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Prevalence of False Positive 50-g Glucose Challenge Test in Risk-based Screening Before 20 Weeks of Gestation and Relationship with Adverse Pregnancy Outcomes

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ABSTRACT

Objectives: To determine the prevalence of false positive results of 50-g glucose challenge test (GCT) in risk-based screening before 20 weeks of gestation and relationship with pregnancy outcomes.

Materials and Methods: A total of 500 singleton pregnancy who were at risk for gestational diabetes mellitus (GDM) and received 50-g GCT for GDM screening before 20 weeks of gestation were included. Women with abnormal 50-g GCT received 100-g OGTT for GDM diagnosis. Prevalence of false positive results of 50-g GCT and GDM were estimated. Various baseline characteristics and pregnancy outcomes were compared between groups.

Results: Mean age was 33.4 ± 4.9 years, mean Body mass index (BMI) was 22.9 ± 4.4 kg/m^2, and 45.6% were nulliparous. Common GDM risks were age ≥ 30 years (81.6%), family history of diabetes mellitus (DM) (30.4%), and overweight/obesity (24.6%). Mean gestational age at GDM screening was 9.8 ± 3.9 weeks. Normal 50-g GCT was found in 243 women (48.6%), 187 women (37.4%) had false positive GCT, and 70 women (14%) had GDM. Women with GDM had significantly higher age, BMI, and more likely to be overweight or obese than others ($p < 0.05$). Gestational weight gain was comparable between normal and false positive GCT but it was significantly greater than GDM ($p < 0.001$). A significant trend of increasing in the rate of large for gestational age (LGA) was observed in normal GCT, false positive GCT, and GDM group (14.4%, 21.9%, and 25.7%, respectively, $p = 0.013$). Logistic regression analysis showed that false-positive GCT and GDM independently increased the risk of LGA (adjusted odds ratio 1.76, 95% confidence interval 1.05-2.94, and 2.15, 95% confidence interval 1.1-4.23).

Conclusion: Prevalence of false positive GCT was 37.4%. False-positive GCT and GDM independently increased risk of LGA.

Keywords: false positive, gestational diabetes, glucose challenge test, large for gestational age.

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ความชุกของการเกิดผลบวกลวงจากการตรวจคัดกรองเบาหวานระหว่างตั้งครรภ์และความสัมพันธ์กับผลลัพธ์ที่ไม่ดีของการตั้งครรภ์

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บทคัดย่อ

วัตถุประสงค์: *เพื่อศึกษาความชุกของผลบวกลวงจากการตรวจคัดกรองภาวะเบาหวานระหว่างตั้งครรภ์ในสตรีที่มีความเสี่ยง ด้วยวิธี 50-g glucose challenge test (GCT) ก่อนอายุครรภ์ 20 สัปดาห์ และความสัมพันธ์กับผลลัพธ์ที่ไม่ดีของการตั้งครรภ์*

วัสดุและวิธีการ: *ทำการศึกษาในสตรีตั้งครรภ์เดี่ยว จำนวน 500 คน ที่มีความเสี่ยงในการเกิดภาวะเบาหวานระหว่างตั้งครรภ์ และได้รับการตรวจคัดกรองด้วยวิธี 50-g GCT ก่อนอายุครรภ์ 20 สัปดาห์ หากผลการตรวจคัดกรองผิดปกติจะได้รับการตรวจวินิจฉัยภาวะเบาหวานด้วยวิธี 100-g oral glucose tolerance test (OGTT) ทำการวิเคราะห์หาความชุกของผลบวกลวงจากการตรวจคัดกรองภาวะเบาหวาน และความชุกของภาวะเบาหวานระหว่างตั้งครรภ์ ทำการเปรียบเทียบข้อมูลต่างๆ และผลลัพธ์ของการตั้งครรภ์ระหว่างกลุ่มที่ผลการตรวจคัดกรองปกติ กลุ่มที่เกิดผลบวกลวงจากการตรวจคัดกรอง และกลุ่มที่ได้รับการวินิจฉัยภาวะเบาหวานระหว่างตั้งครรภ์*

ผลการศึกษา: *อายุเฉลี่ยของสตรีตั้งครรภ์เท่ากับ 33.4 ± 4.9 ปี ค่าเฉลี่ยดัชนีมวลกายเท่ากับ 22.9 ± 4.4 กิโลกรัม/ตารางเมตร ร้อยละ 45.6 เป็นการตั้งครรภ์แรก ปัจจัยเสี่ยงต่อภาวะเบาหวานระหว่างตั้งครรภ์ที่พบบ่อยได้แก่ อายุ 30 ปีขึ้นไป (ร้อยละ 81.6), มีประวัติโรคเบาหวานในครอบครัว (ร้อยละ 30.4), น้ำหนักเกินหรือมีภาวะอ้วน (ร้อยละ 24.6) อายุครรภ์เฉลี่ยที่ได้รับการตรวจคัดกรองคือ 9.8 ± 3.9 สัปดาห์ พบว่าการตรวจคัดกรองได้ผลปกติ 243 ราย (ร้อยละ 48.6) ผลบวกลวง 187 ราย (ร้อยละ 37.4) และ 70 ราย (ร้อยละ 14) ได้รับการวินิจฉัยว่ามีภาวะเบาหวานระหว่างตั้งครรภ์ พบว่าหญิงตั้งครรภ์ที่มีภาวะเบาหวานระหว่างตั้งครรภ์จะมีอายุ ดัชนีมวลกาย และมีภาวะน้ำหนักเกินหรืออ้วน สูงกว่ากลุ่มอื่นอย่างมีนัยสำคัญ ($p < 0.05$) กลุ่มที่ผลการตรวจคัดกรองปกติและกลุ่มที่ตรวจพบผลบวกลวงมีน้ำหนักที่เพิ่มขึ้นระหว่างตั้งครรภ์สูงกว่ากลุ่มที่มีภาวะเบาหวานระหว่างตั้งครรภ์อย่างมีนัยสำคัญ ($p < 0.001$) พบอัตราการเกิดทารกน้ำหนักเกินเกณฑ์ มีแนวโน้มสูงขึ้นอย่างมีนัยสำคัญ ในกลุ่มที่ผลการตรวจคัดกรองปกติ กลุ่มผลบวกลวง และกลุ่มที่มีภาวะเบาหวานระหว่างตั้งครรภ์ (ร้อยละ 14.4, 21.9, 25.7, ตามลำดับ, $p = 0.013$) จากการวิเคราะห์แบบ logistic regression analysis พบว่ากลุ่มผลบวกลวงและกลุ่มที่มีภาวะเบาหวาน เพิ่มความเสี่ยงต่อการเกิดทารกน้ำหนักเกินเกณฑ์อย่างมีนัยสำคัญ (adjusted odds ratio 1.76, 95% confidence interval 1.05-2.94, และ 2.15, 95% confidence interval 1.1-4.23 ตามลำดับ)*

สรุป: *ความชุกของผลบวกลวงจากการตรวจคัดกรองภาวะเบาหวานระหว่างตั้งครรภ์เท่ากับร้อยละ 37.4 โดยกลุ่มผลบวกลวงและกลุ่มที่มีภาวะเบาหวานระหว่างตั้งครรภ์ เพิ่มความเสี่ยงต่อการเกิดทารกน้ำหนักเกินเกณฑ์อย่างมีนัยสำคัญ*

คำสำคัญ: *ผลบวกลวง, ภาวะเบาหวานระหว่างตั้งครรภ์, 50-g glucose challenge test, ทารกน้ำหนักเกินเกณฑ์*

Introduction

Gestational diabetes mellitus (GDM), defined as carbohydrate intolerance that is first recognized during pregnancy, is one of the most common medical complications of pregnancy. GDM increases the risk of various maternal and neonatal complications, including preeclampsia, macrosomia, operative delivery, shoulder dystocia, and birth trauma, and also increases the risk of the baby developing diabetes later in life[1, 2].

Although there is still no global consensus regarding GDM screening and diagnostic strategy, a 2-step approach is currently recommended[1, 2]. A 50-g glucose challenge test (GCT) is used as a screening test, and individuals meeting or exceeding the screening threshold then undergo a 100-g oral glucose tolerance test (OGTT) for GDM diagnosis. Screening is generally performed at 24-28 weeks of gestation, but early screening is suggested in high-risk women. Repeat screening is recommended at 24-28 weeks of gestation if the result of early testing is negative.

Women with abnormal GCT but normal OGTT (false-positive GCT) can be considered as an early form of glucose intolerance that similar adverse outcomes to GDM could develop. Current standard of care is to treat only those who are diagnosed with GDM. However, there is growing evidence to suggest that mild maternal hyperglycemia in the absence of GDM is associated with adverse perinatal outcome. Previous studies have reported that women with false positive GCT were at increased risk of various adverse pregnancy outcomes, including large for gestational age (LGA), macrosomia, shoulder dystocia, cesarean delivery[3-7], but conflicting results have also been reported[8-10].

Although a clinical practice guideline for GDM has been developed and implemented in our institution since 2000, the information on pregnant women with false positive GCT are limited. Therefore, the primary objective of this study was to determine the prevalence of false positive GCT results in risk-based screening before 20 weeks of gestation. The secondary objectives were to evaluate associations between different 50-g GCT results and various characteristics and adverse pregnancy outcomes. Understanding the characteristics of this specific group of women and its association with adverse pregnancy outcomes will help in care improvement as well as developing appropriate strategies to prevent possible associated adverse outcomes.

Materials and Methods

After approval from Siriraj Institutional Review Board, this cross-sectional study was conducted at the Department of Obstetrics and Gynaecology, Siriraj Hospital, which is Thailand's largest tertiary care university hospital. According to the institutional clinical practice guideline[11], GDM screening and diagnosis is offered to all at-risk women. Risk factors for GDM include age ≥ 30 years, pre-pregnancy body mass index (BMI) ≥ 25 kg/m^2, family history of diabetes, presence of hypertension, previous GDM, and history of fetal macrosomia, stillbirth, or fetal anomaly. A 50-g GCT with a cut-off value of ≥ 140mg/dL is used for GDM screening. For patients who meet or exceed the cut-off, a 100-g OGTT is used to diagnose the GDM using the criteria of Carpenter and Coustan. These procedures are offered during the patient's first visit, and they are then repeated at 24-28 weeks of gestation if the first screening result was normal. Sample size was estimated from an estimated prevalence of false positive GCT of 20%. At 95% significance level and 4% allowable error, at least 462 cases were required including 20% loss.

This was a cross-sectional study to

determine the prevalence of false positive GCT results in risk-based screening before 20 weeks of gestation. Data were collected retrospectively from medical record review of 500 at-risk women who started antenatal care before 20 weeks of gestation according to the described screening and diagnostic procedures were included by simple random sampling of women attended antenatal care clinic during January to June 2017. Women with pre-gestational diabetes, multifetal pregnancy, fetal anomaly, intrauterine fetal death, or did not received GDM screening according to institutional guideline were excluded. Women who were diagnosed with GDM from repeat testing were also not included. Data were obtained from medical records, including baseline clinical characteristics, obstetrics data, GDM risk factors, results of 50-g GCT and 100-g OGTT, delivery data, and pregnancy outcomes. Pre-pregnancy BMI status and gestational weight gain (GWG) were categorized according to Institute of Medicine (IOM) recommendation[12]. As part of routine services, all at-risk women received counseling regarding dietary and lifestyle modification during their antenatal care by attending nurses. Further intensive counseling was provided if the women were diagnosed with GDM.

Data on pregnancy outcomes related to GDM included gestational age at delivery, route of delivery, complications during pregnancy, birth weight, and birth asphyxia. Infant birth weight was categorized according to gestational age to LGA and small for gestational age (SGA) if birth weight was ≥ 90^{th} or < 10^{th} percentile for normal newborns, according to standard reference data. Macrosomia was defined as infant birth weight ≥ 4,000 g.

Pregnant women were categorized according to 50-g GCT and 100-g OGTT results in to normal GCT, false positive GCT, and GDM groups. Prevalence of false positive GCT and GDM were estimated. Characteristics and pregnancy outcomes were compared among the 3 groups to evaluate their relationship with different 50-g GCT results.

All data analyses were performed using SPSS Statistics version 21 (SPSS, Inc., Chicago, IL, USA). Data were presented as number and percentage for categorical variables, and mean and standard deviation for continuous variables. Analysis of variance (ANOVA) with Bonferroni post hoc test and chi square test were used to compare variables between groups as appropriate. Logistic regression analysis was used to evaluate independent association between GCT results and adverse outcomes. A p value of < 0.05 was considered to be statistically significant.

Results

A total of 500 women who underwent 50-g GCT for GDM screening before 20 weeks of pregnancy were included. All received GDM screening according to institutional guideline. Table 1 shows baseline characteristics of the women. Mean age was 32.4 years and 45.6% were nulliparous. While majority of the women have BMI in normal range (62.8%), 17.4% and 7.2% were overweight and obese, respectively. Common GDM risks were age > 30 years (81.6%), family history of DM (30.4%), and BMI ≥ 25 kg/m^2 (24.6%). Majority of the women had only 1 risk (64.6%) while 6.6% had at least 3 risks.

GDM screening characteristics and results are shown in Table 2. Mean gestational age (GA) at screening was 9.8 weeks and mean 50-g GCT was 144.2 mg/dL. Of 500 women screened, 48.6% had normal 50-g GCT and GDM was diagnosed by 100-g OGTT in 14%. False positive 50-g GCT, i.e., positive 50-g GCT with normal 100-g OGTT, was found in 37.4%. Among 70 GDM cases, insulin was required in 8 women (11.4%).

Table 1. Baseline characteristics of pregnant women (N = 500).

Characteristics	Mean ± SD
Mean age ± SD (years)	32.4 ± 4.9
Mean pre-pregnancy BMI ± SD (kg/m^2)	22.9 ± 4.4
	N (%)
Nulliparous	228 (45.6%)
Pre-pregnancy BMI category	
Underweight	63 (12.6%)
Normal weight	314 (62.8%)
Overweight	87 (17.4%)
Obesity	36 (7.2%)
GDM risks	
Age ≥ 30 years	408 (81.6%)
Family history of diabetes	152 (30.4%)
Pre-pregnancy BMI ≥ 25 kg/m^2	123 (24.6%)
Previous GDM	11 (2.2%)
Previous macrosomia	2 (0.4%)
Previous stillbirth	8 (1.6%)
Previous fetal anomaly	4 (0.8%)
Hypertension	8 (1.6%)
Number of GDM risks	
1 risk	323 (64.6%)
2 risks	144 (28.8%)
≥ 3 risks	33 (6.6%)

SD: standard deviation, BMI: body mass index, GDM: gestational diabetes mellitus

Table 2. GDM screening characteristics and results (N = 500).

Characteristics	Mean ± SD
Mean GA at GDM screening ± SD (weeks)	9.8 ± 3.9
Mean 50-g GCT ± SD (mg/dL)	144.2 ± 35.3
	N (%)
GDM screening results	
Normal 50-g GCT	243 (48.6%)
False positive (normal 100-g OGTT)	187 (37.4%)
GDM	70 (14%)
Insulin requirement (N = 70)	8 (11.4%)

GDM: gestational diabetes mellitus, GA: gestational age, SD: standard deviation, GCT: glucose challenge test, OGTT: oral glucose tolerance test

Table 3 shows comparison of maternal characteristics between different 50-g GCT results. Women in false positive GCT and GDM groups were significantly older than normal GCT group. GDM women were significantly more likely to have ≥ 3 GDM risks compared to the other 2 groups (p = 0.002). Women with GDM had significantly higher BMI than the other 2 groups and they were significantly more likely to be overweight and obese. However, compared to those with normal GCT, false positive GCT and GDM groups had significantly lower gestational weight gain (14.5 vs. 13.3 vs. 11.6 kg, respectively, p < 0.001). GDM women were significantly more likely to gain weight less than recommendation (34.3%) while women with normal GCT were significantly more likely to gain weight greater than recommendation (39.1%) (p = 0.03).

Table 3. Comparison of maternal characteristics between different GDM screening results.

Characteristics	Normal GCT N = 243	False positive GCT N = 187	GDM N = 70	p value[a]
Mean age ± SD (years)	31.6 ± 5.1[c]	33.4 ± 4.5	32.6 ± 5.3	0.001[b]
Mean pre-pregnancy BMI ± SD (kg/m^2)	22.5 ± 4.5	22.8 ± 4.3	24.7 ± 4.4[d]	0.001[b]
Nulliparous (%)	124 (51.0%)	74 (39.6%)	30 (42.9%)	0.05
GDM risks				
Age ≥ 30 years	193 (79.4%)	163 (87.2%)	52 (74.3%)	0.02
Family history of diabetes	68 (28.0%)	60 (32.1%)	24 (34.3%)	0.49
Previous GDM	2 (0.8%)	3 (1.6%)	6 (8.6%)	< 0.001
Number of GDM risks				0.002
1 risk	173 (71.2%)	113 (60.4%)	37 (52.8%)	
2 risks	60 (24.7%)	62 (33.2%)	22 (31.4%)	
≥ 3 risks	10 (4.1%)	12 (6.4%	11 (15.7%)	
Pre-pregnancy BMI category				
Underweight	36 (14.8%)	24 (12.8%)	3 (4.3%)	
Normal weight	153 (63.0%)	121 (64.7%)	40 (57.1%)	
Overweight	40 (16.5%)	31 (16.6%)	16 (22.9%)	
Obesity	14 (5.8%)	11 (5.9%)	11 (15.7%)	
Mean GWG ± SD (kg)	14.5 ± 4.6	13.3 ± 4.7	11.6 ± 4.8	< 0.001[e]
GWG category				0.03
Less than recommendation	48 (19.8%)	52 (27.8%)	24 (34.3%)	
Adequate	100 (41.2%)	82 (43.9%)	27 (38.6%)	
Greater than recommendation	95 (39.1%)	53 (28.3%)	19 (27.1%)	

[a] Chi square test, b ANOVA, [c] Significantly lower than the other 2 groups, p = 0.001,
[d] Significantly higher than normal (p = 0.001) and false positive groups (p = 0.006).
[e] All groups were significantly different: normal vs. false positive, p = 0.034; normal vs. GDM, p < 0.001; false positive vs. GDM, p = 0.028, GDM: gestational diabetes mellitus, GCT: glucose challenge test, SD: standard deviation, BMI: body mass index, GWG: gestational weight gain

Table 4 shows comparison of pregnancy outcomes between different groups of 50-g GCT results. GA at delivery, route of delivery, birth weight, rate of pregnancy induced hypertension (PIH), SGA, birth asphyxia, and neonatal intensive care unit (NICU) admission were comparable between the 3 groups. A significant increasing trend was observed in the rate of LGA: 14.4% in normal GCT, 21.9% in false positive GCT, and 25.7% in GDM groups (p = 0.013). Significant increase in macrosomia in GDM women was also observed (p = 0.03). Neonatal hypoglycemia occurred in only among women with GDM in 32.8%.

Table 4. Comparison of pregnancy outcomes between different GDM screening results.

Characteristics	Normal GCT N = 243	False positive GCT N = 187	GDM N = 70	p value[a]
GA at delivery ± SD (weeks)	38.2 ± 1.4	38.3 ± 4.4	37.7 ± 1.8	0.33[b]
Birth weight ± SD (g)	3054.1 ± 445.5	3019.1 ± 498.2	3104.4 ± 526.8	0.42[b]
PIH	18 (7.4%)	10 (5.3%)	3 (4.3%)	0.52
Route of delivery				
Vaginal delivery	102 (42%)	83 (44.4%)	27 (38.6%)	0.59
Primary C/S	88 (36.2%)	65 (34.8%)	22 (31.4%)	
Repeat C/S	53 (21.8%)	39 (20.9%)	21 (30.0%)	
SGA	17 (7.0%)	23 (12.3%)	4 (5.7%)	0.09
LGA	35 (14.4%)	41 (21.9%)	18 (25.7%)	0.04[c]
Macrosomia	5 (2.1%)	0 (0.0%)	3 (4.3%)	0.03
Neonatal hypoglycemia	0 (0%)	0 (0%)	23 (32.8%)	< 0.001
Apgar < 7				
1 minute	12 (4.9%)	6 (3.2%)	5 (7.1%)	0.38
5 minute	1 (0.4%)	0 (0.0%)	1 (1.4%)	0.27
NICU admission	4 (1.6%)	4 (2.1%)	3 (4.3%)	0.41

[a] Chi square test, b ANOVA, [c] Chi square for trend = 6.22, p = 0.013

GDM: gestational diabetes mellitus, GCT: glucose challenge test, GA: gestational age, SD: standard deviation, PIH: pregnancy induced hypertension, C/S: cesarean section, SGA: small for gestational age, LGA large for gestational age, NICU: neonatal intensive care unit

Table 5 shows the results pf logistic regression analysis to determine independent associated factors for LGA. After adjusting for potential confounders, factors independently increased the risk of LGA were false positive GCT and GDM independently increased the risk of LGA (adjusted odds ratio (ORs) 1.76, 95% confidence interval (CI) 1.05-2.94, and 2.15, 95%CI 1.1-4.23). On the other hand, factors that significantly decreased the risk of LGA were pre-pregnancy underweight (adjusted ORs 0.35, 95%CI 0.13-0.92), and gestational weight gain less than recommendation (adjusted ORs 0.34, 95%CI 0.17-0.68).

Table 5. Logistic regression analysis to determine independent associated factors for LGA.

Characteristics	Adjusted OR	95% CI	p value
GDM screening results			
Normal GCT	1.0		
False-positive GCT	1.76	1.05-2.94	0.032
GDM	2.15	1.1-4.23	0.026
Pre-pregnancy BMI			
Normal	1.0		
Underweight	0.35	0.13-0.92	0.034
Overweight/obese	1.11	0.64-1.91	0.716
Gestational weight gain category			
Within recommendation	1.0		
Less than recommendation	0.34	0.17-0.68	0.002
Greater than recommendation	0.97	0.58-1.64	0.914

Adjusted for age, parity, and family history of DM.
LGA large for gestational age, ORs: odds ratio, GDM: gestational diabetes mellitus, GCT: glucose challenge test, BMI: body mass index, DM: diabetes mellitus.

Discussion

Some evidence suggested that mild maternal hyperglycemia in the absence of GDM could be associated with adverse perinatal outcomes, including LGA, macrosomia, shoulder dystocia, cesarean delivery[3-7]. A false positive GCT can be considered as an early form of glucose intolerance that adverse outcomes related to GDM could develop, as reported from previous studies, including LGA, macrosomia, shoulder dystocia, cesarean delivery[3-7].

The results of this study showed that prevalence of false positive GCT was 37.4%. This was relatively high compared to previous reported rate between 8.8% to 34.4%[4-7, 9, 10]. The differences might be from variations in screening and diagnostic protocols, including the cut off level of 50-g GCT[4, 5, 7, 10] and criteria for GDM diagnosis[5, 6, 10]. Similar to other studies, women with false positive GCT and GDM were more likely to be older and multiparous[3, 4, 6-8]. However, while some studies also reported higher pre-pregnancy BMI and GWG among women with false positive GCT[3, 4, 8], the results of this study showed that only women with GDM had significantly higher pre-pregnancy BMI than the other 2 groups.

Interestingly, in terms of GWG, significantly less weight gain was observed in both women with false positive GCT and GDM compared to those with normal GCT. Women with false positive GCT and GDM were more likely to gain weight less than recommendation. This is probably due to the effect of dietary counseling and weight gain monitoring among these groups of women. Currently, as a part of routine care, dietary counseling and weight gain control advice are given to women with false positive GCT in a more intensive fashion than those with normal GCT. In addition, these women might have some concerns and awareness regarding the abnormal results and the possibility of developing GDM and related pregnancy complications that they follow the dietary and weight gain control advice more strictly during their antenatal care.

Some previous studies demonstrated and increased in the risk of various adverse outcomes among women with false positive GCT, including LGA, macrosomia, shoulder dystocia, and cesarean delivery[4-7, 13]. On the other hand, indifferences in adverse pregnancy outcomes between normal and false positive GCT had also been reported from some studies[8-10]. Conflicting results were possibly partly

due to different in population characteristics, GDM risks, and thresholds used for the GCT and different diagnostic criteria for GDM[3-8, 10, 13].

In this study, while most of adverse pregnancy outcomes were comparable among the 3 groups, a significant increasing trend in LGA was observed with increasing degree of GCT abnormalities (14.4% in normal GCT, 21.9% in false positive GCT, and 25.7% in GDM group, p = 0.013). A previous study has reported an increase in adverse outcomes along with the greater degree of GCT abnormality, including preeclampsia, birth weight, LGA, cesarean delivery, and shoulder dystocia[6]. It should also be noted that the rate of LGA in women with normal GCT and false positive GCT were relatively higher than 10.5% reported among low-risk pregnant women from the same institution[14], which might reflects that this group of women are still at some risk for abnormal fetal growth. As there are different screening and diagnostic strategies for GDM, i.e., universal vs. selective screening and one-step vs. 2-step approach, there is still no consensus which is the most appropriate strategy. A recent Cochrane systematic review showed no clear evidence which strategy is best for diagnosing GDM[15]. Alternative to the current 2-step approach used in our institution, the use of The International Association of the Diabetes and Pregnancy Study Groups (IADPSG) strategy could possibly increase the diagnosis of GDM to some degree. Although there was a report that GDM diagnosed by IADPSG criteria might have more adverse pregnancy outcomes than women with normal glucose tolerance[16], the American College of Obstetricians and Gynecologists stated that the additional women in whom GDM would be diagnosed by IADPSG criteria may be at a lower risk of adverse outcomes than and may not derive similar benefits from diagnosis and treatment as women in whom GDM was diagnosed by traditional criteria[1]. However, the use of selective screening based on risk factors might miss some GDM women among those without any risk compared to universal screening strategy. Further studies are needed to verify if universal screening would provide additional benefits that is also cost-effective.

After adjusting for potential confounders, false positive GCT and GDM independently increased the risk of LGA (adjusted ORs 1.76, 95%CI 1.05-2.94, and 2.15, 95%CI 1.1-4.23). On the other hand, factors that significantly decreased the risk of LGA were pre-pregnancy underweight (adjusted ORs 0.35, 95%CI 0.13-0.92), and GWG less than recommendation (adjusted ORs 0.34, 95%CI 0.17-0.68). The results are in concordance with other studies that reported both pre-pregnancy BMI and GWG were important determinants of decreasing risk of LGA[14, 17-19].

Some limitations of this study need to be mentioned. As stated earlier, due to a wide variation in GDM screening, diagnostic protocol and criteria, in addition with possible differences in population characteristics related to GDM, generalization of the results of this study might be limited. Moreover, the actual effects of dietary counseling and advice about weight gain control during antenatal care that were routinely provided to all at-risk pregnant women could not be measured. There were also limited samples in subgroup analysis. Larger studies in specific subgroups is needed to validate the results.

In the application of the results into clinical practice, these at-risk women should be informed regarding the risk of GDM-related adverse outcomes, including LGA, even in the absence of GDM. Since GWG is modifiable, appropriate behavioral and dietary intervention for at-risk women, especially those with false positive GCT, could help in better weight gain control that could lower the risk of LGA. These women should be informed about this important issue and awareness of weight gain control should be raised. In addition, close monitoring of weight gain and fetal growth surveillance among these women should be encouraged among caring physicians.

Although no current recommendation for any intervention or treatment among women with false positive GCT, a previous study has demonstrated that the treatment of women with abnormal GCT results improved outcomes by reducing both birth weight and the cesarean deliveries[20]. Further studies with more widely generalizable are needed to elucidate the relationship between 50-g GCT and adverse outcomes

and also to investigate the benefits of specific intervention to prevent or minimize the risk of such adverse pregnancy outcomes.

Conclusion

In conclusion, prevalence of false positive GCT was 37.4% among women who were at-risk for GDM. A significant increasing trend in LGA was observed with increasing degree of GCT abnormalities. False positive GCT and GDM independently increased the risk of LGA, while pre-pregnancy underweight and GWG less than recommendation independently reduced the risk of LGA.

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Potential conflicts of interest

The authors declare no conflict of interest.

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