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Prevalence and Risk Factors of Gestational Diabetes Mellitus in Malaysian Antenatal Mothers in North-East Peninsular Malaysia, A Retrospective, Cross-Sectional Study

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ABSTRACT

Background: Gestational diabetes mellitus (GDM) has a negative impact on prenatal and neonatal outcomes and is a public health concern. The study aims to determine the prevalence of gestational diabetes in Malaysian antenatal mothers and identify risk factors associated with its incidence at one tertiary teaching hospital in Kelantan, Malaysia. **Methods:** A retrospective cross-sectional study collected data from antenatal mothers between 24 and 28 weeks of gestation diagnosed with GDM based on the International Association of Diabetes and Pregnancy Study Groups criteria between January and February 2021. Eighty-nine antenatal mothers were screened. **Results:** The mean age of the participants was 32 years (SD = 5.8). GDM prevalence was 33.7%, and having a history of GDM was significantly associated with prevalence ($p = 0.016$). Chi-square analysis revealed that Kelantanese prenatal mothers with risk factors, particularly those who had previously had GDM, had a significant prevalence of GDM. **Conclusion:** Hence, population health programs and strategies are required are urgently required to reduce risk and improve the health of future antenatal mothers.

Keywords: Gestational Diabetes Mellitus; Antenatal Mothers, Prevalence; Risk Factors; Kelantan

INTRODUCTION

Gestational Diabetes Mellitus (GDM) is a pregnancy-related illness characterized by hyperglycemia and glucose intolerance that is usually associated with an elevated risk of perinatal death and morbidity (DeFronzo *et al.*, 2015; Erem *et al.*, 2015). A GDM woman is six times more likely to develop type 2 diabetes mellitus (DM), hypertension, infections, and pre-eclampsia after giving birth (Gracelyn & Saranya, 2016; Zhu & Zhang, 2016). Hence, this demands early detection, diagnosis, and management of GDM by obstetricians, including nurses and midwives, to provide a coherent care pathway to ensure preventive care, minimizing problems during and after pregnancy for the mother and her unborn child (Mensah *et al.*, 2019).

The prevalence of GDM is still being investigated, which may be due to research findings that do not apply to the general population, which may result in a lack of uniformity in GDM diagnostic criteria or the fact that the trends of GDM prevalence are not yet stable (dos Santos *et al.*, 2020; Egbe *et al.*, 2018). The prevalence of GDM ranges from 1% to 28%, depending on factors such as genetic history, the studied population, the environment in which the population lives, and the lack of consistency in international guidelines for diagnosing GDM (Onyenekwe *et al.*, 2019; Egbe *et al.*, 2018; Debnath *et al.*, 2018; Ali *et al.*, 2016). However, many studies have concluded that GDM prevalence has increased globally (Versteegen *et al.*, 2021; Logakodie *et al.*, 2017).

Malaysia had the highest prevalence of GDM (18.3%) among Southeast Asian countries, followed by India (13.6%), Bangladesh (9.7%), and Sri Lanka (8.1%) (Zhu & Zhang, 2016). Furthermore, a 2019 Malaysian study found that the prevalence of GDM in Malaysia is higher than in most Western countries, ranging from 11.4% to 18.3% in a university hospital and a public health clinic in Selangor (Hassan *et al.*, 2019). GDM's cause is currently unknown. GDM, on the other hand, may occur due to maternal pregnancy adaptation (DeFronzo *et al.*, 2015).

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Antenatal mothers with a high maternal age, a high BMI, a high parity count, a family history of diabetes, and a previous history of GDM in the previous pregnancy are more likely to develop GDM (Logakodie *et al.*, 2017; Ali *et al.*, 2016). Antenatal mothers with a positive family history of diabetes are also twice as likely as average mothers to develop GDM (31.7%) (Debnath *et al.*, 2018; Adam & Rheeder, 2017; Price *et al.*, 2017). According to research, 30–60% of pregnant moms with a previous history of GDM acquire GDM in subsequent pregnancies (Price *et al.*, 2017; Zhu & Zhang, 2016; Padayachee, 2015). A cross-sectional study in Turkmenistan found that most GDM mothers are multigravida (71.6%) (Parhofer *et al.*, 2014). However, there was no significant relationship between socioeconomic status and GDM, possibly due to people with lower socioeconomic status' poor understanding and control of diabetes (Larrabure-Torrealva *et al*., 2018). Mothers with healthy body weights, following healthy dietary patterns, exercising regularly, and not smoking are considered low-risk lifestyle factors. As a result, it suggests that these antenatal mothers are less likely to develop GDM (Zhang *et al*., 2014). Antenatal mothers with a higher body mass index (BMI) (more than 30 kg/m2) (59.2%) were significantly more likely to develop GDM, which sedentary lifestyles and dietary habits can influence (Egbe *et al.*, 2018). Antenatal mothers who lead sedentary lifestyles are twice as likely as active antenatal mothers to develop GDM, whereas antenatal mothers who exercise regularly have a 50% lower risk of developing GDM (Meharry *et al.*, 2019). Therefore, current epidemiological data is essential for informing and guiding lawmakers in their responses to policy development, service planning and evaluation, and research. In addition, due to the life-threatening and life-long implications of GDM for both mother and child health, determining the prevalence of GDM and related risk factors can help minimize the problem.

METHODOLOGY

Study Design

A retrospective, cross-sectional study using the data from Hospital USM was employed to determine the prevalence of GDM and risk factors across antenatal mothers and characteristics from January 2021 to February 2021. The study setting was chosen because the hospital has excellent GDM screening, risk assessment, and monitoring facilities and serves as a resource centre for all public health clinics and district hospitals in northeast Peninsular Malaysia.

Sample and Setting

All antenatal mothers registered at the Antenatal Clinic of Hospital USM, Kelantan, were recruited using purposive sampling. In this study, the researchers included antenatal mothers aged 18 and above at 24 to 28 weeks. The Malaysian Ministry of Health's 2017 recommendation is that GDM testing be performed between 24 and 36 weeks of gestation (Malaysia Health Technology Assessment, 2017). The exclusion criteria were antenatal mothers with pre-existing type 1 or type 2 diabetes, multiple pregnancies, chronic diseases, and medications that may affect glucose metabolism, such as steroids and antipsychotic drugs. The following parameters were utilized to estimate the sample size in this study: the standard normal distribution value was 1.96, the precision was 0.04, and the proportion of good knowledge of GDM was 96.5% (Norfahana *et al.*, 2020) with 95% confidence using a single proportion formula. As a result, the sample size for this study was estimated to be 82. After considering the 10% non-response rate, the sample size was 92 participants.

Instrument

A self-administered, validated, structured questionnaire was used in this study. The questionnaire is divided into two sections. Section A includes socio-demographic information such as age, ethnicity, education level, employment status, household income, current weight and height, gestational status, family history of diabetes mellitus, and GDM. Section B contains the results of all antenatal mothers diagnosed with GDM between 24 and 28 weeks of gestation using a 75-g oral glucose tolerance test (OGTT) and GDM based on the IADPSG criterion of having one or more abnormal values of fasting plasma glucose (FPG) ≥5.1 mmol/l and 2-hour plasma glucose (2hPG) ≥7.8 mmol/l in the OGTT test (Malaysia Health Technology Assessment Section, 2017), which the researchers derived from the participants' obstetric records.

Data Collection

A list of antenatal mothers registered at the antenatal clinic diagnosed with GDM between January 1, 2021, and February 28, 2021, was identified from the antenatal clinic. In addition, identified participants' antenatal records, demographic information, risk factors, gestational week diagnosed with GDM, and current treatment were obtained and documented. Given the Movement Control Order, current physical distancing measures, and other constraints, the researchers strictly followed the Standard Operating Procedures while collecting data. Informed consent was obtained before data collection. Coded numbers were used during data collection to ensure anonymity and confidentiality.

Statistical Analysis

The data gathered was entered into Windows' Statistical Package for Social Sciences (SPSS) version 26. Chi-square statistics (χ^2) were used to examine the association between GDM and risk factors. $P<0.05$ values were considered statistically significant.

Ethical Consideration

The study received ethical clearance from Universiti Sains Malaysia research ethics committee and the Director of the hospital on 17th January 2021 with reference number USM/JEPeM/20120651.

RESULTS

Eighty-nine antenatal mothers (96.7% response rate) participated in the study. The mean age of GDM participants was 32±4.2 years, while non-GDM participants had a mean age of 31±6.3 years (p=0.160). Eighty-eight (98.9%) of those who took part were Malay (p=1.000). Forty-six (51.8%) had pre-university and above (p=0.206). Half of the 30 GDM pregnant women (16.9%) had a low or high educational level in each category. Among the 89 participants, 51 (57.3%) were unemployed and 38 (42.7%) were employed (p=0.653).

In household income, nearly half of the participants (48.3%) had less than MYR 1500, while the remaining 25.8% had between MYR 1500 and 3000 (p=0.303). Only 21.3% of participants (p=0.183) had a normal Body Mass Index (BMI). Sixty-six (74.2%) pregnant women were multigravida, while the remaining 23 (25.8%) were primigravida. The prevalence of GDM did not have a statistically significant relationship with gestational status (p=0.801). Seventy-eight per cent of participants had no history of GDM in previous pregnancies (p=0.016), and 71.9% had no family history of type 2 diabetes mellitus (p=0.806).

Most participants (95.5%) followed Western dietary patterns, which included a high intake of white rice, meat, butter, sweets, and fried foods and a low intake of fruits, vegetables, and whole grains. Only four of the 89 participants followed healthy eating habits: fruits, vegetables, grilled fish, and salad. Nearly half of the GDM pregnant women were inactive (48.4%) or moderately active (43.8%). Only seven of the 89 GDM pregnant women identified were physically active during their pregnancy. Thirty (33.7%) of the 89 participants were diagnosed with GDM using the IADPSG criteria, and 60% were on diet control after being diagnosed with GDM (see Table 1).

Table 1: Association between the risk factors of GDM and the Prevalence of GDM (N=89)

Variables	GDM status		*p*-value
	Yes (%)	No (%)	
Maternal Age			0.160
<35 years	19 (21.3)	42 (47.2)	
≥ 35 years	11 (12.4)	17 (19.1)	
Ethnicity			1.000
Malay	30 (33.7)	58 (65.2)	
Others	0 (0)	1 (1.1)	

Educational Level			0.206
Low education level	15 (16.9)	28 (31.5)	
High education level	15 (16.9)	31 (34.9)	
Employment#			0.653
Yes	14 (15.7)	24 (27.0)	
No	16 (18.0)	35 (39.3)	
Household income#			0.303
Less than MYR 1500	12 (13.5)	31 (34.8)	
MYR 1500 to MYR 3000	8 (9.0)	15 (16.9)	
MYR 3000 to MYR 4500	5 (5.6)	3 (3.4)	
More than MYR 4500	5 (5.6)	10 (11.2)	
Weight, Height and BMI			0.183
Normal	3 (3.4)	16 (18.0)	
Overweight	13 (14.6)	20 (22.5)	
Obese	14 (15.7)	23 (25.8)	
Gestational Status#			0.801
Primigravida	7 (7.9)	16 (18.0)	
Multigravida	23 (25.8)	43 (48.3)	
History of GDM#			0.016
Yes	11 (12.4)	8 (9.0)	
No	19 (21.3)	51 (57.3)	
Family history of diabetes mellitus#			0.806
Yes	9 (10.1)	16 (18.0)	
No	21 (23.6)	43 (48.3)	
Dietary pattern			1.000
Western	29 (32.6)	56 (62.9)	
Prudent	1 (1.1)	3 (3.4)	
Physical Activities			0.657
Inactive	15 (16.9)	28 (31.5)	
Moderately active	14 (15.7)	25 (28.1)	
Active	1 (1.1)	6 (6.7)	

#Tested using Pearson's Chi-Square test, a p-value of ≤ 0.05 was considered statistically significant.

Variables without # tested using Fisher's Exact test, a p-value of ≤ 0.05 was considered statistically significant.

DISCUSSION

This study found that GDM prevalence was 33.7%, higher than in 2018 and 2019 (11.4% to 18.3%) (Hassan et al., 2019; Lee *et al.,* 2018). In addition, the present study showed a rate three times higher than in a public hospital in Kelantan (9.14% of 12,806 deliveries) in 2017 (Jeganathan & Karalasingam, 2016). These studies consistently found an increase in GDM prevalence in Malaysia, implying that the observed increase in GDM prevalence is actual. However, the different diagnostic and screening criteria used globally, such as World Health Organization (WHO) criteria, American Diabetes Association (ADA) criteria, and IADPSG criteria, could explain the differences in GDM prevalence trends. Therefore, further study is required to comprehend the high prevalence of GDM in Kelantan and among Malaysian populations. As a result, GDM issues require increased public health attention.

In this study, no significant association was found between any of the socio-demographic characteristics (maternal age, ethnicity, educational level, employment status, or household income) and the prevalence of GDM

(p>0.05). However, our findings contradict a prior study that identified an association between maternal age and the frequency of GDM in prenatal mothers (Abualhamael *et al.*, 2019).

Previous research found that pregnant women over 35 had twice the risk of developing GDM as younger women (dos Santos *et al.*, 2020; Larrabue-Torrealva *et al.*, 2018). This contrasts with our findings, which suggest that the differences may be due to the small sample size and different GDM diagnostic criteria. In addition, the WHO GDM diagnosis criteria for blood sugar were higher than the ADA or IADPSG criteria, explaining the variation between studies.

Our study showed that over three-quarters of the participants were Malays and had low education. However, according to Census 2020, the Malays' share of the 29.7 million citizens increased by 0.3 percentage points to 69.6% in 2020, up from 69.3% in 2019. Furthermore, Malays constitute 94% of Kelantan's population, making them the largest ethnic group (Department of Statistics Malaysia, 2021). Hence, this explains why Malays were the dominant ethnic group in this study.

Our study showed no significant association between educational background and the prevalence of GDM. Wang *et al*.'s (2020) report reported similar findings. The plausible explanation is that having a high level of education impacts a person's health literacy. Therefore, antenatal mothers with more education can better understand health information and access it from health-related resources. The plausible explanation could be that mothers with greater levels of education are more likely to have access to health information and expertise through technologies like WhatsApp and the Internet.

Furthermore, the effects of public health education campaigns through mass media showed that these platforms could evoke positive behavioral change (Saei *et al.*, 2021). In contrast, our findings contradict the findings of a Dutch study that found a low maternal educational level associated with GDM (Bouthoorn *et al.,* 2015). Future research should examine the association between educational level and misclassification because educational level information was gathered through a questionnaire.

Although there is no association between employment status and the prevalence of GDM in this study, employment status may act as an indirect risk factor for GDM. The plausible explanation is that employment status may influence other risk factors, such as the participant's income, thereby affecting the quality of life for women and possibly causing GDM. Nguyen *et al.*, (2018) reported dissimilar findings. In our study, household income had no significant association with prevalence. A possible explanation could be that different economic status definitions depend on the research region. Another plausible reason could be the study's small sample size. Except for the previous record of GDM (p<0.05), there was no significant association between all demographic characteristics (family history of diabetes mellitus, gravida status, BMI, and women's knowledge of GDM) and the prevalence of GDM. The results explained that antenatal mothers with a first-degree relative with diabetes mellitus were 4.5 times more likely to develop GDM than those who did not have a first-degree relative with diabetes mellitus (Erem *et al*., 2015).

On the other hand, a family history of diabetes mellitus had no significant association with the prevalence of GDM. Our findings are consistent with earlier research (Gracelyn & Saranya, 2016; Erem *et al*., 2015), which revealed that mothers who have had gestational diabetes in the past are more likely to have it again in the next pregnancy. GDM prevalence was strongly associated with GDM history and occurred in 50% of women with a history of GDM in the second pregnancy (Erem *et al.*, 2015). However, gravida status was unrelated to the prevalence of GDM in this study, even though 34.8% of multigravida women had GDM. Earlier studies have found that the prevalence of GDM rises with pregnancy (Larrabure-Torealva *et al*., 2018; Gracelyn & Saranya, 2016). Because the information on gravida status was obtained via a questionnaire, the inconsistency could be due to misclassification.

Participants' responses to non-smoking habits were consistent, and an earlier study discovered an inverse association between smoking and GDM (Erem *et al.*, 2015). As a result, the association between smoking habits and the prevalence of GDM should be researched further. The current study contradicted several studies that reported BMI as a risk factor for GDM, although 38.6% of pregnant women with a BMI greater than 25.0kg/m2 had GDM (Sharma

et al., 2019). BMI has a strong positive association with the prevalence of GDM, and more than 64% of obese women develop GDM (Muche *et al.,* 2019; Gracelyn & Saranya, 2016).

According to our findings, 34.1% of pregnant women who followed Western dietary patterns developed GDM. Due to a lack of variety in responses, the present study's dietary pattern served as a reference. Only four participants in the study had different dietary habits and a prudent dietary pattern (p=1.000), which contradicted the previous studies (Muche *et al.*, 2019; Sharma *et al.*, 2019). In addition, this study found that physical activity level had no association with the prevalence of GDM (p >0.05), contradicting the earlier study's finding that low physical activity level was positively associated with the prevalence of GDM (Muche *et al*., 2019).

Limitations of the Study

The study only included one tertiary teaching hospital in rural northeast peninsular Malaysia. In addition, the data source for this study was antenatal mothers from one single hospital from January to February 2021. Hence, their representation of the total population was also limited. Our study found that, although there have been some improvements in obstetric care for antenatal mothers over the past few years, there is still room for improvement towards better care for future antenatal mothers.

Recommendations for Research

The present study was a retrospective design conducted at a single-centre site in northeast peninsular Malaysia. Hence, the inability to calculate population-based rates and the small number of antenatal mothers with GDM, particularly in the clinic, Therefore, this may have hindered researchers' ability to identify differences in risk based on severity. Additionally, Malaysia currently uses selective risk-based screening for GDM despite recommendations from the World Health Organization (WHO), the International Federation of Gynecology and Obstetrics (FIGO), and the National Institute of Clinical Excellence (NICE) for universal screening, particularly among the high-risk population (Muniswaran *et al.*, 2017). Thus, researchers were unable to explore the relationship between risk factors in GDM with multiple comorbidities. Therefore, a future retrospective, cross-sectional study of tertiary teaching hospitals in Malaysia based on the National Obstetric Registry of Malaysia is needed to examine the prevalence of GDM in antenatal mothers and identify risk factors associated with its incidence.

CONCLUSION

This study concluded that GDM prevalence is high and that there is an association between antenatal mothers and the history of GDM. Therefore, population health measures and prevention programs are urgently required to reduce risk and improve the health of future antenatal mothers.

Conflict of Interest

The authors declare that they have no conflict of interest.

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