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RESEARCH ARTICLE

CORRELATION BETWEEN BLOOD SUGAR LEVELS AND BLOOD PRESSURE IN TYPE 2 DIABETES MELLITUS PATIENTS: LITERATURE REVIEW STUDY

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Abstract

The prevalence of type 2 diabetes continues to increase with age and changes in unhealthy lifestyles. Indonesia itself is ranked seventh with the number of diabetes mellitus sufferers reaching 8.5 million people. Diabetics often experience metabolic syndrome involving hypertension, dyslipidemia, obesity, endothelial dysfunction, and prothrombotic factors, all of which can trigger and worsen cardiovascular complications. This study aims to analyze the correlation between blood sugar levels and blood pressure in people with type II diabetes mellitus using the Literature Review method. This approach utilizes the results of previous research as a basis for concluding the findings of the current research. As a result of the screening, 9 relevant journals were identified that could be used as references. Research findings show a significant correlation between blood sugar levels and blood pressure in people with type 2 diabetes mellitus. Individuals who suffer from diabetes have a higher risk of experiencing high blood pressure or hypertension. Therefore, it is important for hypertension sufferers to maintain health, especially controlling blood pressure, because blood pressure has a significant impact on blood glucose levels. By maintaining blood pressure at a normal value, we can prevent disease complications caused by high blood pressure.

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Introduction:-

Diabetes mellitus is a chronic condition that requires long-term treatment to reduce the risk of complications. An important factor that can influence blood pressure fluctuations is blood sugar levels (McCulloch & Nathan, 2023). Hyperglycemia is the main risk factor for hypertension. Hyperglycemia frequently accompanies metabolic syndrome, which involves hypertension, dyslipidemia, obesity, endothelial dysfunction, and prothrombotic factors (Dilworth et al., 2021). All of these elements can trigger and worsen cardiovascular complications.

The impact of macroangiopathy in diabetes sufferers arises from changes in blood sugar levels, where high sugar levels cause deposition on the walls of blood vessels (Daryabor et al., 2020). An oxidation process occurs, where blood sugar interacts with blood vessel wall proteins, forming Advanced Glycosylated Endproducts (AGEs). These compounds, which are formed from excess sugar and protein, damage the inner lining of blood vessels, attracting fat and cholesterol to stick to the blood vessel walls, and triggering an inflammatory reaction. White blood cells and platelets, along with other materials, form plaque clots that make blood vessel walls hard and stiff. As a result, a blockage occurs which causes changes in blood pressure, which is known as hypertension (Daryabor et al., 2020).

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According to the American Diabetes Association(2019), two out of three diabetes sufferers experience high blood pressure. This process provides a concrete picture of how blood sugar fluctuations in diabetes sufferers can have a serious impact on the structure of blood vessels and contribute to the emergence of hypertension.

High blood pressure is often detected through routine examinations or in the context of work-related or insurance medical examinations(Choi et al., 2019). Individuals who have high blood pressure are three times more likely to have a heart attack, five times more likely to experience heart failure, and eight times more likely to have a stroke, compared to those who have blood pressure within normal limits(Fuchs & Whelton, 2020). Thus, knowing and managing blood pressure is crucial to preventing the risk of heart attack and stroke and maintaining heart function in optimal condition.

Based on previous studies, Alsaadon et al.(2022) revealed that there was a link between blood sugar levels and hypertension in individuals suffering from type 2 diabetes mellitus. In contrast, the results of research conducted by Sugondo et al.(2019)showed that there was no significant relationship between blood sugar levels at any time and blood pressure systolic and diastolic blood. With these differences in findings as background, this study aims to investigate in more depth the correlation between blood sugar levels and blood pressure in people with type 2 diabetes mellitus. By combining the findings from two previous studies, this study seeks to make an additional contribution to the understanding of the complexity of the relationship between blood sugar levels and blood pressure in the same population.

Method:-

This research applies the Literature Review method, an approach where researchers use previous research as a basis for concluding the results of current research. The advantage obtained from this method is that it allows researchers to make decisions efficiently, especially when time is a constraint in searching for a lot of primary evidence which requires quite a long time to examine one by one. The aim of this study was to explore the potential relationship between blood sugar levels and blood pressure in type II diabetes mellitus patients.

Researchers carried out these steps by collecting references from reliable scientific research journals, which relate to the relationship between blood sugar levels and blood pressure in patients with type II diabetes mellitus. These references were obtained through reliable scientific searches in the period 2015-2023 from national and international journals. The screening results showed that there were 9 journals that were relevant and could be used as the main reference in this research.

This screening process involves selecting or filtering data to determine relevant problems and discussions in the research. Researchers use data from journal portals which can be accessed online by utilizing the keywords journal title, year of publication, problem topic, and journal type. Data is obtained from international journal pages which can be accessed freely, making this information source reliable and accessible to various groups.

Results:-

The results of the literature study can be described as follows

Table 1:- Literature Search Results.

No	Title	Author	Research Results
1	Hypertension and Diabetes Mellitus	VasilisTsimihodimos, Clicerio Gonzalez-Villalpando, James B. Meigs and EleFerrannini (2018)	The results showed that (1) the development of hypertension and diabetes mellitus is interrelated over time, (2) the transition from normotension to hypertension is characterized by a sharp increase in blood pressure values, and (3) insulin resistance is one of the common characteristics of prediabetes and prediabetes. prehypertension and early development of the 2 disease states respectively.
2	Relationship of Blood	CrishartantoSimanungkalit,	The results showed a moderate and

	Glucose Levels with Blood Pressure in People With Type 2 Diabetes Mellitus at RSU FLTobingSibolga	MeiyatiSimatupang, Sridina (2021)	significant relationship between fasting blood glucose levels and systolic blood pressure and diastolic blood pressure in type 2 DM patients.
3	Determinants of blood pressure and blood glucose control in patients with comorbid hypertension and type 2 diabetes mellitus in Ghana: A hospital-based cross-sectional study	YakubuAlhassan, AdwoaOforiwaaKwakye,Andrews K. Dwomoh, EmmanuellaBaah-Nyarkoh, Vincent JesseyGanu, Bernard Appiah, Irene A. Kretchy. (2022)	The results of the study showed that of the 329 participants diagnosed with hypertension and Type 2 DM, 41.3% controlled blood pressure, 57.1% controlled blood glucose, while 21.8% had controlled blood pressure and blood glucose levels and had a positive relationship with control of blood pressure and blood glucose levels. One in five patients with hypertension and Type 2 DM have controlled blood pressure and blood glucose levels.
4	Blood Glucose Influence on Cholesterol and Blood Pressure of Patients with Type II Diabetes Mellitus	IdolaPerdanaSulistyoning Suharto, Satria Eureka Nurseskasatmata (2020)	The results of the study show that blood glucose levels and blood pressure have a significance value of 0.000 and a correlation coefficient of 0.798. This can be interpreted that there is an influence between blood glucose and blood pressure with a strong relationship in type 2 diabetes mellitus patients
5	Hypertension and Its Associated Factors Among Type 2 Diabetes Mellitus Patients at Debre Tabor General Hospital, Northwest Ethiopia	YonasAkalu, YitayehBelsti(2020)	The results showed that the prevalence of hypertension in Type 2 DM patients was 59.5%. Stage 1 hypertension was the most common (30.95%). The odds of developing hypertension are higher with longer duration of Type 2 DM (AOR = 1.16, 95% CI (1.08– 1.25), with a BMI \geq 25 kg/m ² (AOR = 3.2, 95% CI (1.71– 5.96)), with poor glycemic control (AOR = 3.0, 95% CI (1.75– 5.19)), and patients who were current smokers (AOR = 3.8, 95% CI (1.98– 14.96)
6	The Analysis of Blood Glucose Level and Blood Pressure on Hypertension Patients in Mersi Village, East Purwokerto, Central Java	NovitsariDwi, WirakhmiIkitNetra (2020)	The research results showed that the majority of respondents were women with a total of 58 people (69.9%), and the majority of respondents, namely 64 people (77.1%), suffered from DM. The average blood glucose level was 212.94 mg/dl and was included in the hyperglycemia category. Additionally, there is a significant correlation between blood glucose levels and blood pressure. Blood glucose levels are closely related to blood pressure in hypertension sufferers and the higher the blood glucose levels, the greater the blood pressure.
7	The Correlation Between Type 2 Diabetes Mellitus and Hypertension in Iraqi	Abdullah Abbas Hamzah Al-Rubaye (2023)	The results showed that the majority of Type 2 DM sufferers were women, more than men in the hypertension

	Patients	group. The most overweight patients were in the Type 2 DM group (71.4%) and the majority of obese patients were in the hypertension group (46.7%). The majority of smoking patients were in the hypertension group (26.7%). Glucose values in hypertension were higher compared to other study groups. The majority of abnormal total cholesterol was found in the hypertension group compared to other study groups. There was a higher percentage of abnormal blood glucose levels in the hypertension patient group and type 2 DM patient group.
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1. Research by Tsimihodimos et al.(2018)

The study of Tsimihodimos et al.(2018) entitled "Hypertension and Diabetes Mellitus". This study aims to analyze the pattern of changes in blood pressure during the development of hypertension in patients with or without diabetes mellitus. The results of the study show that (1) the development of hypertension and diabetes mellitus is interrelated over time, (2) the transition from normotension to hypertension is characterized by a sharp increase in blood pressure values, and (3) insulin resistance is one of the common characteristics of prediabetes and prediabetes. prehypertension and early development of the 2 disease states respectively

2. Research by Simanungkalit & Simatupang(2021)

The study of Simanungkalit & Simatupang(2021) entitled "Relationship Of Blood Glucose Levels With Blood Pressure In People With Type 2 Diabetes Mellitus at RSUD FL Tobing Sibolga" This research aims to determine the relationship between blood glucose levels and blood pressure in people with type 2 diabetes mellitus at RSUD FL Tobing Sibolga. The results showed a moderate and significant relationship between fasting blood glucose levels and systolic blood pressure and diastolic blood pressure in type 2 DM patients.

3. Research by Alhassan & Kwakye(2022)

The study of Alhassan & Kwakye(2022) entitled "Determinants of blood pressure and blood glucose control in patients with co-morbid hypertension and type 2 diabetes mellitus in Ghana: A hospital-based cross-sectional study". This study aims to estimate the prevalence and factors associated with the control of blood pressure and blood glucose levels in patients diagnosed with hypertension and type 2 diabetes mellitus. The results of the study show that of the 329 participants diagnosed with hypertension and type 2 diabetes mellitus, 41.3 % controlled blood pressure, 57.1% controlled blood glucose, while 21.8% had controlled blood pressure and blood glucose levels and had a positive relationship with controlling blood pressure and blood glucose levels. One in five patients with hypertension and Type 2 DM have controlled blood pressure and blood glucose levels.

4. Research by Suharto & Nurseskasatmata (2020)

The study of Suharto & Nurseskasatmata (2020) entitled "Blood Glucose Influence on Cholesterol and Blood Pressure of Patients with Type II Diabetes Mellitus". This study aims to identify the influence of blood glucose and blood pressure in patients with type 2 diabetes mellitus. The results of the study show that there is an influence between blood glucose and blood pressure with a strong relationship in patients with type 2 diabetes mellitus.

5. Research by Akalu & Belsti(2020)

The study of Akalu & Belsti(2020) entitled "Hypertension and Its Associated Factors Among Type 2 Diabetes Mellitus Patients at Debre Tabor General Hospital, Northwest Ethiopia". This study aims to determine the prevalence and factors associated with hypertension in type 2 diabetes mellitus patients at the Debre Tabor General Hospital. The results showed that the prevalence of hypertension in Type 2 DM patients was 59.5%. Stage 1 hypertension was the most common (30.95%). The chance of developing hypertension is higher with a longer duration of Type 2 DM.

6. Research by Dwi & Netra(2020)

The study of Dwi & Netra(2020) entitled "The Analysis of Blood Glucose Level and Blood Pressure on Hypertension Patients in Mersi Village, East Purwokerto, Central Java". This study aims to analyze blood glucose levels and blood pressure in hypertension sufferers in Mersi village, East Purwokerto. The research results showed that the majority of respondents were women with a total of 58 people (69.9%), and the majority of respondents, namely 64 people (77.1%), suffered from DM. The average blood glucose level was 212.94 mg/dl and was included

in the hyperglycemia category. Additionally, there is a significant correlation between blood glucose levels and blood pressure. Blood glucose levels are closely related to blood pressure in hypertension sufferers and the higher the blood glucose levels, the greater the blood pressure.

7. Research by Al-Rubaye(2023)

The study of Al-Rubaye(2023) entitled "The Correlation Between Type 2 Diabetes Mellitus and Hypertension in Iraqi Patients". This study aims to determine whether there is a relationship between T2DM, hypertension, and several other biochemical parameters. The results showed that the majority of Type 2 DM sufferers were women, more than men in the hypertension group. The most overweight patients were in the Type 2 DM group (71.4%) and the majority of obese patients were in the hypertension group (46.7%). There was a higher percentage of abnormal blood glucose levels in the hypertensive patient group.

Discussion:-

Findings from several previous studies consistently show a significant relationship between blood sugar levels and hypertension in type 2 diabetes mellitus patients. The relationship between blood pressure and blood sugar levels emphasizes the importance for patients to monitor and control both so that they remain within normal limits(Syeda et al., 2023). This control process has great benefits, especially in patients with hypertension who also suffer from type 2 diabetes because it can reduce the risk of complications and maintain overall health(Petrie et al., 2018). Thus, routine monitoring and effective management of blood pressure and blood sugar levels become an important aspect in the treatment and prevention of disease in individuals with these two medical conditions.

In a cohort study, it was found that a reduction in blood pressure of around 5-10 mmHg had the potential to reduce the risk of death related to type 2 diabetes threefold(Canoy et al., 2022). In addition, this reduction can reduce the risk of stroke incidence by up to 50% and reduce the risk of heart failure by up to three times compared to patients whose blood pressure is not controlled(Boehme et al., 2018). The importance of controlling blood pressure in hypertensive patients with type 2 diabetes is also reflected in the more significant benefit of reducing the risk of microvascular complications compared with controlling blood sugar levels. Apart from having a positive impact on health aspects, controlling blood pressure can also provide additional benefits in the form of improving quality of life and effective use of health costs(Berra et al., 2020). This suggests that blood pressure management not only contributes to physical well-being but also has the potential to have a holistic positive impact on patients' lives and health outcomes.

The relationship between blood sugar levels and blood pressure arises because of the similar characteristics of disease risk factors in diabetes mellitus (DM) sufferers(Al-Nozha et al., 2016). Insulin resistance and hyperinsulinemia in DM sufferers are believed to increase peripheral vascular resistance and vascular smooth muscle contractility through excessive response to norepinephrine and angiotensin II, which in turn increases blood pressure through physiological feedback mechanisms as well as the Renin-Angiotensin-Aldosterone system(Chakraborty et al., 2023). Hyperglycemia in DM sufferers also contributes to over-expression of fibronectin and collagen IV, triggering endothelial dysfunction and thickening of the glomerular basement membrane, resulting in kidney disease(Wu et al., 2023). Controlling blood sugar levels not only directly affects blood pressure, but also has a positive impact on the function of the cardiovascular system and kidneys(Schwarz et al., 2018). Therefore, controlling blood sugar does not only focus on aspects of diabetes mellitus but also plays an important role in the prevention and management of hypertension, especially in people with type 2 diabetes as a significant risk factor for uncontrolled hypertension.

The findings from this study are different from the results of Sugondo et al.(2019) study which showed that there was no significant relationship between instantaneous blood sugar levels and systolic and diastolic blood pressure. Theoretically, an increase in blood pressure in type 2 diabetes patients is indicated to occur within a period of around 0-10 years due to functional changes in the endothelium(Marunashi & Higashi, 2021). However, this study revealed that most blood sugar levels were within the normal range, while previous studies recorded average hyperglycemia.Rohani et al.'s study,(2023) self-care practices for type 2 diabetes mellitus patients have the opportunity to maintain blood glucose levels. Thus preventing complications. The condition of normal blood sugar levels in this study illustrates that patients have good diabetes mellitus (DM) management, implying a significant difference from previous studies which recorded high average blood sugar levels.

Conclusion:-

Based on the literature review that has been carried out, it can be concluded that the research results show that there is a significant relationship between blood sugar levels and hypertension in people with type 2 diabetes mellitus, and individuals who suffer from diabetes have a greater chance of experiencing high blood pressure or hypertension. Therefore, it is hoped that people will maintain their health, especially blood pressure because blood pressure has an impact on blood glucose levels. By maintaining blood pressure within normal values, we can be proactive in preventing disease complications that are often associated with high blood pressure

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