5%.

Carbon monoxide levels in the blood can be analyzed by the Hinberg-Lang method and the conway diffusion cell method. In the Hinberg-Lang method, the principle is to measure the absorbance of reagents from blood samples added with ammonium hydroxide and measure the absorbance of sample standards from samples added with ammonium hydroxide and sodium dithionite using a spectrophotometer at the maximum wavelength and then multiplied by a conversion factor of 6.08% [10]. As for the conway diffusion cell method, the principle is to liberate carbon monoxide from the blood placed in the outer well using sulfuric acid and then let it react with palladium chloride solution in the inner well [11].

In research [12] on the analysis of COHb in the blood of grilled pentol traders in Banjarbaru using the Hinsberg-Lang method with a working time of 6-10 hours per day, the results showed that 5 out of 6 respondents had COHb levels above normal, an average of 12.78% and 1 out of 6 respondents had COHb levels below normal, namely 2.3%, these results indicate that the level of CO exposure in grilled pentol traders in Banjarbaru is quite high. In another study [13] on analyzing COHb levels in residents around the Tirtonadi bus terminal in Surakarta showed the results of COHb levels in all respondents exceeding the normal limit with an average of 6.22%.

Then in research [14], regarding the analysis of COHb levels in online motorcycle taxi drivers using the conway diffusion cell method with a working time of 6 hours per day in Surakarta, the results of COHb levels in the blood were 0.49% to 0.58%, which means that the level of CO exposure in online motorcycle taxi drivers in Surakarta is still within normal limits. In another study [15] on the analysis of carboxyhemoglobin (COHb) levels in active smokers in Bongkaran village, Pabean Cantikan sub-district, the average COHb level in the blood of 20 respondents was 8.86%, which means that the concentration of carbon monoxide in the blood of respondents exceeds normal limits.

The Hinsberg-Lang method and conway diffusion cell are both types of spectrophotometric methods because they use a spectrophotometer to measure the absorbance of the sample at the maximum wavelength [16]. The Hinsberg-Lang method is still widely used in laboratories for the examination of COHb [17] and the conway diffusion cell method is still often used, especially in laboratories that do not have expensive equipment for examining CO levels in the blood [11].

Based on the above background, research will be conducted on the analysis of COHb levels in the blood of city transportation drivers on Jalan Joyoboyo Surabaya City who are exposed to carbon monoxide gas from the exhaust of motor vehicle fumes using the Hinsberg-Lang method and the conway diffusion cell method.

II. METHOD

A. Research Type

The type of research used is quantitative descriptive research, which does not carry out any treatment or intervention on research variables (non-experimental).

B. Research Location and Time

This research was conducted in October 2022 - May 2023 at the Toxicology Laboratory of the Department of Medical Laboratory Technology of the Health Polytechnic of the Ministry of Health. The population of this study was city transportation drivers on Jalan Joyoboyo Surabaya City, East Java.

C. Research Samples

According to Roscoe in Sugiyono (2013), suggests that the appropriate sample size in research between 30 to 500 people. On this basis, a population sample was taken by purposive sampling of 30 city transportation drivers based on predetermined criteria. This study uses data collection techniques taken from primary data, namely data taken after completing the research.

D. Sampling Technique

The blood taken was whole blood in the median cubital vein using a tourniquet and a 3 mL syringe. After that, it was placed in tubes containing EDTA anticoagulant, then labeled with the patient's identity on each tube. Furthermore, the specimen is put into a cool box which is kept at a temperature according to the temperature of the refrigerator and given an ice pack. The test material is then brought to the laboratory for examination [18].

E. Hinsberg-Lang Method

Prepare test tubes and label them R1 (reagent) and SPL (sample), then 0.1% ammonium hydroxide solution is taken as much as 20 mL and put into an erlenmeyer, then pipet whole blood as much as 10 μ l using a yellow tip and put it in an erlenmeyer containing ammonia solution. Then put the mixture of 5 mL each in test tubes (R1 and SPL), in the SPL tube (sample) give 25 mg sodium dithionite and tube R1 (reagent) is not added sodium dithionite. Both solutions were each measured for absorbance on a UV-Vis spectrophotometer with a maximum wavelength of 414 nm. The absorbance of R1 is called (ΔA) and the absorbance of the SPL standard is called ($\Delta ArHb$), then the COHb concentration is obtained by calculating $\Delta A / \Delta ArHb$ multiplied by the conversion factor, the results are expressed in units of %. NH₄OH 0.1% was used as an absorbent blank. [19].

F. Conway Diffusion Cell Method

The determination of COHb levels by the conway diffusion cell method, The conway niche was washed with washing-up liquid, then cleaned with distilled water. The recesses of the conway dish were filled as follows: A = 1.5 mL of distilled water, B = 0.2 mL of 5N H₂SO₄, C = 1 mL of PdCl₂ solution. Then 0.5 mL of blood was added to part A

containing distilled water, the conway cup was closed and left for 1 hour, after completion, 0.25 mL of PdCl₂ solution was pipetted, the tip of the pipette had to touch the bottom so that the thin layer of Pd metal was not sucked in, then the liquid in the pipette was put into a 25 mL volumetric flask which had previously been filled with 10 mL of distilled water and 1 mL of 5% KI, added distilled water until the mark, then homogenized, then measured the absorbance of the solution using a UV-Vis spectrophotometer at a wavelength of 351 nm, and used distilled water as an absorbent blank. [14].

III. RESULT

The research began with the interview stage and filling out questionnaires to obtain the characteristics of respondents in accordance with the criteria for research subjects, one of which is age. The results of the respondent questionnaire show that the age group with an age range of 51-60 years is more likely to join the study than other age groups, as described in table 1.

TABLE 1
Characteristics of Respondents by Age

No	Age (Year)	Frequency	Percentage %
1	30-40	1	3,3
2	41-50	9	30
3	51-60	13	43,4
4	>60	7	23,3
Total		30	100%

The Characteristics of Respondents by Hour of Work is a description of the length of working hours per day carried out by city transportation drivers on Jalan Joyoboyo. From the data obtained, it is known that the group of respondents with a working time range of 6-8 hours per day is more than the group of respondents with a working time range of >8 hours per day. Characteristics of 30 respondents based on length of work can be seen in table 2.

TABLE 2
Characteristics of Respondents by Hour of Work

No	Hour of Work (hour/day)	Frequency	Percentage %
1	6-8	19	63,4
2	>8	11	36,6
Total		30	100%

The length of service is the period or range of time respondents work as a city transportation driver. All questionnaires that have been filled in by respondents show that the highest percentage of working period (60%) as a city transportation driver comes from the group of respondents with a working period of 5-10 years. The working period of city transportation drivers can be seen in table 3.

TABLE 3
Characteristics of Respondents by Length of Service

No	Length of Service (years)	Frequency	Percentage %
1	5-10	18	60
2	>10	12	40
Total		30	100%

The use of masks can protect a person from exposure to pollution particles in the air that can trigger health problems. The characteristics of the data obtained show that (80%) of city transportation drivers do not wear a mask while working, while the rest wear masks while working. The characteristics of all respondents based on the use of masks can be seen in table 4.

TABLE 4
Characteristics of Respondents by Use of Masks

No	Use of Masks	Frequency	Percentage %
1	Yes	6	20
2	No	24	80
Total		30	100%

From the results of filling out questionnaires and interviews conducted to 30 city transportation drivers on Jalan Joyoboyo, it was found that more respondents had a smoking habit than the non-smoking respondent group. This shows that most respondents are classified as active smokers. Table 5 presents the characteristics of 30 respondents based on smoking habits.

TABLE 5
Characteristics of Respondents by Smoking Habits

No	Smoking Habits	Frequency	Percentage %
1	Yes	27	90
2	No	3	10
Total		30	100%

Characteristic data based on health complaints obtained are then processed and presented in tabular form so that it can be seen that the percentage of respondents with no health complaints is more (96.7%) than the group of respondents with headache health complaints. So that respondents are classified as healthy. Characteristics based on respondents' health complaints are presented in table 6.

TABLE 6
Characteristics of Respondents by Health Complaint

No	Health Complaint	Frequency	Percentage %
1	Dizzy	1	3,3
2	No health complaints	29	96,7
Total		30	100%

The examination of COHb levels in the blood using two methods, namely the Hinsberg-Lang method and the conway diffusion cell method, each method was examined in duplicate and the absorbance was read with a Genesys 150 UV-Vis Spectrophotometer at the maximum wavelength. The results of the examination of COHb levels in the body of city transportation drivers on Joyoboyo Street, Surabaya City can be seen in table 7.

TABLE 7
Examination results of blood COHb levels in city transportation drivers

No	SC	Hinsberg-Lang Method (%)	conway diffusion cell method (%)	Normal Limit (%)
1	SA1	3,8	0,39	<5
2	SA2	4,2	0,45	<5
3	SA3	4,4	0,48	<5
4	SA4	4,5	0,49	<5
5	SA5	4,5	0,51	<5
6	SA6	4,6	0,56	<5
7	SA7	4,8	0,61	<5
8	SA8	4,5	0,49	<5
9	SA9	3,2	0,34	<5
10	SA10	4,5	0,50	<5
11	SA11	3,4	0,35	<5
12	SA12	4,6	0,55	<5
13	SA13	4,7	0,59	<5
14	SA14	4,9	0,64	<5
15	SA15	4,5	0,49	<5
16	SA16	4,4	0,47	<5
17	SA17	4,3	0,45	<5
18	SA18	4,4	0,47	<5
19	SA19	4,5	0,50	<5
20	SA20	4,4	0,48	<5
21	SA21	4,4	0,48	<5
22	SA22	3,9	0,39	<5
23	SA23	4,3	0,46	<5
24	SA24	4,4	0,47	<5
25	SA25	4,2	0,45	<5
26	SA26	4,4	0,47	<5
27	SA27	4,5	0,50	<5
28	SA28	4,1	0,44	<5
29	SA29	4,6	0,55	<5
30	SA30	4,4	0,47	<5
Total		4,35	0,483	

The examination results in table 7 show that COHb levels using the Hinsberg-Lang method have an average COHb level of 4.35% with the highest level obtained a result of 4.9% while for the lowest level obtained a result of 3.2%. In the examination of COHb levels using the conway diffusion cell method, the average COHb level was 0.483% with the highest level of 0.64%, while the lowest level was 0.34%. COHb levels using the Hinsberg-Lang method and the

conway diffusion cell method are still within the normal limits set by the Occupational Safety and Health Administration (OSHA) which is no more than 5%.

IV. DATA ANALYSIS

Data from the examination of COHb levels in the blood is then processed by means of the Stastical Package for the Social Sciences (SPSS) which will be tested for normality first with the Shapiro-Wilk test. If the research data shows normal distribution values, it will continue with the Paired sample T-Test test.

The results of the SPSS output for the data normality test using the Shapiro-Wilk test obtained a significant value of the Hinsberg-Lang method of 0.079 and a significant value of the conway diffusion cell method of 0.150 so it can be concluded that the significant value of the two methods is >0.05 , so the data obtained is normally distributed and continued the Paired Sample T Test.

Then the SPSS output results for the Paired Sample T Test test produce a Sig value. (2-tailed) of 0.000 and has a value smaller than α (0.05). So the Paired Sample T Test test states that H_0 is rejected and the alternative hypothesis H_1 is accepted. Therefore, according to the inputted data, it shows that there is a significant difference in blood COHb levels using the Hinsberg-Lang method and the conway diffusion cell method in city transportation drivers on Joyoboyo Street, Surabaya City.

V. DISCUSSION

The study began with interviews and giving questionnaires and informed consent to the respondents. 30 respondents were obtained who were city transportation drivers on Joyoboyo Street, Surabaya City with an age of more than 30 years, an average working period as a driver of more than 5 years and had working hours above 6 hours. The selection of respondents of the same sex, namely male, is intended to obtain the same characteristics of respondents due to differences in hemoglobin levels and differences in alveolar ventilation in men and women. This study was conducted to analyze COHb levels in the blood of city transportation drivers on Joyoboyo Street, Surabaya City using the Hinsberg-Lang method and the conway diffusion cell method.

A. COHb Level Examination Using the Hinberg-Lang Method

The examination of COHb levels using the Hinsberg-Lang method begins with pipetting 0.1% ammonium hydroxide solution as much as 20 mL into an erlenmeyer, after which 10 μ L of blood is added using a micropipette and then homogenized [20]. But it is necessary to be careful in homogenizing this because if it is too rough in shaking the erlenmeyer it can cause damage to blood cells. Ammonium hydroxide solution has a function as a diluent for blood samples and serves to prevent precipitation due to its alkaline properties [21]. After completely homogeneous, then the solution was divided into two and placed in a test tube of 5 mL each. Then in the second tube added sodium dithionite

as much as 25 mg which makes the color of the sample which was previously clear pink into a dark red color but still clear. The addition of sodium dithionite is intended to bind CO so that the bond with Hemoglobin is released [22]. Sodium dithionite is a white crystalline powder with a weak sulfur odor, and is an inorganic sodium salt that has a role as a reducing agent. Sodium dithionite will be dissolved in blood samples that are alkaline because the ammonium hydroxide mixture causes a reduction reaction so that the carboxyhemoglobin bond will be broken between CO and hemoglobin [23]. Then read the absorbance of each test tube using a Genesys 150 spectrophotometer with a maximum wavelength that has been found to be 414 nm and the concentration of COHb is obtained through the calculation of $(\Delta A)/(\Delta \text{Hb})$ multiplied by the conversion factor of CO saturation percent in Hb of 6.08% and the results are expressed in units of %.

B. COHb Level Examination Using Conway Diffusion Cell Method

In the examination of COHb by the conway diffusion cell method, the maximum wavelength is determined first in order to obtain the absorbance results of the sample. Then the standard curve is determined with 7 kinds of concentrations and the data is processed by making a graph so as to get the formula for the standard curve regression equation for determining COHb levels in samples. Before reading the sample on a UV-Vis spectrophotometer, there are stages before incubation and after incubation. The stage before incubation is the stage where the addition of different reagents to each bulkhead of the Conway cup. Bulkhead A on the left of the cup contains distilled water and blood, bulkhead B on the right of the cup contains 5 N sulfuric acid (H_2SO_4), and bulkhead C in the middle of the cup contains palladium chloride (PdCl_2) 0.005 N and then incubated for 1 hour which aims to make the CO molecules in the blood sample diffuse in the PdCl_2 solution contained in bulkhead C.

The 5 N sulfuric acid (H_2SO_4) reagent serves to liberate CO from the blood sample which will then react with the palladium chloride solution (PdCl_2) in the center of the cup. Sulfuric acid is a strong inorganic mineral acid, this substance dissolves in water in all comparisons. Sulfuric acid works as a catalyst and dehydrating agent so that it helps remove water content from the reaction and the addition of sulfuric acid will accelerate the reaction so that equilibrium is reached [24]. As for palladium, it is a transition metal in group VIII B which has long been known for its use in organic synthetic reactions, namely as a catalyst. PdCl_2 is a suitable reagent to capture CO that diffuses from blood samples during the incubation process, PdCl_2 which reacts with CO causes CO to be oxidized to CO_2 and Pd^{2+} will be reduced to Pd metal, the Pd metal formed appears as a palladium mirror or yellowish gold silver mirror on the surface of the PdCl_2 solution when viewed visually, this indicates the presence of carbon monoxide in the test sample [14].

Then the stage after incubation, namely the absorbance reading stage with the PdCl_2 solution which is reacted with 5% potassium iodide (KI) solution in a 25 mL volumetric flask with distilled water solvent. Potassium iodide is a white crystalline salt with the chemical formula KI, this compound is less easy to absorb water so it is easier to react. Iodide ions (I^-) in KI are easily oxidized to form I_2 by a strong oxidizing agent such as chlorine [25]. In this conway diffusion cell method, 5% potassium iodide (KI) will react with the remaining PdCl_2 (which is pipetted from the middle of the conway cup well after the incubation process) and will produce a brown I_2 color and then measure the intensity using a Genesys 150 UV-Vis spectrophotometer at the maximum wavelength that has been found to be 351 nm. Then it will be known the concentration of I_2 which is equivalent to the concentration of CO in the sample.

C. Differences in COHb Levels Using the Hinberg-Lang Method and the Conway Diffusion Cell Method

Normal levels of COHb in the blood are within the tolerance limit of 2% - <5% so that if COHb levels exceed 5% it will cause various symptoms such as nausea, dizziness and even shortness of breath [26]. According to the Occupational Safety and Health Administration (OSHA), which is the organization responsible for occupational health and safety, the normal value limit for COHb levels is no more than 5%. So for the Hinberg-Lang method and the conway diffusion cell method using the same normal value of <5%.

In the results of the study, all respondents in both methods had blood carboxyhemoglobin levels within normal limits, namely no more than 5%. This can occur because COHb in the blood is directly influenced by the concentration of CO in the air [27]. At low air temperatures CO levels will decrease, this is due to the less dense air at low temperatures causing CO gas concentrations to decrease [28]. Blood sampling for city transportation driver respondents was carried out in the afternoon with low air temperature or not too hot and the volume of passing vehicles was not too crowded so that CO gas exposure to the body was low. In addition, other factors that can influence are non-smoking habits or low levels of smoking consumption, the use of masks when working and based on the questionnaire, most respondents did not experience symptoms due to CO gas exposure.

In each method of examining COHb levels in the blood, the highest carboxyhemoglobin content is held by respondent number 14 (SA14), while the lowest is held by respondent number 9 (SA9). Based on the characteristics of the respondents, it is known that respondent number 14 is 68 years old, works for 9 hours per day, has been a public transport driver for 10 years, does not wear a mask while working, and has a smoking habit. When compared to respondent number 9, who is 39 years old, works for 8 hours per day, has been a public transport driver for 12 years, wears a mask while working, and has a smoking habit, it can be inferred that age, Hour of Work, and mask usage have an influence on the examination of COHb levels. Age is one of the factors of individual vulnerability. Theoretically, age is

directly proportional to blood COHb levels because the elastic properties of the lungs do not change at the age of 7-39 years but the tendency decreases after the age of 40 years, a decrease in cardiovascular capacity due to the aging process results in a person will be more vulnerable to CO exposure so that COHb levels will be higher [29].

Furthermore, the duration of exposure can also influence the examination of COHb levels in the blood. The duration of exposure affects COHb levels in the blood, so the longer someone is exposed to carbon monoxide gas, the greater the concentration of carbon monoxide gas in the blood [18]. The results of this research are also consistent with a study Anggarani et al., (2016) [30] that showed respondents who do not wear masks tend to have higher COHb levels compared to respondents who use personal protective masks while working.

Smoking habits can also be a factor in high blood COHb levels. Generally smokers have 3 times more carbon monoxide in their blood than people who do not smoke where 6% of hemoglobin has been used for carbon monoxide cigarettes and in active smokers COHb in the blood is around 4%-10% [14]. In this study, the questionnaire results showed that respondents who had a smoking habit with sample codes SA14, and SA7 ranked in the top 2. However, there are some exceptions such as those that occur in respondents with sample code SA13 who have the third highest COHb content but do not have a smoking habit and respondents with sample code SA9 who have the lowest COHb content but have a smoking habit, this could be due to age factors and the length of time respondents work per day. It is known that respondent SA13 is 64 years old with a working time of 10 hours per day, while for respondent SA9 is still 39 years old with a working time of 8 hours per day, so that the CO exposure received by respondent SA9 due to the length of work is smaller than respondent SA13 and because the age of respondent SA13 is more than 40 years old resulting in a decrease in cardiovascular capacity so that it will be more vulnerable to CO exposure than respondent SA9 whose age is younger.

As for the length of service, it does not have a significant impact on COHb levels in the blood because carbon monoxide (CO) does not accumulate in the body for extended periods [31]. Normally, blood contains approximately 0.5% COHb, which arises from CO produced by the body during the process of heme digestion metabolism, a component of hemoglobin. Furthermore, the half-life of CO leaving the bloodstream is about 6-8 hours in males [32].

While most respondents had similar COHb levels, whether using the Hinberg-Lang method or the Conway diffusion cell method, based on the Paired Sample T Test, there was a significant difference in COHb levels in the blood between these two methods among public transport drivers on Joyoboyo Street in Surabaya City. This can be seen by the value of COHb levels produced in the Hinberg-Lang method is higher than the Conway diffusion cell method. This may be because in the Hinberg-Lang

examination the blood sample is examined directly so that there is the influence of particles or other disturbing substances present in the sample when reading such as fat that can interfere with the examination. In addition, methemoglobin in the blood can also cause high concentrations [33]. This is different from the Conway diffusion cell method which uses PdCl₂ intermediates to capture CO gas in the sample, then reacted with KI for measurement of COHb levels in the blood so as to minimize the disturbing substances present in the sample.

The Conway diffusion cell method is still favored by some senior forensic toxicology experts because it can detect COHb saturation levels up to 10% or even higher. However, this method requires skills and extensive practice to obtain accurate quantitative results, and the examination of each sample takes a considerable amount of time due to the incubation period [11]. As for the Hinberg-Lang method, although it has the advantage that the volume of blood samples used is generally small, the cost is relatively cheaper, and the procedure used is faster and simpler, this method is sometimes not sensitive enough to rather low levels of CO in the blood [22]. There are several factors that need to be considered so as not to affect the reading of the results of COHb levels such as accuracy in taking or pipetting samples and various reagents, making good reagents, the reagents used must be of good quality, and the cuvette tubes used are clean so as not to affect the absorbance [34].

VI. CONCLUSION

Based on the results of the examination of this study obtained blood COHb levels in the Hinberg-Lang method, the average is 4.35% with the highest COHb levels obtained results of 4.9% in sample code SA14, for the lowest COHb levels obtained results of 3.2% in sample code SA9. While in the Conway diffusion cell method the average is 0.483% with the highest COHb level respondent of 0.64% in sample code SA14, and the lowest level obtained 0.34% in sample code SA9, when compared with the normal value of these levels in both methods including the normal category. and based on statistical tests it can be concluded that there is a significant difference from COHb levels in the blood using the Hinberg-Lang method and the Conway diffusion cell method

As for suggestions that can be conveyed to the public, especially city transportation drivers, are expected to use Personal Protective Equipment (PPE) such as masks while working to reduce the risk of exposure to carbon monoxide gas. As well as implementing a healthy lifestyle and reducing smoking habits as an effort to avoid health problems.

For the next researcher can conduct research on COHb levels in the blood using the same method in this study but in other locations or work professions that may have the same problems such as street vendors, pedicab drivers, and others.

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