ORIGINAL ARTICLE

Gestational diabetes mellitus: The prevalence, associated factors and foeto-maternal outcome of women attending antenatal care.

Logakodie S, Azahadi O, Fuziah P, Norizzati BIB, Tan SF, Zienna ZZR, Norliza M, Noraini J, Hazlin M, Noraliza MZ, Sazidah MK, Mimi O.

Logakodie S, Azahadi O, Fuziah P, et al. Gestational diabetes mellitus: The prevalence, associated factors and foeto-maternal outcome of women attending antenatal care. *Malays Fam Physician.* 2017;12(2);9–17.

Keywords:
Gestational diabetes mellitus, antenatal clinic, Selangor, prevalence, foeto-maternal outcome.

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Abstract

Objective: The aim of the study is to determine the prevalence of gestational diabetes mellitus (GDM), its associated risk factors, foeto-maternal outcomes and prevalence of postnatal diabetes mellitus (DM).

Methods: This is a cross-sectional study using retrospective data from existing antenatal records of new antenatal women who registered at 72 public health clinics in Selangor in January 2014.

Results: A total of 745 antenatal records were reviewed. The prevalence of GDM women was 27.9% (n = 184). GDM risks were higher in women aged 35 years old and above and in those with maternal obesity. GDM women had a higher risk of having a non-spontaneous vaginal delivery compared to non-GDM women. The prevalence of postnatal DM among GDM mother was 12.1%. Working GDM mothers were at higher risk of developing postnatal DM.

Conclusion: The prevalence of GDM among newly registered women attending antenatal public health care in Selangor was higher than previous studies. Health care personnel need to be vigilant in screening women with risk factors.

Introduction

Gestational diabetes mellitus (GDM) is defined as any degree of glucose intolerance with onset or first recognition during pregnancy.[1] Pregnancies affected by GDM imposes a risk for mother and child. The overall pregnancy outcomes among GDM mother were poorer with higher risks of spontaneous miscarriage, preterm labour and caesarean section.[2] Risk of macrosomia, low Apgar score, need for intensive care unit admission, hypoglycaemia, congenital malformation and respiratory distress syndrome (RDS) were also higher among the infants of GDM mothers.[2,3]

The most commonly reported risk factors for GDM were older age, pre-pregnancy obesity, high parity, family history of diabetes (especially in first-degree relatives), previous history of GDM and previous obstetric outcome history (macrosomia infant, congenital malformation and recurrent abortions).[4] Maternal weight and family history of GDM were also associated with maternal GDM.[2,5]

Women who have had GDM have a substantial risk of developing type 2 diabetes mellitus (T2DM), even though most women return to a normoglycaemia state shortly after delivery. Women with gestational diabetes were seven times more likely to develop type 2 diabetes compared with those who had a normoglycaemia pregnancy.[6]

Worldwide, it is estimated that GDM affects less than 1% to 28% of antenatal mothers.[7] The combined prevalence of GDM in 15 multinational centres was 17.8%.[8] Two previous studies showed the prevalence of (GDM) in Malaysia ranged from 18.3% and 24.9% respectively.[9,10] However, not much recent data were available on GDM among antenatal mother attending the antenatal care in a public health clinic in Malaysia. The prevalence of DM has increased from 11.6% (2006) to 15.2% (2011) among adults in Malaysia.[11,12] Hence it is expected that the prevalence of GDM would increase as well.

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Public health clinics in Selangor screen for GDM selectively for patients with risk factors only. Screening is done using 75g oral glucose tolerance test (OGTT) at least once at or around 24 weeks gestation, unless there are indications for it to be done earlier.[13] World Health Organization (WHO) guidelines also recommended to do diabetes screening among antenatal mothers at first antenatal visit and to be repeated at 24-28 weeks of gestation.[14]

Blood for glucose estimation is drawn after an overnight fast (baseline value) and 2 hours after the oral glucose load. The diagnosis of GDM is made if the patient satisfies the criteria for fasting blood glucose ≥ 5.6 or IGT with a 120-minute blood glucose value of ≥ 7.8 mmol/L.[20]

The risk factors of having an abnormal postpartum OGTT include insulin treatment during pregnancy, higher educational level, previous GDM, body mass index (BMI) more than 30 kg/m^2 and women with more than two prior pregnancies are significantly associated with abnormal postpartum abnormal glucose tolerance test.[15,16] Despite this, the rate of postpartum screening using OGTT remains low in clinical practice.[17,18]

The objectives of this paper are to determine the prevalence of GDM, it's associated risk factors and foeto-maternal outcome. The secondary objectives is to determine the prevalence of diabetes at 6-weeks postpartum and associated risk factors among antenatal women attending public health clinics in Selangor. The information can be applied to improve pregnancy care and further enhance pregnancy outcomes.

Method

A cross-sectional study was conducted among antenatal mothers who were registered at 72 public health clinics in Selangor in January 2014. Sample size was calculated using a formula for prevalence study (estimated prevalence of 25%, precision of 0.05, non-respondents of 20% and design effect of 2).[19] The total sample size was 740 and allocated proportionately among all 10 districts in Selangor based on the total number of newly registered antenatal mothers in January 2014. The samples were then distributed evenly to all clinics in each district. For each clinic, samples were selected using a systematic random sampling technique. Antenatal women who were transferred out at any gestation and those with pre-existing Type 1 or Type 2 diabetes mellitus were excluded.

The data on demographic, risk factors, foeto-maternal outcome and postnatal OGTT were extracted from existing antenatal records. Respondents were diagnosed to have GDM when the fasting blood glucose was 5.6 mmol/L or more and/or 2-hours post prandial level was 7.8 mmol/L or more.[20] The association between GDM and risk factors were analysed by chi-square test. As there might be cluster sampling effect in the public health clinic from the 10 districts, multivariate analysis using the generalized estimating equation (GEE) was used to predict the risk of GDM. All analysis were done using Social Package for the Social Sciences version 21.

Results

Socio-demographic characteristics of the respondents

A total of 745 antenatal records were reviewed. Only 659 (88.5%) had complete data were included in the analysis. The majority of the respondents had were Malaysian, aged less than 35 year, of Malay ethnicity, were working and had secondary education (**Table 1**).

Table 1. Socio-demographic characteristics of respondents

Socio-demography	n	%
Nationality		
Malaysian	598	90.7
Non-Malaysian	61	9.3
Age group		
Less than 35 years old	561	85.1
35 years old and above	98	14.9
Ethnic group		
Malays	470	71.3
Chinese	42	6.4
Indians	71	10.8
Others	76	11.5

Socio-demography	n	%
Education level		
No formal / primary education	68	10.3
Secondary education	353	53.6
Tertiary education	234	35.5
Occupation		
Working	363	55.6
Housewife	290	44.4
Gravida		
Primigravida	193	29.3
Multipara	429	65.2
Grand multipara	36	5.5
Trimester at booking		
First trimester	370	56.3
Second trimester	270	41.1
Third trimester	17	2.6

GDM and associated factors

The overall prevalence of GDM was 27.9%. Univariate analysis using chi-square (with Fisher's exact test when applicable) showed there were significant associations between GDM and age group, parity, maternal obesity, first-degree relative with DM, previous history of GDM, history of intra-uterine death and glycosuria of two or more occasions during pregnancy (**Table 2**).

Table 2. Prevalence of GDM by socio-demography and risk factors

Socio-demography	GDM n (%)	Non-GDM n (%)	p-Value (*with Fisher's exact test)
Overall	184 (27.9)	475 (72.1)	
Nationality			
Malaysian	164 (89.1)	434 (91.4)	0.374
Non-Malaysian	20 (10.9)	41 (8.6)	
Age group			
Less than 35 years old	128 (69.6)	433 (91.2)	<0.001
35 years old and above	56 (30.4)	42 (8.8)	
Ethnic group			
Malays	128 (69.6)	342 (72.0)	0.082
Chinese	17 (9.2)	25 (5.3)	
Indians	14 (7.6)	57 (12.0)	
Others	25(13.6)	51 (10.7)	
Education level			
No formal / primary education	19 (10.3)	49 (10.3)	0.886
Secondary education	96 (52.2)	257 (54.1)	
Tertiary education	68 (37.5)	166 (35.6)	
Occupation			
Working	95 (51.6)	268 (56.4)	0.238
Housewife	88 (48.4)	202 (43.6)	
Gravida			
Primigravida	40 (21.7)	153 (32.2)	0.001
Multipara	126 (68.8)	303 (63.8)	
Grand multipara	18 (9.5)	18 (4.0)	

Socio-demography	No formal / primary education	Non-GDM n (%)	p-Value (*with Fisher's exact test)
Maternal obesity (BMI > 27.0 kg/m² or maternal weight more than 80 kg)			
Obese	84 (45.7)	101 (21.3)	<0.001
Non-obese	98 (54.3)	371 (78.7)	
Weight gain more than 2 kg/week			
Yes	38 (20.7)	84 (17.7)	0.379
No	146 (79.3)	391 (82.3)	
Previous macrosomia baby			
Yes	9 (4.9)	10 (2.1)	0.055
No	175 (95.1)	465 (97.9)	
First-degree relative with DM			
Yes	61 (33.2)	80 (16.8)	<0.001
No	123 (66.8)	395 (83.2)	
History of GDM			
Yes	30 (16.3)	28 (5.9)	<0.001
No	154 (83.7)	447 (94.1)	
History of abortion : two times or more			
Yes	9 (4.9)	18 (3.8)	0.522
No	175 (95.1)	457 (96.2)	
History of intrauterine death			
Yes	6 (3.3)	5 (1.1)	0.047
No	178 (96.7)	470 (98.9)	
History of neonatal death			
Yes	3 (1.6)	5 (1.1)	0.692*
No	181 (98.4)	470 (98.9)	
History of foetal malformation			
Yes	1 (0.5)	6 (1.3)	0.680*
No	183 (99.5)	469 (98.7)	
Glycosuria two times or more			
Yes	14 (7.6)	9 (4.9)	<0.001
No	170 (92.4)	465 (95.1)	
Urinary tract infection/candidiasis			
Yes	17 (9.2)	26 (5.5)	0.079
No	167 (90.8)	449 (94.5)	
History of polyhydramnios			
Yes	4 (2.2)	2 (0.4)	0.054*
No	180 (97.8)	473 (99.6)	

* $p<0.05$

GEEs showed significant association between GDM and age group, maternal obesity, first- degree relative with diabetes and previous history of pregnancy with GDM (**Table 3**).

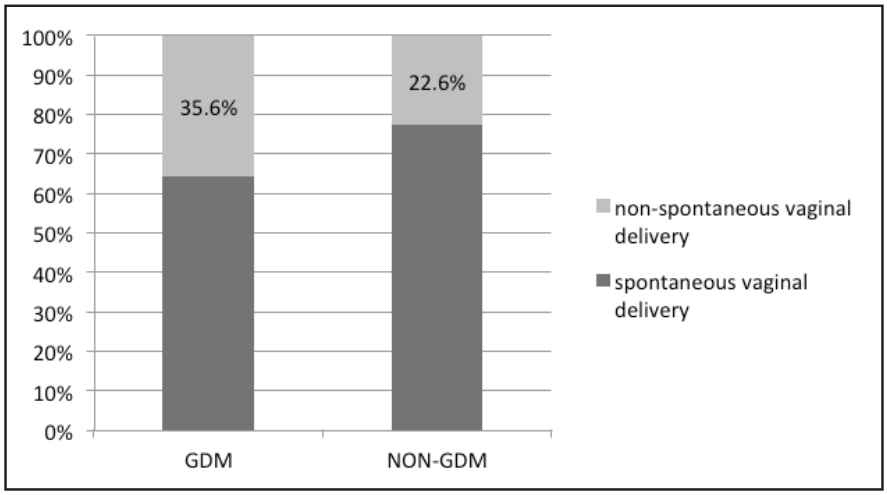
Table 3: Factors associated with GDM (using GEEs)

Variable	Adjusted OR (95% confidence interval)	*p*-Value
Age group		
Less than 35 years old	1.00	
35 years old and above	3.65 (2.21,6.01)	<0.001

Variable	Adjusted OR (95% confidence interval)	*p*-Value
Gravida		
Primigravida	1.00	
Multipara	1.01(0.64,1.57)	0.981
Grand multipara	1.50 (0.65,3.43)	0.341
Maternal obesity		
Non-obese	1.00	
Obese	2.37 (1.60,3.51)	<0.001
First-degree relative with DM		
Yes	1.00	
No	1.88 (1.21,2.91)	0.005
History of GDM		
Yes	1.00	
No	2.36 (1.21,4.57)	0.011
History of intra-uterine death		
Yes	1.00	0.107
No	2.79 (0.80,9.68)	
Glycosuria two times or more		
Yes	1.00	
No	2.25 (0.77,6.58)	0.140

In this study, the mean HbA1c was 5.5% with 21.2% (n=32) having a HbA1c level of 6.0% or greater. However, only 12.5% (n=23) were on insulin. There was a significant association between GDM and mode of delivery with a p-value of 0.001 (**Figure 1**). However, there was no association between GDM and foetal complications (birth weight, hypoglycaemia, obstructed labour, jaundice, intra-uterine death, stillbirth, foetal malformation, RDS and pre-term delivery).

Figure 1. Comparison of mode of delivery between GDM and non-GDM



p=0.001

Postnatal DM

Only 99 (53.8%) of GDM women were screened with a postnatal OGTT of which, 12 (12.1%) had abnormal results. There was a significant association between abnormal postnatal OGTT with insulin management during the antenatal period (p<0.05), maternal obesity (p=0.005) and working mothers (p<0.05). However, no association was found for other risk factors such as maternal age, parity, family history of DM and previous history of GDM.

On further analysis, there were no differences in the sociodemographic characteristics between respondent who have done and not done OGTT (**Table 4**).

Table 4. Sociodemographic characteristics between respondent who have done and not done OGTT.

Socio-demography	OGTT Done n (%)	OGTT Not done n (%)	p- Value (*with Fisher's exact test)
Nationality			
Malaysian	90 (90.9)	69 (88.5)	0.593
Non-Malaysian	9 (9.1)	9 (11.5)	
Age group			
Less than 35 years old	70 (68.6)	51 (68.0)	0.929
35 years old and above	32 (31.4)	24 (32.0)	
Ethnic group			
Malays	73 (71.6)	53 (70.7)	0.816
Chinese	10 (9.8)	7 (9.3)	
Indians	8 (7.8)	4 (5.3)	
Others	11 (10.8)	11 (14.7)	
Education level			
No formal / primary education	12 (11.9)	5 (6.7)	0.317
Secondary education	52 (51.5)	39 (52.0)	
Tertiary education	37 (36.6)	31 (41.3)	
Occupation			
Working	50 (49.5)	43 (57.3)	0.304
Housewife	51 (50.5)	32 (42.7)	

* $p<0.05$

Discussion

The prevalence of GDM among newly registered antenatal women in the month of January 2014 in Selangor was 27.9%, which was higher than the 24.9% found in a study.[10] This could be a reflection of the rise in the national prevalence of T2DM which from 11.6% in 2006 to 15.2% (in 2011) (NHMS 2006, NHMS 2011).[11,12] The National Diabetes Registry report also showed that Selangor had the highest number of T2DM patients (n = 106,101; 16.2%).[21] Another contributing reason could be the use of higher threshold levels for the diagnosis of GDM in previous studies higher cut-off point of fasting blood sugar more than 7 mmol/L and 2-hours postprandial of more than 7.8 mmol/L.[10]

Out of the 10 maternal risk factors identified, logistic regression showed that the significant associated variables were maternal age, obesity, previous history of GDM and first-degree family history of diabetes. Other risk factors were not found to be significant in this study.

GDM risks were higher in women aged 35 years old and above (p<0.001) with a four-fold increase. Other studies have also showed similar findings.[5,9,10] Glucose tolerance is a function of insulin sensitivity and insulin secretion. Pancreatic β-cell function and insulin sensitivity fall with age. Women who were older more likely to have an inadequate β-cell response to stimulation and be more insulin-resistant than younger women, which, make gestational diabetes more likely.[22]

Family history of GDM is also one of the significant associated variables of GDM as shown in this study (p=0.005). Several studies also found that strong family history of diabetes, especially in first-degree relatives is one of the risk factors contributing to GDM.[23,24,26] The familial association was most probably the product of minor alterations that occurred in infants of mothers with abnormal carbohydrate metabolism. This has been previously suggested by epidemiological studies in other populations.[24,25]

A meta-analysis done in 2007, noted that the risk of developing GDM is about four times higher among obese women.[27] In this

study, the odd ratio of developing GDM was 2.45 times higher among obese mothers. In obese women, the pathophysiology of GDM is primarily characterised by the pregnancy induced insulin resistance being amplified by the already elevated pre-pregnancy insulin resistance level.[28] Maternal GDM and obesity are independently associated with adverse pregnancy outcomes.[22,28] The hyperglycaemia and adverse pregnancy outcome study reported that a higher pre-pregnancy BMI and the BMI at 28 weeks were strongly correlated with increased insulin resistance at 28 weeks of gestation.[29] Adipose tissue and placenta believed to produce a large amount of diabetogenic adipokines. Adipokine tumor necrosis factor alpha (TNF-α), is suspected to play an important role in insulin resistance pathways.[30]

Pregnancy complicated by GDM increase the risk of subsequent GDM.[4] The magnitude of risk increases with the number of prior episodes of GDM. Women diagnosed with GDM in early pregnancy, before insulin resistance begins to rise, are likely to have a greater degree of hyperglycaemia, and therefore an increased likelihood of progression to abnormal glucose tolerance/diabetes.[31]

There was a significant difference in the mode of delivery of GDM women compared to non-GDM women (p=0.007). GDM women had a higher risk of having a non-spontaneous vaginal delivery such as operative deliveries (odds ratio [OR] of 1.9) compared to non-GDM women. This finding is similar with other maternal outcome studies. The rate of caesarean deliveries was higher in women with GDM.[5] In a local study, the rate of caesarean section was found to be 10 times higher among diabetic women as compared to healthy women (28.5% vs 18.8%, OR 1.3).[2]

There was no significant difference in the foetal outcome of GDM women compared to non-GDM women in our study. Most of the GDM women in this study were well controlled (84.2% had HbA1c of ≤ 6%). Hence the finding of no significant adverse foetal outcome is expected. A high HbA1c level was shown to be associated with a higher incidence of macrosomia and RDS, as well as increased intensive care unit (ICU) admission.[2] Other studies in the past have revealed that tight glycaemic control may significantly reduce poor perinatal outcome in women with diabetes.[32] Treatment of diabetes in pregnancy, not only decreases perinatal morbidity but have also been found to augment the health-related quality of life of pregnant women.[32]

The prevalence of abnormal postpartum OGTT among GDM women in Selangor in this study was 12.1% which is lower compared to previous studies.[33-35] It was reported that women with GDM have a 17% to 63% risk to develop postpartum diabetes within 5 to 16 years.[36] In our study, the prevalence could be lower because of the shorter interval between delivery and screening which is approximately 6 weeks in this study. Therefore, prolonged periodical follow-up for this group of women may be needed to increase detection rate of abnormal postpartum OGTT. Abnormal postpartum glucose test was higher among GDM women who required insulin during pregnancy. This finding is consistent with other studies.[37]

Strength and limitations

This study was carried out at all public antenatal clinics in urban and rural areas within Selangor. These findings can potentially identify strategies to improve the management of future antenatal women. However, there was inadequate documentation as the data were collected retrospectively. There were also lack of results and defaulter tracing after postpartum glucose tolerance test resulting in a smaller sample size.

Conclusion

The prevalence of GDM among newly registered antenatal women in Selangor was 27.9% which was higher than previous studies. Factors associated with GDM were maternal age, obesity, history of first-degree relative with diabetes and previous history of GDM. Health care personnel may need to recognize and screen this group of women to detect and manage GDM early. Poor postpartum diabetes screening of GDM women demonstrates that strategies to improve their attendance are needed.

Recommendations

We need to ensure that all women at risk of GDM as in this study, should be screened for diabetes antenatally and postnatally. They also need to be on follow-up especially for those who were on insulin during pregnancy.

Acknowledgment

The authors would like to thank the Director General of Health Malaysia, the Selangor Health Director, Selangor District Health Officers for their kind permission and support to conduct and present this study. We would also like to thank the nursing staff for their invaluable assistance in data collection.

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