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Correlation between Random Blood Glucose and Total Cholesterol Levels among Health Screening Participants at 7 Ulu Primary Health Center, Palembang

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ABSTRAK

Diabetes melitus dan dislipidemia sering ditemukan bersamaan dan sama-sama meningkatkan risiko penyakit kardiovaskular, tetapi data hubungan glukosa darah sewaktu (GDS) dengan kolesterol total pada peserta skrining di layanan primer masih terbatas. Penelitian ini bertujuan mengetahui hubungan kadar GDS dengan kadar kolesterol total pada peserta skrining kesehatan di Puskesmas 7 Ulu Palembang. Penelitian analitik observasional dengan desain potong lintang ini dilaksanakan pada kegiatan skrining 17 Desember 2024 terhadap 96 peserta dewasa yang tidak sedang menggunakan obat antidiabetes atau penurun lipid, dipilih secara *consecutive sampling*. GDS dan kolesterol total diperiksa dari darah kapiler tanpa puasa menggunakan alat *point-of-care testing* (POCT). Analisis utama menggunakan korelasi Spearman dan analisis tambahan menggunakan uji *Chi-square* Pearson. Median GDS 126,5 mg/dL (Q1–Q3 98,3–152,5), rerata kolesterol total 203,1 ± 32,6 mg/dL, dan 52,1% peserta memiliki kolesterol total ≥200 mg/dL. GDS berkorelasi positif sedang dengan kolesterol total (ρ = 0,52; IK95% 0,35–0,66; p < 0,001). Kolesterol total ≥200 mg/dL lebih sering ditemukan pada kelompok GDS ≥140 mg/dL (batas operasional) dibandingkan <140 mg/dL (75,7% vs 37,3%; OR kasar 5,23; IK95% 2,09–13,10). Kadar GDS berhubungan positif dengan kolesterol total pada peserta skrining ini, tetapi hubungan tersebut belum disesuaikan terhadap perancu sehingga GDS tidak dapat dijadikan dasar tunggal pemeriksaan lipid..

Keywords: dislipidemia; glukosa darah sewaktu; kolesterol total; layanan kesehatan primer; skrining kesehatan

ABSTRACT

Diabetes mellitus and dyslipidemia frequently coexist and both increase cardiovascular risk , yet data on the relationship between random blood glucose (RBG) and total cholesterol among screening participants in primary care remain limited . This study aimed to determine the correlation between RBG and total cholesterol levels among health screening participants at 7 Ulu Primary Health Center, Palembang. This analytical observational cross-sectional study was conducted during a screening activity on December 17 , 2024 and included 96 adults participants not currently using antidiabetic or lipid- lowering selected drugs by consecutive sampling. RBG and total cholesterol were measured in non- fasting capillary blood using point-of-care testing (POCT) devices . The primaries analysis used Spearman correlation and the secondary analysis used Pearson's chi-square test . Median RBG was 126.5 mg / dL (Q1–Q3 98.3–152.5), mean total cholesterol was 203.1 ± 32.6 mg / dL , and 52.1% of participants had total cholesterol ≥200 mg / dL . RBG showed a moderate positive correlation with total cholesterol (ρ = 0.52; 95% CI 0.35–0.66; p < 0.001). Total cholesterol ≥200 mg / dL was more frequent in the RBG ≥140 mg / dL group (operational cut- off) than in the <140 mg / dL group (75.7% vs 37.3%; crude OR 5.23; 95% CI 2.09–13.10). RBG was positively associated with total cholesterol among these screening participants ; however , the association was not adjusted for confounders , and RBG cannot serve as the sole basis for lipid testing.

Keywords : *dyslipidemia ; health screening ; primary health care ; random blood glucose ; total cholesterol*

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Introduction

Diabetes mellitus (DM) is a non-communicable disease with a growing burden. The 11th edition of the IDF Diabetes Atlas estimates that 20.4 million Indonesians aged 20–79 years will be living with diabetes in 2024, placing Indonesia in fifth place globally, and approximately 73.2% of these are estimated to be undiagnosed [1]. The 2023 Indonesian Health Survey (SKI) reported a DM prevalence based on blood sugar levels in the population aged ≥15 years at 11.7% (Table 7.12, p. 239), far above the prevalence based on doctor diagnosis in the same age group, which is 2.2% (Tables 7.10–7.11, pp. 237–238) [2]. The difference between these two estimates indicates a detection gap, although it cannot be directly interpreted as the number of undiagnosed cases because the measurement methods and denominators are different.

Lipid disorders are also common. The 2023 SKI reported that in the population aged ≥15 years, 27.8% had borderline high total cholesterol (200–239 mg / dL) and 11.7% had high total cholesterol (≥240 mg / dL) (Table 7.30, p. 257) [2]. Elevated total cholesterol is only one form of dyslipidemia ; dyslipidemia also includes abnormalities in LDL cholesterol, HDL cholesterol, and triglycerides [3]. Dyslipidemia and hyperglycemia are each risk factors for atherosclerotic cardiovascular disease , and simultaneous management of both is recommended to reduce cardiovascular risk [3, 4].

Biologically, glucose and lipid metabolism are interrelated. In insulin resistance, insulin inhibition of lipolysis is reduced, increasing the flow of free fatty acids to the liver and increasing the production of triglyceride-rich lipoproteins (VLDL) [5, 6]. Dyslipidemia patterns Diabetic patients are primarily characterized by high triglycerides, low HDL cholesterol, and a predominance of small-dense LDL particles; total cholesterol may not reflect all of these changes [6, 7]. However, total cholesterol was chosen in this study because it is a lipid parameter available in POCT examinations for screening non-communicable disease risk factors in primary care, along with blood sugar examinations [8].

Research results in Indonesia regarding the relationship between blood glucose levels and total cholesterol are still varied and conducted in different populations. Kriswiastiny et al. reported the relationship between blood sugar levels and total cholesterol in outpatients with type 2 diabetes mellitus at a hospital in Bandar Lampung [9]. Rakhmawati studied 40 patients with type 2 diabetes mellitus at the South Purwokerto Community Health Center and found a significant correlation between random blood glucose and total cholesterol [10]. In contrast, Haiti and Christyawardani, who examined 30 non-diabetic students aged 18–21 years after a 12-hour fast in Palembang, found no significant association ($p = 0.646$) [11]. Thus, previous studies generally involved patients with diagnosed diabetes who were likely undergoing therapy, or younger age groups with fasting examinations. Data on adult screening participants who were not currently taking anti-diabetic or lipid-lowering drugs, with non-fasting examinations as is the practice in community health centers, are still limited.

This study aimed to determine the relationship between random blood glucose (GDS) and total cholesterol levels as a continuous variable in health screening participants at the 7 Ulu Community Health Center in Palembang. As a supplementary analysis, the proportion of total cholesterol ≥200 mg / dL was compared between GDS groups based on operational cutoffs. The results are expected to provide local correlation information that can support further research; this study did not assess the diagnostic accuracy, clinical benefit, or efficiency of the GDS-based screening strategy.

Method

Design, location, and time. This study is an observational analytical study with a cross - *sectional design* and is reported with reference to the STROBE guidelines [12]. The study was conducted at the 7 Ulu Community Health Center, Seberang Ulu I District, Palembang City, on one day of

health screening activities, namely December 17, 2024. Data were collected prospectively on the day of the activity, while data processing and analysis were carried out after the activity was completed.

Participants. The study population was adult participants who participated in the health screening activity at the 7 Ulu Community Health Center on the day of the event. The sample was selected using *consecutive sampling* , meaning that each participant who arrived sequentially and met the criteria was offered participation until the end of the activity. Inclusion criteria were being ≥18 years old, undergoing GDS and total cholesterol examinations at the same session, and being willing to sign *an informed consent form. Consent* . Exclusion criteria included pregnancy, taking cholesterol-lowering medications (e.g., statins) or antidiabetic medications , and incomplete examination data. Pregnancy status and medication use were determined based on participant information. Participants taking medications were excluded because these medications directly alter glucose and cholesterol levels and may confound the relationships studied; consequently, the study results cannot be generalized to patients undergoing therapy. History of diabetes or dyslipidemia , body mass index, smoking habits, hypertension, and menopausal status were not collected.

Sample size. The minimum sample size was calculated using the Fisher transformation-based correlation coefficient test formula, $n = [(Z\alpha + Z\beta)/(0.5 \times \ln((1 + r)/(1 - r)))]^2 + 3$, with a minimum correlation considered significant of $r = 0.30$, $\alpha = 0.05$ two-sided, and a test power of 80% ($Z\alpha = 1.96$; $Z\beta = 0.84$) [13]. The calculation resulted in 84.9 which was rounded up to 85 participants. After correction for the anticipated 10% incomplete data, namely $85/(1 - 0.10) = 94.4$, the minimum target was set at 95 participants. In the implementation, all participants who met the criteria on the day of the activity and had complete data pairs were included, so the number analyzed was 96 participants.

Laboratory examination. Capillary blood was drawn aseptically from the fingertip by trained laboratory personnel. Glucose (GDS) levels were measured using an enzyme-based electrochemical glucometer , while total cholesterol was measured using a cholesterol oxidase -based POCT device . Both parameters were measured during the same sampling session without fasting, as per screening procedures; the time of the last meal was not recorded. The devices were checked with a control solution from the manufacturer before use on the day of the examination. The agreement of the results of both devices with the reference laboratory method was not assessed in this study.

Operational definitions. Blood glucose and total cholesterol were analyzed as continuous variables in the primary analysis. For additional analyses, blood glucose was categorized into <140 mg / dL and ≥140 mg / dL . The 140 mg / dL cutoff was an operational limit for the study, not a diagnostic criterion; in the 2021 PERKENI guidelines, the range of 140–199 mg / dL applies to 2-hour plasma glucose after an oral glucose tolerance test, not to non-fasting capillary blood glucose [14]. Therefore, blood glucose groups were not labeled as normal, prediabetic , or high. Blood glucose values ≥200 mg / dL were reported separately descriptively because blood glucose ≥200 mg / dL is only diagnostically significant when accompanied by classic symptoms and requires confirmation with appropriate testing [14, 15]. Total cholesterol was categorized into <200 mg / dL (desirable), 200–239 mg / dL (borderline high), and ≥240 mg / dL (high), following the categories also used in the 2023 SKI [2, 16]; For additional analysis, the high and borderline high categories were combined into total cholesterol ≥200 mg / dL .

Data analysis. Participant characteristics and laboratory levels were analyzed descriptively. Data normality was tested using the Shapiro – Wilk test . Because GDS was not normally distributed , the primary analysis used Spearman correlation to assess the monotonic relationship between GDS and total cholesterol. 95% confidence intervals (CI) for ρ were calculated using the Fisher-z transformation using the Bonett – Wright standard error [17]. The correlation strength

is interpreted as negligible (0.00–0.09), weak (0.10–0.39), moderate (0.40–0.69), strong (0.70–0.89), and very strong (0.90–1.00) [18]. Additional analyses used Pearson's *Chi-square test* without continuity correction because all expected frequencies were >5. Measures of association are reported as *odds. Crude prevalence ratio* (OR) with 95% CI using Woolf method , and prevalence ratio (RP) with 95% CI using logarithmic method, because OR overestimates the association when the outcome is frequently found [19]. The GDS group <140 mg / dL served as the reference group. Due to sample size limitations, no adjustment for confounders was made , so all association measures are rough estimates. Analysis was performed on complete *-case data* with a significance limit of p <0.05 two-sided using IBM SPSS Statistics ; 95% CI for ρ and RP were calculated manually based on the referenced formulas.

Research ethics. All participants provided written informed consent prior to the examination. Participant identities were coded, and the data analyzed did not contain any personal identification. Examination results were communicated to participants through the community health center screening service, and participants with abnormal results were referred to the community health center doctor for further evaluation according to service procedures.

Results and Discussion

A total of 96 screening participants met the criteria and had complete paired GDS and total cholesterol data, allowing all participants to be analyzed. Women constituted the majority of participants (66.7%), while the largest age group was 40–49 years (35.4%), with a mean age of 44.7 ± 10.8 years (Table 1).

Table 1. Characteristics of screening participants (n = 96)

Characteristics	n	%
Gender		
Woman	64	66.7
Man	32	33.3
Age (years)		
<30	8	8.3
30–39	23	24.0
40–49	34	35.4
50–59	22	22.9
≥60	9	9.4
GDS (mg / dL)		
<140	59	61.5
140–199	34	35.4
≥200	3	3.1
Total cholesterol (mg / dL)		
<200 (desired)	46	47.9
200–239 (high limit)	38	39.6
≥240 (high)	12	12.5

Source: primary data, 2024. Percentages were calculated across all participants (n = 96). GDS categories are descriptive/operational, not diagnostic. GDS = random blood glucose.

Blood glucose levels were not normally distributed (Shapiro – Wilk p = 0.014), while total cholesterol showed no deviation from normal distribution (p = 0.466) (Table 2). The lowest recorded blood glucose value was 68 mg / dL and the highest was 247 mg / dL , both within the instrument's measurement range; no values were excluded as outliers .

Table 2. Descriptive statistics of GDS and total cholesterol levels

Statistics	GDS (mg / dL)	Total cholesterol (mg / dL)
n	96	96
Mean ± SB	129.1 ± 37.1	203.1 ± 32.6
Median (Q1–Q3)	126.5 (98.3–152.5)	201.5 (181.8–226.3)
Minimum–maximum	68–247	128–275
p Shapiro – Wilk	0.014	0.466

Source: primary data, 2024. SB = standard deviation; Q1–Q3 = first quartile to third quartile; GDS = random blood glucose.

The primary analysis showed a moderate positive correlation between GDS levels and total cholesterol (ρ = 0.52; 95% CI 0.35–0.66; p < 0.001; n = 96 pairs). This means that in this sample, there was a trend for higher GDS to be associated with higher total cholesterol; this trend was not consistent across participants.

In additional analysis, total cholesterol ≥200 mg / dL was found in 75.7% of participants with a blood glucose level ≥140 mg / dL , compared to 37.3% in participants with a blood glucose level <140 mg / dL (Pearson's χ^2 = 13.43; df = 1; p < 0.001) (Table 3). The odds of having total cholesterol ≥200 mg / dL in the blood glucose level ≥140 mg / dL group were 5.23 times greater than in the reference group (crude OR 5.23; 95% CI 2.09–13.10). Expressed as a proportion, the prevalence of

total cholesterol ≥200 mg / dL in the blood glucose level ≥140 mg / dL group was approximately twice that of the reference group (RP 2.03; 95% CI 1.39–2.96). It should be noted that 22 of the 50 participants (44%) with total cholesterol ≥200 mg / dL were in the GDS <140 mg / dL group .

Table 3. Comparison of total cholesterol categories according to GDS groups

GDS (mg / dL)	KT ≥200 mg / dL n (%)	KT <200 mg / dL n (%)	n	Rough OR (IK95%)
≥140	28 (75.7)	9 (24.3)	37	5.23 (2.09–13.10)
<140	22 (37.3)	37 (62.7)	59	1.00 (reference)
Total	**50 (52.1)**	**46 (47.9)**	**96**	

Source: primary data, 2024. KT = total cholesterol; GDS = random blood glucose. Percentages are calculated per row. Pearson's χ^2 without continuity correction = 13.43; df = 1; p < 0.001. OR = odds Crude prevalence ratio (unadjusted); prevalence ratio 2.03 (95% CI 1.39–2.96). The GDS threshold of 140 mg / dL was the operational limit of the study.

This study demonstrated a moderate positive correlation between GDS levels and total cholesterol in adult screening participants who were not currently taking antidiabetic or lipid-lowering medications. The 95% correlation CI (0.35–0.66) indicates that the strength of the association in the source population may range from weak to moderately strong. The direction of this association is consistent with studies in patients with type 2 diabetes in Bandar Lampung and Purwokerto [9, 10]. However, comparisons should be made with caution because both studies involved patients with diagnosed diabetes who were likely undergoing therapy, with different age characteristics and measurement methods. While this study excluded medication users and used non-fasting POCT examinations. The OR of approximately five represents crude odds that have not been adjusted for age, sex, or other factors, and therefore does not indicate a fivefold increase in risk or an independent association; a RP of approximately two more accurately reflects the difference in proportions between groups in this sample.

The literature describes several possible mechanisms underlying this association. Insulin resistance increases the flow of free fatty acids from adipose tissue to the liver, which then serve as substrates for triglyceride and VLDL formation, while chronic hyperglycemia can promote lipoprotein glycation and slow LDL clearance [5, 6, 7]. These mechanisms were not examined in this study because insulin, HbA1c, LDL cholesterol, HDL cholesterol, and triglycerides were not measured. Furthermore, a single blood glucose test cannot reflect either chronic hyperglycemia or insulin resistance, and total cholesterol alone does not reflect the pattern of dyslipidemia. diabetics that primarily involve triglycerides, HDL, and LDL particle characteristics [6]. This study also did not measure cardiovascular outcomes.

These results differ from the study by Haiti and Christyawardani in Palembang, which found no significant association between glucose and cholesterol levels (p = 0.646) [11]. Protocol differences are the primary explanation: that study included 30 nondiabetic college students aged 18–21 years and were screened after a 12-hour fast, while this study included 96 adult screening participants and were screened without fasting. The glucose range in that study was also narrow (mean 89.76 ± 7.42 mg / dL) [11], while the GDS in this study ranged from 68–247 mg / dL ; this limited range may weaken the observed correlation coefficient . The small sample size also limits the power of the test, so the nonsignificant results in that study cannot be interpreted as definitive proof of no association.

The proportion of total cholesterol ≥200 mg / dL in these screening participants (52.1%) was descriptively higher than the national figure for the 2023 SKI for the combined high and borderline high categories (39.5%) [2]. This comparison is contextual only because the SKI included residents aged ≥15 years with different weighted sampling and laboratory methods, while the sample in this study was adult participants selected consecutively on a single day of activity at a single community health center. Differences in age composition are suspected to play a role, but the reasons for participant attendance were not collected so this difference cannot be further explained. Three participants (3.1%) had a

GDS ≥200 mg / dL ; this value is a screening result, not a diagnosis of DM, and requires symptom evaluation and confirmatory testing according to guidelines [14,15].

From a service perspective, these findings do not support the use of GDS as the sole trigger for lipid screening. In this sample, 44% of participants with total cholesterol ≥200 mg / dL actually had GDS <140 mg / dL , which would have been missed if lipid screening were only targeted to participants with GDS ≥140 mg / dL . These findings are more appropriate to support the concurrent assessment of cardiometabolic risk factors according to guidelines and clinical considerations [3, 4, 8], while the accuracy, benefit, and efficiency of specific screening algorithms require appropriately designed studies.

This study has several limitations. First, the cross-sectional design cannot demonstrate causality. Second, recruitment on a single day at a single site and the exclusion of participants taking medications may introduce selection bias and limit generalizability to all community health center visitors and patients undergoing therapy; the direction of this bias's influence on the correlation magnitude is uncertain. Third, the GDS was affected by the time and type of last meal, which were not recorded, potentially leading to misclassification at the 140 mg / dL cutoff . The GDS does not reflect long-term glucose control like HbA1c. Fourth, POCT results were not compared with reference laboratory methods, so the magnitude of measurement error is unknown. Fifth, confounders such as age, sex, body mass index, diet, physical activity, smoking, and menopausal status were not analyzed or collected, so all association measurements are crude estimates.

Conclusion

In adult health screening participants who met the criteria and were not currently taking antidiabetic or lipid-lowering medications at the 7 Ulu Community Health Center in Palembang, there was a moderate positive association between random blood glucose levels and total cholesterol levels ($\rho = 0.52$; 95% CI 0.35–0.66; $p < 0.001$). Total cholesterol ≥200 mg / dL was more frequently found in the blood glucose level ≥140 mg / dL group , a threshold for the study (crude OR 5.23; 95% CI 2.09–13.10; RP 2.03; 95% CI 1.39–2.96). This association was not adjusted for confounders and does not indicate that blood glucose levels can be used to predict cholesterol levels.

comprehensive cardiometabolic risk assessment according to guidelines and clinical considerations, without relying on a specific GDS value as the sole requirement for cholesterol testing. Future studies are recommended to recruit participants from multiple days and locations, record the time of the last meal and medication use, measure a complete lipid profile, and plan multivariate analyses to control for confounding .

Thank-you note

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Conflict of Interest

The author declares no conflict of interest in this research.

Data Availability

Anonymous participant data and analysis outputs may be made available to editors and reviewers upon request to the corresponding author for verification purposes.

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