Comparison of Cholesterol Levels in Cigarette Smokers and Electronic-Cigarette Smokers

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ARTICLE INFO	ABSTRACT
	Smoking causes an increase in cholesterol levels in the blood. Tobacco has been widely known for its nicotine content that has a considerable influence on the increase in blood lipid levels. Normally, lipids play an important role in all aspects of biological life but excessive cholesterol causes changes in lipid composition, induces ROS formation and lipid oxidation. This process can also cause damage to proteins and DNA, changing cellular function, which causes tissue damage. This research applied an analytical survey, with an analytical cross-sectional design involving 30 subjects. The mean cholesterol level of tobacco smokers was 210.0 mg/dL and the mean cholesterol level of electronic-cigarette smokers was 123.73 mg/dL. The average difference in cholesterol levels among smokers was tested using one-way ANOVA, with p-value = 0.000 (p <0.05). The cholesterol level of the tobacco smoker group was significantly higher when compared to the electronic smoker group.

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INTRODUCTION

Smoking has become a significant problem that remains difficult to solve until today. Various impacts and dangers of smoking have been made public, but smoking habits in the community are still difficult to stop (Indra et al., 2015). It is known that cigarettes contain substances that are toxic to the body such as tar, nicotine, lead, and carbon monoxide, which can affect health (Safyudin & Subandrate, 2016). The data from Riskesdas (2018) recorded that the prevalence of smoking in adolescents aged 10-18 years increased from 2013 (7.20%) to 2018 (9.10%). This figure was still far from the 2019 RPJMN target of 5.4%. Whereas, male smokers aged> 15 years in 2018 were still at a high rate (62.9%) and were still considered to have the highest prevalence of male smokers in the world (Fauzi et al., 2019).

Tobacco is consumed in various ways, such as eaten (*nginang*, usually combines with lime and betel nut), smelled (snuff), smoked (in the form of a cigar, pipe with tobacco, or cigarette smoke), and others (Gopdianto et al., 2013). The epidemic of tobacco-related problems due to smoking is currently one of the biggest public health threats in the world (Damayanti, 2016). Tobacco use and exposure to cigarette smoke are the main causes of cardiovascular disease, including heart attacks and strokes, contributing to around three million deaths per year (WHO, 2018). Nowadays, cigarettes are developing from tobacco cigarettes to electronic cigarettes. The emergence of this type of cigarette makes tobacco smokers begin to switch to using electronic cigarettes because of the social construction of electronic cigarettes. An electronic cigarette is considered healthier, modern, and effective to help people to quit smoking (Santana et al., 2018)

Electronic nicotine delivery system (ENDS) is commonly known as electronic cigarette or e-cigarette and vape. This tool is intended to transfer nicotine by heating vape liquid into an inhaled aerosol. Vape liquid is a solution containing nicotine, flavoring agents, and solvents such as propylene glycol or glycerin (Bhalerao et al., 2019).

The adverse health consequences of the use of electronic cigarettes for primary smokers and those exposed to cigarette smoke come from aerosol inhalation and nicotine levels that enter the respiratory system. Nicotine is known to be very toxic at high doses, and cases of nicotine poisoning due to vape fluid have increased in recent years. Nicotine is also a pharmacologically active biomolecule that causes addiction, changes brain function, and is known to be harmful to fetal growth if exposed during pregnancy (Bhalerao et al., 2019)

Smoking is a factor that causes an increase in cholesterol in the blood (Sanhia et al., 2015). It has long been known that tobacco contains nicotine and has a considerable influence on increasing blood lipid levels (Rao & Subash, 2013). Normally, lipids play an important role in all aspects of biological life, which among others are functioning as a hormone or hormone precursor, helping the digestive system, providing energy, having storage functions, and serving as metabolic fuel. Lipids act as functional and structural compounds in a biomembrane and form insulation to allow nerve conduction or to prevent heat loss (Devaranavadgi et al., 2012). High cholesterol levels in the body can trigger diseases, such as high blood pressure, stroke, heart disease, gallstones, and kidney failure (Hayati and Sulistyawati, 2015).

Excessive cholesterol causes changes in lipid composition, which will induce ROS formation and lipid oxidation (Amiya, 2016; Manzoni et al., 2019). This process can also trigger damage to proteins and DNA, changing cellular function, which instigates tissue damage (Manzoni et al., 2019). Besides, atherosclerosis, which is a condition in which the arteries are narrow and become less flexible, occurs when fat, cholesterol, and other substances in the blood form plaque that builds up in the artery walls. Openings in the arteries are narrow when plaque builds up, and blood can no longer flow properly to various parts of the body (CDC, 2014). Nicotine, a poison contained in smoke tobacco, is known to have an effect on the secretion of catecholamines and

cortisol which can then change the metabolism of carbohydrates and fats. Changes in lipid metabolism can initiates dyslipidemia (Girish & Harish, 2018). Therefore, this study aimed to compare the cholesterol levels in tobacco smokers and electronic smokers.

MATERIALS AND METHODS

This research has conducted an ethical clearance with registration number 251/KEPK/STIKES-NHM/EC/VII/2019. This study applied an analytical; survey research, with cross-sectional analytical design, conducted at one time and once, no follow-up to look for the relationship between the independent variable and dependent variable, by taking a sample of tobacco smoker groups and electronic smoker group on Jalan Garuda, Sampang Regency.

The sample size is the number of members used as samples. If the population is> 100, a sample of 15-30% is taken. If the population is <100, a sample of 25-50% is taken (Sugiyono, 2012). The samples were taken using community research sampling with tobacco cigarettes and electronic cigarettes to investigate the blood cholesterol levels of the samples located in Jalan Garuda, Sampang Regency. A total of 30 respondents took part in this study, consisting of 15 tobacco smokers and 15 electronic cigarette smokers.

RESULT AND DISCUSSION

Table 1 presented that the majority of respondents were aged 24-26 years (56.7%). The respondents covered 50% of tobacco smokers and 50% of electronic-cigarette smokers. As demonstrated in Table 2, the highest cholesterol level in the group of tobacco smokers was 235 mg/dL and the lowest level was 166 mg/dL. Meanwhile, the highest and the lowest cholesterol levels in the group of electronic-cigarette smokers were 142 mg/dL and 106mg/dL, respectively. In general, the highest cholesterol level was found in the group of tobacco smokers and the lowest

cholesterol level was in the group of electronic smokers.

Table 3 shows that the average cholesterol level in tobacco smokers was 210.0 mg/dL, while in electronic-cigarette smokers was 123.73 mg/dL, signifying that the average cholesterol level in tobacco smokers was higher than that in electronic-cigarette smokers. The one-way ANOVA statistical test resulted in significantly different cholesterol levels between the smokers in both groups, with p-value = 0.000 (p <0.05).

Several studies have reported an increase in the cholesterol levels in the smoker group when compared to the non-smoker group (Alharbi, 2011; Devaranavadgi et al., 2012; Gopdianto, Wuling & Ticoalu, 2013; Hassan et al., 2013; Adelina, Handayani & Kurniawan, 2016; Attard et al., 2017; Girish & Harish, 2018). However, the studies on differences in cholesterol levels in tobacco smokers and electronic-cigarette smokers are limited.

It has long been known that the main content of tobacco, nicotine, has a profound effect on the increased lipids in the blood. Lipids have an important role in all aspects of life such as hormones or hormone precursors, play a role in the digestive system, as an energy reserve, and have a functional and structural role in cell membranes and form insulation to allow nerve conduction or to prevent loss of body heat, but the amount is closely related to metabolic abnormalities (Oyewole et al., 2013).

The clearly illustrated study of the effects of smoking is hypercholesterolemia, which is associated with an increased risk of heart disease (Szkup et al., 2018). Some of the mechanisms that cause the accumulation of lipids due to smoking include (a) nicotine stimulates the adrenal sympathetic system which causes increased secretion of catecholamines resulting in increased lipolysis and an increase in free fatty acids (FFA) in serum which if it continues to occur will result in increased secretion of hepatic FFA and hepatic triglycerides together with very-low-density lipoprotein (VLDL) in the bloodstream; (b) the

decrease in estrogen occurs due to smoking which will decrease HDL; and (c) the presence of hyperinsulinemia in smokers causes an increase in cholesterol, LDL and TG due to decreased lipoprotein lipase activity (Hassan et al., 2013).

There are several studies comparing tobacco cigarettes with electronic cigarettes. One study compared tobacco smoke with electronic-cigarette vapor to assess indoor air quality and determine the risk of a significant decrease in air quality with the previous one but no significant risk. Meanwhile, several studies showed that electronic cigarettes prevent exposure to tobacco-burning poisons indoors and do not affect the results of complete blood tests or hemodynamic parameters (Kim & Baum, 2015).

Table 1. General characteristics of respondents from Gunung Sekar Village, Jalan Garuda, Sampang Regency in 2019

Characteristics	Frequency (n)	Percentage (%)
Age (Years)		
18-20 years old	8	26.7
21-23 years old	5	16.7
24-26 years old	17	56.7
Types of Cigarettes		
Tobacco	15	50.0
Electronic	15	50.0

Table 2. Results of Blood Cholesterol Level Test using the COD-PAP Method

No	Respondent Code	Cholesterol levels of tobacco smokers (mg/dL)	No	Respondent Code	Cholesterol levels of electronic-cigarette smokers (mg/dL)
1	R1	166	1	R16	166
2	R2	175	2	R17	120
3	R3	177	3	R18	123
4	R4	180	4	R19	110
5	R5	183	5	R20	131
6	R6	187	6	R21	106
7	R7	192l	7	R22	138
8	R8	195	8	R23	142
9	R9	202	9	R24	117
10	R10	218	10	R25	127
11	R11	222	11	R26	125
12	R12	225	12	R27	137
13	R13	228	13	R28	132
14	R14	230	14	R29	115
15	R15	235	15	R30	119

Table 3. Average Blood Cholesterol Levels in Tobacco Smokers and Electronic-Cigarette Smokers

Types of Cigarettes	Cholesterol Levels (mg/dL) Mean±SE	p-value
Tobacco	210.0±6.00	0.000*
Electronic	123.73±2.76	

Evidence supporting the use of electronic cigarettes to help stop smoking is limited due to the lack of clinical studies (Løchen, 2017). Short-term studies have found that the use of electronic cigarettes helps prevent the dangers caused by smoking tobacco in a large number of volunteers who want to quit smoking tobacco (Bullen et al., 2010; Polosa, 2015). However, it should be noted that several studies did not assess the effect of electronic-cigarette use on smoking cessation and re-smoking in the long term (Kaur et al., 2018).

In this study, although electronic smoker cholesterol levels were lower when compared to tobacco smoker cholesterol levels, electronic cigarettes are not necessarily safe to use. The widespread and increasing use of electronic cigarettes is quite alarming due to the lack of research on the long-term health effects of their use on biological systems. Therefore, future research should establish, in real-life conditions, not only the long-term, but also the short-term negative effects of electronic cigarette use, both in active and passive users, and provide mechanistic insight into the effects of their use (Qasim et al., 2017).

CONCLUSION

This study concludes that the cholesterol level of the tobacco-cigarette smoker group is higher than the cholesterol level of the electronic-cigarette smoker group, with significantly different average cholesterol levels.

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