

## Carbon Monoxide (Co) Level in Exhaled Breath of Smoker High School Students

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### ABSTRACT

**Background:** Smoking behavior is one of the health behavior problems throughout the ages among young generations in Indonesia. Hence, smoking or tobacco use remains a global epidemic as it is devastating global health and economic costs. **Aims:** This study aims to find the relationship between smoking and CO Levels in exhale breath among high school students and to describe the proportion of smoking and other behavior risk factors. **Method:** This is a cross-sectional study with 438 respondents from 5 high schools in Sawangan Primary Health Care working area who are available to participate in this study and to be tested by the smoke analyzer. **Result:** The result of this study shows that from 297 (67,8%) smokers, 56 (12,8%) students were daily smokers, 177 (40,4%) students were periodic smokers, and 64 (14,6%) students ever tried smoking even just once in a lifetime. This study also describes that the CO level in exhaled Breath was 2,64 ppm on average with a maximum level of 34 ppm. Using the Kruskal Wallis test, this study found a significant relationship between smoking behavior and CO level in exhaled breath. Besides that, the chi-square test in this study shows that there were different proportions between sex, type of smoke, having a smoker in a family member, and willingness to quit smoking with smoking behavior. **Conclusion:** it can be concluded that smoking behavior impacts the level of Carbon Monoxide inside the body and smoking behavior can be differentiated and impacted by multiple factors.

**Keywords:** CO Level, High School Students, Smoke Analyzer, Smoking Behavior

### INTRODUCTION

Smoking behavior is one of health behavior problems throughout the ages among young generations in Indonesia as it is widespread among adults and teenagers. This refers to an article states the use of tobacco among youth (girls and/or boys) has increased in 63 of 135 countries surveyed, and now over 50 million 13 to 15-year-olds smoke cigarettes or use smokeless tobacco products (Strategies, 2022).

Smoking or tobacco use remains a global epidemic as it is devastating global health and economic costs. It has been released that tobacco use caused more than 8.67 million deaths worldwide (6.53 million men, 2.14 million women) and approximately US \$2 trillion in economic damage in 2019 alone, although most deaths were attributable to smoking, 1.3

million died from second-hand smoke exposure (Strategies, 2022).

In Indonesia, the conditions at this time indicate that tobacco consumption remains steadily high. There are 60,8 million adult men and 3,7 million adult women who are smokers (Martini *et al.*, 2022). The Global Adult Tobacco Survey stated that the prevalence of tobacco use among Indonesia's adult populations has experienced insignificant changes as it only marginally decreased from 36.1% in 2011 to 34.5% in 2021 (Swarnata *et al.*, 2024). Furthermore, the data also show an increasing trend of tobacco use among children and adolescents. The prevalence of smoking in the 10 -19 years age group has increased from 7,2% in 2013 to 9,1% in 2018 or almost 20% higher than the prevalence in the previous five years (Martini *et al.*, 2022).

Indonesia specifically Depok City

already has regulations controlling tobacco such as tobacco advertising, promotion, and sponsorship ban, illustrated health warnings on tobacco packaging and labelling, including applying the Smoke Free Area in order to prevent and overcome the adverse effects of cigarette smoke. Ironically, smoking behavior in Indonesia being culturized by society even though many smokers agree and admit that smoking could lead to various diseases such as cancer (Husein & Menga, 2019). Hence, smoking is still a problem in Indonesia with a huge number of consumers (Martini *et al.*, 2022).

Many young age generations initiate smoking every year making the smoking epidemic worse and start consuming cigarette at a young age endures prominent danger for the future. Therefore, purpose of this study was to present the relationship between smoking behavior and CO Level in exhaled breath among high school students and to describe the proportion of smoking behavior risk factors.

## METHODS

This is a cross-sectional study to find the relationship between smoking and CO Levels in exhale breath among high school students and to describe the proportion of smoking and other behavior risk factors.

### Population and Sample

Population in this study was the high school students aged 12 to 18 years old who enrolled in state junior and senior high school in Sawangan Primary Health Care Area, Depok City, West Java Province. Sample of this study was students in the population who meet the inclusive criteria which include the students aged 12 - 18 years old who enrolled in the selected schools and willing to join this study and willing to be tested by smoke analyzer. Total sample size was 438 students which was calculated by using Slovin Sample Size.

### Sampling Selection

List of schools were schools located in the working area of Sawangan Primary Health Care. The list consisted of total 25 schools with total population 6007 students. 5 schools were selected to meet the required sample size. The schools were selected randomly by simple random

sampling technique.

### Variables

Variables in this study were student age, sex, smoking behavior, type of smoke, age start smoking, reason to smoke, cigarette amount per day, cigarette amount per week, duration of smoking in month and year, way to get cigarette, willing to quit smoking, reason to quit smoking, knowledge about smoking impact, smoking behavior in family, smoking behavior in relatives, and CO level in exhaled breath as the result of smoke analyser testing.

### Data Collection

The data was collected by using questionnaire conducted by Health Ministry of Indonesia named smoking behavior screening questionnaire for age school children. Variables collected with questionnaire in this study were sex, age, smoking behavior, duration of smoking per month, the amount of cigarette consumed per week, type of smoke consumed, reason to smoke, and willing to quit smoking. Meanwhile, the CO level of respondents in this study were measured by using Micro<sup>+</sup>™ Smokerlyzer Bedfont SN: CM916471 5019.

### Interview Based Survey

Students from 5 schools were interviewed with questions from the questionnaire and being asked their willingness before being tested by using smoke analyser to find the CO level in exhaled breath. The students answered the questions and the enumerator fill the answer sheets. In average, it took 15 - 20 minutes per students to complete all the questions and being tested with smoke analyzer.

### Data Analysis

The data was analysed using SPSS 26, while Microsoft Excel was used for data entry. This study descriptively described the proportion of sex, age, smoking behavior, duration of smoking per month, the amount of cigarette consumed per week, type of smoke consumed, reason to smoke, willing to quit smoking, and the result of CO test. Furthermore, this study used Kruskal Wallis test to statistical analysis the relationship between smoking behavior and the result of CO test. Then, this study used chi square test to statistical analysis the proportion between sex of respondent, smoking behavior, reason to smoke, and willing to quit smoking with

smoking behavior. Normality test also being conducted in this study for CO level variable with result of Kolmogorov-smirnov test of normality was 0,000 significance value or it can be concluded that the CO level data is not normal.

## RESULTS AND DISCUSSION

### Descriptive

Smoking is the act of inhaling and exhaling the fumes of burning plant material which the act is most commonly associated with tobacco as smoked in cigarette, cigar, or pipe and it contains nicotine that is addictive and can have both stimulating and tranquilizing psychoactive effect (Sweator, David T.; Roses, Christine; Field, 2024). The result of this study showed that from 438 respondents, 141 (32,2%) students were not a smoker, while 297 (67,8%) others were smoker or ever tried smoking once in a lifetime, with details of the result 56 (12,8%) students were daily smoker, 177 (40,4%) students were periodic smoker, and 64 (14,6%) students were ever tried smoking even just one smoke.

Smoking is associated with numerous adverse diseases and it is proofed by a study that reported the association between the percentage of smokers and the prevalence of smoking-attributable morbidity showed significant results with p value <0,005 on the variables of diabetes mellitus (p = 0,000),

hypertension (p = 0,000), and lung tuberculosis (p = 0,008) (Martini *et al.*, 2022).

A young age teenager or adolescent begins smoking differs by gender and the exact age of beginning smoking also varies and different in all populations, which the risk of initiation in smoking can be higher due to family and social causes for participating easily in social groups or even due to social beliefs that promotes smoking (Grapatsas *et al.*, 2017). Table 1 describes the numeric variables in this study and shows that the mean score of respondent's age in this study were 15,78 (16) years old with the youngest were 12 years old and the oldest were 18 years old. This study also reveals that the respondents were evenly start smoking at 13,78 (14) years old with the youngest age was 7 years old and the oldest age at 17 years old.

For the amount of smoking per week, this study shows that the average of smoke consumed per week was 17 smokes with the lowest amount was 1 smoke per week and the highest amount was 112 smokes per week. The smoking duration found in this study was 25,42 times per month with the lowest duration was 1 time per month and 132 times per month. This study also describes the CO level in exhaled breath was 2,64 ppm in average with minimum level was 0 ppm and maximum level was 34 ppm.

**Table 1.** Descriptive of Numeric Variables

No.	Variables	Mean	Min.	Max	Sd
1.	Age	15,78	12	18	1,156
2.	Age of start smoking	13,78	7	17	2,081
3.	The amount of smoke per week	17	1	112	16,143
4.	Duration of smoking per month	25,42	1	132	21,657
5.	CO test result	2,64	0	34	2,635

### Analytic

Chemical substances such as nicotine that contain in cigarettes are harmful (Taufiq, 2023). According to a study, CO level >11 parts per million (ppm) found in 94 (25.5%) smokers was associated with a significant increase in death and in overall population, CO > 11 ppm but not smoking was associated with an increased rate of all-cause death (Dillinger *et al.*, 2024). The objective of this study is to measure the relation between smoking behavior and CO level in exhaled breath among high school

students. By using Kruskal Wallis test as being showed in table 2, there was a significant relationship between smoking behavior and CO level in exhaled breath with pvalue score was 0,000 (pvalue<0,05). The result of this study align with a study by Amaliah, *et al* that indicated a relationship between smoking status and CO levels among high school student in Banda Aceh City (Amaliah *et al.*, 2023). Another study held by Pan *et al* also found that smokers had higher concentration of baseline exhaled CO than non-smokers (Pan *et al.*, 2021).

**Table 2.** Kruskal Wallis Test Result of Smoking Behavior and CO Level

No	Variables	N	Mean Rank	Pvalue
	<b>Smoking Behavior</b>			
1	Daily Smoker	56	238,76	
2	Periodic Smoker	177	260,62	
3	Ever tried smoker even just one smoke	64	185,44	0,000
4	Non-Smoker (Never Smoke)	141	157,82	

This study also reveals the different proportion between smoking behavior risk factors as illustrates in table 3 that there were significant different proportion between sex (pvalue=0,000), type of smoke (pvalue=0,007), willing to quit smoking (pvalue=0,000), and having smoking family members (pvalue=0,037) with smoking behavior. Moreover, this study also found that the proportion of male smoker still higher than female smoker and most of them were periodic smoker.

Hence, the result of study is in accordance with Zyambo, et al study that illustrates the factors statistically associated with smoking status among school-going adolescents in Zambia were age, grade, friends' cigarette smoking status, parents smoking status, being taught at school about the dangers of smoking, and having a discussion at school about smoking and health (Zyambo *et al.*, 2022). Besides that, other study also presented that there was a higher percentage of males among smokers which higher percentage of males were in the heavy smokers' group than light smokers (95.0% vs. 71.4%, p-value = 0.039) (Pan *et al.*, 2021). As also reported in a study conducted by Ozgunay *et al.* which found the significant intergroup difference between male and female (pvalue=0.099) (Ozgunay *et al.*, 2018).

Conventional smoke such as cigarette was still being favored by high school students with 45 (80,4%) of daily smokers, 145 (81,9%) of periodic smokers, and 54 (84,4%) of ever tried smoker were using conventional smoke. Hence, only 10 (17,9%) of daily smokers and 19 (10,7%) of periodic smokers were using both of conventional and electrical smoke. Consimilar with this study, a study held by Arisona *et al.* also demonstrated that majority of students prefer to use conventional cigarettes (91.7%) compared to e-cigarettes (6.8%) or shisha cigarettes (1.5%) due to Indonesians far earlier know conventional cigarettes (Arisona *et al.*,

2020).

Most of high school smokers still have an eagerness to quit smoking which 38 (67,9%) of daily smoker, 166 (93,8%) of periodic smokers, and 63 (98,4%) of ever tried smoking students stated that they want to stop smoking. This result is consistent with Albayrak *et al.* study which reported 80% of students who smoked declared that they want to quit smoking and among the smokers, 55,2% of them tried to quit smoking even just able to stop smoking for a period between one day and one month at maximum (Albayrak & Ergun, 2015).

Although only few smokers having smoking family members, this study reveals that there was a significant different proportion between having smoker in family members with smoking behavior which 12 (21,4%) of dailysmokers, 38 (21,5%) of periodic smokers, 24 (37,5%) of ever tried smoking smokers, and 44 (31,2%) of non-smokers were having smoker in their family members. The result of this study was in line with Azzahra and Andriyani study which revealed that there was a relationship between the influence of parents on teenager and smoking behavior (pvalue of 0,043) (Azzahra, 2022). A study conducted by Nurhasana, *et al* also shows that

Even though this study found that there was no significant different proportion between reason to smoke variable with smoking behavior, friends could become the greatest influence of high school student smoking behavior followed by curiosity, filling the leisure time, and having smoker in their family member. From 56 daily smokers, 30 (53,6%) of them were smoking by following their friends while 20 (35,7%) of them were smoking in order to fulfil their curiosity and 3 (5,4%) of them were smoking during their leisure time. Azzahra and Andriyani on their study found that there was a relationship between peers-influence with smoking behavior (pvalue

of 0,000) (Azzahra, 2022). Moreover, the result of Mahathir study showed a significant correlation between peer conformity and smoking behavior among male adolescents (pvalue=0,000) (Mahathir *et al.*, 2020).

**Table 3.** Chi Square Test Result of Smoking Behavior Risk Factors

Independent Variables	Smoking Behavior								PValue
	Daily Smoker		Periodic Smoker		Ever tried smoker even just one smoke		Non-Smoker		
	n	%	n	%	n	%	n	%	
<b>Sex</b>									
Female	1	1,8	2	1,1	2	3,1	34	24,1	0,000
Male	55	98,2%	175	98,9%	62	96,9%	107	75,9%	
<b>Type of Smoke</b>									
Conventional Smoke (Cigarette)	45	80,4%	145	81,9%	54	84,4%	-	-	0,007
Electronic Smoke (Vape)	1	1,8%	13	7,3%	9	14,1%	-	-	
Both Conventional and Electric Smoke	10	17,9%	19	10,7%	1	1,6%	-	-	
<b>Willing to Quit Smoking</b>									
Yes	38	67,9%	166	93,8%	63	98,4%	-	-	0,000
No	18	32,1%	11	6,2%	1	1,6%	-	-	
<b>Smoking Family Members</b>									
No	44	78,6%	139	78,5%	40	62,5%	97	68,8%	0,037
Yes	12	21,4%	38	21,5%	24	37,5%	44	31,2%	
<b>Reason to Smoke</b>									
Following Friends	30	53,6%	97	54,8%	42	65,6%	-	-	0,662
Family Influence	3	5,4%	5	2,8%	1	1,6%	-	-	
Curiosity	20	35,7%	62	35%	20	31,3%	-	-	
Leisure time	3	5,4%	12	6,8%	1	1,6%	-	-	
Releasing Stress	0	0%	1	0,6%	0	0%	-	-	
<b>Total</b>	56	100%	177	100%	64	100%	141	100%	

**CONCLUSION**

From this study, it can be concluded that smoking behavior impact the level of Carbon Monoxide inside body and smoking behavior can be differentiated and impacted by multiple factors. The amount of male smoker still higher than female smoker, conventional smoke such as cigarette was still being preferred, most of high school smokers still have an urge to quit smoking, only few smokers having smoking family members, and although there was no significant different proportion between reason to smoke with smoking behavior, friends could become the greatest influence of high school student smoking behavior followed by curiosity.

Therefore, we should start to consider the usage and the implementation of a good and sustained health school curriculum as well as take into account the relationships among

parents, teachers, friends, and tobacco regulatory laws for bringing a behavior change and substantially reduce the rate of smoking among high school students. Besides that, the practiced tobacco control regulations such as Smoke Free Area should be evaluated as it will have an impact on people health status within the area and will lightly prevent the curiosity of young generation. Moreover, quit smoking services in every primary health care need to be optimized and strengthened as well as enhancing the number of smoking behavior detection/survey among teenagers then establishing a non-smoker peer campaign as a role model among adolescents.

This study has potential limitation. First, the interview session must be quick as possible due to participants are only available during a certain period. Second, variable of willing to quit smoking could be biased as the participant interviewed by health worker and other working

partners as well as conducted in a public space of school. In consequence, the participant might have internal pressure to answer the question with proper answer. Even though interviewer never failed to explain that their answers were confidentially guaranteed.

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