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THE CORRELATION OF BLOOD SUGAR LEVELS WITH THE ELASTICITY OF CORONARY ARTERIES

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ABSTRACT	Keywords
<p>Coronary arteries are blood vessels that carry oxygen and nutrients to the heart muscle. These vessels can experience constriction due to the accumulation of plaque which causes atherosclerosis. Atherosclerosis is characterized by reduced coronary artery elasticity. Blood glucose levels are one of the factors that cause atherosclerosis. The aims of this study were to determine whether there was a correlation between blood sugar levels with the elasticity of coronary arteries.</p> <p>This study is an analytical study with a cross-sectional design. The population in this study were all patients who visited the Gyated Tulungagung treatment clinic that was more than 30 years old and female. Through an accidental sampling technique, 30 respondents were obtained. The study was conducted from March 1, 2016, to May 1, 2016. Data was collected using a quantum resonance magnetic analyzer (QMRA) to determine the value of blood sugar levels and the value of elasticity of coronary arteries. The data obtained were analyzed statistically by bivariate linear regression tests to determine whether there was a significant correlation between blood sugar levels with the elasticity of coronary arteries.</p> <p>The results showed that the p-value is $0.000 < 0.05$, which means that there was a significant correlation between blood sugar levels and the elasticity of the coronary arteries. High blood glucose levels can damage the vascular endothelium and also increasing platelet age great, so that can resulting atherosclerosis. Every individual should be able to control blood sugar levels with a healthy lifestyle and early detection regularly to prevent the decrease of coronary arteries elasticity because that can lead to coronary heart disease (CHD).</p>	<p><i>Atherosclerosis, the elasticity of coronary arteries, blood sugar level, coronary heart disease</i></p>

INTRODUCTION

Coronary arteries are blood vessels that carry oxygen and nutrients to the heart muscle (Hospital Authority, 2016). This artery can narrow if there is an accumulation of plaque (Jafar, 2011). Besides this plaque buildup can also cause arteries to stiffen or experience a decrease in elasticity commonly known as atherosclerosis. This is in accordance with the opinion of Sloop et al. (1999) in Rahman (2012) which states that atherosclerosis can cause acute or chronic manifestations that cause thickening and stiffness in blood vessels. Thickening and narrowing of the coronary arteries can cause coronary heart disease (PJK). Majid (2008) states that the narrowing of the coronary arteries due to the process of atherosclerosis or seizures or a combination of both are the main causes of coronary heart disease.

CHD is one of the cardiovascular diseases which is the number one cause of death in the world (Iskandar, Abdul Hadi, 2017). Cardiovascular disease kills 17.9 million people each year which constitutes 31% of all deaths in the world (WHO, 2019). CHD is a major health problem in most developed countries (Anwar, 2004). Heart disease is the number one cause of death in Indonesia, and the most feared is coronary heart disease (Redaksi Agromedia, 2009). Based on the 2013 Riskesdas data, it was found that in Indonesia, CHD had the highest prevalence of cardiovascular disease at 1.5% (Kemenkes, 2017).

One of the causes of CHD is high blood sugar levels (hyperglycemia). According to Yuliani, Oenzil, and Iryani (2014), people with type 2 diabetes mellitus have a risk of two to four times heart disease when compared to people who do not have diabetes mellitus. WHO (2019) states that increasing blood glucose is one of the factors that can damage heart health. Chronic hyperglycemia is a major risk factor for morbidity and mortality in cardiovascular

disease (Wagenknecht et al., 2006 in (Agus Darmawan, Dodik Tugaworo, 2011).

Based on the background described, it is known that hyperglycemia and atherosclerosis can cause CHD, but it is not yet known whether there is a correlation between blood sugar levels and atherosclerosis which is characterized by reduced coronary artery elasticity. This study aims to determine whether there is a relationship between blood sugar levels and the elasticity of coronary arteries. It is hoped that the results of this analysis can be useful as a consideration in efforts to prevent interventions through early detection and general health promotion.

MATERIALS AND METHODS

This study is an analytical study with cross-sectional design. The population in this study were all female patients who visited the Gipateda Tulungagung care clinic over 30 years old. The sampling technique used in this study was an accidental sampling technique so that 30 respondents were obtained. Data collection was carried out from March 1, 2016 to May 1, 2016. Data on blood sugar levels and elasticity of coronary arteries were collected using a quantum resonance magnetic analyzer (QMRA), a high-tech medical device that can detect various problems in human organs through acupuncture point on the palm. The collected data was analyzed with the minimum, maximum, mean, standard deviation, and bivariate linear regression tests to determine whether there was a significant relationship between blood sugar levels and the elasticity of coronary arteries.

RESULTS

The description of the research variable data which is continuous data is presented and analyzed based on the results of the average, maximum, minimum, and standard deviation. The presentation of this data aims to

determine the average value of blood sugar levels compared to the maximum value and the average value of elasticity coronary arteries compared to the minimum value, the data is as follows:

Table 1. The description of data on variable blood sugar levels and elasticity of coronary arteries

	N	Mini mum	Maxi mum	Me an	Stan dard Devia tion
Blood sugar levels	30	2.106	11.960	7.328	2.449
Elasticity of coronary arteries	30	0,990	2,000	1,448	0,326
Age of Respon dents	30	34	66	50,5	9.258
A p value of blood sugar levels with elasticity of coronary arteries 0,000					
A p value of respondents age with elasticity of coronary arteries 0,001					

Table 1 shows that blood sugar levels have an average value of 7,328 and a maximum value of 11,960. The coronary artery elasticity has an average value of 1,448 and a minimum value of 0,999. The test results using bivariate linear regression showed $p < 0,05$ which means there was a significant relationship between blood sugar levels and the elasticity of the coronary arteries.

DISCUSSION

Coronary arteries are arteries that have special functions as suppliers of nutrients and oxygen to the heart muscle (Suharto, 2004). The heart can function properly when getting supplies as needed. The heart muscle can experience a

malfunction if a coronary artery problem occurs (Titin Andri Wihastuti, Sri Andarini, 2016). Decreasing coronary artery elasticity is one of the problems that often occurs in Indonesia. Coronary arteries can experience a decrease in elasticity or experience stiffness if the results of the examination using QMRA are below the normal limit. The normal value of coronary artery elasticity using the QMRA tool is 1.553-2.187. Based on Table 1 it is known that the average value of coronary artery elasticity is 1,452, this indicates that the average respondent experiences a decrease in the elasticity of the coronary arteries. A decrease in the elasticity of the coronary arteries can be caused by a buildup of plaque in the coronary arteries, called atherosclerosis. High blood sugar levels are one of the factors that trigger the occurrence of atherosclerosis (Redaksi Agromedia, 2009). Blood sugar levels are measured by doing a blood sugar test (Charles Fox, 2011). In this study blood, sugar levels were measured using QMRA (Therese Michel-Mansour, 2016). Sugar circulating through the blood is the main energy source for body cells. Blood sugar levels are controlled by hormones insulin (Lanywati, 2011). The hormone insulin works by carrying blood sugar to the body's cells to be metabolized into energy and stored inside the liver in the form of glycogen (Ashok K. Srivastava, 2012). The content hormone unstable insulin in the body causes sugar metabolism to be abnormal. Decreasing insulin levels results in a decrease in the body's ability to process sugar into energy and convert sugar into glycogen. This causes the amount of sugar in the blood to exceed the normal limit called hyperglycemia (Tandra, 2017).

Table 1 shows that the average blood sugar level is 7,328 and the maximum value is 11,960. The normal value of blood sugar levels using the QMRA tool is 2.163 - 7.321. When compared between the average value of the examination results with the normal value of blood sugar levels, the

average value of blood sugar levels includes exceeding the upper limit of normal values. Based on data analysis, the significance value of $p < 0,000 < 0,05$, which means there is a significant correlation between blood sugar levels and the elasticity of the coronary arteries. High sugar levels in the blood for long periods of time can cause narrowing of the arteries and reduce the elasticity of the coronary arteries. Farra Ramadany, Asist Pujarini and Candrasari (2013) explained that hyperglycemia results in damage to large vessel walls and peripheral blood vessels, and can increase platelet aggregation. This process can cause atherosclerosis. Besides that the level of sugar in the blood can also increase blood viscosity, which can increase the incidence of atherosclerosis (Lannywati Ghani, 2016).

High blood sugar levels can also increase the permeability of the endothelial cells in finally result in occurrence atherosclerosis. Budiman B, Sihombing R (2015) explains that hyperglycemia causes the microvascular system in the arterial endothelial layer to increase permeability resulting in fat-containing molecules entering to in arteries, including coronary arteries. Damage to endothelial cells can also trigger an inflammatory reaction that results in the deposition of macrophage cells, platelets, and fibrous tissue. this result in occurrence atherosclerosis

Besides increasing blood sugar levels can also cause damage to the coronary artery endothelium (Sargowo, 2015). (Ratri Dwitiya Nestiti, Noormartany, Nina Susana Dewi (2015) explained that people with diabetes mellitus characterized by hyperglycemia are the cause of endothelial dysfunction which is the beginning of atherosclerosis. Damage that results in cell endothelium produces adhesion molecule cells like cytokines, chemokines, and growth factors, as well as basic fibroblast growth

factors. Monocytes and T-lymphocytes enter to surface endothelium and headed to sub endothel. Next monocytes differentiate to be macrophages and take oxidized LDL that is of nature more atherogenic when compared with LDL. Oxidized LDL result in Dead cell and produce response inflammation. Damage endothelium that is result in occurrence response protective so that forming plaque atherosclerosis (Majid, 2008).

High blood sugar levels can also cause heart disease. This is in accordance with the research of Yuliani, Oenzil and Iryani (2014) that there is a very significant correlation between the duration of diabetes and the incidence of CHD in type 2 DM patients. The results of this study are in line with previous studies that high blood sugar levels (hyperglycemia) that last long can increase deposits of fatty substances in the vessel wall blood which can ultimately affect the elasticity of the coronary arteries or coronary arteries to be hard or stiff.

Age can also affect the elasticity of the coronary arteries. Based on table 1 the results show that the respondent's age is on average 50.6 years, and the p value is $0.001 < 0.05$, which means there is a correlation between age and the elasticity of the coronary arteries. Decreasing coronary elasticity (atherosclerosis) is the main cause of CHD. CHD develops as we age, which increases in age, the higher the chances of suffering from CHD (Susilo, 2015). The results of this study are in line with the results of the study of Supriyono (2008) in obtaining the results that fasting blood sugar levels are associated with CHD events ($p = 0,0001$). The incidence of CHD is 4.1 times more common in women < 45 years and has fasting blood sugar levels > 126 mg/dl compared to fasting blood sugar < 126 mg/dl.

CONCLUSIONS

Based on the research that has been done, it can be concluded that there is that relationship significant grade blood sugar with the elasticity of the coronary arteries. High blood glucose levels can trigger blood vessel endothelial damage and increase platelet aggregate, who that can resulting atherosclerosis. Each individual must be able to control blood sugar levels with a healthy lifestyle and early detection regularly to prevent stiffness in the coronary arteries that can cause CHD.

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