Gestational Diabetes Mellitus and Associated Risk Factors Among Pregnant Women in Tuaran, Sabah State, Malaysia

Malezya, Sabah Eyaleti, Tuaran'daki Gebe Kadınlarda Gestasyonal Diyabet Mellitus ve İlişkili Risk Faktörleri

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ABSTRACT Objective: To determine the prevalence of gestational diabetes mellitus (GDM) and its associated risk factors among pregnant women in Tuaran District, Sabah State, Malaysia. **Material and Methods:** A cross sectional analytical study was conducted in Tuaran. Data collection was done by interview method using structured questionnaire and antenatal records review. The study population was all the pregnant women, at and above 24 weeks of gestation who attended the antenatal care clinics in Tuaran District from March to June, 2018. The pregnant women with pre-existing diabetes were excluded from the study. Convenience sampling method was used and 195 pregnant women participated in the study. Descriptive and analytical statistics were done by using SPSS statistical software. GDM has emerged as a major public health concern all over the world. It would develop maternal and foetal adverse outcomes. The prevalence of GDM ranged from 1% to 28% worldwide and from 18.3% to 27.9% in Malaysia. **Results:** The prevalence of GDM among all participants in Tuaran District was 28.2%. The risk factors significantly associated with GDM were advanced maternal age (p=0.042), presence of family history of diabetes mellitus (p=0.009) and previous history of GDM (p=0.001). **Conclusion:** The prevalence of GDM among pregnant women in Tuaran District was found to be higher than the previous studies done in Malaysia. Promotion of healthy lifestyle, provision of intense health education, quality antenatal care and early detection with proper management of GDM among pregnant women are crucial for prevention and control of GDM and reduction of adverse maternal and foetal outcomes.

Keywords: Diabetes, gestational; pregnant women; prevalence; risk factors; malaysia

ÖZET Amaç: Malezya, Sabah Eyaleti, Tuaran Bölgesi'ndeki hamile kadınlar arasında GDM prevalansını ve bununla ilişkili risk faktörlerini belirlemek. **Gereç ve Yöntemler:** Tuaran'da kesitsel analitik bir çalışma gerçekleştirildi. Veri toplama, yapılandırılmış anket ve doğum öncesi kayıt incelemesi kullanılarak görüşme yöntemi ile yapılmıştır. Çalışma popülasyonu, Mart-Haziran 2018 tarihleri arasında Tuaran Bölgesi'ndeki doğum öncesi bakım kliniklerine katılan 24. gebelik haftası ve üzerindeki tüm gebelerdi. Önceden diyabeti olan gebeler çalışma dışı bırakıldı. Kolaylıkla örnekleme yöntemi kullanılmış ve çalışmaya 195 gebe katılmıştır. Tanımlayıcı ve analitik istatistikler SPSS istatistik yazılımı kullanılarak yapılmıştır. Gestasyonel Diabetes Mellitus (GDM), tüm dünyada önemli bir halk sağlığı sorunu olarak ortaya çıkmıştır. Maternal ve fetal olumsuz sonuçlar geliştirebilir. GDM prevalansı dünya çapında %1-28 ve Malezya'da %18,3-27,9 arasında değişmektedir. **Bulgular:** Tuaran Bölgesi'ndeki tüm katılımcılar arasında GDM prevalansı %28,2 idi. GDM ile anlamlı olarak ilişkili risk faktörleri ileri anne yaşı (p=0,042), ailede diabetes mellitus öyküsü varlığı (p=0,009) ve daha önce GDM öyküsü (p=0,001) idi. **Sonuç:** Tuaran Bölgesi'ndeki gebeler arasında GDM prevalansı, Malezya'da yapılan önceki çalışmalardan daha yüksek bulundu. Sağlıklı yaşam tarzının teşvik edilmesi, yoğun sağlık eğitiminin sağlanması, kaliteli doğum öncesi bakım ve hamile kadınlar arasında GDM'nin uygun yönetimi ile erken teşhis, GDM'nin önlenmesi ve kontrolü ile olumsuz maternal ve fetal sonuçların azaltılması için çok önemlidir.

Anahtar Kelimeler: Diyabet, gestasyonal; hamile kadın; yaygınlık; risk faktörleri; Malezya

Gestational diabetes mellitus (GDM) has been emerging as one of the major public health problems all over the world because of its increasing trend. It is defined as any degree of glucose intolerance with onset or first recognition during pregnancy.[1] About 4% of pregnant mothers worldwide were complicated

with GDM and prevalence varies from 1% to 28% depending on the study location, characteristics of population studied and criteria used for diagnosis.[2,3] In Malaysia, there is an evidence of increasing GDM prevalence ranged from 18.3% to 27.9%.[4,5]

The commonly reported risk factors associated with GDM are advanced maternal age, pre-pregnancy obesity, high parity, hyperlipidaemia, poor obstetric outcomes, family history of diabetes mellitus, previous history of maternal complications and previous GDM history.[5,6] GDM complicates short- and long-term consequences for the mother and the foetus.[6] Pregnant women affected by GDM are at high risk of developing hypertension during pregnancy, macrosomia-related complications such as obstructed labour, preeclampsia and postpartum haemorrhage.[7-9] Development of type 2 diabetes mellitus in subsequent years of life is the substantial risk of GDM to maternal.[5,9] Foetal adverse outcome is found to be an increased risk of large birth weight, neonatal hypoglycaemia, polyhydramnios, stillbirth, premature birth, intrauterine death, perinatal complications and congenital malformations.[8,9] The babies born to GDM mothers also have tendency to develop childhood obesity and premature onset of diabetes mellitus in their early stages of life.[10]

Depending upon the magnitude of the severity of GDM complications, the mothers affected will be suffered financially and socially in their families and societies.[11] Because of the adverse effects of GDM on foetal, neonatal and maternal, screening is crucial to detect GDM early as it allows proper interventions and management in order to reduce the potential risk factors for GDM, prevent adverse effects of GDM, improve pregnancy outcomes, reduce foetal adverse outcomes and prevent future risk of emerging diabetes mellitus.

This study was conducted in Tuaran District of West Coast Division, Northwest of Sabah State, Malaysia which has diverse ethnicity, sociocultural and economy background. Although many studies have been conducted on GDM in different parts of Malaysia, there has been no such investigation done in Tuaran District, Sabah. The objectives of the study were to estimate the prevalence of GDM and to de-termine its influencing factors among pregnant women in Tuaran District. It is expected to provide an invaluable input to the health authorities for effective planning, implementation and evaluation of GDM intervention programs based on the local situations.

MATERIAL AND METHODS

This is a cross sectional analytical study conducted in Tuaran District, Sabah State, Malaysia from March 2018 to June 2018. The study areas involved were all the public health clinics (Maternal and Child Health Clinic Tuaran, Klinik Kesihatan Tamparuli, Klinik Kesihatan Kiulu and Klinik Kesihatan Tenghilan) located in Tuaran District. Almost all the pregnant women in Tuaran District were supposed to visit the public health clinics available in Tuaran for antenatal care. The inclusion criteria for selecting study population was all the pregnant women at 24 weeks gestational period or more who attended those antenatal clinics during the period from March 2018 to June 2018. The pregnant women who had pre-existing diabetes and those who did not give consents were excluded from the study.

Sample size calculation was done using formula, $n = Z^2 P (1-P)/d^2$ and "P" was based on an estimated prevalence of GDM in Tuaran (10.5%). With the assumptions of 20% non-respondents and incomplete questionnaire forms, the minimum sample size required was calculated as 173 subjects. Convenience sampling method was used and 195 pregnant women were selected from the public health clinics.

Primary data was obtained from face-to-face interview using modified validated questionnaire whereas secondary data was obtained from antenatal books of pregnant mothers who participated in the study. The validated questionnaire was adopted and modified from the study "Awareness of Gestational Diabetes and its Risk Factors among Pregnant Women in Samoa" done by Price, L. A., Lock, L. J., Archer, L. E., & Ahmed, Z. (2017).[12] The questionnaire used was converted into Bahasa Malaysia with forward and backward translation. Pretesting of the questionnaire was done with 23 pregnant women attending maternal and child health unit of "Klinik 1

Malaysia" which was not involved as a study setting. The questionnaire was adapted and refined based on the pre-test results.

The well trained research assistants conducted face to face interviews using structured questionnaire once they received informed consents from the participants. There were five main sections with closed ended questions included in the questionnaire which encompassed maternal personal data, socio-demographic characteristics, GDM risk factors, previous history of GDM and pregnancy outcomes.

The dependent variable in this study was GDM and it was defined operationally as pregnant women who had any degree of glucose intolerance during pregnancy and diagnosed to have GDM. According to the risk-based screening criteria for GDM in Malaysian Clinical Practice Guidelines on Diabetes (2017), the parameters used were age ≥ 25, BMI ≥ 27 kg/m^2, weight >80 kg, parity of ≥ 5, previous history of stillbirth and hypertension. The participants who met the criteria for GDM screening had to undertake modified oral glucose tolerance test (OGTT). GDM was diagnosed when the result of the OGTT screening test using oral glucose 75 g showed abnormal with fasting blood sugar ≥ 5.1 mmol/L and/or 2-hours postprandial blood sugar ≥ 7.8 mmol/L. The independent variables studied were socio-economic characteristics of pregnant mother (ethnicity, education, occupation, income), advanced maternal age (35 years old and above), family history of diabetes mellitus, previous GDM history, high parity and previous maternal and foetal complications.

To ensure ethical consideration of the research, informed consents were obtained from the participants. They were made feel free to withdraw from the study at any time. The data collected from the participants were kept confidentially. Social and cultural sensitivity was maintained throughout this study. Ethical approval of the study was attained from Medical Research Ethics Committee, University Malaysia Sabah dated 23rd February 2018 with approval code of JKEtika 1/18(16) and National Medical Research Register, Ministry of Health, Malaysia dated 18th May 2018 with Ethical approval letter of NMRR -17-3215-39226 (IIR).

Descriptive and analytical statistics were done on the data from completed questionnaire forms using Statistical Package for the Social Sciences version 23. Frequencies and proportions were used to describe the sociodemographic findings and to calculate the prevalence of GDM. Mean and standard deviations were used for continuous variables and numbers and percentages were used for categorical variables. Chi-square test and odds ratio were used to determine the association between GDM and risk factors. The results were stated as p-values, odds ratios and their 95% confidence intervals. A p-value less than 0.05 (two-tailed) was considered as statistical significant.

RESULTS

The following results were revealed from the data analysis.

SOCIO-DEMOGRAPHIC CHARACTERISTICS OF THE PARTICIPANTS

Majority of the participants was Malaysian citizens (96.4%). Mean age of all participants was 30.7 years old and the age of participants below 35 years old was (73.8%). Multiparous was (58%), unemployed was (67.7%) and the participants attained secondary education and above was (92.3%). Most of the participants were Kadazan/Dusun ethnicity (62%) followed by Bajau (14.4%) and others such as Malay and Murut made up of (23.6%) (Table 1).

ORAL GLUCOSE TOLERANCE TEST (OGTT) RESULTS

Among 195 participants, 48 (24.6%) did not meet the criteria for GDM screening with OGTT according to the Malaysians Clinical Practice Guidelines on Diabetes. But they had to undertake routine urine sugar tests at their first and subsequent visits in antenatal clinics. The urine sugar test results of those 48 participants were found negative and they were considered as non GDM. The remaining 147 (75.4%) participants who fulfil the screening criteria were supposed to be at risk for GDM and they had to go through OGTT. The results revealed that 55 out of 147 participants (37.4%) had abnormal OGTT results (Table 2). Among these participants with abnormal OGTT results, 8 (14.6%) had high fasting blood

TABLE 1: Sociodemographic characteristics.		
	n	%
Maternal age		
< 25 years old	30	15.4
25-< 35 years old	114	58.4
> 35 years old	51	26.2
Nationality		
Malaysian	188	96.4
Non-Malaysian	7	3.6
Ethnicity		
Kadazan /Dusun	121	62.1
Bajau	28	14.4
Malay	6	3.1
Murut	1	0.5
Others	39	20.0
Education level		
Tertiary education	46	23.6
Secondary	134	68.7
Primary	13	6.7
No education	2	1.0
Working Status		
Working	63	32.3
Not working	132	67.7
Parity		
Nullipara	34	17.4
Primipara	48	24.6
Multipara	104	53.3
Grandmultipara	9	4.6
Total household income (RM)		
< 1000	58	29.7
1000-3000	103	52.8
>3000	34	17.4

sugar, 35 (63.6%) had abnormal results in 2 hours post prandial test and 12 (21.8%) had abnormal results in both tests.

PREVALENCE OF GDM

According to the above findings, it was shown that GDM prevalence among all participants who attended health clinics in Tuaran District was 28.2% (i.e. 55 out of 195 participants had GDM) and GDM among participants who were at risk was 37.4 % (i.e. 55 out of 147 pregnant women who were at risks of GDM).

GDM AND RISK FACTORS

This study revealed that GDM was significantly associated with maternal age, family history of diabetes mellitus and previous GDM history with (OR 2.0, 95% CI: 1.019-3.962, p=0.042), (OR 2.8, 95% CI: 1.267-6.392, p=0.009) and (OR 5.6, 95% CI: 1.951-15.978, p=0.001) respectively (Table 3). But no significant association was shown between GDM and the risk factors such as ethnicity, education, family income, employment status, previous maternal and foetal complications and parity of mothers.

◼ DISCUSSION

GDM prevalence among the pregnant women in Tuaran District was found to be higher than the national prevalence. It was quite alarming as it would reflect

TABLE 2: OGTT results among at risk respondents.		
Results OGTT	**n**	**%**
Abnormal results (GDM)	55	37.4
Normal results (Non-GDM)	92	62.6
Total	147	100

TABLE 3: GDM and associated risk factors.							
	GDM		**Non-GDM**				
Variables	**n**	**%**	**n**	**%**	**p-value**	**OR**	**95% CI**
Overall	55	28.2	140	71.8	-	-	-
Maternal Age							
< 35 years old	35	24.3	109	75.7	0.042	2.009	1.019-3.962
> 35 years old	20	39.2	31	60.8			
Family history of DM							
Yes	14	48.3	15	51.7	0.009	2.846	1.267-6.392
No	41	24.7	125	75.3			
Previous history of GDM							
Yes	11	64.7	6	35.3	0.001	5.583	1.951-15.978
No	44	24.7	134	75.3			

the high burden of GDM in Tuaran, Sabah. It could also be expected that there would be a rising trend of diabetes mellitus in the next 5 to 10 years ahead because those women with GDM are being potential for developing diabetes mellitus. Thus, intensive prevention and control interventions for GDM among pregnant women seemed to be an urgent need for Tuaran District.

High GDM prevalence in Tuaran District was most probably due to sociodemographic characteristics of the study location and recently changed diagnostic and screening criteria for GDM in that district. In Tuaran, altered GDM screening and diagnostic criteria have been started to practice in early 2018 according to the Clinical Practice Guideline, Management of Diabetes in Pregnancy, Malaysia (2017). Regarding screening criteria, the pregnant mother's age for GDM screening was set down to 25 years old regardless of the presence of risk factors whereby they need to undergo OGTT at least once at 24-28 weeks of gestation. For the diagnostic value of fasting blood sugar, it has become lowered as compared to the value set in previous years. Previously, minimum diagnostic value of fasting blood sugar was set at 5.8mmol/L for GDM but according to the new criteria, the recommended diagnostic value for fasting blood sugar was 5.1mmol/L. But the cut off value for 2 hours postprandial had remained the same (i.e.7.8 mmol/L). Such changes in diagnostic and screening criteria for GDM were supposed to be attributing factors for higher case detection rate of GDM in Tuaran District.

Compared to the cross sectional study done at Selangor, Malaysia in 2014 by Logakodie et al., GDM prevalence among pregnant mothers who attended public health clinics in Tuaran (28.2%) was found higher than that of prevalence among pregnant mothers who attended the public health clinics in Selangor, Malaysia (27.4%).[5] Another study done by Aini et al. in 2010 revealed that only (8.6%) of pregnant women who delivered at 14 state hospitals in Malaysia got GDM.[13] It has indicated that GDM prevalence in Malaysia has been increasing in trend which might be due to the effects of interactions among sociodemographic factors, lifestyle and cultural factors.

Advanced maternal age, family history of diabetes mellitus and previous GDM history were the significant risk factors associated with GDM in our study. Our study revealed that risk of GDM among pregnant mothers at 35 years old and above was 2 fold higher than that of pregnant mothers below 35 years old (Table 3). Results of some studies done previously in Malaysia supported to our study. Referring to the study done by Bener et al., pregnant women who had GDM were significantly higher in the age group of 35 to 45 years.[14] A study done by Erem et al. (2015) showed that GDM prevalence significantly associated with increased maternal age (i.e. 0.7% GDM in below 25 year-old age group and 9.5% GDM in 35 years old and above age group).[15] These findings suggested that the screening for detection of GDM among pregnant women should be done at their early age of life. As advanced maternal age was one of the risk factors for GDM in Tuaran, besides performing lifestyle changes, raising awareness of risk factors and early detection of GDM, counselling and family planning services should also be reinforced.

The pregnant mothers who had family history of diabetes mellitus were observed 2.8 fold increased risk of GDM than that of pregnant mothers without family history of diabetes in our study (Table 3). This finding was supported by a study done by Katarzyna Cypryk et al., reported that family history of diabetes was a strong risk factor as (40%) of GDM patients were found to have first degree relatives with diabetes (p<0.05) and it had increased the risk by 90%.[16] In a study done by Erem et al. revealed that women with history of diabetes in first degree relatives had a higher prevalence of GDM (p<0.001) compared to women without such family history and had a 4.5 fold increased risk for developing GDM. Since family history of diabetes is one of the potential risk factors for developing GDM among pregnant women, strengthening of diabetes mellitus prevention and control programs at different levels of health care system is crucial important to reduce the incidence of diabetes in the community.

Our study also showed that the pregnant women with previous GDM history had 5.6 fold higher risk of developing GDM than the pregnant women who

did not have previous history of GDM (Table 3). This finding was supported by the results of the other studies conducted by different researchers at different areas. A study done by Erem et al. revealed that pregnancy complicated by GDM increased the risk of subsequent GDM. In their study they observed that 50% of pregnant women with GDM had a past history of GDM and had a 84-fold increased risk of developing GDM compared to women without a previous history of GDM.[16] A cohort study done by MacNeill et al. in Nova Scotia, Canada found that the recurrence rate for GDM in subsequent pregnancy was 35.6%.[17] Another study done retrospectively among 792 Korean pregnant women who had previous GDM history also found to have higher chance for development of GDM in their subsequent pregnancies.[18] These findings were also similar to the study done among pregnant women in Haryana, India which showed previous history of GDM had an increased association with GDM with OR of 27.46.[19] Since previous history of GDM was found an associated risk factor of GDM in this study, it could be assumed that there would be high risks of developing GDM for consecutive pregnancies among those women with GDM in Tuaran. To address this problem, it is important to promote decent lifestyles and overall health to reduce risk factors, to perform extensive screening of GDM among pregnant women at their early age and to strengthen risk approach antenatal care for high risk groups among pregnant women.

In this study, no significant association was found between GDM and other potential risk factors such as socio-demographic characteristics (ethnicity, education level, household income and employment status), high parity, previous adverse foetal outcomes and previous maternal complications. But these factors might be the confounding factors for high prevalence of GDM among pregnant women in Tuaran District. Some other factors which were not included in our study like nutrition, dietary pattern, eating habits, maternal obesity, life style etc. could also be considered as the confounding and further extensive studies should be carried out on GDM.

There were some limitations in conducting this study. As we used cross sectional study design, the causal relationships could not be determined. The convenience sampling used also had highly prone to sampling bias and the sample might not be a representative of the entire population. Since the sample size in this study was not large enough, it might influence the statistical power and generalizability of the study results. Although this study was a pilot study on GDM restricted only to Tuaran District, the findings from the study were expected to be some sort of helpful for the health planners at district and state levels.

CONCLUSION

High prevalence of GDM among pregnant women in Tuaran District, Sabah, Malaysia highlighted that GDM has become one of the major public health problems in Sabah State. Strengthening of primary prevention measures such as health promotion, health education, healthy lifestyle and behavioural changes are essential as they play an important role in elimination of risk factors and reduction of GDM incidence among pregnant women. Early screening and detection of GDM is also vital as it allows prompt and effective management to improve pregnancy outcomes, reduce adverse effects of GDM on foetal and maternal and to prevent future development of type 2 diabetes mellitus. Screening for GDM is strongly recommended to start in the 1st trimester which would enhance the early detection of GDM and ensure prevention of adverse pregnancy outcomes. Large scale community based research on magnitude of GDM problem, its determining factors and pregnancy outcomes of women with GDM is suggested to carry out across Sabah State in future. Strengthening and increased coverage of health education intervention programs on GDM are recommended to raise awareness of GDM risk factors, consequences and complications etc. among women especially reproductive age group which would make positive impact on reduction of GDM prevalence. Innovative strategic plan of action for prevention and control of GDM with optimal use of available resources are required to be formulated and implemented in order to achieve positive outcomes for both maternal and infant. The findings revealed from this study are expected to be invaluable baseline information for health managers to develop effective strategic plans for alleviation of risk factors and reduction of GDM prevalence

among pregnant women in Sabah community especially for remote areas.

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