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Relationship of Carboxyhemoglobin (CoHb) And Hemoglobin (Hb) Levels In Active Smokers In Gresik Regency

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ABSTRACT Smoking habits negatively affect the body to cause death. This is because cigarettes contain many harmful chemicals. The purpose of this study was to analyze the relationship between carboxyhemoglobin levels and hemoglobin levels in active smokers in Gresik Regency using the Conway dish method which was read with a spectrophotometer. This research was conducted in March-June 2023 at the Toxicology and Hematology Laboratory, Department of Technology, Medical Laboratory, Poltekkes, Ministry of Health, Surabaya using an analytical observational research type. The test material used is whole blood, with research variables of COHb and Hb levels. The results of the analysis showed an average COHB and Hb of 0.89% and 14.6 g / dl with a significance value of 0.304 using the Spearman correlation test. With the limitations of the variables studied, it can be concluded that there is no relationship between COHb and Hemoglobin in active smokers in Gresik Regency.

INDEX TERMS Level Carbon Monoxide, Level Carboxyhemoglobin, Level Hemoglobin.

I. INTRODUCTION

In Indonesia, smoking habits are still often found as in the 2018 RISKESDAS data, East Java ranks fifth in the region with the highest smoking rate in Indonesia at 28.9% of the population. According to 2019 East Java BPS data, it shows residents aged 15 years and over who have smoking habits, one of which is Gresik Regency, where a percentage of 351,195 residents smoke. The risk of health problems due to smoking includes cardiovascular disease, lung disease, tumors, endocrine diseases such as diabetes, metabolic syndrome, and chronic inflammation [1]. When COHb is present, the blood cannot transport oxygen to body tissues. Reduced oxygen supply of tissues leads to hypoxia. Due to the binding concentration of COHb, the tissues and cells of the body are ultimately deprived of oxygen. This can lead to blood flow problems such as increased blood viscosity, which in turn can lead to blood clots and narrowing of blood vessels due to lack of oxygen transport supply to the body's cells [2].

Cigarettes contain many harmful chemicals. One harmful chemical in cigarettes is carbon monoxide (CO). Carbon monoxide is an inhalable gas produced when cigarettes are burned. Carbon monoxide gas from cigarettes is inhaled into the lungs, flows into the alveoli, and then

enters the bloodstream. CO gas that enters the blood will bind to hemoglobin just as oxygen will bind to hemoglobin, forming carboxyhemoglobin (COHb) in the process. If too much COHb levels in the body can cause oxygen in the direction to decrease, causing a decrease in Hb. But this can be influenced by several factors such as the amount of cigarette consumption, length of smoking, to diet and healthy life in individual smokers. A study by Ishorina et al. [3]. showed that COHb levels increased in harmony with Hb were therefore positively correlated. Conversely, Wibowo [4] in his research, showed no relationship between smoking habits and hemoglobin levels in smokers exposed to CO. From the research that has been done there are differences in results between the relationship between COHb and Hb, so research is needed on the relationship between carboxyhemoglobin (COHb) levels and hemoglobin in active smokers in Gresik Regency. With the background mentioned above, smoking habits are still rife among people in Gresik Regency and have an impact on physical health.

II. METHODOLOGY

This study uses a type of analytical observational research because it is in accordance with the purpose of the study to determine whether the variables are related to each other.

Cross sectional design to analyze variable data collected at one specific point in time in a predetermined population to facilitate the sampling and examination process. The study was conducted in March-June 2023. The subjects in this study are active smokers in Gresik Regency with male gender because smokers are generally male, with a minimum smoking duration of 1 year, cigarette consumption per day of at least 3 cigarettes, and have a habit of smoking in coffee shops which are generally gathering places for people who smoke, this can have an impact on people around them. This examination is carried out in the Hematology and Toxicology laboratory of the Department of Medical Technology, Medical Laboratory, Surabaya Health Polytechnic.

A. COHb EXAMINATION PROCEDURE

The Conway diffusion method is used to measure COHb levels using a UV-Vis spectrophotometer. This method is better because it is more complex and there is an incubation time for the compound to react with the sample which is then read with a tool. The principle of this method is that whole blood samples are added CO-free aquades to lyse erythrocyte cells. Before the readings are carried out on the spectrophotometer, the conway dish is inserted reagents and samples in each part of the dish. The reagents and samples on the dish were incubated for ± 1.5 hours. After incubation, the PdCl₂ solution reacted with a 5% KI solution is measured on a device with a maximum wavelength to read the absorbance of the solution. [18] Readings on the tool are done by adding blanks to minimize errors and tool quality control.

The process of determining the Maximum Wavelength is carried out by inserting 10 mL of aquades into a 25 mL measuring flask, then adding 1 mL of 5% KI, 0.20 mL of PdCl₂ 0.005 N, and adding aquades until the mark. Absorbance is measured at 350–550 nm. The second stage is to determine the operating ti

me Put 10 mL of aquades into a 25 mL measuring flask, add 0.25 mL of blood, 1 mL of 5% KI, 0.20 mL of PdCl₂ 0.005 N, and add aquades until the mark. The solution is tested at a maximum wavelength of 60 to 120 minutes. The next stage of making the standard curve is preparing 6 pieces of 25 mL measuring flasks, each filled with aquades 10 mL and 1 mL KI, into measuring flasks 1-6, each added 0.005 N PdCl₂ solution as follows: Measuring flask 1 = 0.35 mL; Measuring flask 2 = 0.40 mL; Measuring flask 3 = 0.45 mL; Measuring flask 4 = 0.50 mL; Measuring flask 5 = 0.55 mL; Measuring flask 6 = 0.60 mL. Then added aqueous to the limit, beat until homogeneous, and measured the absorbance of the solution at the maximum wavelength.

The recess part of the conway is washed with cleaning liquid, then cleaned with aquades. The recess of the conway dish is filled as follows:

Part A = 1.5 mL of aquades

Part B = 0.2 mL H₂SO₄ 5N

Part C = 1.0 mL of PdCl₂ solution

After that, part A containing the aqueous is added 0.25 mL of blood, and the Conway dish is closed and left to work during operational time. After the operational time is complete, the pipette is inserted with 0.25 mL of PdCl₂ solution. The tip of the pipette must touch the base so that a thin layer of Pd metal is not sucked in. After that, put the contents of the pipette into a 25 mL measuring flask previously filled with 10 mL of aquades and 1 mL of 5% KI. By using aqueous as an absorbent form, the absorbance of the solution can be measured at λ maximal using a UV-Vis spectrophotometer (absorbent = 0)[14]

B. HEMOGLOBIN EXAMINATION PROCEDURE

Checking hemoglobin levels using the cyanmethemoglobin method with the Mindbray BC-5000 Hematology Analyzer tool. This method is the most accurate method compared to other methods because the tool works automatically. Before the inspection, the calibration of the tool is carried out to find out whether the reagent is working properly or not, as well as after the use of the tool, procedures for equipment maintenance are carried out.

This measurement principle depends on the absorbance of light by the photo detector. After the recovered venous blood is inserted into the EDTA tube containing the anticoagulant, the Mindray BC-5000 Hematology Analyzer is used to take readings. The tool automatically generates inspection results.

Hemoglobin examination using the Hematology Analyzer Mindray BC-5000. Before checking, the appliance must have been turned on and warmed up for 30 minutes. Blood with EDTA anticoagulants is homogenized first before the examination. On the device screen, the identity of the sample is entered (name, age, and address), then the blood sample is inserted into the suction device, and the knob is pressed once by holding the sample tube until the suction device comes out of the sample tube (a “beep” sound). The tool will process the sample automatically for one minute, then the results will appear on the screen and can be printed.

III. RESULTS

The study was conducted on 30 respondents of active smokers in Gresik Regency. Respondents are selected according to sample criteria, which include being male, having smoked for at least one year, consuming more than three tobacco cigarettes every day, and being willing to be a respondent (TABLE 1).

TABLE 1
CHO_b and Hb Results

No	Sample Code	COHb levels (%)	Hb levels (mg/dL)
1	001	1,38	14,4
2	002	0,43	13,9
3	003	0,50	14,9
4	004	1,18	14,8
5	005	0,63	14,3
6	006	0,86	14,1

7	007	0,67	13,8
8	008	0,42	15,4
9	009	1,34	14,4
10	010	1,56	13,9
11	011	0,62	14,2
12	012	1,09	14,2
13	013	0,62	13,8
14	014	1,37	14,9
15	015	0,44	13,9
16	016	1,35	14,5
17	017	0,63	13,9
18	018	0,49	16,0
19	019	0,49	15,5
20	020	0,56	15,1
21	021	0,36	15,5
22	022	1,96	13,3
23	023	0,68	12,4
24	024	0,62	15,9
25	025	1,10	17,8
26	026	0,68	15,7
27	027	0,91	15,3
28	028	0,87	13,8
29	029	1,18	13,9
30	030	1,75	15,4
average		0,89	12,4

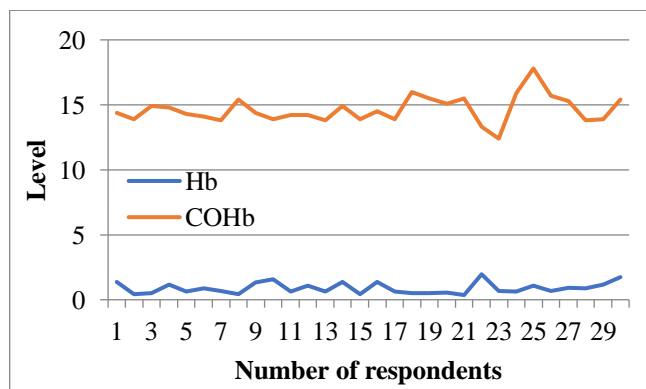


FIGURE 1. The results of the examination of carboxyhemoglobin (COHb) levels in the blood of 30 active smoker respondents in Gresik Regency.

The results of the examination of carboxyhemoglobin (COHb) levels in the blood of 30 active smoker respondents in Gresik Regency were below the normal value of carboxyhemoglobin (COHb) (COHb levels < 3.5%) (FIGURE 1). The highest COHb content result in sample 022 was 1.96%. The lowest COHb level was found in sample 021 at 0.36%. The results of checking blood hemoglobin (Hb) levels in 30 respondents of active smokers in Gresik Regency had an average of 14.6 g/dL. The highest hemoglobin (Hb) content resulted in sample 025, with a result of 17.8 g/dL. The lowest hemoglobin (Hb) level in sample 023 was of 12.4 g/dL. The results of the examination of COHb and Hb levels were analyzed using the SPSS program with the Spearman Test. After the data from the examination of carboxyhemoglobin and blood hemoglobin levels, the Spearman correlation test in the SPSS program version 16.0 obtained a Sig. (2-tailed) values of 0.304 > 0.05. Thus, it was concluded that there is no

relationship between carboxyhemoglobin and hemoglobin in the blood of active smokers in Gresik Regency.

IV. DISCUSSION

Based on data from research conducted by the author shows that COHb levels in table 1 of all respondents obtained normal results (COHb levels < 3.5%) this can be influenced by cigarette consumption of respondents per day, which are included in the category of light smokers and moderate smokers. Therefore, the COHb value does not indicate a high value.

While hemoglobin levels in respondents obtained mostly normal results and there was one hemoglobin level below normal values, namely 12.4 g / dL. Low HB levels can be influenced by several factors such as lack of consumption of nutritious foods and endurance.

The data obtained was then carried out a spearman correlation test to determine the relationship between two or more variables that are quantitative. The relationship between the two variables in question is whether the relationship is close, or there is no relationship.^[5] The two variables used in this study are COHb and Hb. The sig value obtained is 0.304 and the correlation value is -0.194 which means that the correlation relationship is not unidirectional or there is no relationship between the two variables.

This is not in accordance with research conducted by Ischorina et al. (2016) which found that there is a relationship between COHb and hematocrit in adult male active smokers. This difference can be influenced by the criteria on active subjects that are different from the author, in the study of Ischorina et al. (2016) using samples as many as 20 samples and there are criteria for smoking at least 10 cigarettes per day, while the authors using 30 samples with criteria for smoking at least 4 cigarettes per day.

In addition to the differences in the characteristics of the respondents used, several other influence factors that can distinguish the latest research from previous studies such as body health, environment and endurance factors of respondents.

VI. CONCLUSION

In a study entitled "The Relationship between Carboxyhemoglobin (COHb) and Hemoglobin (Hb) Levels in Active Smokers in Gresik Regency" showed no correlation between COHb and Hb in active smokers in Gresik Regency, with a significance value of 0.304 and a correlation value of -0.194 which means that the correlation relationship is not unidirectional or there is no relationship between the two variables. Respondents' COHb levels obtained normal results, while respondents' Hb levels were obtained by one respondent who exceeded normal values. This result can be influenced by the consumption of smokers who are still in the category of light and moderate smokers, as well as by their lifestyle. For the community, especially active smokers, it is expected to control smoking consumption in an effort to

reduce the side effects that will occur on the body in the future. Efforts to reduce cigarette consumption can also have an effect on people around them, so they are not often exposed to cigarette smoke. In the community, especially active can improve a healthy lifestyle and habituate a clean environment from cigarette smoke.

REFERENCES

- [1] Amelia R, Nasrul E, Basyar M (2016). The relationship of smoking degree based on the Brinkman Index with hemoglobin levels. *Andalas Health Journal*. 2016;5(3):619-24.
- [2] Anam, F. (2019). Indonesian Teenagers, Stay Away from Cigarettes! Solo: Metagraph, Creatif Imprint of Triad.
- [3] Andayani, A., Aprilia, A., & Firsta Yosika, G. (2022). Comparison of hemoglobin levels in smokers based on age at Nganjuk Hospital. *J. Synthesis Submitted*: May 12, 2022(1), 1–8.
- [4] Anonymous. (2021). Mindray BC-5000 Hematology Analyzer Work Instructions. Poltekkes Kemenkes Surabaya: Medical Laboratory Technology
- [5] Aqil, M. & Roy E. 2015. SPSS and SAS Applications For Experiment Design. Yogyakarta : Absolute Media.
- [6] Health Research and Development Agency, (2018). *Risikedas National Report 2018*. Publishing Institute of Health Research and Development Agency, Jakarta. ISBN 978-602-373-118-3
- [7] Dewanti, I. R. (2018). Identification of CO Exposure, Habits, COHb Blood and Worker's Health Complaints on Basement Waterplace Apartment, Surabaya. *Journal of Environmental Health*, 10(1), 59.
- [8] Banten Health Office, (2017). *Understanding Smoking and Its Consequences*. dinkes.bantenprov.go.id/read/berita/488/Pengertian-Merokok-Dan-Akibatnya.html
- [9] Erdina, A. (2016). Differences in Hemoglobin Levels between Passive Smokers and Nonsmokers in Class X and XI High School Students in Sukoharjo. (Doctoral dissertation, Sebelas Maret University).
- [10] Fikry, A. (2017). Erythrocytes and data interpretation. In Thesis : National Faculty of Science and Technology, Jakarta.
- [11] Gandasoerbrata R. (2013). *Clinical Laboratory Guide*. Jakarta: Dian Rakyat.
- [12] Glantz, S. A. & Bareham, D. W. (2018). *E-Cigarettes : Use, Effects on Smoking, Risks, and Policy Implications*. DOI: 10.1146/Annurev-publhealth-040617-013757. Epub 2018 Jan 11
- [13] HHS. (2014). *The Health Consequences of Smoking-50Years of Progress: A Report of the Surgeon General*. A Report of the Surgeon General.
- [14] Hiru, D. (2015). *Hemoglobin*. PT Gramedia Main Library. Jakarta.
- [15] Ischorina, F., Suliati, & Suprabawati, O. D. (2016). The relationship of Carboxyhemoglobin (Hb-CO) levels to hemoglobin (Hb) levels and hematocric levels (PCV) in active smokers. *In Health Science Analysts*, 5(2), 380–387.
- [16] Juniawati, E. R. (2020). Analysis of carboxyhemoglobin (Cohb) levels in volunteer traffic control officers in Solo City using the Conway Diffusion Cell method.
- [17] Ministry of Health of the Republic of Indonesia. (2018). *InfoDATIN: World Diabetes Day*. Data and Information Center of the Ministry of Health.
- [18] Lushniak, B.D. (2014). Antibiotic Resistance: A Public Health Crisis. *Public Health Report*, 129, 314-316.
- [19] Maulidya, Frisca Chairunnisa (2022) Correlation of carboxyhemoglobin (Cohb) levels with hemoglobin levels and erythrocyte index in pedicab drivers in South Surabaya. Thesis, Poltekkes Kemenkes Surabaya.
- [20] Nururrahman (2014). The Effect of Smoking on Health and Human Character Formation, Proceedings of the National Seminar. Cokroaminoto Palopo University
- [21] Ministry of Health Regulation Number 28 of 2013. (State Gazette of the Republic of Indonesia Year 2010 Number 585).
- [22] Putri ME., 2018. Correlation of the number of cigarettes with Co levels in adolescent smokers at Smk Kota Jambi, *Jurnal Akademika Baiturrahim Jambi*, 7(2): 123.
- [23] Rahmi. (2018). Examination of hemoglobin levels in active smokers in Helvetia Medan Village. *Regional Development Industry & Health Science, Technology and Art of Life*, ISSN : 2620-6048, 176–185.
- [24] Rosita, B., & Andriyati, F. (2019). Comparison of cadmium metal (Cd) levels in the blood of active and passive smokers at bus terminals. *Sainstek : Journal of Science and Technology*, 11(2).
- [25] Salem, H. & Katz, S. A. (2016). *Inhalation Toxicology 3rd Edition*. ISBN 9781138033665 Published October 19, 2016 by CRC Press
- [26] Sugiyono, D. (2013). *Quantitative, Qualitative, and Action Research Methods*.
- [27] Thaniyavarn, T. (2019). Carboxyhemoglobin. Retrieved December 5, 2022, from Medscape: <https://emedicine.medscape.com/article/2085044-overview>
- [28] Wibowo, D. V., Pangemanan, D. H. C., & Polii, H. (2017). Relationship of Smoking with Hemoglobin and Platelet Levels in Adult Smokers. *Journal of E-Biomedicine*, 5(2). <https://doi.org/10.35790/ebm.5.2.2017.18510>
- [29] World Health Organization (WHO). 2013. WHO report on the Global Tobacco Epidemic 2013: enforcing bans on.