

Risk Factors for the Incidence of Gestational Diabetes Mellitus in Pregnant Women in the Third Trimester in Aceh Besar Regency, Aceh Province, and Rejang Lebong Regency, Bengkulu Province, Indonesia

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ABSTRACT:

Background: Diabetes Mellitus (DM) is a growing global health problem, with Indonesia ranking fifth worldwide. Gestational Diabetes Mellitus (GDM) is a serious pregnancy complication that poses both acute and long-term risks to mothers and infants. This study aimed to analyze the relationship between risk factors and the incidence of GDM in third-trimester pregnant women.

Methods: This was an analytical survey with a cross-sectional design conducted in Aceh Besar Regency and Rejang Lebong Regency from April to September 2024. The study population included all third-trimester pregnant women in these areas. A total of 104 samples were selected using a purposive sampling technique. Data were collected through random blood glucose (RBG) testing and questionnaires to gather information on age, family history of DM, a previous history of GDM, and Body Mass Index (BMI). The data were analyzed using the chi-square test and logistic regression to identify the dominant risk factors.

Results: The analysis revealed that several factors were significantly associated with the incidence of GDM. Mothers aged 45 years or older had a 3.18 times higher risk (OR=3.18; p=0.042), and a family history of DM increased the risk by 2.96 times (OR=2.96; p=0.031). A previous history of GDM was the most dominant predictor, with a risk increase of 6.65 times (OR=6.65; p=0.004). Additionally, obesity significantly increased the risk of GDM by more than fivefold (OR=5.73; p=0.048).

Conclusion: This study confirms that advanced maternal age, genetic history, a previous history of GDM, and obesity are the primary risk factors for GDM in pregnant women. These findings are crucial for guiding early detection programs and targeted interventions in high-diabetes-prevalence areas to reduce GDM-related complications and the overall public health burden.

KEYWORDS: Gestational Diabetes Mellitus (GDM), Risk Factors, Pregnant Women, Maternal Age, Obesity, Family History

INTRODUCTION

Diabetes Mellitus (DM) is a continuously increasing global health issue with significant medical and economic burdens. Data from the International Diabetes Federation (IDF) Diabetes Atlas 2025 shows that 589 million adults worldwide live with diabetes, equivalent to 1 in 9 people, and this number is projected to increase to 853 million by 2050, while about 43% of sufferers are still undiagnosed¹⁻³. A NCD-RisC study even estimates that global DM cases reached 800 million people in 2022, with nearly 445 million adults not receiving treatment⁴⁻⁶. Indonesia ranks fifth in the world with about 20.4 million sufferers (11.3%) in 2024, and without intervention, this number is predicted to increase to 40.7 million cases (16.09%) by 2045. However, this projection can be reduced to 23.2 million cases (9.22%) if risk factors are controlled. The main risk factors include old age, genetic history, gestational diabetes, obesity, hypertension, and smoking habits, which contribute to the high prevalence of DM both globally and nationally. Therefore, early detection efforts through random blood glucose (RBG) tests are very important to identify at-risk individuals so that lifestyle interventions and medical therapy can be done as early as possible, while a multifactorial prevention strategy based on behavioral changes and public health education is crucial to curb the DM epidemic in the future^{7,8}.

Gestational Diabetes Mellitus (GDM) is one of the serious complications that can be experienced by pregnant women in Indonesia. Based on epidemiological data, the national prevalence of GDM in the pregnant population ranges from 1.9 to 3.6%⁹⁻¹¹. However, this number can increase to 5.1% in women with a family history of diabetes and reach 40–60% in those who have previously experienced GDM. They have a high risk of developing impaired glucose tolerance or even progressing to type 2 diabetes within 5–10 years after giving birth. The risk of GDM is even higher if the mother has a history of obesity, a lack of physical activity, polycystic ovary syndrome (PCOS), or a habit of consuming excessive sweet foods, as well as a history of giving birth to large babies¹¹⁻¹⁴.

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In pregnant women, GDM can cause various pregnancy complications such as hypertension, preeclampsia, eclampsia, miscarriage, and obstructed labor, increasing the need for cesarean sections in almost a quarter of cases¹⁵⁻¹⁷. Preeclampsia is a dangerous condition characterized by high blood pressure and proteinuria, which can lead to organ dysfunction and even death for both the mother and fetus if not treated promptly^{18,19}. Additionally, pregnant women with GDM tend to gain excessive weight, are at risk of developing diabetes in subsequent pregnancies, and have a 50–87% chance of developing Type 2 diabetes in the future. Studies also show that mothers with GDM have a 2.5 times higher risk of developing metabolic syndrome and cardiovascular disease compared to those with normal pregnancies, and they may also face psychological distress due to complications and a difficult delivery process^{20,21}.

For the fetus and baby, the risk of complications is also very high and can have long-term effects. A primary consequence is macrosomia, where a baby is born with a weight above normal (>4 kg) due to the excessive transfer of glucose from the mother to the fetus, which is then stored as fat. Macrosomic babies are at risk of shoulder dystocia, where the baby's shoulders become stuck during delivery, which can result in serious physical injury or even death. Additionally, GDM can cause miscarriage before 23 weeks, premature birth, and stillbirth. Babies are also at high risk of neonatal hypoglycemia due to high insulin levels that are not balanced by glucose supply after the umbilical cord is cut. Hypoglycemia can lead to seizures, brain damage, or death if not treated immediately. Other risks include respiratory distress or Respiratory Distress Syndrome (RDS), hyperbilirubinemia (high bilirubin levels causing jaundice), congenital heart defects, central nervous system abnormalities such as anencephaly and spina bifida, and circulatory system disorders like polycythemia and stroke²²⁻²⁴.

Beyond acute complications, the long-term effects of GDM also need to be a concern. Babies born to mothers with GDM are more prone to growth and cognitive development issues, obesity, and tend to have a higher risk of developing Type 2 diabetes in adulthood. Studies show that exposure to an unbalanced metabolic environment during pregnancy affects the fetus's genetic and hormonal regulation, leading to a risk of chronic diseases from a young age. Meanwhile, for mothers, the risk of Type 2 diabetes remains high for decades after pregnancy, so regular health monitoring and check-ups are highly recommended. Regional data from the Aceh Health Office in 2023 recorded 154,889 diabetes cases, with Aceh Besar Regency accounting for 11.2% of the total. Reports from Bengkulu Province also show a significant upward trend from 2,109 cases in 2020 to 3,746 cases in 2023, indicating a potential surge in GDM incidence as the prevalence of diabetes mellitus rises in the community. This phenomenon highlights the importance of health education, early detection, and integrated management for pregnant women, especially in high-diabetes-prevalence areas like Aceh Besar and Rejang Lebong, Bengkulu.

METHOD

This study is an analytic survey with a cross-sectional design conducted to determine the relationship between risk factors and random blood glucose levels in third-trimester pregnant women. The research was carried out in the regions of Aceh Besar Regency, Aceh Province, and Rejang Lebong Regency, Bengkulu Province, from April to September 2024. The study population consisted of all third-trimester pregnant women in both areas. A total of 104 samples were selected using the sample size estimation formula for a cross-sectional design, with 52 respondents from Aceh Besar Regency and 52 from Rejang Lebong Regency. Purposive sampling was used for the data collection. The inclusion criteria were third-trimester pregnant women who came to the TPMB (Independent Midwife Practice) for a pregnancy check-up. The exclusion criteria included pregnant women with hypertension, endocrine disorders, or those who had already been diagnosed with Type 1 or Type 2 diabetes before pregnancy. Data was collected through random blood glucose testing and the completion of observation sheets and questionnaires. This process gathered information on the history of Body Mass Index (BMI), family history of DM, history of GDM, age, and parity. The tools and materials used included a blood glucose meter, alcohol swabs, latex gloves, and tissues. All data were then analyzed using the chi-square (χ^2) test with a 95% significance level. To identify the most dominant risk factor, bivariate analysis with logistic regression was performed.

RESULT

Univariate Analysis

Univariate analysis aims to describe or explain the characteristics of each research variable individually, without examining its relationship with other variables. The following are the general characteristics of the study respondents.

Table 1. General Characteristics of Respondents

Variable	Category	Frequency (n)	Percentage (%)
Age	<35 years	86	82.7
	≥35 years	18	17.3
Family History of DM	Yes	32	30.8
	No	72	69.2

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History of GDM	Yes	12	11.5
	No	92	88.5
BMI	Normal	42	40.4
	Overweight	43	41.3
	Obese	14	13.5
	Underweight	5	4.8
Blood Glucose Level	Normal (<140 mg/dL)	91	87.5
	Elevated (≥140–199 mg/dL)	12	11.5
	High (≥200 mg/dL)	1	1.0
Total Respondents		104	100.0

The descriptive analysis of 104 respondents shows that the majority were under 35 years of age (82.7%), while only 17.3% were aged 35 years or older. Most respondents reported no family history of diabetes mellitus (69.2%), whereas nearly one-third (30.8%) did have such a history. In terms of obstetric history, only 11.5% had experienced gestational diabetes mellitus (GDM), while the vast majority (88.5%) had no prior history of GDM.

With regard to nutritional status based on body mass index (BMI), respondents were almost evenly distributed between the normal category (40.4%) and the overweight category (41.3%), while smaller proportions were classified as obese (13.5%) and underweight (4.8%). Blood glucose measurements indicated that most respondents had normal levels (<140 mg/dL) at 87.5%, while 11.5% had elevated levels (≥140–199 mg/dL), and only 1.0% had high levels (≥200 mg/dL). Overall, these findings suggest that most respondents were of reproductive age, had no history of GDM, and maintained normal blood glucose levels. Nevertheless, the presence of overweight and obesity, combined with a family history of diabetes in nearly one-third of respondents, points to potential risk factors for glucose intolerance and future metabolic complications.

Table 2. Factor Analysis of Maternal Characteristics Associated with the Incidence of Gestational Diabetes Mellitus

Variable	Category	Incidence of Gestational Diabetes Mellitus			p-value	OR (95% CI)
		DMG (+) n (%)	DMG (-) n (%)	Total n		
Age	<45 year	7 (8,1)	79 (91,9)	86	0,042	3,18 (1,01–10,04)
	≥45 Year	6 (33,3)	12 (66,7)	18		
Family History of DM	Yes	8 (25,0)	24 (75,0)	32	0,031	2,96 (1,06–8,25)
	No	5 (6,9)	67 (93,1)	72		
History of GDM	Yes	5 (41,7)	7 (58,3)	12	0,004	6,65 (1,70–25,92)
	Tidak ada	8 (8,7)	84 (91,3)	92		
BMI	Normal	3 (7,1)	39 (92,9)	42	0,210	Ref.
	Overweight	5 (11,6)	38 (88,4)	43		
	Obesity	4 (28,6)	10 (71,4)	14		
	Underweight	1 (20,0)	4 (80,0)	5		
Total		13	91	104		

The analysis indicates that several maternal characteristics are significantly associated with the occurrence of gestational diabetes mellitus (GDM). Mothers aged ≥45 years exhibited a substantially higher incidence of GDM (33.3%) compared to those aged <45 years (8.1%), with a statistically significant association ($p = 0.042$) and an odds ratio (OR) of 3.18 (95% CI: 1.01–10.04), suggesting that the risk is more than threefold. A family history of diabetes also proved to be an important determinant, with mothers having such a history showing a GDM incidence of 25.0% compared to 6.9% among those without, yielding a significant association ($p = 0.031$; OR = 2.96; 95% CI: 1.06–8.25). The strongest predictor identified was a history of prior GDM, where recurrence was observed in 41.7% of cases compared to only 8.7% among those without such a history, a highly significant finding ($p = 0.004$; OR = 6.65; 95% CI: 1.70–25.92). Body mass index (BMI) also demonstrated a significant relationship: obese mothers had a GDM incidence of 28.6%, markedly higher than the 7.1% observed in mothers with normal BMI, with $p = 0.048$ and OR = 5.73 (95% CI: 1.06–30.97). In the overweight group, incidence was somewhat elevated (11.6%) but did not reach statistical significance (OR = 1.70; 95% CI: 0.37–7.81), while the underweight group (20.0%) was too small to yield reliable conclusions. These findings highlight that advanced maternal age, a family history of diabetes, a previous history of GDM, and obesity are significant risk factors for

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GDM, whereas being overweight appears to increase risk but without statistical significance. These results underscore the importance of targeted screening and preventive interventions among high-risk pregnant women to reduce the incidence of GDM.

DISCUSSION

The findings of this study demonstrate that several maternal characteristics are significantly associated with the incidence of gestational diabetes mellitus (GDM). The univariate analysis of 104 respondents showed that the majority of mothers were in the <35 years age group (82.7%), while only 17.3% were aged ≥ 35 years. Most respondents reported no family history of diabetes mellitus (69.2%), whereas 30.8% had such a history. A previous history of GDM was relatively uncommon, reported by only 11.5% of respondents. In terms of nutritional status based on body mass index (BMI), the largest proportions were found in the overweight (41.3%) and normal (40.4%) categories, followed by obesity (13.5%) and underweight (4.8%). Blood glucose measurements indicated that most respondents had normal levels (<140 mg/dL) at 87.5%, while 11.5% showed elevated levels (≥ 140 –199 mg/dL), and only 1.0% fell into the high category (≥ 200 mg/dL). These results suggest that most respondents were of reproductive age and in relatively good metabolic condition, although the relatively high prevalence of overweight and obesity highlights potential latent risk factors for glucose intolerance.

The bivariate analysis further revealed significant associations between specific maternal characteristics and the incidence of GDM. Mothers aged ≥ 45 years had a markedly higher incidence of GDM (33.3%) compared to those aged <45 years (8.1%). This difference was statistically significant ($p = 0.042$) with an odds ratio (OR) of 3.18 (95% CI: 1.01–10.04), indicating that advanced maternal age increases the risk more than threefold. Similarly, mothers with a family history of diabetes showed a GDM incidence of 25.0%, compared with only 6.9% among those without such a history. This association was significant ($p = 0.031$) with an OR of 2.96 (95% CI: 1.06–8.25), suggesting that family history nearly triples the risk.

The strongest predictor identified was a prior history of GDM. Among mothers with such a history, recurrence occurred in 41.7% of cases compared to only 8.7% among those without. This association was highly significant ($p = 0.004$) with an OR of 6.65 (95% CI: 1.70–25.92), confirming that women with a previous history of GDM are more than six times as likely to develop GDM in subsequent pregnancies. Body mass index was also found to play a significant role. Obese mothers had a GDM incidence of 28.6% compared with only 7.1% among those with normal BMI, with a significant association ($p = 0.048$; OR = 5.73; 95% CI: 1.06–30.97), indicating that obesity increases the risk nearly sixfold. Meanwhile, overweight mothers had a higher incidence (11.6%) compared with normal-weight mothers, but this difference was not statistically significant (OR = 1.70; 95% CI: 0.37–7.81). For underweight mothers, the incidence was 20.0%, but the small sample size ($n = 5$) precludes drawing reliable conclusions. The most dominant finding—that a history of GDM increases the risk of recurrence by up to 6.65 times—is supported by strong scientific evidence. A systematic review by Kim et al. (2014) in the journal *Diabetes Care* concluded that women with a history of GDM have a 50–70% chance of developing it in a subsequent pregnancy, demonstrating that the condition has a strong recurrent characteristic^{25,26}. Additionally, the findings on the role of obesity align with global trends. A study in Malaysia by yong et al. (2019) showed that pregnant women with a high pre-pregnancy BMI have a significantly greater risk of GDM, confirming that weight management before and during pregnancy is a crucial prevention strategy^{27–29}. This is supported by research in Thailand by Pongsiri et al. (2018), which showed that genetic history is a strong predictor of GDM incidence, confirming that hereditary factors play a significant role in glucose metabolism during pregnancy.^{27,30}

CONCLUSION

Based on a comprehensive analysis of this research, it can be concluded that Gestational Diabetes Mellitus (GDM) is a significant health issue requiring serious attention, particularly in areas with a high prevalence of diabetes like Aceh Besar and Rejang Lebong. This study not only confirms global trends but also identifies specific risk factors that are strong predictors of GDM incidence. The key findings demonstrate that a previous history of GDM is the most dominant predictor, with a risk increase of up to 6.65 times, making

it a critical indicator for healthcare providers. Furthermore, maternal age ≥ 45 years, a family history of diabetes, and obesity were also proven to significantly increase the risk of GDM, with respective increases of 3.18 times, 2.96 times, and 5.73 times. This conclusion has crucial implications for both clinical practice and public health. Clinically, the findings emphasize the need to shift from universal screening to a more focused and risk-based approach. Pregnant women with one or more of these factors should undergo more stringent screening and monitoring to enable early detection and timely intervention. From a public health perspective, this data reinforces the argument for multifactorial prevention strategies, including health education on weight management and healthy lifestyles before and during pregnancy.

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