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Carbon Monoxide Levels in The Lungs of Workers in City of Makassari in 2023

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ABSTRACT

***Background**: Smoking is an unhealthy behavior that can cause health problems that affect the damage to the body's organs, namely the lungs. Measurement of carbon monoxide levels using a smoke analyzer is an alternative for early detection of health problems in the lungs due to smoking. **Aims**: This study aims to determine smoking behavior and the amount of cigarette consumption with carbon monoxide levels in the lungs of workers in Makassar City. Research **Methods**: This study design is a quantitative analysis, with a cross-sectional study method, using secondary data from the smoking cessation program, Makassar City Health Office, with random sampling techniques obtained 157 men aged 40-60 years. Secondary data obtained are the results of carbon monoxide (CO) measurements using a smoke analyzer by blowing on the device. Processing of data using SPSS 25 with the chi square test. **Results**: The results showed that there were people who had a habit of smoking very high levels of carbon monoxide in the lungs (61.9%) with a p value = 0.000 and the number of cigarettes consumed during one year very high levels of carbon monoxide in the lungs (72.0%) with a p value = 0.000. **Conclusion**: there is a relationship between smoking habits and the number of cigarettes consumed by workers who smoke. Preventive interventions such as lung CO examination is an assessment of risk factors for health problems.*

***Keywords**: Impact of Smoking, Smoke Analyzer, Smoking Behavior.*

INTRODUCTION

The harmful effects of smoking can be seen from the many compounds present in a single cigarette. The problem of lung disease is one of the risk factors of smoking behavior that triggers health problems such as cough symptoms, shortness of breath and other symptoms such as chest pain and coughing up blood. The fatal impact of smoking behavior is that deaths caused by non-communicable diseases increase and will continue along with changes in unhealthy behavior. (Holt *et al.*, 2013).

The disease caused by smoking behavior that is often found with persistent signs of airflow limitation in the airway that is persistent and progressive, which is associated with an increased chronic inflammatory response in the airway, lung parenchyma due to exposure to harmful particles or gases caused by smoking (KLHK, 2020) .

Smoking is one of the bad habits that we often encounter in various places, until now people still smoke in any place. The impact that is immediately seen is that there are cigarette butts, the smell of cigarettes and the availability of ashtrays. This illustrates that existing regulations have not been able to overcome the problem of smoking behavior in the community. This smoking habit is caused by the chemicals contained in cigarettes, namely nicotine. Nicotine is a psychoactive substance that is easily available throughout the world. Nicotine as a whole-serves as the main ingredient in the form of tobacco, cigarettes, and others in humans. This shows a complex mechanism involving the

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nervous system in the brain that gives opiate and dependence effects so that smokers find it difficult to stop smoking (Tiwari *et al.*, 2020). One of the other dangerous contents is carbon monoxide, a toxic gas that has no taste and smell. If you inhale too much carbon monoxide gas, red blood cells will have more to do with carbon monoxide than oxygen. As a result, muscle and heart function will decrease.

Makassar is one of city in South Sulawesi with high prevalence of smokers. In 2018, the prevalence of smokers aged >10 years in Makassar city was 24.51% (Ministry of Health, 2018), indicating that smoking behavior starts at an early age due to the lack of optimal promotive and preventive efforts among the community. In addition, smoking in childhood is a predictive factor for smoking in adulthood.

Makassar City Health Office through the smoking cessation program in primary health care by providing services, which are screening adult men to check carbon monoxide levels in the lungs. This study aims to determine smoking behavior and the number of cigarettes consumed daily on carbon monoxide levels in the lungs. This is in line with the goal of a smoke-free area, which is to create a clean and healthy area without cigarette smoke in a specified place.

METHODS

This study design is a quantitative analysis, with a cross-sectional study method, using secondary data from the smoking cessation program, Makassar City Health Office. The data used were data on individuals who had participated in the smoking cessation program in March-October 2023. Data collection involved local health centers, samples were taken that were included in the inclusion criteria, among others, men aged 40-60 years, had smoked, currently still smoking, and willing to participate in early detection of carbon monoxide in the lungs. The sampling technique was carried out by simple random sampling. 157 samples were obtained that met the criteria. Secondary data obtained are the results of carbon monoxide measurements using a smoke analyzer by blowing on the device. This statistical analysis is to see the relationship between smoking habits and the number of cigarettes consumed with CO levels in the lungs.

Data processing is checking the completeness and clarity of data, assigning codes to each variable, entering data into a computer program and checking that the data is free from errors. This data was analyzed using SPSS 25 with the analysis technique used was the chi square test to determine the relationship between two variables.

RESULTS AND DISCUSSION

Uses a smoke analyzer detector that helps measure CO in the breath and also the bloodstream by conducting a non-invasive breath test (Ramani *et al.*, 2023). The goal is to determine a person's level of cigarette use, whether the person is a smoker or not. This smoke analyzer is easy to use, by blowing or exhaling on the device and the results will be seen on the detection device layer.

The number of respondents in this study was 157 people consisting of 63 smokers and 94 non-smokers with an age group ≥40 years-60 years who were still actively working.

Table 1. Identity of respondent

	n (157)	%
Age		
>60	45	28,7
40-49	52	33,1
50-59	60	38,2
Education		
Academy/Higher Education	32	20,4
Junior High School	104	66,2
Senior High School	21	13,3
Job Type		
Civil Servant	27	17,2
Contract Worker	74	47,1
Private Sector Employees	26	16,6
Labor	30	19,1
Smoking Habbit		
Yes	63	40,1
No	94	59,9

Secondary data source Makassar Health Office 2023

Table 1. The largest age category is at the age of 50-59 years 38.2%, age 40-49 years 33.1% and age> 60 years 28.7%. Then the highest educational status at the junior high school level was 69.4%, Academy / College 20.4% and high school level 10.2%. The distribution of types of work in this study included civil servants 17.2%, contract employees 47.1%, private

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employees 16.6% and laborers 19.1%. From the results of this study found people who have a habit of smoking as much as 40.1% and who do not smoke 59.9%.

Smoking behavior that starts from adolescence to productive age is one measure of the length of smoking in respondents. Furthermore, the longer the duration of smoking, the greater the risk of the impact of smoking behavior on lung health. People aged ≥40 years are at high risk of diseases caused by cigarette smoke that can affect lung health. This is due to the length of smoking time with age.

The level of education affects smoking behavior, the lack of knowledge of a person with low education about health and the difficulty of receiving healthy messages will have an impact on healthy living behavior. Smoking habits such as heavy smokers are longer than light and moderate smokers, the longer people with smoking habits, the more cigarettes consumed every day.

Table 2. Total Cigarette Consumption

Cigarette consumption per/day	n (63)	%
<10 cigarettes	37	58,7
>21 cigarettes	5	7,9
11-20 cigarettes	21	33,3
Total	**63**	**100,0**

Secondary data source Makassar Health Office 2023

Based on table 2, the total number of respondents who have smoking behavior is 63 people. Smoking behavior is less than 10 cigarettes per day as much as 58.7%, 11-20 cigarettes 7.9% and more than 21 cigarettes per day as much as 33.3%. The large number of cigarettes smoked every day is due to the effect of addiction so that smokers increase the number of cigarettes every day.

Table 3. Correlations between Smoking Behavior and Lung CO Levels

Smoking Behavior	CO levels in the lung		Total	P
	Low	High		
Smoker	24 (38,1%)	39 (61,9%)	63 (100%)	0,000
Non-Smoker	89 (97,4)	5 (5,3%)	94 (100%)	0,000

Table 3. The statistical test found a significant relationship between smoking behavior and lung CO levels. Smoking behavior had high lung levels of 61.9% and those who did not smoke had low lung CO levels of 97.4%. After doing the chi-square test, the p value is 0.000 so that the p value is <0.05.

Smoking habits that are too frequent can affect lung function. Based on the Indonesian pulmonary physician association for smoker criteria, CO levels are ≥10 ppm. The increase in CO levels in smokers is due to CO gas from inhaled cigarettes (Hilyah *et al*., 2021). so that daily smoking behavior has a higher risk of CO exposure in the lungs than those who do not smoke frequently.

Table 4. Correlation between the number of cigarettes consumed and lung co levels

Number of cigarettes consumed	CO levels in the lung		Total	P
	Low	High		
High Risk	7 (28,0%)	18 (72,0%)	25 (100%)	**0**
At risk	106 (80,3)	26 (19,7%)	132 (100%)	**0**

Table 4, based on the statistical test of the number of cigarettes consumed with CO levels in the lungs, the number of cigarettes consumed by the at-risk group who had high-risk levels of CO in the lungs was 72.8% and people who did not have low levels of CO in the lungs were 80.3%. After the chi square test, it was found that there was a relationship between the consumption of cigarettes at risk with Co levels in the lungs with a value of 0.000 so that the p value <0.005.

Smoking behavior using conventional cigarettes is as risky as people who use e-cigarettes. Based on the Indonesian pulmonary physician association for smoker criteria, CO levels are ≥10 ppm. The increase in CO levels in smokers is due to CO gas from inhaled cigarettes (Hilyah *et al*., 2021)

These detection tools produce different combinations of sensitivity and specificity but are still quite high. However, it is often reported that CO analyzers have a low ability to detect light smokers or regular smokers.

A lung carbon monoxide (CO) test called a smoke analyzer CO detector can help measure CO levels in a person's breath and bloodstream by conducting a non-invasive breath test. This test is conducted to determine the level of CO

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levels in a person's lungs, both active smokers and passive smokers. also has the potential to have an influence in increasing smoking cessation efforts. With at-risk individuals aged ≥40 years, having a history of cigarette smoke exposure both active and passive smokers.

Smoking is the single most preventable cause of death and disease worldwide and is the leading cause of chronic obstructive pulmonary disease (Lugg *et al.*, 2022). Carbon monoxide is one of the harmful substances contained in cigarettes, a substance that is toxic to the body. Its affinity for hemoglobin is 300 times stronger than oxygen. If we are exposed to this gas too much and too often it will reduce or eliminate the ability of hemoglobin to circulate oxygen throughout the body. If the concentration of CO is very high, it can cause death because CO can affect the body's nervous system, cardiovascular system, fertility and all organs of the body.

The measurements of the results of the CO examination in the lungs are if the results are found to be 1-6 ppm in the normal category, 7-10 ppm in the light/passive smoker category, 11-20 ppm in the smoker category, and ≥20 ppm in the heavy category. The results of this study were 157 respondents aged ≥40 years who were smokers or not who had an active smoking habit of 63 people and 94 people who were not smokers. In the age range above 40 years is very at risk of exposure to lung disease because the range of smoking time has been long with the number of cigarettes above 10 cigarettes. In heavy smokers, the largest group was at the age of 50-59 years, namely 60 people (38.2%). The risk of acute and chronic CO exposure and toxicity associated with heavy smoking, cigar, pipe, or water pipe smoking, Further research is needed to better understand the relative risks of smoke vapor products and CO. Chronic exposure to high CO levels may lead to polycythemia secondary to CO-mediated chronic functional anemia and cellular hypoxia resulting in high circulating erythropoietin levels (Dorey *et al.*, 2020).

The number of cigarettes consumed is a factor of the nicotine content in cigarettes. Neuronal nicotinic acetylcholine receptors (nAChRs) play an important role in mediating the effects of nicotine in the brain. These receptors are pentameric ligand-gated ion channels consisting of various subunits. The main subunits involved in nicotine addiction include α4, α6, ß2, and ß4 sub-units. Activation of nAChRs by nicotine leads to the release of neurotransmitters such as dopamine, which contributes to the reinforcing effects of nicotine and the development of addiction (Son *et al.*, 2020).

A dose-response relationship was observed between smoking duration and eCO levels, which showed a moderate positive correlation (Spearman rank correlation coefficient = 0.463, P < 0.001).This study provides valuable insight into the relationship between exhaled CO levels and smoking status, which emphasizes the importance of such assessments in addiction cessation services and respiratory health *(Ramani et al.*, 2023).

In another study, very frequent smoking behavior prior to the device examination, CO levels were obtained at baseline, followed by 5, 10, 15, 30 and 45 minutes after cigarette use. There was a significant increase in CO levels for conventional cigarettes compared to other modes (Vasthare *et al.*, 2018).

The level of education is dependent on a person's ability to adapt, which is measured normatively based on the level of formal education. Education is one of the intellectual abilities of human resources. Based on the results of this study, the junior high school education level was 69.4%, the Academy/ College was 20.4% and the lowest was the high school level of 10.2. According to research, low education has a chance of smoking 3 times compared to higher education.

The results of this study (table 3) suggest that there is a relationship between smoking behavior and the content of CO levels in the lungs. People who have a habit of smoking there are high levels of CO in the lungs. Variables that affect the blood COHb levels of passive smokers are how long exposure to cigarette smoke to passive smokers is in the smoking location, the presence or absence of an air ventilation system, the distance between smokers and non-smokers and how many smokers are in that location. The use of electronic cigarettes and clove cigarettes both have nicotine, in research (Jankowski *et al.*,

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2019) smoking behavior that uses e-cigarettes is more than twice the dependency p<0.001 than clove smokers. Similarly, double user dependence on nicotine is higher when using e-cigarettes. This shows that nicotine in e-cigarettes is much more addictive.

The respiration of smokers to carbon monoxide levels is 72.5% influenced by duration, frequency, the last period of smoking, and the distance of residence to the source of exposure. Reducing smoking frequency and quitting smoking can prevent and control carbon monoxide respiration. (Apoorva *et al.*, 2023). CO levels in the smoker group were significantly different from non-smoker levels, namely 22 ppm / red zone in smokers higher than non-smokers by 1-5 ppm/green zone.

There were 97.4% who did not have smoking behavior and 5.3% who had high levels of CO in their lungs. In another study, one of the impacts of frequent exposure to CO resulted in one of the lung diseases. A total of 26.7% of the study subjects were exposed to CO substances (n = 172). We found significant differences (P < 0.001) among study subjects who were in the yellow/red zone of the Smokerlyzer device or with a history of bronchial asthma. Our results revealed that among the subjects with a history of bronchial asthma and/or CO who were in the yellow/red zone of the Smokerlyzer (Ramani *et al.*, 2023). Potential molecular mechanisms for non-smokers include inflammation, oxidative stress, airway remodeling, and lung aging (Pega *et al.*, 2021)

Table 4, the relation between the number of cigarettes consumed with CO levels in the lungs shows that the number of cigarettes consumed is very risky, namely, cigarette consumption of more than 11-21 cigarettes per day is a smoker at risk of experiencing CO levels in the lungs by 72.0% and low levels of CO in the lungs by 28.0%. The number of cigarettes consumed at risk is the number of cigarette consumption of less than 10 cigarettes per day experiencing low levels of CO in the lungs by 80.3% and high levels of CO in the lungs by 19.7%. Low CO levels did not differ significantly between those who had tried cigarettes, only once, sometimes or once per week CO levels were significantly higher p<0.05 among those who reported that they smoked 1-6 or 6 cigarettes per week. There is a significant correlation between consumption of the number of daily cigarettes with expiratory air CO levels in smokers with a value of p=0.009, found in smokers with estimated CO levels of 15-34 ppm when smoking 20 cigarettes / day. Increased CO levels when increasing cigarette consumption to 20-60 ppm when 40 cigarettes per day. A heavy cigarette smoker presented twice with symptoms of CO toxicity and was found to have levels 21.8 to 24.2%. A heavy smoker presented twice with symptoms of CO toxicity and was found to have levels of 21.8 to 24.2%. symptoms of toxicity in the working lung after smoking (Dorey *et al.*, 2020).

The level of CO exposure determines the resulting health effects. The key to reduce the CO-related burden of disease is education. By knowing the levels of CO in the lung the importance of CO detectors, smokers can be more educated and more concern to prevention the impact of smoking. The government can further improve stop smoking services for active smokers and increasingly expand the application of smoke -free areas to protect passive smokers from exposure to cigarette smoke or carbon monoxide.

Smoking cessation efforts are the most effective intervention to reduce exposure to cigarette smoke that risks the development of obstructive pulmonary disease, so prevention and control efforts must be actively carried out at the basic health service level, namely Health Center. By increasing promotive services through the dissemination of information about prevention, increasing knowledge about the harmful effects of smoking and helping to change clean living behavior.

Through efforts to prevent smoking-related diseases, the Makassar City Health Office conducts preventive efforts, namely examining CO levels in the lungs for men aged ≥40-60 years. This is done to activate smoking cessation programs in basic health facilities and to integrate government programs in implementing smoke-free areas. Through the examination of CO in the lungs, it can be known the exposure to the dangers of cigarette smoke in the workplace to lung health, both active and passive smokers.

Preventive interventions such as lung co examination is an assessment of risk factors for health problems in the

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community, involving cross-sectors in an integrated manner including the implementation of a smoke-free zone policy which can be the most leverage for behavior change.

CONCLUSION

Smoking is an unhealthy behavior that affects health. Exposure to cigarette smoke actively or passively affects CO levels in the lungs. In this study, there is a relationship between smoking behavior and carbon monoxide levels in the lungs and there is a relationship between the number of cigarettes consumed per day and carbon monoxide levels in the lungs.

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