



Research Article

Blood Sugar Levels and Lipid Profiles of T2DM among Hypertension Patients in Bambanglipuro Health Centre

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ABSTRACT

Background: Type 2 diabetes mellitus is a common chronic disease with multiple complications contributing to the global healthcare burden. Untreated T2DM causes multiple organs and systemic injury, including heart, kidney, nerve, and blood vessels, which impairs quality of life and increases mortality rates caused by complications of diabetes. Some of these complications play a clear role in increasing diabetes mortality. The objective of this study was to determine the differences in blood glucose level and lipid profile among T2DM patients with hypertension and without hypertension.

Method: This research was a cross-sectional analytic study. Research subjects were taken using a purposive sampling technique with inclusion and exclusion criteria among the 40 T2DM patients in the Chronic Disease Management Program called Prolanis at Bambanglipuro Health Centre. The inclusion criteria were T2DM patients who were members of Prolanis. The exclusion criteria were patients with a history of complications such as heart disease, stroke, and cancer. Accordingly, in total, 32 T2DM patients were joining this study. We collected the total cholesterol, HDL, and LDL data and analyzed it with an independent T-test. The fasting blood glucose level, HbA1C, and triglyceride data were analyzed using the Mann-Whitney U test.

Results: There were differences in LDL levels ($p=0.005$) in T2DM patients with hypertension and without hypertension. Meanwhile, there was no difference in fasting blood glucose among T2DM patients with hypertension and without hypertension.

Conclusion: There was a significant difference in LDL, and there were no significant differences in fasting blood glucose levels in T2DM patients with hypertension and without hypertension.

Keywords: Diabetes Mellitus; Hypertension; Blood Glucose Level; Lipid Profile



INTRODUCTION

Diabetes mellitus is a long-term metabolic condition marked by an abnormally high blood glucose level. According to the International Diabetes Federation (IDF), diabetes mellitus patients in 2019 are estimated to be 463 million people aged 20-79 years. Patients with uncontrolled Diabetes Mellitus (DM) will experience blindness, heart disease, and kidney failure (1). The prevalence of DM is estimated to increase as the population grows, reaching 578 million people in 2030 and 700 million globally in 2045. Indonesia is the 7th country globally, with the most DM patients of 10.7 million (2). The prevalence of DM in Indonesia is 2%, and Yogyakarta province has the second-highest prevalence of 3.1% in Indonesia (3). Diabetes mellitus type 2 is the most common type of diabetes mellitus in Indonesia.

Type 2 diabetes mellitus will increase the prevalence of lipids, resulting in cardiovascular disease (CVD). In Type 2 Diabetes Mellitus (T2DM), cholesterol levels are around 28% to 34%, triglyceride level 5% to 14%, and lower High-Density Lipoprotein (HDL) level (4). High carbohydrate consumption in T2DM patients can interfere with carbohydrate metabolism, which results in increased fatty acid synthesis in the liver, and converts fat into cholesterol (5). Atherosclerosis, or the appearance of fat in blood arteries, is caused by high cholesterol levels. Atherosclerosis can cause cardiovascular disease by clogging the blood arteries of the heart. (6,7).

Hypertension is significant comorbidity of diabetes, with around 67% of individuals with diabetes having a blood pressure of 140/90 mmHg or higher and using antihypertensive medications (8). About 66% of diabetics had excessive blood pressure in 2017 (9). Insulin delivery and weight gain produce hypertension in T2DM patients, resulting in reduced arterial distensibility, leading to a rise in systolic blood pressure (10).

According to epidemiological studies, cardiovascular mortality is 2-3 times higher in a diabetic with hypertension than a diabetic without hypertension (11). Low-Density Lipoprotein cholesterol is an atherogenic component that has a clinically significant influence on cardiovascular disease development. Low-Density Lipoprotein cholesterol is an independent predictor of cardiovascular events in people with T2DM (12). A meta-analysis of 102 prospective studies including 698,782 people indicated that DM is linked to a two-fold increased risk of coronary heart disease, stroke, and mortality from cardiovascular causes such as heart failure, cardiac arrhythmia, sudden death, hypertension, and aortic aneurysms (13).

This research aimed to determine the differences in blood glucose level and lipid profile in T2DM patients with hypertension and those without hypertension. The results of this study contribute as input for making policies to control T2DM at the Bambanglipuro Health Center and other regions that have similar characteristics.

METHOD

This study was employed a cross-sectional analytic survey to determine the differences in blood glucose level and lipid profiles in T2DM patients with hypertension and without hypertension at Bambanglipuro Public Health Center, Bantul, Yogyakarta. The population in this study was 40 T2DM patients. Research subjects were taken using a purposive sampling technique with inclusion and exclusion criteria. The inclusion criteria were T2DM patients who were members of the Chronic Disease Management Program (*Prolanis*). Exclusion criteria were patients with a history of complications such as heart disease, stroke, and cancer.

Type 2 diabetes mellitus with hypertension using criteria having a blood pressure of >140/90 mmHg. We used medical records at Bambanglipuro Health Centre taken in December 2020. We collected 32 samples that fulfilled our criteria during the data collection, consisting of 16 T2DM patients with hypertension and 16 T2DM patients without hypertension (normal blood pressure). The Shapiro Wilk test was used to test the data normality distribution.

The Independent T-test was used to calculate total cholesterol, HDL, and LDL data. At the same time, the Mann-Whitney test was employed to analyze fasting blood glucose levels, HbA1C, and triglyceride data. For each analysis, we used a 0.05 significant p-value.

RESULTS

A. Characteristics of the Respondent

Table 1 shows the sociodemographic of respondents for this study (sex, age, and educational background). Females were dominating this respondent in this research. The age group of 56-65 years was the most populated (56.25%). The majority of the respondent were farmers (56.25%). We found the p-value was >0.05 on each characteristic, indicating that both groups' sex, age, and profession are homogeneous.

Table 1. Characteristics of the Respondent

Characteristics of Subjects		T2DM with hypertension	T2DM without hypertension	Total	p-value
		n (%)	n (%)	n (%)	
Sex	Female	12 (75.0)	7 (43.75)	19 (59.37)	0.074
	Male	4 (25.0)	9 (56.25)	13 (40.63)	
Age	36-45 years old.	0 (0.0)	1 (6.25)	1 (2.12)	0.774
	46-55 years old	2 (12.5)	2 (12.5)	4 (12.5)	
	56-65 years old	9 (56.25)	9 (56.25)	18 (56.25)	
	>66 years old.	5 (31.25)	4 (0.25)	9 (28.13)	
Occupation	Civil Servant	1 (6.25)	2 (12.5)	3 (9.38)	0.310
	Private	0 (0.0)	2 (12.5)	2 (6.25)	
	Entrepreneur	3 (18.75)	2 (12.5)	5 (15.63)	
	Farmer	9 (56.25)	5 (31.25)	13 (40.63)	
	Laborer	1 (6.25)	0 (0.0)	1 (3.13)	
	Unemployed	3 (12.5)	5 (31.25)	8 (25.0)	

B. The Differences in Blood Glucose Level and Lipid Profile

Our analysis results indicated that only T2DM patients with hypertension had higher LDL levels than those without hypertension ($p < 0.05$). Table 2 presents the differences in blood glucose level and lipid profiles in this study, including fasting glucose level, HbA1C, total cholesterol, LDL, HDL, and triglyceride presented.

Table 2. The Differences in Blood Glucose Level and Lipid Profile

Variable	T2DM with Hypertension	T2DM without hypertension	p-value
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	<i>Mean ± SD</i>	<i>Mean ± SD</i>	
Fasting Blood Glucose Level	100.25 ± 32.70	138.06 ± 83.08	0.356**
HbA1C	7.59 ± 1.79	8.58 ± 3.01	0.534**
Total Cholesterol	191.12 ± 46.86	190.69 ± 32.48	0.730*
HDL	46.44 ± 7.28	46.19 ± 8.30	0.996*
LDL	126.38 ± 38.00	123.00 ± 26.9	0.005*
Triglyceride	176.88 ± 116.64	165.31 ± 56.434	0.749**

*) Independent T-Test

**) Mann Whitney U Test

On the examination of fasting blood glucose level, the result was 100.25 ± 32.70 mg/dl in T2DM with hypertension and a mean fasting blood glucose level of 138.0 ± 83.08 mg/dl without hypertension. There was no significant difference between fasting blood glucose levels in the T2DM group with hypertension and without hypertension ($p > 0.05$). The mean HbA1C level in the blood was 7.59 ± 1.79% for T2DM with hypertension and the mean of 8.58 ± 3.01% without hypertension. There was no significant difference between HbA1C levels in T2DM with hypertension and without hypertension ($p > 0.05$).

The mean for total cholesterol was 191.12 ± 46.86 and 190.69 ± 32.48 mg/dl for T2DM with hypertension, respectively. There was no significant difference between total cholesterol levels in the T2DM group with hypertension and without hypertension ($p > 0.05$). The HDL level among the two groups showed that the mean HDL level was 46.44 ± 7.28 mg/dl for the T2DM with hypertension and a mean of 46.19 ± 8.30 mg/dl for those without hypertension. There was no significant difference between HDL levels in the T2DM with hypertension and those without hypertension ($p > 0.05$). The mean of LDL examination was 126.38 ± 38.00 mg/dl in the T2DM group with hypertension and 123.00 ± 26.9 mg/dl without hypertension.

The result was a significant difference in LDL on T2DM with hypertension and without hypertension ($p < 0.05$). The triglyceride test for T2DM with hypertension means 176.88 ± 116.64 mg/dl and 165.31 ± 56.434 mg/dl without hypertension. The result was no significant triglyceride level among the two groups (p -value > 0.05).

DISCUSSION

In this study, there were significant differences in LDL level, and the mean LDL levels in T2DM with hypertension (SD 126.38 ± 38.88) were higher than those without hypertension (123.00 ± 26.90). The fasting blood glucose level, total cholesterol, HDL, and triglycerides in T2DM without hypertension had a lower mean than in T2DM with hypertension, but there was no significant difference. According to Siregar (12), there is a substantial positive link between increased total cholesterol, triglycerides, HDL, and LDL with hypertension in the T2DM population. However, only the lipid profile (no blood sugar levels) was compared with hypertension in this study. In contrast to Kumar's research that compared fasting blood sugar HbA1C and lipid profile (14).

A rise in LDL cholesterol levels has been linked to an increased risk of cardiovascular disease in some studies (12,15). The incidence of hypertension will result in atherosclerosis. Atherosclerosis involves endothelial dysfunction, impaired lipid metabolism, oxidative stress, activation of vascular smooth muscle, genetic factors, and recently, it is also widely known that there is a role for inflammation at each stage of atherosclerosis formation. Atherosclerosis, characterized by endothelial dysfunction, is linked to metabolic syndrome and cardiovascular disease risk factors. Blood pressure factors, central obesity, hyperinsulinemia, and dyslipidemia occur before insulin resistance (16).

There is also a considerable reduction in LDL catabolism in T2DM patients, resulting in a prolonged duration of LDL in plasma, enhancing fat deposition into the artery wall (15). Low-Density Lipoprotein cholesterol has become a significant focus on managing lipid profiles in patients with coronary artery disease or risk factors equivalent to coronary artery disease, such as diabetes, who must have cholesterol control. According to the European Society of Cardiology's (ESC) recommendations for treating dyslipidemia. Low-Density Lipoprotein is tight if it is less than 70 mg/dL (17). It demonstrates the importance of a lipid profile in cardiovascular disease risk and diabetes prognosis.

In addition to an increase in LDL, high blood glucose levels potentially make the initiation of atherosclerosis by stimulating the proliferation of endothelial cells and blood vessel muscle cells (18). Hyperglycemia is frequently linked to hyperinsulinemia, dyslipidemia, and hypertension in individuals with T2DM. This situation could be resulting cardiovascular disease and stroke. For example, among studies of T2DM patients, hypertension increased by 42%-44% the risk of death and cardiovascular events, whereas T2DM without hypertension only 7%-9% the risk of death and cardiovascular disease (19).

This study shows that most patients with T2DM with hypertension were female. This research was in line with previous research that stated the most T2DM with hypertension was female, 63.9% (12). Most T2DM patients are aged 56-65 years old. This follows a study that found that people over 45 had a greater risk of developing type 2 diabetes than people under 45 (20). This is because as we age, our tissues' capacity to absorb glucose from the blood declines (21).

In this study, the mean fasting blood glucose levels in T2DM with hypertension ($SD\ 138.06 \pm 83.08$) were higher than those without hypertension (100.25 ± 32.70). It shows that the relationship between T2DM and hypertension is complex. Hypertension makes insulin sensitivity decrease (22). Even though insulin plays a role in increasing glucose uptake in many cells and carbohydrate metabolism, insulin resistance will occur. Therefore, blood glucose levels can also be disrupted (23). Autonomic dysfunction, activation of the Renin-Angiotensin-Aldosterone (RAAS) system, insulin resistance, sympathetic nerve activation, endothelial dysfunction, and arterial stiffness are some factors known to contribute to hypertension in diabetes (2). Excess insulin levels can also cause increased sodium retention by the kidney tubules, leading to hypertension.

The results of this study were influenced by external variables such as food consumption, cigarettes, glycemic control, and fat (24). Although treating linked risk factors is considerably more likely to be cardioprotective than merely maintaining glucose levels. Effective glycemic control is required to reduce the risk of nephropathy, retinopathy, and neuropathy (1). The American Diabetes Association's decision to lower the glucose threshold for "impaired fasting glucose" from 110 mg/dl to 100 mg/dl highlights the importance of better glycemic control (25). Therefore, a proper diet is needed to deal with T2DM with hypertension to control blood glucose levels, blood pressure, and lipid profiles. Some non-pharmacological therapies include weight loss programs for the obese, increasing a potassium-based diet, the Dietary Approach to Stop Hypertension (DASH), and regular exercise. Although it did not evaluate the benefits of the DASH diet in diabetic patients, their implementation seems reasonable in people with diabetes since they may positively affect glycemic and lipid profiles. Therefore, current ADA standards recommend adopting all diabetic patients with blood pressure values of $> 120/80$ mmHg (26).

CONCLUSION

This study found a significant difference in LDL, and there were no significant differences in fasting blood glucose level, HbA1C, cholesterol, HDL, or triglyceride in patients with T2DM hypertension and without hypertension.

Authors' contribution

QFR, DGT contributed to the research design and developed the first draft of the manuscript. QFR contributed to the data collection and statistical analysis. DGT and RC contributed to reviewing and evaluating this manuscript for publication.

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Conflict of interest

There is no conflict of interest in this research.

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