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Differences in Alcohol Consumption Duration on Cholesterol Levels

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Abstract

Background: Alcohol is toxic containing hydrophilic ethanol so that it easily enters the body which will be converted into acetaldehyde by aldehyde dehydrogenase (ALDH) and oxidized to acetate. Excessive acetate is converted into acetyl-CoA which is converted into fatty acids that will continue to accumulate to increase cholesterol. Consuming alcohol within 5 years with a frequency of 3-4x per week can increase cholesterol levels. The study aimed to determine the difference in the duration of alcohol consumption (≤ 5 and > 5 years) on cholesterol levels. **Method**: Analytic observational research with a cross-sectional approach. Samples were taken randomly from as many as 20 people who consumed alcohol ≤ 5 and > 5 years at a cafe in Salatiga. Cholesterol levels were examined using the POCT method, and then cholesterol levels were statistically analyzed using Shapiro Wil and Independent T-Test. **Result**: The mean cholesterol levels of respondents who consumed alcohol ≤ 5 and > 5 years were 172.30 ± 16.63 mg/dL and 236.80 ± 34.74 mg/dL, respectively. Cholesterol levels of respondents who consume alcohol ≤ 5 are still in the normal category while cholesterol levels of respondents who consume > 5 years fall into the high-risk category. Based on the statistical results, it is known that the data is normally distributed and there are differences between respondents who consume alcohol ≤ 5 years and > 5 years. **Conclusion**: The cholesterol levels of respondents who consumed alcohol > 5 years were higher than those who consumed alcohol ≤ 5 years.

Keywords: duration of alcohol consumption, acetaldehyde, cholesterol level, POCT, high-risk

INTRODUCTION

Alcohol or alcoholic beverages contain ethanol which is a psychoactive and toxic substance and is additive. Alcohol consumption caused 2.6 million deaths worldwide in 2019, with the highest death rates per 100,000 people in Europe (52.9) and Africa (52.2). Global alcohol consumption data shows that there are approximately 400 million people with alcohol use disorders aged 15 years and above, and approximately 209 million with alcohol dependence [1]. Deaths due to alcohol abuse in Indonesia are around 65, with more than 13,000 people having alcohol abuse-related illnesses [2]. According to a Ministry of Health survey in 2023, 2.2% of the Indonesian population consumed alcoholic beverages aged 10 years and above [3].

Ethanol in alcohol when consumed can activate oxidative and nonoxidative metabolism. The main pathway of ethanol metabolism occurs due to the hydrophilic nature of ethanol that easily diffuses passively through biological membranes, and can reach concentration equilibrium in the cell. Oxidative metabolism of ethanol occurs in hepatocytes and is more dominant than nonoxidative. Ethanol will be oxidized in 2 stages sequentially by alcohol dehydrogenase (ADH) and aldehyde

dehydrogenase (ALDH) to produce the final product of acetate. The imbalance of free NAD and NADH, the enzymes that convert acetaldehyde into acetate, can cause an imbalance in the concentration of redox couples which in turn can convert acetate units into fatty acids. Fatty acids will affect fat metabolism, so fat will accumulate in the liver [4].

Alcohol consumption can pose health risks even at low levels, but most alcohol-related harm comes from episodic heavy alcohol consumption or continuous alcohol consumption. The level of risk depends on several factors including the amount of consumption, frequency of drinking, individual health status, age, gender, and other individual characteristics [1]. Habitual alcohol consumption can impact health risks both physically such as liver disease, heart disease, various types of cancer, and mentally such as depression, anxiety, and alcohol use disorders [1,5].

The results showed that consuming alcohol within 1-5 years, frequency of 3-4 times per week, and amount > 10 shots increased the respondents' HDL levels by increasing lipase activity and decreasing cholesteryl ester transfer protein (CETP) [6]. Excessive alcohol consumption can also increase serum C-Reactive Protein (CRP), leading to inflammation and risk of coronary heart disease (CHD). In addition, alcohol consumption in large portions can also clinically increase serum cholesterol and triglyceride levels [7].

Cholesterol is a type of fat needed by the body, circulates in the vascular system, and is produced in the liver, skin, intestines, brain, and stomach [8,9]. Cholesterol can also come from outside the body, namely through the consumption of animal foods such as meat, poultry, fish, margarine and milk. Cholesterol is needed by the body in certain amounts to carry out metabolic processes, including as an ingredient for the formation of cell membranes, fat emulsions, bile acid production, and so on [9]. However, if the amount of cholesterol is excessive, it can cause problems in organs such as blood vessels, heart and brain [10]. Cholesterol levels in the body can be determined through laboratory examinations, one of which uses the POCT (Point Care of Test) method. The advantages of the POCT method include being cheap, easy to use and can even be done at home without having to go to the laboratory, the samples needed are few and the results can be known quickly [11]. Cholesterol levels required by the body in normal conditions are < 200 mg/dL. If the cholesterol level in the body in the range of 200-239 mg/dL is in the high risk limit category, while if the cholesterol level in the body> 240 is in the high risk category [11,12]. The purpose of this study was to determine the difference in the duration of alcohol consumption (≤ 5 and > 5 years) on cholesterol levels.

METHOD

This type of research is analytic observational with a cross sectional approach. The study was conducted in September 2023. The study population was alcohol drinkers in one of the cafes in Salatiga. The study sample was alcohol drinkers ≤ 5 years and > 5 years with the determination of the total sample using a saturated sample of 20 people who met the inclusion and exclusion criteria. The inclusion criteria included male respondents, smokers, and more than 21 years of age. While the exclusion criteria in the study were having a history of liver disease, DM, and hypotorid. The tools

and materials used in this study were sterile lancets, POCT, and capillary blood. Measurement of cholesterol levels using the POCT method using capillary blood samples from respondents who have consumed alcohol ≤ 5 years and > 5 years. The research data were primary data obtained from direct measurement of cholesterol levels using the POCT method, and supported by data from observations and filling out questionnaires by respondents. Data from the measurement of respondents' cholesterol levels were statistically analyzed using the Shapiro-Wilk test and continued with the independent t-test.

RESULTS AND DISCUSSION

The results in this study were obtained from the examination of cholesterol levels using capillary blood samples of alcohol-drinking respondents with a duration of consumption ≤ 5 years and > 5 years. Measurement of cholesterol levels using the POCT method, the data is presented based on the reference value category of cholesterol levels presented in Table 1. Normal cholesterol levels < 200 mg/dL; high risk limit > 200-239 mg/dL; and high risk > 240 mg/dL.

Table 1. Cholesterol Levels Based on Duration of Alcohol Consumption

Lama Konsumsi	Cholesterol Level Categories Based on Reference Values								
	Normal or Desirable (< 200 mg/dL)			Borderline High Risk (200-239 mg/dL)			High Risk (> 240 mg/dL)		
	mg/dL±SD	n	%	mg/dL±SD	n	%	mg/dL±SD	n	%
≤ 5 years	170±20,2	10	100	-	0	0	-	0	0
> 5 years	-	0	0	217±10,9	6	60	271±26,2	4	40

The results of the examination of cholesterol levels in respondents with a duration of alcohol consumption ≤ 5 years are known to all respondents (100%) in the normal category with an average cholesterol level of 170 mg/dL. Whereas in respondents who consumed alcohol > 5 years, most respondents (60%) were in the high risk category with an average cholesterol level of 217 mg/dL, and 40% of respondents were in the high risk category with an average cholesterol level of 271 mg/dL (Table 1).

Table 2. Statistical test results.

No	Statistical Test	p-value
1.	*Shapiro Wilk*	
	Duration of Alcohol Consumption ≤ 5 years	.918
	Duration of Alcohol Consumption 5 years	.365
2.	*Lavene*	.049
3.	*Independent Sampel T-Test*	.000

The normality test results showed that the cholesterol level data for both groups of respondents who consumed alcohol ≤ 5 years and > 5 years were normally distributed (p-value > 0.05). However, the variance homogeneity test results obtained a p-value of 0.049 so that the data is not homogeneous. These results indicate a significant difference between the variance of the group of respondents who consumed alcohol ≤ 5 years and respondents who consumed alcohol > 5 years. Data analysis was continued with t-test, and the significance value of 0.000 was obtained so that there was a significant difference in cholesterol levels between groups of respondents who consumed alcohol with a duration of consumption ≤ 5 years and > 5 years (Table 2).

Based on the results of the study, it is known that all respondents who consume alcohol ≤ 5 years have cholesterol levels in the normal category. Whereas respondents who consumed alcohol > 5 years were mostly in the borderline high risk category and some were in the high risk category. This is because the duration of alcohol consumption is one of the factors that greatly affect the risk that arises as a result of consuming alcohol. Based on the results of the study, it is also known that the longer a person consumes alcohol, the higher the cholesterol level. A person who consumes alcohol within 12 months has a lower risk of being affected by alcohol consumption [13]. The longer a person consumes alcohol, the greater the risk that will be caused as a result of consuming alcohol.

Alcohol contains ethanol which is addictive and is a psychoactive substance that can cause changes in the body's systems, both chronically and acutely [14,15]. Ethanol can activate metabolic pathways both oxidatively and nonoxidatively. Ethanol is water soluble so that it can easily diffuse passively through biological membranes, and can reach concentration equilibrium in cells. Oxidative ethanol metabolism is more dominant than nonoxidative metabolism. Ethanol will be oxidized to produce the final product, acetate, through 2 stages. Sequentially, ethanol oxidation is carried out by the enzyme, alcohol dehydrogenase (ADH), into acetaldehyde. The next stage of acetaldehyde will be converted into acetate by aldehyde dehydrogenase (ALDH) [4]. The oxidation of ethanol to acetaldehyde mainly occurs in the hepatocytes of the liver which is responsible for the metabolism of alcohol that enters the body [16]. Both oxidation stages involve the coenzyme NAD+ (Nicotinamide Adenine Dinucleotide) which reduces NADH (Nicotinamide Adenine Dinucleotide Hydrogen). An imbalance of free NAD and NADH can cause an imbalance in the concentration of redox couples which in turn can convert acetate units into fatty acids. The liver will channel acetate to other tissues, so that acetate is converted to acetyl-Coa which will eventually be fully oxidized to carbon dioxide through the citric acid cycle. Coa coenzyme will produce phosphatidic acid by phospholipases such as patatin 3 or adiponutrin [4].

While the nonoxidative metabolism of alcohol involves several enzymes that will catalyze the incorporation into different molecules such as glucuronic acid, phosphate, phosphatidylcholine or fatty acids. Fatty acids formed through both oxidative and nonoxidative metabolic pathways will affect fat metabolism, causing fat to accumulate in the liver. Fat accumulation in the liver can lead to steatosis and liver fibrosis [4,16,17].

Alcohol consumption over a period of time can cause fatty acid buildup, so the longer a person consumes alcohol, the more fatty acids accumulate. The accumulation of fatty acids can affect the

amount of fat in the body, one of which is cholesterol. Alcohol metabolism that takes place over a longer period of time can trigger non-oxidative pathways that have relatively little impact on the process. This pathway involves various enzymes that conjugate alcohol with endogenous metabolites, which can affect lipid metabolism and increase cholesterol production [18]. The group of respondents who consumed alcohol for more than 5 years reflects the potential impact of longer-term alcohol consumption on health. This indicates that there is significant variability in the body's response to longer periods of alcohol consumption.

Differences in the duration or duration of alcohol consumption may affect cholesterol levels, especially when divided between respondents who consumed alcohol for less than 5 years and those who consumed alcohol for more than 5 years. Respondents who consumed alcohol for less than 5 years tended to show lower cholesterol levels, which may be related to the body's adaptation to alcohol over a relatively short period of time. This adaptation allows the body to manage fat metabolism more efficiently. On the other hand, respondents who consumed alcohol for more than 5 years showed a tendency to have cholesterol levels within the high-risk range. The mechanism of high cholesterol levels due to increased lipoprotein lipase activity and changes in very low-density lipoproteins may affect blood lipid composition and contribute to elevated cholesterol levels. Impaired lechitin-cholesterol-acyl-transferase enzyme in alcoholic cirrhotic patients may also inhibit the formation of HDL molecules that transport cholesterol from body tissues to the liver for excretion. As a result, excessive alcohol consumption can lead to elevated cholesterol levels and cardiovascular health risks [19].

The results of this study are reinforced by the results of statistical tests which state that there are significant differences in cholesterol levels between groups of respondents who consume alcohol with a duration of consumption ≤ 5 years and > 5 years. This study is also in line with other studies which state that consuming alcoholic beverages has an impact on increasing serum cholesterol and triglyceride levels clinically [20]. However, in addition to the duration of consumption there are other factors that are very influential, namely the type, frequency and concentration / amount of alcohol consumption [21]. These factors were not investigated in this study, which is a limitation of the study.

CONCLUSION

The duration or duration of alcohol consumption affects the cholesterol levels of respondents, the cholesterol levels of respondents who consume alcohol ≤ 5 years are measurably lower than those of respondents who consume alcohol more 5 years. Alcohol consumption is not recommended because it can increase blood cholesterol levels.

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