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RELATIONSHIP OF BLOOD GLUCOSE LEVELS WITH BLOOD PRESSURE IN PEOPLE WITH TYPE 2 DIABETES MELLITUS AT RSU FL TOBING SIBOLGA IN 2021

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ABSTRACT

Diabetes mellitus is a metabolic disorder caused by abnormalities in insulin secretion, insulin action or both. The IDF recorded 10,700,000 dm sufferers in 2019. Most people with type 2 DM have hypertension. Uncontrolled blood glucose levels can affect blood pressure. This study aims to determine the relationship between blood glucose levels and blood pressure in people with type 2 diabetes mellitus in RSU FL. Tobing Sibolga City. This type of research is analytical observational with a retrospective cross-sectional research design. The study used data on fasting blood glucose levels and blood pressure obtained from medical records. The study sample was 632 visits of outpatient type 2 DM patients at FL Hospital. Tobing Sibolga City. The data obtained were tested for normality with Kolmogorov-Smirnov, then tested for correlation using Spearman.

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1. Introduction

Diabetes mellitus is a metabolic disorder characterized by an increase in blood glucose levels exceeding normal limits, the condition of hyperglycemia is caused by abnormalities in insulin secretion, insulin work or both (PERKENI, 2019). Insulin is a hormone that controls carbohydrate metabolism by transporting glucose into cells (Hall and Hall, 2020). The World Health Organization (2018) stated that the global prevalence of diabetes in adults >18 years of age has increased from 108 million people (4.7%) in 1980 to 422 million people (8.5%) in 2014.

In 2016, there were 1.6 million deaths caused by diabetes (WHO, 2018). The International Diabetes Federation (2019) stated that, there are 463 million people with diabetes mellitus worldwide and the proportion of the incidence of type 2 diabetes mellitus (non-dependent insulin) reaches 90% of the world's population suffering from diabetes mellitus. The International Diabetes Federation (2019) also predicts an increase in the number of people with diabetes mellitus in Indonesia in adults (aged 20-79 years) from 10.7 million people in 2019 to 13.7 million people in 2030 and 16.6 million people in 2045. The prevalence of diabetes mellitus in Indonesia is fairly high, this is evidenced by data from the International Diabetes Federation which states that the number of DM sufferers in 2017 was 10.3 million people (IDF, 2017), increasing to 10.7 million people in 2019. The high incidence of DM caused in 2019 Indonesia to be included in the top ten countries with the largest diabetes in the world (IDF, 2019).

Most people with type 2 diabetes mellitus suffer from hypertension (Ferrannini and Cushman, 2012). Hypertension is a persistent increase in systolic and diastolic blood pressure (Dipiro et al., 2017). According to the research of Sun et al. (2019) of the 13,931 subjects with type 2 diabetes mellitus, there were 85.1% (11,855 subjects) of whom suffered from hypertension. Hypertension and diabetes mellitus have become major public health problems (Yaogai Lv et al., 2018). One of the factors that influence the rise and fall of blood pressure is blood glucose levels. High blood glucose levels are a risk factor for hypertension (Ferrannini and Cushman, 2012). Hyperglycemia if not

controlled will cause serious damage to body organs, especially nerves and blood vessels, which will lead to microvascular and macrovascular complications (WHO, 2018).

The mechanisms underlying the association of hypertension with type 2 diabetes mellitus include insulin resistance on the nitric-oxide pathway, the stimulating effect of hyperinsulinemia on the activity of the sympathetic nervous system, the development of smooth muscles, sodium-fluid retention, and the excitatory effects of hyperglycemia on the renin-angiotensin-aldosterone system that can cause an increase in blood pressure (Ferrannini and Cushman, 2012). According to Petrie, Guzik, and Touys (2018), the cause of morbidity and mortality in diabetes mellitus is a complication of cardiovascular disease that can be aggravated by the presence of hypertension. Hypertension is the main risk factor for the occurrence of Atherosclerotic Cardiovascular Disease (ASCVD) and microvascular complications in people with diabetes mellitus (ADA, 2019).

General Hospital (RSU) FL. Tobing Sibolgame City is one of the main type B hospitals owned by the Sibolga City government located in Sibolga City City with the prevalence of type 2 diabetes mellitus which increases every year. Based on the results of preliminary observations made by researchers at RSU FL. Tobing Sibolga City in 2020, the number of visits of diabetes mellitus patients with and without complications who were hospitalized or outpatient at Sibolga City Hospital in 2019 was 7,368 visits. Sibolga City General Hospital (RSU) was chosen as the research model. Type 2 diabetes mellitus is a disease that often occurs in this hospital, so this location can support research. Similar research has been traced but has never been carried out at sibolga city hospital. Therefore, this study aims to determine the relationship between blood glucose levels and blood pressure in people with type 2 diabetes mellitus at FL General Hospital. Tobing Sibolga City.

2. Research Methods

2.1 Research Type and Design

The research carried out is a type of analytical observational research with a retrospective cross-sectional research design. Analytical observational research is research that is carried out by observing the subject, without giving any intervention to the subject of the study. The cross-sectional research design is a study that studies the correlation between risk factors (independent) and effects (dependent).

2.2 Population And Sampel

The population in this study was all visits recorded in the medical records of outpatient type 2 diabetes mellitus patients at the Sibolga City General Hospital during the study period of July 1, 2019 – July 31, 2020, which was 4,848 visits. The samples in this study were visits recorded in the medical records of outpatient type 2 diabetes mellitus patients at the Sibolga City General Hospital who met the inclusion and exclusion criteria in the research period of July 1, 2019 – July 31, 2020, which was 632 visits. The visit in this study was defined as a control visit in outpatient type 2 diabetes mellitus patients who were treated at Sibolga City Hospital, North Sumatra Province. The data obtained from such medical records are recorded on the data collection sheet manually by the researcher using a laptop electronic device. The data collected are in the form of No.RM, gender, age, therapy, duration of drug use, complications, results of measuring fasting blood glucose levels, systolic and diastolic blood pressure, then after all data are collected, purposive sampling will be selected from populations that meet the inclusion and exclusion criteria.

2.3 Analysis Techniques

Data analysis on this study was carried out using the help of software . The analysis begins with a normality test to determine the normal or not analytical distribution of data, the normality test uses the Kolmogorov-Smirnov parameter because the sample size is >50, with the normal distribution criterion being $p>0.05$. The results of the data distribution are declared not normally distributed ($p<0.05$). This study used a type of correlative hypothesis and data in the form of a numerical-numeric scale, so the analysis used the Spearman correlation test because the distribution of data was abnormal. The correlative hypothesis test between the two variables will be carried out at a confidence level of 95%. The strength of the correlation will be statistically interpreted based on the value of the correlation coefficient (r). The correlation strength is expressed very weak when the value of r = 0.0 – <0.2; weak when the value of r = 0.2 – <0.4; medium if the value of r = 0.4 –

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<0.6; strong if the value of r = 0.6 – <0.8; and very strong when the value of r = 0.8 – 1.00. The correlation test is said to have a significant relationship, if the p-value <0.05 (Dahlan, 2014).

3. Result And Discussion

3.1 Result

TABEL 1
ANALYSIS OF THE RELATIONSHIP BETWEEN FASTING BLOOD GLUCOSE LEVELS AND SYSTOLIC AND DIASTOLIC BLOOD PRESSURE IN PATIENTS WITH TYPE 2 DM

Usia		r	*p*
41-50 tahun	Tekanan Darah Sistolik (mmHg)	0,512	0,003
	Tekanan Darah Diastolik (mmHg)	0,511	0,003
51-60 tahun	Tekanan Darah Sistolik (mmHg)	0,632	0,000
	Tekanan Darah Diastolik (mmHg)	0,265	0,001
61-70 tahun	Tekanan Darah Sistolik (mmHg)	0,466	0,000
	Tekanan Darah Diastolik (mmHg)	0,109	0,023

Based on table III, the results of statistical analysis using the Spearman test in the age group of 41-50 years, showed a moderate and significant strength of the relationship between fasting blood glucose levels and systolic blood pressure and diastolic blood pressure in patients with type 2 DM. The results of this study are in line with research by Putra et al. (2019), which states that there is a moderate and significant correlation between blood glucose levels and systolic and diastolic blood pressure in patients with type 2 DM.

The results of the analysis of the relationship between fasting blood glucose levels and systolic blood pressure in patients with type 2 DM aged 51-60 years at RSU FL. Tobing Sibolga City, which is shown in table III, obtained results that the strength of the relationship is statistically strong and there is a significant relationship between fasting blood glucose levels and systolic blood pressure, in addition to that a weak relationship strength was obtained and there was a significant relationship between fasting blood glucose levels and diastolic blood pressure in patients with type 2 DM aged 51-60 years at RSU FL. Tobing Sibolga City.

The results of the Spearman correlation test in the age group of 61-70 years, showed a moderate relationship strength and there was a significant relationship between fasting blood glucose levels and systolic blood pressure, and there was a very weak and significant relationship strength between fasting blood glucose levels and diastolic blood pressure in patients with type 2 DM aged 61-70 years at FL Hospital. Tobing Sibolga City.

3.2 Discussion

Based on table I, information was obtained that as you get older, the risk of developing type 2 diabetes mellitus is also increasing. The age group with the most visits was found in the age group of 61-70 years, namely 435 visits of type 2 diabetes mellitus patients. This is in accordance with research conducted previously by Putra et al. (2019) at Sanglah Hospital which stated that, the majority of people with type 2 diabetes mellitus are aged 61-80 years. The increase in age can cause degradation of the work of body systems including the endocrine system so that it has an impact on the occurrence of insulin resistance which will trigger unstable blood glucose levels, therefore more and more data on visits by diabetes mellitus patients are found in patients with the elderly (Isnaini and Ratnasari, 2018).

The percentage of the incidence of type 2 diabetes mellitus in the age group of 61-70 years, which is female, is known to still dominate compared to men, namely 53.3% in women and 46.7% in men. This is in line with the research of Rosyada and Trihandini (2013) which found that in the elderly people with diabetes mellitus in Indonesia, most of them are female (52.9%). The greater number of female patient visits can be caused because the life expectancy of women in most societies is higher than that of men so that the large number of women who survive until old age results in a high number of visits for people with type 2 diabetes mellitus who are female (Leslie et al., 2012).

The results of the study in the middle value section shown in table II also showed that fasting blood glucose levels tend to increase with age. The same thing was also found in a study conducted

by Putra (2019) that as you get older, the risk of an increase in blood glucose levels and impaired glucose tolerance will also increase. These results are also in line with research by Rudi and Kwureh (2017) conducted on people with diabetes mellitus at RSUD M. Djoen Sintang, found that the most disturbed fasting blood glucose levels occurred in respondents aged ≥45 years, and the age of ≥45 years was more at risk of experiencing disturbed fasting blood glucose compared to the age of <45 years. This can occur due to degenerative factors, where there is a decrease in body function in glucose metabolism (Lathifah, 2017). According to Trisnawati and Setyorogo (2013) elderly individuals are more prone to hyperglycemia because in the elderly there will be a decrease in mitochondrial activity in muscle cells by 35% which is related to an increase in fat levels in the muscles by 30% which causes insulin resistance and when pancreatic beta cells are not adequate in producing insulin to compensate for insulin resistance, then the blood glucose level will increase. Under normal conditions, 0.5% of pancreatic β cells in adults will experience apoptosis but this will be compensated by replication and neogenesis. The size of beta cells is normally relatively constant, so in adulthood the number of cells β maintained in optimal levels. With age, the number of β cells will decrease due to the process of apoptosis exceeding replication and neogenesis, so that insulin secretion will decrease and hyperglycemia occurs which if continued can cause pancreatic beta cell dysfunction (Decroli, 2019).

Kumar et al. (cit., Nuraini, 2015), suggest that starting at the age of 45, the walls of the arteries will thicken and gradually narrow and become stiff as collagen accumulates in the smooth muscle layer of blood vessels, causing vasoconstriction and increased blood pressure. Systolic blood pressure will increase with age until the age of 70 years because the elasticity of the blood vessels decreases, and the diastolic blood pressure will increase until the age of 50 and 60 years, and then it will settle or decrease. Aging can cause some physiological changes in which there is an increase in peripheral arterial resistance and sympathetic activity. The sensitivity of the reflector baroreceptor will decrease in addition, kidney function will also decrease which occurs a decrease in kidney blood flow and glomerular filtration rate, especially in the elderly so that it can cause disturbances in blood pressure.

The results of the analysis of the relationship between fasting blood glucose levels and systolic blood pressure in patients with type 2 DM aged 51-60 years at the FL General Hospital (RSU). Tobing Sibolga City, North Sumatra Province, which is shown in table III, obtained results that the strength of the relationship is statistically strong and there is a significant relationship between fasting blood glucose levels and systolic blood pressure, in addition to that a weak relationship strength was obtained and there was a significant relationship between fasting blood glucose levels and diastolic blood pressure in dm type 2 patients aged 51-60 years at the FL General Hospital (RSU). Tobing Sibolga City, North Sumatra Province.

The results of the Spearman correlation test in the age group of 61-70 years, showed a moderate relationship strength and there was a significant relationship between fasting blood glucose levels and systolic blood pressure, and there was a very weak and significant relationship between fasting blood glucose levels and diastolic blood pressure in patients with type 2 DM aged 61-70 years at the FL General Hospital (RSU). Tobing Sibolga City, North Sumatra Province.

In this study, no data were analyzed as a whole, so based on the results of the analysis of the relationship of blood glucose levels with blood pressure presented in table III, in the age group of 41-50 years, 51-60 years and age 61-70 years, it can be concluded that the value of the correlation coefficient in systolic blood pressure is $r < 0.7$ which tends to interpret a strong correlation force while in diastolic blood pressure obtained a value of $r < 0.6$ which indicates the strength of moderate correlation, and also p value < 0.05 in both systolic and diastolic blood pressure, it can be declared Ha accepted and H0 rejected, which Ha means that there is a significant relationship between blood glucose levels and blood pressure in people with type 2 diabetes mellitus at the FL General Hospital (RSU). Tobing Sibolga City, North Sumatra Province. The existence of a significant association between blood glucose levels and blood pressure indicates that blood glucose levels can control the rise.

The results of the study obtained by the researchers are in line with previous studies conducted by Winta et al. (2018) that there is a significant relationship between blood glucose levels and blood pressure in elderly people with type 2 diabetes mellitus at Mardi Waluyo Blitar Hospital with a p value = 0.017. The theory states that when blood glucose levels increase in the

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long term in people with diabetes mellitus, it will trigger an increase in extracellular osmotic pressure which causes fluid discharge from tissues (into blood vessels) to reduce the pressure difference between intracellular and extracellular, as a result of which this flow will increase the amount of body fluids and blood in the extracellular (circulatory volume) thus causing an increase in systemic blood pressure (Ohishi, 2018). The research of Yan et al. (2016) states that, the group with impaired fasting blood glucose levels (hyperglycemia) had a significantly higher risk of hypertension compared to the group with normal fasting blood glucose levels. The relationship between blood glucose levels and blood pressure makes DM patients able to maintain blood glucose levels and blood pressure because hypertension that occurs in dm sufferers can increase the risk of cardiovascular disease which is the main cause of morbidity and mortality in DM sufferers (Petrie et al., 2018). Therefore, by controlling blood glucose levels within normal limits, of course, it will maintain blood pressure within normal limits as well.

4. Conclusion

There was a relationship with moderate and significant strength between blood glucose levels and systolic blood pressure (r=0.466; p=0.000) and a relationship with very weak and significant strength between blood glucose levels and diastolic blood pressure (r=0.109; p=0.023) in people with type 2 diabetes mellitus aged 61-70 years at FL General Hospital. Tobing Sibolga City Depiction of the behavior of using latrines Known The type of latrine that was most widely used by respondents was the type of gooseneck latrine as many as 84 people (93.3%). And the condition of unqualified latrines was 56 (62.2%) latrines while the eligible latrines were 34 latrines (37.8%).

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