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Association between fasting blood glucose and high-density lipoprotein levels among pregnant women with gestational diabetes mellitus at primary health centers

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ABSTRAK

Latar Belakang: *Diabetes melitus gestasional (DMG) merupakan kontributor signifikan terhadap morbidita padas ibu dan bayi baru lahir di seluruh dunia. Di Indonesia, prevalensi DMG diperkirakan berkisar antara 1,9% hingga 3,6% pada tahun 2019 dan sekitar 3–5% pada tahun 2020. Namun, prevalensi sebenarnya kemungkinan lebih tinggi karena banyaknya kasus yang tidak terdiagnosis dan implementasi skrining DMG yang kurang optimal pad ibu hamil. DMG dikaitkan dengan berbagai gangguan metabolisme, termasuk dislipidemia yang ditandai dengan penurunan kadar Lipoprotein Densitas Tinggi (HDL), yang dapat meningkatkan risiko komplikasi kehamilan.*

Tujuan: *Penelitian ini bertujuan untuk meneliti hubungan antara kadar glukosa darah puasa (FBG) dan kadar HDL pada ibu hamil di Puskesmas Banguntapan II dan Puskesmas Sewon II.*

Metode: *Studi ini menggunakan desain potong lintang dengan menggunakan data sekunder dari program skrining diabetes melitus gestasional yang dikumpulkan antara Oktober 2019 dan April 2020. Sebanyak 47 ibu hamil yang memenuhi kriteria inklusi dan eksklusi dimasukkan dalam analisis. Data dianalisis menggunakan uji korelasi Kendall's Tau dengan tingkat signifikansi p<0,05).*

Hasil: *Temuan menunjukkan bahwa 63,8% responden memiliki kadar glukosa darah puasa yang tinggi, sedangkan 76,6% memiliki kadar HDL yang rendah. Analisis statistik menunjukkan tidak ada hubungan yang signifikan antara FBG dan kadar HDL (p=0,478), dengan koefisien korelasi r=0,107, yang menunjukkan hubungan yang sangat lemah antara kedua variabel tersebut.*

Kesimpulan: *Tidak ada hubungan yang signifikan antara glukosa darah puasa dan kadar HDL di antara ibu hamil dalam populasi penelitian. Penelitian lebih lanjut dengan ukuran sampel yang lebih besar dan area studi yang lebih luas direkomendasikan untuk memahami lebih lanjut interaksi metabolik selama kehamilan.*

KATA KUNCI*: diabetes melitus gestasional; glukosa darah puasa; lipoprotein densitas tinggi; kehamilan.*

ABSTRACT

Background: *Gestational diabetes mellitus (GDM) is a significant contributor to maternal and neonatal morbidity worldwide. In Indonesia, the prevalence of GDM was estimated to range from 1.9-3.6% in 2019 and approximately 3–5% in 2020. However, the actual prevalence is likely higher due to the large number of undiagnosed cases and the suboptimal implementation of GDM screening among pregnant women. GDM is associated with various metabolic disturbances, including dyslipidemia characterized by decreased high-density lipoprotein (HDL) levels, which may increase the risk of pregnancy-related complications.*

Objectives*: This study aimed to examine the association between fasting blood glucose (FBG) levels and HDL levels in pregnant women at Banguntapan II and Sewon II Primary Health Centers.*

Methods: *This study employed a cross-sectional design using secondary data from a gestational diabetes mellitus screening program collected between October 2019 and April 2020. A total of 47 pregnant women who met the inclusion and exclusion criteria were analyzed. Data were analyzed using Kendall's Tau correlation test with a significance level of p < 0.05.*

Results: *The findings showed that 63.8% of respondents had elevated fasting blood glucose levels, while 76.6% had low HDL levels. Statistical analysis indicated no significant association between FBG and HDL levels (p=0.478), with a correlation coefficient of r=0.107, suggesting a very weak relationship.*

Conclusions: *There was no significant association between fasting blood glucose and HDL levels among pregnant women in the study population. Further research with a larger sample size and broader study area is recommended to understand metabolic interactions during pregnancy better.*

KEYWORDS*: fasting blood glucose; high-density lipoprotein; gestational diabetes mellitus; pregnancy*

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INTRODUCTION

Gestational diabetes mellitus (GDM) is a condition of impaired glucose tolerance first detected during pregnancy. GDM occurs in women without a previous history of diabetes who experience elevated blood glucose levels during pregnancy (1). Elevated blood glucose levels in women characterize GDM without a pre-existing history of diabetes. This condition typically arises in the second trimester, between 24 and 28 weeks of gestation, and blood glucose levels generally normalize postpartum (2). The prevalence of GDM has risen over the past decade, influenced by factors such as low physical activity, increasing obesity rates, and the rising age of pregnant women. GDM accounts for approximately 90% of diabetes cases in pregnant women, affecting about one in ten pregnancies. Globally, the prevalence of GDM is around 17%, though reported incidence rates vary from 10% in North America to as high as 25% in Southeast Asia. These variations are attributable to differences in population characteristics, geographic region, diagnostic criteria, and data collection methods (3). In Indonesia, the estimated prevalence of gestational diabetes mellitus (GDM) ranged from 1.9% to 3.6% in 2019 (4). Another estimate suggests that approximately 135,000 pregnant women experienced GDM in 2020, representing a prevalence of around 3–5% (4).

However, these figures likely underestimate the true prevalence, as many cases remain undiagnosed. This is primarily due to the suboptimal implementation of GDM screening for pregnant women in both clinical practice and the community, despite its official recommendation. A 2018 SEAMEO report indicated a GDM prevalence of 7.1%, based on screening results from community health centers. Furthermore, random blood glucose (RBG) screening data from 2017, collected at 10 community health centers in Bantul Regency, showed the highest prevalence at Banguntapan II and Sewon II Community Health Centers, with rates of 84.2% and 76.3%, respectively.

GDM is a silent disease that can adversely affect both mother and fetus (5). Gestational diabetes can lead to several complications for mothers, including excessive weight gain, pre-eclampsia, eclampsia, the need for cesarean delivery, and cardiovascular issues, which, in severe cases, can be fatal (6). In addition, infants born to mothers with GDM are at increased risk of neonatal complications, including macrosomia, hypoglycemia, preterm birth, and other metabolic disorders, all of which may contribute to increased neonatal morbidity and necessitate intensive postnatal care (7).

The main risk factors for GDM include a history of GDM, macrosomia, and congenital anomalies, as well as other factors such as body mass index, pregnancy-induced hypertension, a family history of diabetes, maternal age, multiparity, polycystic ovary syndrome, and a history of previous problematic pregnancies (8). Hormonal changes associated with GDM result from the placenta producing hormones such as estrogen and human placental lactogen (HPL), which increase insulin production during pregnancy. Over time, elevated levels of these hormones can impair insulin action, leading to insulin resistance and elevated blood glucose levels (9). This finding is supported by Afifah et al., who demonstrated that structured social nervous exercise significantly reduced fasting blood glucose levels among pregnant women with GDM. Exercise can be used as a strategy to reduce hyperglycemia experienced during GDM. Regular exercise is important for a healthy pregnancy (10).

In GDM), insulin resistance disrupts metabolic homeostasis, particularly by impairing the synthesis and clearance of plasma lipoproteins (11)(12). These alterations reduce lipogenesis and enhance lipolysis in adipose tissue, resulting in dyslipidemia (13). Dyslipidemia is a metabolic disorder involving lipids, characterized by elevated levels of total cholesterol, triglycerides (TG), and low-density lipoprotein (LDL), as well as decreased levels of high-density lipoprotein (HDL) (14). In GDM, common conditions include elevated triglyceride levels and reduced HDL cholesterol. While LDL cholesterol levels may not always increase, the characteristics of LDL particles change, becoming smaller and denser, which increases their atherogenicity (15). Elevated fasting blood glucose (FBG) further contributes to reduced HDL levels through hyperglycemia-induced glycation of HDL particles and apolipoprotein A-I. This modification impairs HDL structure and function and accelerates its clearance from circulation, thereby decreasing HDL levels (16). These findings align with Fatimeh et al. (2022), who reported that women with GDM had higher levels of total cholesterol, LDL, very low-density lipoprotein (VLDL), and triglycerides (TG), and lower levels of HDL, compared to pregnant women without GDM.

Research conducted by Widya et al. (2021) reported a relationship between blood glucose levels and high-density lipoprotein (HDL) levels in patients with type 2 diabetes mellitus (17). Meanwhile, another study by Putri et al. (2020) showed no correlation between fasting blood glucose (FBG) levels and total cholesterol, HDL, and low-density lipoprotein (LDL) levels, but found a correlation between FBG levels and triglycerides in patients with type 2 diabetes mellitus (18). Based on these findings, this study aims to examine the relationship between fasting blood glucose levels and HDL levels in pregnant women with gestational diabetes mellitus (GDM) at the Banguntapan II and Sewon II Community Health Centers. These centers were selected due to their high prevalence of pregnant women with GDM compared to other health centers in Bantul Regency.

MATERIALS AND METHODS

This study was a cross-sectional secondary data analysis conducted in 2023 using gestational diabetes mellitus (GDM) screening data collected between October 2019 and April 2020. The secondary data were obtained from the "Screening DMG Ibu Hamil di Pelayanan Primer Puskesmas Bantul" program, a routine gestational diabetes screening initiative conducted at Primary Health Centers under the Bantul District Health Office. The study was carried out at the Yogyakarta Health Office Laboratory and involved pregnant women from the catchment areas of the Banguntapan II and Sewon II Primary Health Centers. The study population comprised serum samples from pregnant women with gestational ages between 24 and 28 weeks who underwent fasting blood glucose (FBG) examinations during the data collection period. GDM was defined as fasting blood glucose (FBG) ≥ 92 mg/dL according to IADPSG criteria and ADA 2019 guidelines. A total of 47 serum samples were included in the final analysis, selected via a total sampling technique that incorporated all samples meeting the predetermined inclusion and exclusion criteria. The inclusion criteria for this study were non-hemolyzed, non-lipemic serum samples, while the exclusion criteria were serum samples with questionable or incomplete fasting blood glucose (FBG) data. The sample size was determined based on the total number of available records during the study period. Data collection was conducted by trained healthcare personnel at Primary Health Centers in accordance with standard laboratory procedures, while the researchers performed data extraction and analysis.

Respondent characteristics were obtained from maternal screening records of the "Screening DMG Ibu Hamil di Pelayanan Primer Puskesmas Bantul" program. Trained healthcare personnel at the Primary Health Centers measured fasting blood glucose (FBG) levels. In contrast, high-density lipoprotein (HDL) levels were analyzed at the Yogyakarta Health Office Laboratory and Health Laboratory Calibration Center. All laboratory measurements were performed using Tokyo Boeki Medisys TMS 30i analyzers in accordance with standard laboratory procedures. The researchers were not involved in the primary data collection and only performed data extraction and analysis. HDL levels were categorized according to the NCEP ATP III criteria, with low HDL defined as <45 mg/dL and normal HDL as ≥45 mg/dL.

Statistical analysis was performed using SPSS software. Univariate analysis was conducted to describe the frequency distribution of respondent characteristics and study variables. Bivariate analysis was performed using the Kendall's Tau correlation test, as the variables were ordinal and not normally distributed. Statistical significance was defined as $p<0.05$. Ethical approval for this study was obtained from the Institutional Ethics Committee with registration number KE/AA/VIII/10111204/EC/2023.

RESULTS AND DISCUSSIONS

Table 1 indicates that the majority of respondents (87.2%) were aged 20–35 years, a demographic considered to be in the low-risk reproductive age group. Most participants (70.2%) had a secondary education level, and a significant proportion (78.7%) were unemployed. In terms of obstetric characteristics, the majority (59.6%) were primiparous. Regarding nutritional status, most respondents (61.7%) had a normal body mass index, though a notable proportion (27.7%) were classified as obese.

Furthermore, the majority of respondents (80.9%) reported no family history of diabetes mellitus, and an even larger proportion (93.6%) had no prior history of macrosomia. Overall, the study population was predominantly composed of individuals with generally low obstetric risk. However, the presence of obesity and a small proportion reporting a family history of diabetes may still represent potential risk factors warranting further analysis. **Table 2** indicates that 63.8% of respondents were diagnosed with Gestational Diabetes Mellitus (GDM), compared with 36.2% who were not diagnosed with GDM. This represents a high prevalence of GDM within the study population. Regarding lipid profiles, a significant majority of respondents (76.6%) had low High-Density Lipoprotein (HDL) levels, while only 23.4% had high HDL levels. Low HDL levels are commonly associated with metabolic changes during pregnancy.

The coexistence of a high prevalence of GDM and a predominance of low HDL levels may suggest underlying metabolic alterations among pregnant women in this study. However, it is important to note that **Table 2** presents descriptive findings and does not assess the statistical association between GDM status and HDL levels. Based on **Table 3**, a higher proportion of GDM cases was observed among pregnant women in the high-risk age group (<20 or >35 years), at 66.70%, compared with 63.40% in the low-risk age group. However, statistical analysis showed no significant association between maternal age and GDM status ($p=0.875$). Although the proportion of GDM appeared to be slightly higher in the high-risk age group, maternal age was not identified as a significant factor in this study.

This finding may be related to the relatively small number of respondents in the high-risk age category, which could have limited the ability to detect statistically meaningful differences. Nevertheless, maternal age remains an important factor associated with gestational diabetes. Previous studies have reported that women aged ≥35 years are more likely to experience decreased insulin sensitivity and reduced pancreatic β-cell function, which can contribute to impaired glucose metabolism during pregnancy.

Table 1. Univariate frequency distribution of respondent characteristics (n=47)

Variabel	Number (n)	Percentage (%)
Age		
At Risk (<20 or >35 years)	6	12.80
Not at Risk (20-35 years)	41	87.20
Education		
Basic	7	14.90
Secondary	33	70.20
Higher	7	14.90
Occupation		
Not Working	37	78.70
Working	10	21.30
Parity		
Nulliparous	12	25.50
Primiparous	28	59.60
Multiparous	7	14.90
BMI (Body Mass Index)		
Underweight (<18.5 kg/m^2)	5	10.60
Normal (18.5–24.9 kg/m^2)	29	61.70
Obesity (≥25.0 kg/m^2)	13	27.70
Family history of diabetes mellitus		
Yes	9	19.10
No	38	80.90
History of macrosomia		
Yes	3	6.40
No	44	93.60

In contrast, pregnancies occurring at younger ages (<20 years) may also present physiological challenges because maternal metabolic systems are not yet fully mature, potentially increasing vulnerability to pregnancy-related complications, including GDM (19, 20). In women aged ≥35 years, decreased insulin sensitivity results from aging and metabolic changes. Aging is associated with increased peripheral insulin resistance and a decline in pancreatic β-cell function. During pregnancy, this condition is exacerbated by placental hormones such as human placental lactogen, progesterone, and cortisol, which have diabetogenic effects. As a result, β-cells fail to compensate adequately, leading to hyperglycemia and an increased risk of GDM (20). In contrast, in women aged <20 years, the metabolic and endocrine systems are not yet fully mature. Pregnancy at this age leads to competition for nutrients between the mother, who is still growing, and the fetus. This condition can disrupt metabolic balance, impair glucose regulation, and increase metabolic stress. Additionally, physiological adaptation to insulin resistance during pregnancy is not optimal, thereby increasing the risk of GDM **(Table 3)**. In this study, a high percentage (85.7%) of pregnant respondents with gestational diabetes mellitus (GDM) had a high level of education. The highest prevalence of GDM was found among respondents with higher education (85.7%), followed by those with primary education (71.5%) and secondary education (57.6%). However, no statistically significant association was found between educational level and the incidence of GDM (p=0.546). These findings are inconsistent with the study by Arania et al. (2021), which reported a significant association between educational level and the incidence of diabetes mellitus, indicating that individuals with lower educational levels tend to have lower health knowledge and are more likely to adopt unhealthy lifestyles and eating patterns that may increase the risk of diabetes mellitus (21). Nevertheless, individuals with higher educational levels may still engage in unhealthy lifestyle behaviors, indicating that education alone does not necessarily ensure effective diabetes prevention practices (22).

Table 2. Distribution of gestational diabetes mellitus and high-density lipoprotein (hdl) among respondents

Variabel	Category	Number (n)	Percentage (%)
GDM Status	GDM	30	63.8
	Non-GDM	17	36.2
HDL Level	Low	36	76.6
	High	11	23.4
Total		47	100

**GDM: Gestational Diabetes Mellitus; *HDL: High Density Lipoprotein*

Based on the occupational characteristics presented in **Table 1**, the majority of respondents were housewives, accounting for 37 individuals (78.7%). However, according to **Table 3**, the highest proportion of GDM cases was observed among respondents who were civil servants, at 66.7%. Statistical analysis using Kendall's tau test yielded a p-value of 0.652, indicating no significant association between maternal occupation and the incidence of GDM. These findings are consistent with a study conducted by Puri Pratiwi et al. (2019), which also reported no significant association between occupation and the incidence of GDM in Bantul Regency, Yogyakarta (p=0.270) (23). Although occupation is not directly associated with the incidence of gestational diabetes mellitus, it may indirectly influence the risk through differences in physical activity levels. Mothers who do not work, such as housewives, tend to have lower levels of physical activity, which may lead to a sedentary lifestyle. Lorenzo et al. (2025) reported that sedentary behavior is an independent risk factor for GDM and is associated with various metabolic disturbances, including elevated glucose, triglyceride, and body mass index levels. Therefore, low physical activity may contribute to an increased risk of GDM among pregnant women (24).

Based on the parity characteristics in **Table 1**, most of the pregnant respondents were primiparous, namely 28 people (59.6%). However, based on **Table 3**, the proportion of GDM cases was higher among pregnant women with multiparous parity, at 65.70%. This finding is in line with previous studies suggesting that multiparous pregnant women tend to experience physiological and reproductive changes during pregnancy that may increase insulin resistance and susceptibility to gestational diabetes mellitus (25). Mothers who give birth too frequently do not allow their bodies sufficient time to recover, resulting in various complications for both mother and child during pregnancy, childbirth, and the postpartum period. Higher pregnancy frequency is associated with increased insulin resistance (a precursor to gestational diabetes) and weight gain, both of which are risk factors for diabetes mellitus in pregnant women (26).

Furthermore, the results of Kendall's tau test showed a p-value of 0.563 ($p > 0.05$), indicating no significant relationship between parity and fasting blood glucose (FBG) levels among pregnant women at the Banguntapan II and Sewon II Community Health Centers. These results are consistent with a previous study by Friscilia (2019), which reported no significant relationship between parity and the incidence of gestational diabetes mellitus in pregnant women at the Bantul District Health Center in Yogyakarta, with a p-value of 0.909 (27).

Based on the Body Mass Index (BMI) distribution in **Table 3**, the majority of respondents had a normal BMI, accounting for 29 individuals (61.70%). However, when examining the relationship between BMI and GDM status, the highest proportion of elevated FBG was observed among pregnant women with an obese BMI, reaching 76.90%. Despite this pattern, the Kendall's tau analysis yielded a p-value of 0.132 (>0.05), indicating that there was no statistically significant association between BMI and the incidence of Gestational Diabetes Mellitus (GDM) among pregnant women at the Banguntapan II and Sewon II Community Health Centers. Nevertheless, previous studies have shown that BMI, particularly in the overweight and obese categories, is an important metabolic factor associated with GDM. Lorenzo et al. (2025) reported that BMI is directly correlated with GDM and plays a key role in its pathophysiology, especially through mechanisms such as insulin resistance and impaired glucose metabolism (24).

Table 3. Relationship between respondent characteristics and GDM status

Characteristic	GDM Status				Total		R	*p*
	GDM		Not GDM					
	N	%	n	%	n	%		
Age								
At Risk (<20 or >35 years)	4	66.70	2	33.30	6	100	0.023	0.875
Not at Risk (20–35 years)	26	63.40	15	36.60	41	100		
Education								
Basic	5	71.50	2	28.60	7	100	0.078	0.546
Secondary	19	57.60	14	42.40	33	100		
Higher	6	85.70	1	14.30	7	100		
Occupation								
Not Working	23	62.20	14	37.80	37	100	0.067	0.651
Working	7	70.00	3	30.00	10	100		
Parity								
Nulliparous	7	58.30	5	41.70	12	100	0.008	0.733
Primiparous	18	64.30	10	35.70	28	100		
Multiparous	5	71.40	2	28.60	7	100		
BMI								
Underweight (<18,5 kg/m^2)	2	40.00	3	60.00	5	100	0.002	0.132
Normal (18,5–24,9 kg/m^2)	18	62.10	11	37.90	29	100		
Obesity (≥25,0 kg/m^2)	10	76.90	3	23.10	13	100		
Family history of diabetes mellitus								
Yes	6	66.70	3	33.30	9	100	0.029	0.842
No	24	63.20	14	36.80	38	100		
History of macrosomia								
Yes	2	66.70	1	33.30	3	100	0.015	0.914
No	28	63.60	16	36.40	44	100		

**GDM: Gestational Diabetes Mellitus; *HDL: High Density Lipoprotein; *BMI: Body Mass Index*

From a pathophysiological perspective, obesity is closely associated with severe insulin resistance and chronic low-grade inflammation. This condition is characterized by increased production of proinflammatory cytokines, such as TNF-α and IL-6, adipokine dysfunction, and elevated oxidative stress. These alterations reduce peripheral tissue sensitivity to insulin. During pregnancy, this condition is further exacerbated by increased placental production of diabetogenic hormones, leading to more pronounced insulin resistance. If the compensatory capacity of pancreatic β-cells is inadequate, hyperglycemia will develop, ultimately meeting the diagnostic criteria for Gestational Diabetes Mellitus (GDM) **(Table 3** (28),(29),(30).

A family history of diabetes mellitus (DM) is theoretically considered one of the risk factors for gestational diabetes mellitus (GDM), as genetic predisposition may influence insulin resistance and pancreatic β-cell function. A study by Lorenzo et al. (2025) also identified family history as a factor associated with GDM (24). Based on Table 1, the majority of respondents (80.9%) had no family history of diabetes. However, Table 3 shows that the proportion of GDM cases was higher among respondents with a family history of diabetes (66.7%), indicating a descriptive tendency toward increased risk. Nevertheless, the results of the Kendall's Tau test showed no statistically significant association between a family history of DM and glucose dysregulation among pregnant women at the Banguntapan II and Sewon II Community Health Centers (p=0.842; p>0.05). These findings are consistent with the study by Ayurike (2019), which also reported no significant association between a family history of diabetes and the incidence of GDM (p=0.738). The absence of a statistically significant relationship in this study may be attributed to the limited sample size and the unequal distribution of respondents, with most participants lacking a family history of DM. In addition, other factors such as body mass index, maternal age, physical activity, and dietary patterns may exert a stronger influence on the development of GDM compared to family history (27).

A history of delivering a macrosomic infant can be a risk factor for gestational diabetes mellitus (GDM) in pregnancy. Based on **Table 1**, the majority of respondents (93.6%) did not have a history of macrosomic delivery. However, according to **Table 3**, the proportion of respondents who experienced GDM was higher among those with a history of macrosomic delivery, reaching 66.7%. Despite this, the statistical test showed a p-value of 0.914, indicating that the association was not statistically significant. This finding is not consistent with a previous study conducted at RS R. D. Kandou Manado, 2022-2024, which reported that a history of macrosomic delivery was present in 15% of mothers with GDM and was significantly associated with the incidence of GDM (p = 0.01) **(Table 3)** (31).

The discrepancy between these results may be attributed to the relatively small sample size, unequal distribution of respondents, or differences in population characteristics, which may have reduced the statistical power of this study. Theoretically, a history of macrosomia reflects underlying metabolic disturbances in previous pregnancies, such as undiagnosed hyperglycemia. This condition is also associated with maternal metabolic predisposition, including obesity, insulin resistance, and possible latent type 2 diabetes mellitus. Therefore, a history of macrosomia can serve as an indicator of impaired glucose regulation that may recur in subsequent pregnancies. Furthermore, international guidelines, including those from the World Health Organization (WHO), recognize a history of macrosomic delivery as a classical risk factor for GDM in future pregnancies. Cohort studies have also shown that women with higher body mass index and poor glycemic control in previous pregnancies are at increased risk of macrosomia and large for gestational age (LGA) infants, which subsequently elevates the likelihood of recurrent GDM (29).

Table 4. Relationship between GDM and HDL Levels

		HDL				Number		*r*	*p*
		Low (<45)		High (>45)					
		N	%	n	%	n	%		
GDM Status	GDM (FBG>92)	24	80.00	6	20.00	30	100	0.107	0.478
	Not GDM (FBG<92)	12	70.60	5	29.40	17	100		
Total		36	76.60	11	23.40	47	100		

**HDL: High Density Lipoprotein* *FBG *fasting blood glucose* **GDM: Gestational Diabetes Mellitus*

Based on **Table 4**, a higher proportion of pregnant women with GDM had low HDL levels (80%) compared with those without GDM (70.6%). However, statistical analysis showed no significant association between fasting blood glucose (FBG) and HDL levels (p=0.478), with a very weak correlation coefficient (r=0.107). These findings suggest that although low HDL levels were more common among women with GDM, fasting blood glucose did not independently influence HDL concentrations in this study population. One possible explanation is that fasting blood glucose reflects short-term glycemic status. In contrast, HDL metabolism is influenced by various factors, including insulin resistance, inflammatory pathways, adipokine activity, dietary patterns, and hormonal changes during pregnancy. Therefore, changes in HDL concentrations may not necessarily occur in parallel with alterations in fasting blood glucose levels alone. The findings of this study differ from those reported by Widiya et al. (2021), who identified a significant association between FBG and HDL levels (p = 0.009). This discrepancy may be related to differences in population characteristics, diagnostic criteria for GDM, and the timing of laboratory measurements during pregnancy (17).

However, this study is in line with the findings of Pali et al. (2025), which reported no significant association between fasting blood glucose and HDL levels (p = 0.476). These findings suggest that the relationship between blood glucose levels and HDL is not always consistent and may be influenced by various factors beyond glycemic control. In addition, several studies have reported that the correlation between glucose levels and HDL is generally weak, indicating that lipid metabolism is multifactorial (32).

Physiologically, pregnancy is characterized by increased insulin resistance due to hormones such as cortisol, estrogen, progesterone, and human placental lactogen (HPL), which alter glucose and lipid metabolism (20). This condition increases the activity of hormone-sensitive lipase, thereby promoting lipolysis and elevating circulating free fatty acids. These free fatty acids are subsequently processed in the liver into triglycerides and packaged as very low-density lipoprotein (VLDL), which then interacts with HDL particles. This process results in triglyceride-enriched HDL that is more rapidly catabolized, thereby decreasing HDL levels (20). However, these metabolic changes do not always directly correlate with fasting blood glucose levels, which may explain the weak association observed in this study.

From a maternal nutrition perspective, these findings highlight that the management of pregnant women, particularly those at risk of GDM, should focus not only on glycemic control but also on optimizing lipid profiles. Nutritional interventions aimed at increasing HDL levels, such as increasing intake of unsaturated fats, increasing dietary fiber, and promoting a balanced diet, are essential to support maternal metabolic health and reduce the risk of pregnancy complications (33). This study utilized secondary data with a limited sample size and a cross-sectional design; therefore, the findings cannot fully represent causal relationships. In addition, several potential variables, such as dietary patterns and physical activity, were not included in the analysis. Nevertheless, this study provides important preliminary insights into the metabolic profile of pregnant women in primary health care settings. Future studies employing prospective designs and more comprehensive variables are expected to strengthen these findings.

CONCLUSION AND RECOMMENDATION

This study found a relatively high proportion of GDM (63.8%) and low HDL levels (76.6%) among pregnant women at Banguntapan II and Sewon II Community Health Centers. Although low HDL levels were more frequently observed among women with GDM, no statistically significant association was identified between maternal characteristics (age, education, occupation, parity, BMI, family history of diabetes mellitus, and history of macrosomia) and GDM status in this study population. Similarly, no significant association was observed between GDM status and HDL levels. Further studies with larger sample sizes, broader population coverage, and additional variables, such as dietary patterns and physical activity, are recommended to provide a more comprehensive understanding of metabolic changes during pregnancy.

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