

Universal Screening of Gestational Diabetes Mellitus: Prevalence and Diagnostic Value of Clinical Risk Factors

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Objective: To estimate the prevalence of Gestational Diabetes Mellitus (GDM) by using universal screening and to show the diagnostic value of the clinical risk factors at Lampang Hospital.

Material and Method: This is a cross sectional study. Data were collected prospectively at the antenatal care clinic of Lampang Regional Hospital between January 4 and September 30, 2010. All pregnant women of appropriate gestational age (GA) were screened by glucose challenge test (GCT) then by oral glucose tolerance test (OGTT) if the GCT result was abnormal. Data were calculated for the prevalence of GDM and the diagnostic value of clinical risk factors.

Results: Six hundred thirteen pregnant women enrolled into the present study with 593 women left for the analysis. The prevalence of GDM at antenatal care clinic of Lampang Hospital was 9.3%. Among GDM cases, 21.8% had no risk factor. Having one risk factor double the chance of having GDM, while having three risk factors gives 42.9% chance of having GDM. Having at least one risk factor could allow better detection with sensitivity of 78.2, specificity of 49.8, PPV of 13.7, NPV of 95.7, LR+ of 1.6 and LR- of 0.4. This would produce 52.8% of pregnant women at risk.

Conclusion: With GDM prevalence of 9.3%, our population should be classified to the high prevalence group. Among GDM cases, 21.8% had no risk factor. Moreover, with 95.7% NPV and 0.4 LR-, this would make this set of risk factors merely a fair screening test. This should prompt the re-evaluation of risk-based screening policy that is generally adopted throughout the country. Cost-effectiveness is the only major concern for the deployment of the universal screening program. It has to be further studied in an evidence-based manner.

Keywords: Gestational diabetes mellitus, Universal screening

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Gestational diabetes mellitus (GDM) is defined as carbohydrate intolerance of variable severity with onset or first recognition during pregnancy⁽¹⁾. It carries significant and often high maternal and fetal complications including preeclampsia, polyhydramnios, fetal macrosomia, birth trauma, operative delivery, neonatal metabolic complications and perinatal death⁽²⁾. This condition also comprises to overt diabetes later in life⁽³⁾.

It is believed that the incidence of GDM has been increasing lately. This increasing incidence over the past 15 years correlates with the increasing incidence of obesity in general population⁽⁴⁾. In Thailand, both obesity in pregnancy and GDM will surely be the main health burden of the country in the near future. Accurate screening and early diagnosis of

GDM is very important. Healthcare personnel can give proper intervention in order to ensure a satisfactory pregnancy outcome, if they are aware of this disease and proper screening is done. Studies showed that identifying and treating women with GDM could substantially reduce the risk of adverse perinatal outcomes⁽⁵⁻⁸⁾.

Despite more than 40 years of research, there is no consensus in the optimal approach to the screening of GDM⁽⁹⁾. There are three major controversies. First, which diagnostic criteria should be used to diagnose GDM. Second, which plasma glucose level should be the cutoff point after a 50 grams (gm) glucose test was done to identify the women at risk⁽¹⁰⁾. And third, universal or selective screening of GDM should be used⁽¹¹⁾. In the fifth International Workshop-Conference on Gestational Diabetes, the recommendation favors selective screening rather than universal screening⁽¹²⁾. It endorsed the recommendation of the fourth workshop that the screening strategy should be based on risk assessment. Nevertheless, Gabbe et al in 2004,

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surveyed practicing obstetricians and gynecologists in 2003 and found that 96% used universal screening for gestational diabetes⁽¹³⁾.

The guideline from the workshop showed that in the low risk group, blood glucose testing is not routinely required. One of the low risk criteria was member of an ethnic group with a low prevalence of GDM but this did not include Asians. In most hospitals in Thailand, this guideline has been adopted with the belief that Thais or Asians are in the ethnic group with low prevalence of GDM. While most studies in this country used selective screening, and only a few reports used universal approach, there is not sufficient information to support such belief^(2,14-16).

In contrary, there are growing evidences showing that Thais or Asians are in the high prevalence group, especially for type 2 diabetes^(17,18). In the United States, Asians along with African-Americans, Native Americans, and Hispanic women were reported to have higher risk for GDM compared to white women^(19,20).

In Thailand, incidence of GDM varied among studies. The prevalence of GDM at Lumphun Hospital was 1.5%, Siriraj Hospital 2.5%, Chiang Mai University 7.05% and Chonburi Hospital 5.1%^(2,14-16). All the above hospitals, except Chonburi Hospital, used selective screening policy. Furthermore, some studies revealed non-compliance to this practice guideline^(2,21). This means that even women with risk factors of GDM were not properly screened, which contributed to such a low incidence of this condition.

Lampang Regional Hospital is one of regional hospitals in Thailand taking care of pregnant women in Lampang and nearby provinces. With 800 beds facility, it can very well represent the health context of a public hospital of Northern Thailand. The present study was aimed to estimate the prevalence of GDM by using universal screening approach. It was also aimed to show the diagnostic value of the clinical risk factors that are generally used.

Material and Method

This is a cross sectional study. Data were collected prospectively at the antenatal care clinic of Lampang Regional Hospital between January 4 and September 30, 2010. All pregnant women of appropriate gestational age (GA) for screening were asked to participate in this GDM universal screening scheme. All relevant data including demographic information, familial history, obstetric history, risk factors for GDM, glucose challenge test (GCT) results and oral glucose tolerance test (OGTT) results

(if applicable) were collected for analysis. This research had been endorsed by the Ethics Committee of Lampang Regional Hospital.

The screening protocol started with GCT using 50 gm glucose per oral with plasma glucose measurement after one hour. The positive result was defined as plasma glucose 140 mg/dL or more. Then, OGTT was done with 100 gm glucose ingestion. For the diagnosis using plasma glucose, cutoff values at fasting period, 1, 2 and 3 hours were 95, 180, 155 and 140 mg/dL, accordingly^(9,12). This protocol was performed in all women at their first antenatal care visits or at 24 weeks of gestation or more. This was up to the risk factor that a woman had. Women with a history of GDM in prior pregnancy, body mass index (BMI) 30 kg/m² or more or family history of type 2 diabetes in the first-degree relative were screened at their first prenatal visits and again at GA 24 weeks or more if the test was negative. All other cases were screened at GA 24 weeks or more. Women with glucosuria were screened immediately when it was detected. OGTT was considered positive when any two of the plasma glucose values were equal or greater than the above criteria. Either with positive fasting glucose value (95 mg/dL or more) or not, patients would be advised to control their diet for at least two weeks before 2-hour postprandial plasma glucose would be checked to judge for the need for insulin treatment.

In the analysis, after the prevalence was calculated, the population was classified into two groups as risk group and non-risk group. Risk factors were maternal age 30 years old or more, family history of type 2 diabetes in the first degree relatives, glucosuria, BMI 25 kg/m² or more, hypertension, history of GDM in previous gestation, history of DFIU (dead fetus in utero), fetal anomaly and macrosomia (birth weight 4,000 gm or more).

The diagnostic value of clinical risk factors would be analyzed using sensitivity, specificity, PPV (positive predictive value), NPV (negative predictive value), LR+ (positive likelihood ratio) and LR- (negative likelihood ratio). STATA statistical software version 11 was used for the analysis of both descriptive and inferential statistics. The significant of statistical parameters were considered at $p < 0.05$ and 95% of confidence interval (CI).

Results

Six hundred thirteen pregnant women who were enrolled in the nine months study period. Eighteen women were excluded because they were lost to

follow-up or could not complete the screening protocol. There were 593 women left for the analysis. Fifty-five cases of GDM were diagnosed. The prevalence of GDM was 9.3%. Description of this group of population is shown in Table 1. It shows demographic characteristics, obstetric history and risk factors of GDM.

Among the 55 cases of GDM detected in the present study, 21.8% had no risk factor. Table 2 shows the chance of having GDM, classified by numbers of risk factors exposed. The more risk factors the women had the higher chance of having GDM increased. In

this population, pregnant women had three risk factors as maximum. By having three risk factors in a pregnant woman, she had a 42.9% chance of having GDM.

Diagnostic parameters when using clinical risk factors as primary screening method for GDM is shown in Table 3. Having at least one risk factor increase the ability of detection with sensitivity of 78.2, specificity of 49.8, PPV of 13.7, NPV of 95.7, LR+ of 1.6 and LR- of 0.4. These figures were from using the age of 30 years old or more as the cutoff point. This would produce 52.8% of pregnant women at risk.

Table 1. General characteristics of pregnant women who had GDM screening

Characteristic (n = 593)	n (%)
Primigravida	237 (40.0)
Nullipara	288 (48.6)
Ethnicity	
Thai/Chinese-Thai	564 (95.1)
Hill tribe	12 (2.0)
Others	17 (2.9)
GDM risk factor	
Age 30 years or more	176 (29.7)
Family history of diabetes in 1 st degree relative	79 (13.3)
Known hypertension	3 (0.5)
History of macrosomia	0 (0.0)
History of DFIU	3 (0.5)
History of fetal anomaly	0 (0.0)
History of GDM	6 (1.0)
Glucosuria	43 (7.2)
BMI 25 kg/m ² or more	130 (21.9)

GDM = gestational diabetes mellitus; DFIU = dead fetus in utero; BMI = body mass index

Table 2. Chance of having GDM classified by number of risk factor exposed (n = 593)

Number of risk factor	Chance of having GDM, n (%)
0 (n = 280)	12 (4.3)
1 (n = 215)	18 (8.4)
2 (n = 77)	16 (20.8)
3 (n = 21)	9 (42.9)

Discussion

The present study found that the prevalence of GDM was 9.3%. After reviewing contemporary similar studies in Thailand, this prevalence is higher than others, which reported from 1.5 to 7.1%^(2,14,15). This is readily explained by different method of data collection, screening policy and diagnostic criteria. Most of these studies used selective screening policy and NDDG (National Diabetes Data Group) criteria to diagnose GDM. Alternatively, the present study used Carpenter and Coustan criteria. There are reports showing that Carpenter and Coustan criteria is more sensitive and increased GDM detection by 40 to 50%^(22,23). There are also studies probing that, GDM women by Carpenter and Coustan criteria but not by NDDG criteria still demonstrated higher complications e.g. operative deliveries, macrosomia, shoulder dystocia, neonatal hypoglycemia and hyperbilirubinemia^(22,24). Hence, benefit of treating mild GDM still outweighed risks⁽⁷⁾.

By comparing with the US study, which also used Carpenter and Coustan criteria, the incidence of 5.1% from the US study is still less than the present study⁽²²⁾. There is also a study from Malaysia reporting an incidence of 24.9% but with different diagnostic criteria⁽²⁵⁾. This may confirm that, the Asian population is not in the group with low prevalence of GDM.

The present study also showed that the famously used clinical risk factors of GDM screening could detect only 78.2% of GDM cases. By using risk-based screening scheme, there are 52.8% of pregnant woman who would be set to enter the screening

Table 3. Diagnostic parameters when using clinical risk factors as primary screening method

Number of risk	Sensitivity	Specificity	PPV	NPV	LR+	LR-
At least 1	78.2	49.8	13.7	95.7	1.6	0.4
At least 2	45.5	86.4	22.5	93.9	3.3	0.5
3 risk factors	16.4	97.8	42.9	92.0	7.3	0.8

process. However, with 95.7% NPV and 0.4 LR- made this set of risk factors merely a fair screening test. With 21.8% of GDM cases missed and the adverse effect of untreated GDM that is well known to be harmful to both mother and child, this may not be acceptable⁽²⁶⁾.

The present study conforms to other previous studies in one point that, there is more likelihood of having GDM when a woman has more numbers of risk factors^(15,16). However, by using more than one risk factor to define the need of GCT, this will just lower the sensitivity.

Recommendations of GDM screening have been varied widely, although ADA (American Diabetes Association) and ACOG (American College of Obstetrics and Gynecology) recommended selective screening with variety of risk factors. There was insufficient data to support that this policy is appropriate for the Thai population. Most of the hospitals in Thailand including Lampang Regional Hospital use selective screening, while there are increasing evidences that Thais as Asians are not in the ethnic group of low prevalence of type II diabetes or GDM⁽¹⁶⁻¹⁸⁾. It has to be admitted that by using selective screening, considerable amount of GDM cases would be missed. This is because of the low sensitivity of the risk factors and from the incomppliance to the guideline. There are findings from both Siriraj Hospital and Maharaj Nakorn Chiang Mai Hospital confirming this^(2,21).

With relatively high prevalence of GDM in our population, universal screening at ≥ 24 weeks may be an appropriate policy. Woman at risk for pre-gestational impair glucose tolerance such as the one with history of GDM in previous gestation, BMI 30 kg/m² or more or strong family history of type 2 diabetes might be screened at their first visits. Cost-effectiveness is the only major concern for the deployment of the universal screening program. This has to be evaluated thoroughly in an evidence-based manner.

Conclusion

With GDM prevalence of 9.3%, Thai population should be classified to the high prevalence group. Among GDM cases, 21.8% had no risk factor. This should prompt the re-evaluation of risk-based screening policy that is generally adopted throughout the country. By using such risk-based screening scheme, only 52.8% of pregnant woman would be set to enter screening process. However, with 95.7% NPV and 0.4 LR-, this would make this set of risk factors

merely a fair screening test. Moreover, 21.8% of GDM cases might be missed and the adverse effect of untreated GDM, which is well known, is harmful to both mother and child. Therefore, this may not be acceptable. Cost-effectiveness is the only major concern for the deployment of the universal screening program. It has to be further studied in an evidence-based manner.

Potential conflicts of interest

None.

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การตรวจคัดกรองเบาหวานจากการตั้งครรภ์แบบทุกราย: ความชุกและคุณค่าของปัจจัยเสี่ยงทางคลินิกที่ใช้ที่คลินิกฝากครรภ์โรงพยาบาลลำปาง

คารินทร์ อโรรา, รยีน อโรรา, ศิริวรรณ แสงทอง, วันเพ็ญ ลีลาพร, จุฬารณม์ แสงรัตนธงชัย

วัตถุประสงค์: เพื่อศึกษาความชุกของการตรวจคัดกรองเบาหวานจากการตั้งครรภ์โดยตรวจทุกราย และเพื่อหาคุณค่าของชุดปัจจัยเสี่ยงทางคลินิกที่ใช้ที่คลินิกฝากครรภ์ โรงพยาบาลลำปาง

วัสดุและวิธีการ: เป็นการศึกษาแบบตัดขวางเก็บข้อมูลแบบเดินหน้าที่คลินิกฝากครรภ์ โรงพยาบาลศูนย์ลำปาง ตั้งแต่วันที่ 4 มกราคม ถึง 30 กันยายน พ.ศ. 2553 สตรีตั้งครรภ์ทุกรายได้รับการตรวจคัดกรองเบาหวานตามอายุครรภ์ที่เหมาะสมด้วย *glucose challenge test (GCT)* หากผลผิดปกติให้ตรวจต่อด้วย *oral glucose tolerance test (OGTT)*

ผลการศึกษา: มีสตรีตั้งครรภ์ที่เข้าร่วมในการศึกษาคั้งนี้ 613 ราย มี 593 ราย เหลือในการวิเคราะห์พบความชุกของเบาหวานจากการตั้งครรภ์ร้อยละ 9.3 โดยร้อยละ 21.8 ไม่มีความเสี่ยง สตรีที่มี 1 ความเสี่ยงพบมีโอกาสเป็นเบาหวานเพิ่มขึ้นเท่าตัว ขณะที่สตรีที่มี 3 ความเสี่ยงมีโอกาเป็นเบาหวานถึงร้อยละ 42.9 การมีอย่างน้อย 1 ความเสี่ยง มีความสามารถในการพยากรณ์เบาหวานด้วย *sensitivity* ร้อยละ 78.2 *specificity* ร้อยละ 49.8 *PPV* ร้อยละ 13.7 *NPV* ร้อยละ 95.7 *LR+* 1.6 และ *LR-* 0.4 และทำให้ต้องมีสตรีที่จะต้องถูกคัดกรองร้อยละ 52.8

สรุป: ด้วยความชุกของเบาหวานจากการตั้งครรภ์ ร้อยละ 9.3 สตรีฝากครรภ์ที่โรงพยาบาลลำปาง สมควรถูกจัดให้เป็นกลุ่มเสี่ยงสูงในการเป็นเบาหวานจากการตั้งครรภ์ ในบรรดาสตรีตั้งครรภ์ที่เป็นเบาหวาน ร้อยละ 21.8 ไม่มีความเสี่ยงใดๆ ด้วย *NPV* ร้อยละ 95.7 และ *LR-* 0.4 ชุดความเสี่ยงดังกล่าวมีประสิทธิภาพในการคัดกรองเพียงเล็กน้อย ดังนั้นจึงควรมีการพิจารณานโยบายการคัดกรองเบาหวานจากการตั้งครรภ์ด้วยชุดความเสี่ยงที่เป็นที่นิยมกันทั่วประเทศเสียใหม่ อย่างไรก็ตามเรื่องความคุ้มค่าเป็นปัจจัยหลักในการตัดสินใจใช้การคัดกรองแบบตรวจทุกราย โดยควรมีการศึกษาแบบหลักฐานเชิงประจักษ์สนับสนุนมากกว่านี้
