GLOBAL TEN PUBLIC HEALTH AND NURSING JOURNAL
Volume 4, No. 1, 2026, December, Page 1- 5
ISSN: 2579-7913
DOI: 10.36568/gtphnj.v4i1.255

Fasting blood glucose levels are associated with cholesterol and triglyceride levels in patients with Diabetes Mellitus

Anita Joeliantina, Indriatie, Endang Soelistyowati

Department of Nursing, Poltekkes Kemenkes Surabaya
Corresponding author: Anita Joeliantina (e-mail: anita@poltekkes-surabaya.ac.id).

ABSTRACT

Dyslipidemia is a condition characterized by elevated total cholesterol or triglycerides (TG), low-density lipoprotein (LDL), high-density lipoprotein (HDL) levels, or a combination of these abnormalities. In patients with Diabetes Mellitus (DM), the most common dyslipidemia pattern is hypertriglyceridemia, decreased HDL cholesterol levels, and increased LDL particle levels, which increases the risk of cardiovascular disease (CVD) in patients with DM. This study aimed to demonstrate the relationships between cholesterol, triglyceride, and BMI levels and fasting blood glucose in patients with DM. This study used a correlational analysis design with a cross-sectional approach. The sample size in this study was 40 adult patients with DM recruited from the Mojo and Kenjeran Community Health Centers in Surabaya using purposive sampling. Data collection used secondary data obtained from the Mojo and Kenjeran Community Health Centers in July 2024. Data analysis to assess the correlation between cholesterol, triglyceride levels, and BMI with blood glucose levels was performed using Pearson correlation. These factors indicate a relationship if the significance value is less than 0.05 or the calculated r value exceeds the table r (0.312). Based on the Pearson correlation test results, there is a significant relationship between cholesterol and triglyceride levels and fasting blood glucose levels, with significance values (p) of 0.022 and 0.23, respectively. BMI data shows no significant relationship with blood glucose levels, with a p-value of 0.939. Fasting blood glucose levels in this study showed a significant and positive relationship with cholesterol and triglyceride levels, but were not significantly related to BMI. This condition requires attention because patients with DM have a risk of developing complications, especially atherosclerosis.

Keywords: Blood Glucose; Body Mass Index; Cholesterol; Dyslipidemias; Triglycerides.

INTRODUCTION

DM is a chronic condition that occurs when the body cannot produce enough insulin or cannot use insulin effectively. It is diagnosed by observing elevated blood glucose levels. Over time, high blood glucose levels (known as hyperglycemia) cause damage to many tissues in the body, leading to the development of disabling and life-threatening health complications (International Diabetes Federation., 2015). Chronic hyperglycemia in patients with DM over the long term can cause damage such as dysfunction and failure of various organs, especially the eyes, kidneys, nerves, heart, and blood vessels. Fifty percent of people with DM die from cardiovascular disease (primarily heart disease and stroke) (Vinodmahato et al., 2011). Type 2 diabetes mellitus (T2DM) is a chronic disease that, if not well controlled, can be associated with atherosclerosis, diabetic nephropathy, neuropathy, and retinopathy (International Diabetes Federation., 2015)(Mbbs et al., 2016).

Cholesterol, TG, and lipoproteins are measured to evaluate a person's risk of developing atherosclerotic disease, especially if there is a family history of early heart disease, or to diagnose certain lipoprotein disorders. Cholesterol and TG are transported in the blood by combining with plasma proteins to form lipoproteins. These lipoproteins are called LDL and HDL (Smeltzer et al., 2010).

Dyslipidemia is a condition characterized by increased total cholesterol or TG, LDL, and HDL levels, or a combination of these abnormalities (Bereda, 2022). In patients with DM, the most common dyslipidemia pattern is hypertriglyceridemia, decreased HDL cholesterol (HDL-C) levels, and increased LDL cholesterol (LDL-C) levels, which increases the risk of

cardiovascular disease (CVD) in patients with DM (Bereda, 2022).

DM is associated with a significantly increased risk of early atherosclerotic cardiovascular disease. Dyslipidemia is common in patients with DM, and there is strong evidence that cholesterol-lowering improves cardiovascular outcomes, even in patients with seemingly normal lipid profiles (Schofield et al., 2016). Dyslipidemia is a common feature of DM (Schofield et al., 2016)(Chapman et al., 2011). Dyslipidemia is associated with atherosclerosis, which can lead to cardiovascular disease (Bereda, 2022)(Alidu et al., 2023)(American Diabetes Association, 2019). Studies have shown a relationship between atherosclerotic cardiovascular disease and serum cholesterol and triglyceride levels in both type 1 and type 2 DM (Howard et al., 2000). The risk of coronary heart disease (CHD) is greater at certain serum cholesterol levels in patients with DM, and the association with hypertriglyceridemia is stronger than in the general population (Wentworth et al., 1993).

A study (Rakhmawati, 2024) found a correlation between total cholesterol and fasting blood glucose levels in patients with type 2 DM (Rakhmawati, 2024). Another study showed a significant association between fasting blood glucose and triglyceride levels in patients with T2DM at the Nano Med Sunter Clinic (Hikmah & Oktaviani, 2022). Patients with DM must properly control their blood glucose levels because worsening glycemic control will exacerbate lipid and lipoprotein abnormalities. Available evidence suggests that dyslipidemia is secondary to insulin resistance or factors closely associated with insulin resistance, such as adiposity (Nnakenyi et al., 2022). In both type 1 and type 2 DM, poor glycemic control increases TG levels and decreases HDL-C levels, with a moderate effect on LDL-C levels (Kenneth R. Feingold, 2023). Therefore, glycemic control and management of dyslipidemia are important for patients with T2DM to further reduce the risk of cardiovascular disease. Fasting blood glucose and glycated hemoglobin (HbA1c) concentrations are associated with vascular disease risk even in individuals without DM (Schofield et al., 2016)(Nnakenyi et al., 2022).

The aim of this study was to demonstrate the associations between cholesterol, triglyceride, and BMI levels and fasting blood glucose (FBG) in patients with DM.

METHOD

This study employed a correlational analytical design with a cross-sectional approach to examine the association between cholesterol levels, triglyceride (TG) levels, body mass index (BMI), and fasting blood glucose levels among patients with diabetes mellitus (DM). The study included 40 adult patients with DM aged 40 years and above, selected through purposive sampling from secondary data obtained from the Mojo and Kenjeran Community Health Centers in Surabaya. Data collection was conducted in July 2024 using patient records that included demographic characteristics (age and gender), cholesterol levels, triglyceride levels, BMI, and fasting blood glucose levels. Measurements of cholesterol, triglycerides, and fasting blood glucose were performed using a portable GCU (Glucose, Cholesterol, Uric Acid) device. Data were analyzed using the Pearson correlation test to determine the relationships among cholesterol, TG, BMI, and blood glucose levels, with statistical significance established at $p < 0.05$ or when the calculated correlation coefficient (r) exceeded the critical r-table value of 0.312. Ethical approval for the study was obtained from the Health Research Ethics Commission (No. 2288/KEPK-Poltekkes_Sby/V/2024), and all respondents had previously been informed about the data collection procedures and provided written informed consent.

RESULTS

Data on the characteristics of patients with DM obtained from secondary data are as follows: the majority (60%) were aged <60 years, 77.50% were female, 75% had cholesterol levels ≥200 mg/dL, 62.50% had triglyceride levels ≥200 mg/dL, 60% had a BMI ≥25%, and 75% had fasting blood glucose levels ≥126 mg/dL (Table I).

TABLE I
CHARACTERISTICS OF PATIENTS WITH DM (N=40)

Characteristics	Mean	frecuency	Percentage (%)
Age (years)	57.58		
< 60		24	60.00
≥ 60		16	40.00
Gender			
Laki-laki		9	22.50
Perempuan		31	77.50
Cholesterol level (mg/dL)	176.63		
< 200		10	25.00
≥ 200		30	75.00
Trygliseride level (mg/dL)	149.13		
< 150		15	37.50
≥ 150		25	62.50

Characteristics	Mean	frecuency	Percentage (%)
BMI (%)	23.98		
< 25		11	27.50
≥ 25		24	60.00
Fasting Blood Glucose level (mg/dL)	161.05		
≤ 126		10	25.00
> 126		30	75.00

Based on the Pearson correlation test results, there were significant relationships between cholesterol and triglyceride levels and fasting blood glucose levels, with significance values (p) of 0.022 and 0.23, respectively. BMI data showed no significant relationship with blood glucose levels, with a p-value of 0.939 (Table II).

TABLE II RESULT OF THE PEARSON CORRELATION ANALYSIS

Variabel	FBG level	
	r hitung	p
Cholesterol	0.362	0.022
TG	0.360	0.023
BMI	0.013	0.939

Patients with DM can experience not only impaired carbohydrate metabolism but also lipid and protein metabolism. Dyslipidemia can affect lipid metabolism in patients with DM. Multiple mechanisms contribute to the dyslipidemia seen in patients with T2DM, influenced by both glucose control and factors such as obesity and inflammation (Kenneth R. Feingold, 2023).

Cholesterol is obtained from food and synthesized in most cells of the body. Cholesterol is a component of cell membranes and a precursor of steroid hormones and bile salts used for fat absorption. High blood cholesterol, particularly cholesterol in lipoprotein particles called LDL, contributes to the formation of atherosclerotic plaques in the lumen of arteries, particularly in the heart and brain (Lieberman & Peet, 2018). Fats are lipids composed of triacylglycerols (also called TG). Triacylglycerols are the main lipids in food. Furthermore, excess glucose in the body can be converted to TG in the liver, with most being stored in adipose tissue. Adipose tissue triacylglycerols are the primary energy source during fasting. Body mass index (BMI) is a ratio based on body weight and height. A high BMI increases the risk of cardiovascular disease, including hypertension, DM, and changes in blood lipid levels (Smeltzer et al., 2010)(Potter et al., 2013).

This study aimed to determine the relationships among blood glucose levels, cholesterol, TG, and BMI. In patients with DM, elevated blood glucose levels can affect cholesterol, triglyceride, and BMI levels.

The study results showed a significant and positive relationship between fasting blood glucose levels and cholesterol levels. This finding aligns with the study by Santos, Prihatiningsih, and Yanti (2025), which found a positive and significant relationship between fasting blood glucose levels and cholesterol levels in patients with DM mellitus (Santos et al., 2025). Other research, consistent with this finding, also showed a correlation between blood glucose levels and total cholesterol in patients diagnosed with T2DM (Rakhmawati, 2024). DM has been shown to increase the risk of CHD in all populations studied. However, there is a paucity of information regarding the importance of diabetes-related risk factors for CHD, particularly the role of lipid levels, as LDL-C is often not elevated in individuals with DM. LDL-C is a strong independent predictor of coronary heart disease in individuals with DM, even when components of diabetic dyslipidemia are present. These results support recent recommendations for aggressive LDL-C control in individuals with DM, with a target level of <100 mg/dL (Howard et al., 2000).

The results of this study indicate a significant relationship between blood glucose and triglyceride levels. Other studies have shown a significant relationship between fasting blood sugar and triglyceride levels in patients with T2DM at the Nano Med Sunter Clinic, with a Pearson correlation strength of 0.38 (Hikmah & Oktaviani, 2022). The triglyceride-glucose index (TyG), a reliable indicator of insulin resistance (IR), has been shown to be associated with poor clinical outcomes in patients with acute coronary syndrome, heart failure, ischemic stroke, and others (Liao et al., 2022). The TyG index, based on fasting blood glucose (FBG) and TG, has been used in clinical practice as a simple and reliable surrogate marker of IR, and previous studies have demonstrated a high correlation with the hyperinsulinemic-euglycemic clamp technique (the gold standard for assessing IR) (Liao et al., 2022) (Du et al., 2014) (Simental-mendía et al., 2019).

Regarding the relationship between BMI and blood glucose levels, the results of this study are

consistent with existing research, indicating no significant association, although a positive correlation was observed (Hossain et al., 2025). Hypertension, diabetes, dyslipidemia, fasting glucose levels, total cholesterol, low-density lipoprotein cholesterol, and triglyceride levels were positively correlated, while mean age was inversely correlated with BMI (Song et al., 2021). There is a substantial correlation between blood glucose levels and BMI due to dietary changes (Hossain et al., 2025), so patients with DM must manage their diet to maintain a normal BMI.

The primary strategy for managing the three cardiovascular risk factors is managing hyperlipidemia, hypertension, and diabetes mellitus. Nurses should provide patients with the following information: current height and weight (to determine BMI), waist circumference measurement (for obesity assessment), blood pressure, and laboratory test results, such as blood glucose, glycated hemoglobin (diabetes), total blood cholesterol, and HDL and LDL (Smeltzer et al., 2010). Improved glycemic control generally benefits lipoprotein levels in diabetes, with decreased cholesterol and triglyceride levels due to reduced circulating very low-density lipoprotein (VLDL) and increased LDL catabolism, driven by reduced glycation and increased LDL receptor expression (Schofield et al., 2016).

The first limitation of this study is the small sample size, which cannot be generalized. Second, the data collected is secondary, requiring further analysis of primary data with a larger sample size. Third, the lipid profile examination was incomplete, and needs to be supplemented to better demonstrate the risk of atherosclerosis.

DISCUSSION

FBG levels in this study showed a significant and positive association with cholesterol and TG levels, but not significantly with BMI. This Condition Requires Attention Because Patients With DM Are At Risk Of Developing Complications, Particularly Atherosclerosis. Patients With DM Must Practice Diabetes Self-Care To Maintain Blood Glucose Levels, Which Can Help Prevent Complications. The role of health workers is essential in continuing to provide education and support to patients with DM, enabling them to regularly carry out self-care.

CONCLUSION AND SUGGESTION

FBG levels in this study showed a significant and positive association with cholesterol and TG levels, but not significantly with BMI. This Condition Requires Attention Because Patients With DM Are At Risk Of Developing Complications, Particularly Atherosclerosis. Patients With DM Must Practice Diabetes Self-Care To Maintain Blood Glucose Levels, Which Can Help Prevent Complications. The role of health workers is essential in continuing to provide education and support to patients with DM, enabling them to regularly carry out self-care.

REFERENCES

Alidu, H., Dapare, P. P. M., Quaye, L., Amidu, N., Bani, S. B., & Banyeh, M. (2023). Insulin Resistance in relation to Hypertension and Dyslipidaemia among Men Clinically Diagnosed with Type 2 Diabetes. BioMed Research International, 2023. https://doi.org/10.1155/2023/8873226

American Diabetes Association. (2019). Standards of Medical Care in Diabetesd2019. Diabetes Care, 42(Supplement 1), S131–S135.

Bereda, G. (2022). Pathophysiology and Management of Dyslipidaemia. 34369–34375. https://doi.org/10.26717/BJSTR.2022.43.006869

Chapman, M. J., Ginsberg, H. N., Amarenco, P., Andreotti, F., Catapano, A. L., Descamps, O. S., Fisher, E., Kovanen, P. T., Kuivenhoven, J. A., Lesnik, P., Masana, L., Nordestgaard, B. G., Ray, K. K., Reiner, Z., & Taskinen, M. (2011). Triglyceride-rich lipoproteins and high-density lipoprotein cholesterol in patients at high risk of cardiovascular disease : evidence and guidance for management. 1345–1361. https://doi.org/10.1093/eurheartj/ehr112

Du, T., Yuan, G., Zhang, M., Zhou, X., Sun, X., & Yu, X. (2014). Clinical usefulness of lipid ratios , visceral adiposity indicators , and the triglycerides and glucose index as risk markers of insulin resistance. 1–10. https://doi.org/10.1186/s12933-014-0146-3

Hikmah, A. M., & Oktaviani, C. (2022). Kadar Trigliserida Pada Pasien Diabetes. Jurnal Ilmiah Kedokteran Dan Kesehatan, 1(2), 11–16.

Hossain, S., Islam, A., Nawal, C., Fouzia, S., Nasima, A., & Mukta, A. (2025). Association Between Blood Glucose and Body Mass Index With Dietary Diversity and Physical Activity : A Cross - Sectional Study on Marma Tribes of Bandarban in. 1–8. https://doi.org/10.1002/hsr2.71113

Howard, B. V, Robbins, D. C., Sievers, M. L., Lee, E. T., Rhoades, D., Devereux, B., Cowan, L. D., Gray, R. S., Welty, T. K., Go, O. T., & James, W. (2000). LDL Cholesterol as a Strong Predictor of Coronary Heart Disease in Diabetic Individuals With Insulin Resistance and Low LDL. 20(3), 830–835.

International Diabetes Federation. (2015). IDF Diabetes Atlas Seventh Edition 2015.

Kenneth R. Feingold, M. (2023). Dyslipidemia in Patients with Diabetes. Endotext [Internet], December.

Liao, Y., Zhang, R., Shi, S., Zhao, Y., He, Y., Liao, L., Lin, X., Guo, Q., Wang, Y., Chen, L., Li, W., Li, S., Chen, K., & Fang, Y. (2022). Triglyceride - glucose index linked to all - cause mortality in critically ill patients : a cohort of 3026 patients. Cardiovascular Diabetology, 1–14. https://doi.org/10.1186/s12933-022-01563-z

Lieberman, M., & Peet, A. (2018). Marks' basic medical biochemistry : a clinical approach (5th ed.). Wolters Kluwer.

Mbbs, S. C. T., Nureslyna, I., Mbbch, S., & George, E. (2016). Relationship between dyslipidaemia and glycaemic status in patients with type 2 diabetes mellitus. Malaysian J Pathol, 38(2), 123–130.

Nnakenyi, I. D., Nnakenyi, E. F., Parker, E. J., Uchendu, N. O., Anaduaka, E. G., Ezeanyika, L. U., Parker, E. J., & Orizu, N. (2022). Relationship between glycaemic control and lipid profile in type 2 diabetes mellitus patients in a low- resource setting. Pan African Medical Journal, 41(281).

Potter, P. A., Perry, A. G., Stockert, P. A., & Hall, A. M. (2013). Fundamentals of Nursing (8th ed.). Elsevier Inc.

Rakhmawati, A. (2024). Korelasi Kadar Glukosa Darah Dengan Kolesterol Total Pada Pasien Diabetes Melitus Tipe 2 Di Puskesmas Purwokerto Selatan. Jurnal Bina Cipta Husada, XX(2), 32–41.

Santos, S. Dos, Prihatiningsih, D., & Yanti, N. L. G. P. (2025). Jurnal sosial dan sains. 5(Dm), 6391–6400.

Schofield, J. D., Liu, Y., & Rayaz, P. R. (2016). Diabetes Dyslipidemia. Diabetes Therapy, 7(2), 203–219. https://doi.org/10.1007/s13300-016-0167-x

Simental-mendía, L. E., Simental-mendía, E., Rodríguez-hernández, H., Rodríguez-morán, M., & Guerrero-romero, F. (2019). The product of triglycerides and glucose as biomarker for screening simple steatosis and NASH in asymptomatic women. 15(5), 715–720. https://doi.org/10.5604/16652681.1212431.as

Smeltzer, S. C., Bare, B. G., Hinkle, J., & Cheever, K. H. (2010). Brunner & Suddarth's Textbook of Medical-Surgical Nursing Twelfth Edition (12th ed.). Wolters Kluwer Health / Lippincott Williams & Wilkins.

Song, W., Bae, E. H., Ahn, J. C., Oh, T. R., Kim, Y., Kim, J. S., Kim, S., Kim, S. W., Han, K., & Lim, S. Y. (2021). Effect of body mass index and abdominal obesity on mortality after percutaneous coronary inter- vention : a nationwide , population-based study. 36(Suppl 1), 90–98.

Vinodmahato, R., Gyawali, P., Raut, P. P., Regmi, P., Psd, K., Pandeya, D. R., & Gyawali, P. (2011). Association between glycaemic control and serum lipid profile in type 2 diabetic patients : Glycated haemoglobin as a dual biomarker . Biomedical Research, 22(3), 375–380.

Wentworth, D., Stamler, J., The, F. O. R., Risk, M., Vaccaro, O., Trial, I., Neaton, J. D., Medicine, O. F. I., Medicine, F. O. F., Division, T. H. E., Biostatistics, O. F., Health, O. F. P., Heart, T. H. E. N., Correspondence, A., Requests, R., & Jeremiah, T. O. (1993). Diabetes, Other Risk Factors, and 12-Yr Cardiovascular Mortality for Men Screened in the Multiple Risk Factor Intervention Trial. DIABETES CARE, 16(2), 434–444.