



The Relationship Between Blood Glucose and Increased Total Cholesterol in Outpatients at the Telaga Biru Community Health Center in Pontianak

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Abstract

Blood glucose and total cholesterol are important metabolic indicators that are physiologically interrelated. Prolonged hyperglycemia can disrupt lipid metabolism, leading to elevated total cholesterol levels. This study aimed to determine the association between blood glucose levels and total cholesterol among outpatients at Telaga Biru Community Health Center, Pontianak. An analytical observational study with a cross-sectional design was conducted in February 2025. Fasting blood glucose was measured using the GOD-PAP (Glucose Oxidase-Peroxidase Aminoantipyrine Phenol) method, and total cholesterol was measured using the CHOD-PAP (Cholesterol Oxidase-Peroxidase Aminoantipyrine Phenol) method with a spectrophotometer. Thirty outpatients were enrolled through accidental sampling. Blood glucose was classified as elevated if >115 mg/dL, and total cholesterol was classified as elevated if ≥ 200 mg/dL. Data were analyzed using Fisher's Exact test. Results showed that 50% of respondents ($n=15$) had elevated blood glucose levels, while 26.7% ($n=8$) had elevated total cholesterol levels. Fisher's Exact test yielded a p-value of 0.035 ($p < 0.05$), indicating a statistically significant association between blood glucose levels and total cholesterol. It can be concluded that there is a significant association between blood glucose levels and elevated total cholesterol in this outpatient sample, though larger studies are needed for broader generalization.

Keywords: Glucose, Cholesterol Total. Public Health Centre

Introduction

Non-communicable diseases (NCDs), particularly metabolic disorders such as diabetes mellitus and dyslipidemia, represent a growing global health burden. Blood glucose is the primary energy substrate for cellular function, especially in the brain and skeletal muscle. Its regulation depends on insulin secretion from the pancreatic beta cells, which facilitates glucose uptake by peripheral tissues or its

storage as glycogen. Disruptions in this regulatory axis—arising from poor dietary habits, physical inactivity, obesity, or impaired pancreatic function—can destabilize glucose homeostasis and trigger a cascade of metabolic complications.¹

Hyperglycemia is the defining biochemical feature of Diabetes Mellitus (DM), a chronic metabolic disorder resulting from insufficient insulin secretion or peripheral insulin resistance. Its prevalence is increasing globally at an alarming rate, with significant implications for cardiovascular and metabolic health. Risk factors include genetic predisposition, unhealthy dietary patterns, and physical inactivity, all of which compound the failure of glucose regulation.²

Chronic hyperglycemia promotes insulin resistance, which impairs the body's ability to regulate lipid metabolism. Specifically, it upregulates hepatic lipoprotein synthesis, suppresses HDL production, and elevates LDL and triglyceride concentrations. These lipid abnormalities increase susceptibility to atherosclerosis and cardiovascular disease, which are among the leading causes of death in individuals with DM. Dyslipidemia in this context is largely driven by hyperglycemia's stimulatory effect on hepatic lipid synthesis pathways.³

Cholesterol is an essential lipid involved in hormone synthesis, bile acid production, and cell membrane integrity.⁴ Insulin dysfunction in DM disrupts fat metabolism. Excess carbohydrates that are not oxidized for energy are converted to triglycerides and stored in adipose tissue. When storage capacity is exceeded, surplus glucose promotes lipogenesis, and cholesterol derived from fat and protein catabolism can accumulate in vessel walls. This accelerates the development of vascular atherosclerosis, a serious and life-threatening complication of DM.⁵

According to the World Health Organization,



over half a billion people globally have diabetes, projected to reach 1.3 billion by 2050.⁶ The International Diabetes Federation reports a high and rising prevalence of DM in Indonesia.⁷ In 2023, Indonesia's national diabetes prevalence reached 11.7%. In West Kalimantan Province, DM ranks second among non-communicable diseases with an 11.1% prevalence, exceeded only by hypertension.

Prior studies examining the link between blood glucose and lipid parameters have predominantly been conducted in hospital-based settings or among diagnosed diabetic populations. Evidence from general primary care outpatient populations, where metabolic abnormalities may be present at an earlier, subclinical stage, remains limited—particularly in the Indonesian context. Telaga Biru Community Health Center, Pontianak, serves as a key primary care facility in North Pontianak Subdistrict and regularly receives outpatients presenting for routine laboratory examination, including blood glucose checks. This provides a valuable opportunity to study early metabolic interactions in a real-world, community-based setting. Therefore, this study aims to determine the association between blood glucose levels and total cholesterol among outpatients at Telaga Biru Community Health Center, Pontianak.

Materials and methods

Study Design

This study employed an analytical observational design with a cross-sectional approach, in which the independent and dependent variables were measured simultaneously without any intervention. This design was selected to determine the relationship between fasting blood glucose levels and total cholesterol levels among outpatients, providing a snapshot of the respondents' condition at the time of the study.⁸

Sample and Experimental Design

The population of this study consisted of all outpatients who visited Telaga Biru Public Health Center, Pontianak. The sample was a subset of the population selected using an accidental sampling technique, in which individuals who were encountered by the researcher and met the study criteria were included as respondents.

The inclusion criteria were: patients aged over 18 years, patients who visited the health center for fasting blood glucose examination, and patients who were willing to participate by signing an informed consent form. The exclusion criteria included patients who were not present at the time of data collection and those who withdrew or refused to continue participation during the study. This study received ethical approval from the Health Research Ethics Committee of Poltekkes Kemenkes Pontianak. All participants provided written informed consent prior to enrollment. As accidental sampling was employed, a non-probability technique, findings should be interpreted with attention to potential selection bias, which is acknowledged as a study limitation.

Research Variables

The independent variable in this study was fasting blood glucose level, measured through laboratory examination. The dependent variable was total cholesterol level, also measured through laboratory analysis. Age and sex were recorded for descriptive purposes but were not included as covariates in the statistical analysis.

Examination Procedure

The research procedure was conducted in three main stages: pre-analytical, analytical, and post-analytical phases. In the pre-analytical stage, respondents were informed about the study objectives and procedures, and their eligibility was confirmed, particularly ensuring a fasting period of 8–10 hours.

Participants were also asked to sign an informed consent form. In addition, all necessary laboratory equipment and materials were prepared. In the analytical stage, venous blood samples were collected from the respondents following standard procedures. The samples were then analyzed to measure fasting blood glucose and total cholesterol levels using enzymatic methods at the Integrated Laboratory of Poltekkes Kemenkes Pontianak.

All results were recorded systematically to ensure data accuracy. In the post-analytical stage, the laboratory results were validated and verified to ensure data quality. The data were then recorded and processed for analysis. When necessary, the results were also communicated to the respondents as part of health information feedback.

Data Analysis

Data were analyzed using SPSS statistical software. Univariate analysis was performed to calculate the frequency distribution and percentage of each variable category, namely fasting blood glucose level (normal: ≤ 115 mg/dL; elevated: > 115 mg/dL) and total cholesterol level (normal: < 200 mg/dL; elevated: ≥ 200 mg/dL). Bivariate analysis was conducted using Fisher's Exact test to examine the association between categorical blood glucose and categorical total cholesterol, as both variables were measured on a nominal scale and the sample size was small ($n=30$). A p-value of < 0.05 was considered statistically significant.

Result

This research was conducted at the Telaga Biru Community Health Center in Pontianak. The population in this study consisted of outpatients at the Telaga Biru Community Health Center Pontianak. The research was carried out in February 2025. There were 30 respondents in this study.

Univariate Analysis

Univariate analysis aims to explain or describe the characteristics of each research test variable.

Table 1. Demographic distribution based on patients at the Telaga Biru Community Health Center Pontianak

Demographic of population	Frequency
Age	
Adult	22 (73.3%)
Elderly	8 (26.7%)

Demographic of population	Frequency
Gender	
Man	3 (10.0%)
Woman	27 (90.0%)
Blood Glucose Level	
Elevated	15 (50.0%)
Normal	15 (50.0%)
Cholesterol level	
Elevated	8 (26.7%)
Normal	22 (73.3%)

The age distribution of respondents shows a dominance of the adult group, with 22 people (73.3%), while the elderly group consists of 8 people (26.7%). In total, the number of respondents in this study is 30, encompassing both age groups. The characteristics of respondents by gender indicate that the majority are female, totaling 27 people (90.0%), while males amount to only 3 people (10.0%). These findings show

that the patient population in this study is dominated by females. The distribution of blood glucose levels shows an equal proportion between the two categories. Fifteen respondents (50.0%) had blood glucose levels within the normal range (≤ 115 mg/dL), while the remaining 15 respondents (50.0%) had elevated blood glucose levels (> 115 mg/dL). Meanwhile, the distribution of total cholesterol levels shows that the majority of respondents had normal levels, with 22 people (73.3%), while 8 respondents (26.7%) had elevated cholesterol levels. Total cholesterol levels are categorized as normal if < 200 mg/dL and elevated if ≥ 200 mg/dL.

Bivariate Analysis

Two variables suspected of being related are examined in a process known as bivariate analysis. Through computerized techniques using SPSS software, the data collected from this study were examined using Fisher's Exact test.

Table 2. Association Between Blood Glucose Level and Total Cholesterol Level (Values shown as frequency and row percentage; p-value from Fisher's Exact test, two-sided)

Blood Level	Glucose	Cholesterol total					Sig Fisher's Exact	
		Normal		Elevated		Total		
		Frequency	%	Frequency	%	Frequency		%
Elevated		14	46.7	1	3.3	15	50	0.035
Normal		8	26.7	7	23.3	15	50	
Total		22	73.3	8	26.7	30	100	

Table 2 presents the cross-tabulation of blood glucose and total cholesterol categories. Of 30 respondents, 15 (50.0%) had elevated blood glucose levels (> 115 mg/dL), while the remaining 15 (50.0%) had normal levels. Regarding total cholesterol, 22 respondents (73.3%) had normal levels (< 200 mg/dL) and 8 respondents (26.7%) had elevated levels (≥ 200 mg/dL). Fisher's Exact test yielded a p-value of 0.035 ($p < 0.05$), indicating a statistically significant association between blood glucose category and total cholesterol category among outpatients at Telaga Biru Community Health Center, Pontianak.

Discussion

This study demonstrates a statistically significant association between blood glucose levels and total cholesterol among outpatients ($p = 0.035$), indicating that hyperglycemia tends to coexist with elevated cholesterol levels. Although the sample size was relatively small ($n = 30$), the balanced distribution of glycemic status and the predominance of normal cholesterol levels provide a relevant snapshot of early metabolic alterations in a primary care setting.

The observed relationship is biologically plausible and consistent with prior evidence. Purwanti et al. (2016) reported a significant association between fasting glucose and lipid parameters in patients with type 2 diabetes mellitus, supporting the notion that disturbances in glucose homeostasis are closely linked to lipid metabolism. Chronic hyperglycemia promotes insulin resistance, a central mechanism that not only impairs glucose uptake but also alters hepatic lipid regulation, leading to increased cholesterol synthesis and reduced lipid clearance.⁹ This is further mediated

by upregulation of HMG-CoA reductase activity, a key enzyme in cholesterol biosynthesis, which accelerates hepatic cholesterol production under hyperglycemic conditions.

From a metabolic perspective, these findings align with the broader framework of metabolic syndrome, where hyperglycemia, dyslipidemia, and other cardiometabolic risk factors coexist and interact. Individuals with elevated glucose levels are more likely to exhibit lipid abnormalities, including increased total cholesterol, as part of a clustered metabolic disturbance.¹⁰ Excess glucose is diverted into lipogenesis, contributing to adipose tissue accumulation and dyslipidemia, thereby reinforcing the pathological link between glucose and lipid metabolism.

Although lifestyle factors such as diet and physical activity were not measured in this study, they may amplify the observed association. High-glycemic diets and physical inactivity are known to exacerbate both hyperglycemia and dyslipidemia, and future research should include these variables to better characterize their role.¹¹ Conversely, physical activity improves insulin sensitivity and facilitates the utilization of glucose and fatty acids as energy substrates, thereby reducing circulating glucose and lipid concentrations.^{12,13}

In addition, psychosocial stress may also play a role. Elevated cortisol from chronic stress increases blood glucose and stimulates lipolysis, releasing free fatty acids that are subsequently converted into cholesterol in the liver. As this variable was not assessed in the present study, its contribution cannot be confirmed and warrants investigation in future

research.¹⁴ This highlights the multifactorial nature of metabolic dysregulation, extending beyond purely biochemical mechanisms.

Despite extensive literature on the association between hyperglycemia and dyslipidemia, most studies have been conducted in hospital-based settings or focused on diagnosed diabetic populations. Evidence from primary healthcare settings, particularly involving general outpatient populations with mixed metabolic status, remains limited. Moreover, few studies simultaneously capture early-stage metabolic alterations—where glucose and lipid abnormalities may already coexist but have not yet progressed into clinically defined metabolic syndrome. This gap is particularly relevant in low- and middle-income settings, where primary care serves as the first point of contact for disease detection but often lacks integrated metabolic screening.

This study contributes novel insight by demonstrating a significant association between blood glucose and total cholesterol within a primary care outpatient population, reflecting early metabolic interaction outside of specialized or high-risk cohorts. Unlike prior studies that predominantly focus on diabetic or hospitalized patients, this research highlights the presence of metabolic interdependence in a more general clinical population. The use of real-world data from a community health center setting further strengthens its relevance, emphasizing the importance of integrated screening strategies for both glycemic and lipid parameters at the primary care level. These findings support the need for early, combined metabolic risk assessment as part of routine outpatient services.

Despite these contributions, several limitations should be acknowledged. First, the small sample size ($n=30$) may restrict the generalizability of the findings. Second, the cross-sectional design precludes causal inference; no temporal relationship between blood glucose and cholesterol levels can be established. Third, potential confounders such as age, dietary habits, and physical activity were not controlled in the analysis. Fourth, the accidental sampling method may introduce selection bias, as participants were enrolled based on availability rather than random selection. Future research employing larger sample sizes, longitudinal designs, and controlled assessment of confounders is necessary to better characterize the causal pathways linking hyperglycemia and dyslipidemia.

In summary, the findings reinforce that the association between blood glucose and total cholesterol is part of an interconnected metabolic network influenced by physiological, behavioral, and environmental factors. Early identification and integrated management targeting both glycemic control and lipid regulation are essential to reduce the risk of cardiometabolic complications.

Conclusion

This study demonstrates a statistically significant association between blood glucose levels and total cholesterol among outpatients at Telaga Biru Community Health Center, Pontianak ($p = 0.035$),

indicating that higher blood glucose levels were significantly associated with elevated total cholesterol levels. These findings support the integration of combined glycemic and lipid screening within routine outpatient services at community health centers. Larger, longitudinal studies are needed to confirm causality, explore underlying mechanisms, and account for potential confounders such as diet, physical activity, and body mass index.

Conflict of interest

Authors state no conflict of interest.

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