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THE ASSOCIATION BETWEEN SOCIODEMOGRAPHIC, BODY MASS INDEX AND MEDICAL FACTORS RELATED TO GESTATIONAL DIABETES MELLITUS (GDM): FINDINGS FROM THE NATIONAL HEALTH MORBIDITY SURVEY (NHMS) 2016.

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ABSTRACT

Background: GDM is shown to be closely linked with different adverse pregnancy outcomes both at the fetal and maternal level including an increased risk of caesarean-section delivery, intrauterine growth retardation, preeclampsia and macrosomia. This study aimed to determine the sociodemographic, body mass index and medical factors linked with gestational diabetes mellitus in Malaysia.

Materials and Methods: Data from NHMS 2016 was used and a cross-sectional design was implemented with a two-stage stratified cluster sampling. This study employed descriptive statistics whereby the focus was on the percentage of each variable. Complex sample logistic regression was used to identify factors linked with GDM at both univariate and multivariable levels. The data were presented as adjusted odds ratio with 95% CI and with p values (<0.05)

Result: The overall prevalence of GDM from this survey was 12.4% (1349). Results from multivariable analyses showed that there were significant associations between GDM and age group of 25-49 years old (p<0.001), Malay ethnicity (p=0.024), hypertensive medical history (p=0.003) and body mass index of both overweight and obesity (p<0.001).

Conclusion: Early screening and proper management of this group should be done continuously by healthcare personnel. This study offers crucial information for practitioners and policymakers to take effective measures to address the issue highlighted and to improve the GDM-related care for reproductive aged women. Future studies on effects of GDM on live long obesity and non-communicable diseases should be conducted to address these important issues.

Keywords: Gestational diabetes mellitus, gestational weight gain, National Health and Morbidity Survey 2016

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1.0 Introduction

Gestational diabetes mellitus (GDM) is often defined as glucose intolerance of varying degree which is usually started at or detected during pregnancy (1). The presence of any one of these results; 2-hour postprandial (2-HPP) ≥7.8 mmol/L during 24-28 weeks of pregnancy or FPG ≥5.1 mmol/L proves the diagnosis of GDM (2). One of the primary causes of maternal and infant mortality is due to GDM (3). According to the Malaysian Health and Morbidity Survey on Maternal and Child Health 2016, the prevalence of GDM was 13.5% (4). However, reported prevalence worldwide varies between 1 and 45% of pregnancies with GDM (5).

Along with the increasing probability of being diagnosed with Type 2 diabetes mellitus after pregnancy, GDM is indicated to be closely associated with different adverse pregnancy outcomes both at the foetal and maternal level including an increased risk of caesarean-section (C-section) delivery, preeclampsia, macrosomia and intrauterine growth retardation (IUGR) (6). New born delayed brain maturity and neurobehavioral abnormalities showed a comparatively lower intelligence than normal babies, language impairments, poor attention and impulsivity which are often associated with GDM. (7). Hence, it is of utmost importance to ensure that GDM is managed well to avoid various pregnancy outcomes linked with it (8).

Past research has identified several risk factors for GDM including obesity, overweight, advanced maternal age and family history of diabetes (9). There is a potential risk factor for adverse pregnancy outcomes due to excessive gestational weight gain (GWG) as shown in the recent data (10). Excessive weight gain during pregnancy could be defined based on the published guidelines by the Institute of Medicine in 2009 in which the appropriate thresholds for body mass index (BMI) were described (11). The thresholds were mainly selected based on the historical data which showed a linear increase in adverse neonatal and maternal outcomes in association with GWG in women without GDM and pregestational diabetes mellitus (PGDM) (12). Approximately 36% of mothers experienced excessive gestational weight gain (GWG). Large gestational age (LGA) birth weight, caesarean delivery, and lower Apgar scores are often associated among women without diabetes (13).

This study was designed to identify the sociodemographic, body mass index and medical factors associated with gestational diabetes mellitus in Malaysia using a national morbidity and health survey. We also hypothesized that excessive first trimester BMI and advanced maternal age are both risks to develop GDM along with other risk factors.

2.0 Materials and Methods

2.1 Data source

This research used the data from the National Health and Morbidity Survey 2016: Maternal and Child Health (4). This study employed stratified random sampling. The strata chosen were Primary and Secondary stratum. Primary stratum encompasses the states in Malaysia which includes the Federal territories and the Secondary stratum encompasses districts within the primary stratum. The information of Living Quarters (LQs) from birth registration is utilized as the sampling unit. A proportionate random selection of the LQs within each district

in all states in Malaysia was done. The NHMS 2016 report (IPH, 2016) showed a thorough explanation on this section (4). The objectives of this study were taken into account to generate data cleaning and sample weights. The questions that were left unanswered by the respondents were excluded from the analysis and coded as missing values. Only complete data was included in the analysis.

2.2 Study participants

The respondents of this study were all mothers aged 15-49 years staying within the chosen Living Quarters (LQs). The birth registrations from the period of June 2014 to January 2015 were provided by the National Registration Department to be used as a sampling frame. Total of 1349 respondents were obtained for this study.

2.3 Outcome variables

The method utilized for data collection were face-to-face interview using mobile device and structured questionnaire. The questionnaire was available in two languages (Malay and English) and pre-tested before the data collection. Other sociodemographic variables were also being captured. Based on the respondent's responses, the history of non-communicable diseases (diabetes mellitus, hypertension and hypercholesterolemia) was captured.

Weight and height of pregnant mothers for the first trimester were obtained from antenatal records as well as status of GDM. A standard weight was supplied to each team for standardization for the purpose of field implementation.

2.4 Statistical analysis

Data was analysed using SPSS version 26.0 for Windows (SPSS Inc., Chicago, IL, USA) with complex sample analysis. Descriptive statistics such as the frequency and percentage of each variable was performed. Simple logistic regression and multiple logistic regression were used to identify factors associated with GDM at both univariate and multivariable levels. Variable that was included in the study were sociodemographic variables (location, age, ethnic groups, education level, occupation,) maternal comorbidity and body mass index. The final model was presented with adjusted odds ratio (AOR) and 95% confidence interval (CI).

2.5 Ethical Approval and Consent forms

The survey's purpose and methods were explained to the participants in the form of bilingual consent form (Malay and English). The study protocol and ethics were approved by the Medical Research and Ethics Committee prior to the distribution of the consent forms. This survey was registered at the National Medical Research Register (NMRR), bearing the number of NMRR-15-511-25359. All respondents had access to the information sheet and consent form. A signed consent was taken from guardians with a witness present for minors or disabled persons. A thumbprint impression was taken from illiterate respondents with a literate person as the witness.

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3.0 Result

Total respondents for this study were 1349. According to Table 1, the overall prevalence of GDM from this survey was 12.4% (1349). Highest prevalence of GDM was reported among those residing at urban locality (12.5%), aged between 40-44 years of age (31.8%), Indian ethnicity (13.7%), those with secondary school education level (13.0%), public sectors (15.0%), hypertensive (36.3%) and obesity (22.1%).

Table 1: Prevalence of GDM according to sociodemographic and factors associated (N=1349)

Sociodemographic Variable	Count	Estimated Population	Prevalence (%)	95% CI	
				Lower	Upper
Location					
Urban	804	38720	12.5	11.0	14.2
Rural	545	18376	12.4	11.1	13.9
Age Group					
< 25	57	3102	4.0	2.8	5.7
25-29	273	15374	9.9	8.7	11.3
30-34	477	19234	13.7	11.8	15.8
35-39	350	14018	21.0	18.5	23.8
40-44	171	5127	31.8	28.0	35.9
45-49	21	242	23.8	13.8	38.0
Ethnic Group					
Chinese	103	6054	9.3	7.7	11.3
Malay	1011	39225	13.6	12.4	15.0
Indian	67	2887	13.7	9.4	19.5
Other Bumiputera	120	6123	12.2	9.4	15.7
Others	42	2285	7.7	4.7	12.5
Education Level					
Primary/ no formal	152	5901	10.0	7.9	12.6
Secondary	725	31310	13.0	11.7	14.4
Higher	464	19333	12.7	10.8	15.0
Occupation					
Self-employed	97	3731	11.4	8.7	14.8
Public sector	326	11881	15.0	13.0	17.3
Private sector	292	15069	12.1	9.7	15.0
Housewives	617	25473	12.2	10.9	13.8
Maternal comorbidity					
Hypertensive	50	1575	36.3	26.9	46.8
Thalassemia	24	630	13.4	7.6	22.5
Asthma	38	1725	12.2	8.9	16.5
Body mass index					
Underweight	48	2221	4.8	3.4	6.7
Normal	470	21930	9.6	8.1	11.4
Overweight	401	17712	17.1	15.1	19.3
Obesity	368	13076	22.1	19.3	25.3

Results from multivariate analyses (Table 2) showed that there were significant associations between GDM with age group of 25-44 years (p<0.001), age group of 45-49 years (p=0.008), Malay ethnicity (p=0.024), hypertensive medical history (p=0.003) and body mass index for both obesity and overweight category (p<0.001). No association was reported for education level, locality and occupation.

Table 2: Multivariate analyses of GDM and its associated factors.

Variable	Univariable		Multivariable	
	Crude OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Locality				
Rural	1			
Urban	1.01 (0.83, 1.24)	0.918	-	
Age group				
24 and less	1		1	
25-29	2.66 (1.75, 4.05)	<0.001	2.31 (1.47, 3.64)	**<0.001**
30-34	3.83 (2.77, 5.29)	<0.001	3.28 (2.29, 4.71)	**<0.001**
35-39	6.44 (4.55, 9.11)	<0.001	5.18 (3.6, 7.44)	**<0.001**
40-44	11.29 (7.89, 16.17)	<0.001	9.03 (6.25, 13.05)	**<0.001**
45-49	7.57 (3.43, 16.7)	<0.001	3.83 (1.43, 10.25)	**0.008**
Ethnicity				
Chinese	1		1	
Malay	1.54 (1.24, 1.90)	<0.001	1.31 (1.04, 1.66)	**0.024**
Indian	1.54 (1.05, 2.26)	0.029	1.26 (0.79, 2)	0.330
Other Bumiputera	1.35 (0.95, 1.93)	0.096	1.3 (0.89, 1.89)	0.172
Others	0.82 (0.45, 1.46)	0.49	0.94 (0.5, 1.77)	0.843
Education level				
Primary/ no formal	1		1	
Secondary	1.34 (0.99, 1.81)	0.05	1.14 (0.82, 1.58)	0.429
Higher	1.31 (1.03, 1.66)	0.028	1.01 (0.76, 1.34)	0.935
Occupation				
Self-employed	1		1	
Public sector	1.37 (0.97, 1.93)	0.072	1.19 (0.77, 1.84)	0.423
Private sector	1.07 (0.76, 1.50)	0.691	1.22 (0.84, 1.78)	0.289
Housewives	1.08 (0.80, 1.47)	0.597	1.27 (0.93, 1.73)	0.135
Medical history				
Hypertensive	4.08 (2.61, 6.39)	<0.001	2.09 (1.29, 3.38)	**0.003**
Thalassemia	1.09 (0.59, 2.00)	0.788	-	
Asthma	098 (0.67, 1.43)	0.901	-	
Mother Body Mass Index (1st trimester)				
Underweight	1		1	
Normal	2.12 (1.42, 3.18)	<0.001	1.91 (1.26, 2.91)	**0.003**
Overweight	4.12 (2.72, 6.25)	<0.001	3.14 (2.07, 4.75)	**<0.001**
Obesity	5.68 (4.11, 7.85)	<0.001	4.08 (2.97, 5.62)	**<0.001**

*Classification table, 87.4%; Nagelkerke R Squares, 10.3%

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4.0 Discussion

This study showed a statistically significant association between GDM and its associated factors. Using logistic regression, significant maternal risk factors for GDM were maternal age, ethnicity, medical history, overweight and obesity.

Overall, the prevalence of GDM gradually increases along with the rising maternal age with the highest prevalence among those aged between 40-44 years old (31.8%) with a more than 10-fold increase ($p<0.001$). Other studies have also shown similar findings with this study (15-17). GDM is more common among older women. This may be due to the falling levels of insulin functions and sensitivity that is linked with age factor. This causes older women to be more likely to develop GDM compared to younger women (18).

According to research, 1 in 4 women in South East Asia has GDM (19). In this study, Indian ethnicity women had the highest prevalence of GDM (13.7%) compared to another ethnicity. In terms of ethnicity, Malay women were strongly associated with GDM in our study ($p=0.024$). Logakodie et al study among antenatal public health care in Selangor, Malaysia did not find any association between ethnicity and GDM (20). Studies by Nirmala et al showed women of Malay ethnicity had higher probability of GDM compared to another Malaysian ethnicity (21).

Having hypertension was strongly associated with GDM in this study ($p=0.003$). Women with hypertension had an odd ratio of developing GDM 2 times higher than other medical conditions. Most studies conducted reported positive association between hypertension during pregnancy and GDM. (22-23). Women with GDM are shown to have a higher risk of poor pregnancy outcomes such as eclampsia or pre-eclampsia (24-25). No positive association was found between GDM and other medical history of respondents.

The increasing trend of obesity among childbearing women in Malaysia is alarming, causing higher BMI and unintentional gestational weight gain (4,26). These conditions could contribute to higher risk of pregnant women to develop higher blood glucose level which likely leads to poor pregnancy outcome (27). This study showed incidents of GDM increased with BMI. The odd ratio of developing GDM was 4 times higher among obese mothers ($p<0.001$) and 3 times higher among overweight GDM mothers ($p<0.001$). The pathophysiology of GDM is mainly characterised by the pregnancy induced insulin resistance being amplified by the already elevated pre-pregnancy insulin resistance level in obese women (28). Adverse pregnancy outcomes are independently linked with Maternal GDM and obesity (28).

The other main factors of GDM such as dietary intake, previous history of GDM and family history of diabetes were not taken into account in this study hence becoming limitations of this research. These factors should be investigated as these are some important factors that cause GDM. The main strength of this study is that it has the advantage of having respondents from a population-based study.

5.0 Conclusion and recommendation

In conclusion, the prevalence of GDM in NHMS 2016 was 12.4%. Significant associations were shown between GDM and age group, Malay ethnicity, hypertensive medical history and body mass index. Early screening and proper management of this group should be done continuously by healthcare personnel. Vulnerable groups of GDM such as those on insulin should be closely and regularly monitored. This study offers crucial information for practitioners and policymakers to take effective measures to address the issue highlighted and to improve the GDM-related care for reproductive aged women. Endocrinologists and Dietitians referral for GDM management are crucial for better glycemic control. Future studies on effects of GDM on live long obesity and non-communicable diseases should be conducted to address these important issues.

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Declaration

These authors declare that there is no conflict of interest in any form. There is no conflict of interest with the funder; no influence in the design, data collection, data analysis or manuscript writing as this is secondary data-based study

Authors contribution

Author 1: Literature review, Author 2: Introduction ,Author 3: Methodology and analysis

Author 4: Discussion and Author 5 & 6: Referencing and proof reading

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