

## Prevalence and Adverse Pregnancy Outcomes of Gestational Diabetes Detected by Two Methods of Screening

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**Objective :** To compare the prevalence and pregnancy outcomes in women diagnosed with gestational diabetic mellitus (GDM) by Carperter-Coustan (CC) criteria (old criteria) and new gestational diabetes by the International Association of the Diabetes and Pregnancy Study Groups (IADPSG) criteria.

**Material and Method :** A retrospective study was carried out by reviewing medical record of 900 pregnant women from January 2012 to June 2013 using CC criteria and in 900 pregnant women from January 2015 to December 2015 using IADPSG criteria between 24-28 weeks gestation. Both groups were similar in therapy and follow up protocol.

**Results :** IADPSG criteria increased the prevalence of gestational diabetic mellitus diagnosed to 15.3 % compared with 11.3 % by CC criteria. Adopting IADPSG criteria was associated with higher rate of cesarean section (P 0.01), reduce birth weight (P 0.027) and increase asymptomatic neonatal hypoglycemia. No significant pregnancy outcomes between diabetes pregnant in both groups.

**Conclusions :** The adaptation of the IDAPSG criteria for diagnosis GDM would increase but not associated with improve pregnancy outcomes.

**Keywords :** gestational diabetes mellitus, 50 gram glucose challenge test, 75 gram glucose tolerance test  
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## การศึกษาความชุกและผลลัพธ์ของการตั้งครรภ์โดยการตรวจคัดกรองโรคเบาหวานระหว่างการตั้งครรภ์ด้วยวิธีการ 2 วิธี

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**วัตถุประสงค์ :** เพื่อศึกษาเปรียบเทียบความชุกและผลลัพธ์ของการตั้งครรภ์ในหญิงตั้งครรภ์ที่เป็นโรคเบาหวานระหว่างการตั้งครรภ์ โดยใช้วิธี Carperter-Coustan (วิธีเก่า) และวิธีใหม่โดยใช้ International Association of the Diabetes and Pregnancy Study Groups (IADPSG)

**วัสดุและวิธีการ :** ผู้วิจัยทำการศึกษาย้อนหลังดำเนินการโดยทบทวนเวชระเบียน ในหญิงตั้งครรภ์ 900 คน ตั้งแต่เดือนมกราคม 2555 ถึงเดือนมิถุนายน 2556 โดยใช้วิธี Carperter-Coustan และในหญิงตั้งครรภ์ 900 คน ตั้งแต่เดือนมกราคม 2558 ถึงเดือนธันวาคม 2558 โดยใช้วิธี IADPSG โดยคัดกรองระหว่างอายุครรภ์ 24-28 สัปดาห์ การดูแลรักษาเบาหวานระหว่างตั้งครรภ์และการติดตามรักษาทั้งสองกลุ่มไม่มีความแตกต่างกัน

**ผลการวิจัย :** วิธี IADPSG พบความชุกของเบาหวานระหว่างการตั้งครรภ์ ร้อยละ 15.3 สูงกว่าเมื่อเปรียบเทียบกับวิธี Carperter-Coustan พบความชุกเพียงร้อยละ 11.3 วิธี IADPSG สัมพันธ์กับการเพิ่มขึ้นของอัตราการผ่าตัดคลอดบุตร (P 0.01) น้ำหนัก

ทารกแรกเกิดลดลง (P 0.027) และภาวะน้ำตาลในเลือดต่ำของทารกแรกเกิดโดยไม่มีการเพิ่มขึ้น เมื่อเปรียบเทียบระหว่างหญิงตั้งครรภ์ที่เป็นโรคเบาหวานระหว่างการตั้งครรภ์ใน 2 วิธี พบว่าผลลัพธ์ของการตั้งครรภ์ไม่มีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติ

**สรุป :** วิธี IADPSG พบความชุกของเบาหวานระหว่างการตั้งครรภ์เพิ่มขึ้น แต่ผลลัพธ์ของการตั้งครรภ์ในหญิงตั้งครรภ์ที่เป็นโรคเบาหวานระหว่างการตั้งครรภ์ไม่เปลี่ยนแปลง

## Introduction

Gestational diabetes mellitus (GDM) is an importance women health problem, it increases risk of maternal and fetal complication<sup>(1-2)</sup>. The prevalence of GDM varies according to regions, age, body mass index, and by screening and diagnostic criteria. GDM increases risk of birth injury in vaginal delivery and cesarean delivery about 6-7 %<sup>(3)</sup>. The prevalence of GDM at Bhumibol Adulyadej Hospital reported in 2004 was 2.6 %<sup>(4)</sup>. Before July 2012, Carpenter-Coustan (CC) criteria for screening GDM had been used at this hospital, and used two-step 50 g. glucose challenge test, cut-off level 140 mg/dl, followed by 100-g 3-h oral glucose tolerance test (OGTT). Starting in July 2012, method of screening has been changed to one-step 75-g 2-h OGTT and used the International Association of the Diabetes and Pregnancy Study Groups (IADPSG) criteria for diagnosis of GDM<sup>(5)</sup> in pregnant women high risk of GDM. IADPSG criteria have been adopted by several hospitals and there have been studies reported from several countries. Most of the reported revealed increase the prevalence of GDM, and in some studies showed an improvement of pregnancy outcomes. There were retrospective studies showed that using IADPSG criteria prevalence of GDM ranged from 12.4-35.5 % compared with 2.59 % - 10.6 % by CC criteria and lower rate of the primary cesarean delivery and decreased fetal macrosomia, large-for-gestational age and other poor neonatal outcomes<sup>(6-9)</sup>.

The aim of this study was to compare the prevalence of GDM diagnosed by using IADPSG criteria with 2-step 75 g. OGTT and the effect to adverse pregnancy outcomes.

## Material and method

The patients of this retrospective analytic study were pregnant women attending antenatal care and delivered at Bhumibol Adulyadej Hospital, who met criteria for GDM screening and were diagnosed of GDM. 900 GDM patients diagnosed by two- step, using CC criteria were randomized during January 2012 to June 2013. Another group of 900 patients diagnosed by one-step using IADPSG criteria were randomized during January to December 2015. The inclusion criteria were 1) singleton fetus 2) delivered at 24 0/7 weeks of gestation or greater. Women with pregestational diabetes or with fasting plasma glucose (FBS) of 126 mg/dl or greater or with random plasma glucose of 200 mg/dl or greater at the first prenatal visit were excluded. The study was approved by Ethics Committee of Bhumibol Adulyadej Hospital.

Institutional guidelines for women diagnosed with GDM did not change throughout the course of the study: women with GDM were measured for FBS and 2-hr postprandial plasma glucose, and diet control treatment was provided until delivery. Insulin therapy was initiated if dietary manipulation was failed.



Study data were obtained from the hospital computerized obstetrics database. Data collected included pregnant women basic and clinical characteristics, route of delivery, maternal and neonatal complications and outcomes. The prevalence of both groups were identified, the patients characteristics and pregnancy outcome were compared.

### Statistical analysis

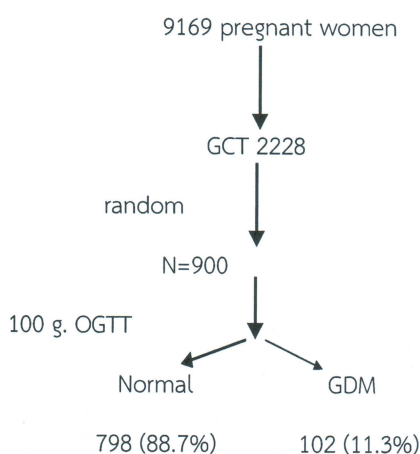
Primary outcome was prevalence of GDM diagnosed by using IADPSG criteria with by 2-step 75 g. OGTT. The secondary outcomes were adverse pregnancy outcomes including maternal outcomes

and neonatal outcomes. Statistical analyses were performed using SPSS 17.0. Continuous variables are expressed as mean. Categorical data are expressed as number and percentage. Mann-Whitney U test used to compare continuous variables between two independent groups. Categorical variables were compared using the Chi-square test or Fisher's exact test. A P value < 0.05 was considered significant.

### Results

The prevalence of GDM by CC criteria was 11.3 % (102 of 900) and by IADPSG was 15.3 % (138 of 900) (Fig.1).

Jan 2012 – June 2013 (CC criteria =2-step)



Jan 2015 – Dec 2015 (IADPSG criteria =1step)

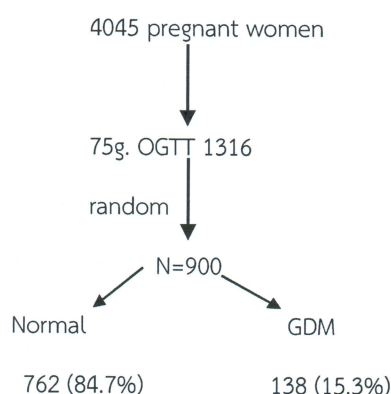


Fig. 1. Flow chart

Table 1 showed maternal characteristics of both groups. Pre pregnancy BMI was higher in 1 step group (P = 0.010) and nulliparous was found higher in 1 step group (P = 0.023). No significant difference in maternal age, total weight gain, previous pregnancy complications, chronic hypertension, family history of DM, hyperthyroid and hypothyroid. Route of delivery was significantly difference. In pregnant women 1 step group, delivery by cesarean section higher than 2 steps

group (P = 0.004). There were no significant in between group in the rate of gestational age at delivery, pregnancy induced hypertension, vaginal tear, length of hospital stays and insulin treatment, as shown in Table 2

In Table 3 shows neonatal outcomes of the populations. Birth weight was significant lower in 1 step group (P = 0.027) and asymptomatic hypoglycemia was significantly difference higher in 1 step group (P = 0.002). No differences in LGA and SGA, Apgar scores, RDS, NICU admission and fetal death.

Maternal outcomes were compared, and found no significant difference between groups in the rate of gestational age at delivery, route of delivery, pregnancy induced hypertension, vaginal tear, length of hospital stay and insulin treatment (Table 4).

Neonatal outcomes compared, found no significant difference in birth weight, LGA, SGA, birth injury, Apgar score, respiratory distress, hypoglycemia, hyperbilirubinemia, NICU admission fetal death and neonatal death (Table 5).

**Table 1 Maternal characteristics between CC criteria and IADPSG criteria.**

Characteristics	2 Steps (N = 900) n (%)	1 Step (N = 900) n (%)	P - Value
Maternal age, year			
<25	154 (17.1)	159 (17.7)	0.789
25-29	186 (20.7)	176 (19.6)	
30-34	311 (34.5)	300 (33.3)	
≥35	249 (27.7)	265 (29.4)	
Pre-pregnancy BMI (kg/m <sup>2</sup> )			
<18	93 (10.3)	159 (17.7)	0.010
18 - 22.9	488 (54.2)	176 (19.6)	
23 - 26.9	198 (22)	300 (33.3)	
≥27	121 (13.5)	265 (29.4)	
Total weight gain (kg, means)	14.1±5.4	14.2±5.5	0.865
Parity			
Nulliparous	323 (35.9)	370 (41.1)	0.023
Multiparous	577 (64.1)	530 (58.9)	
Previous pregnancy complication			
Prior fetal death	20 (2.2)	8 (0.9)	0.065
Prior fetal macrosomia	11 (1.2)	18 (2.0)	
Prior gestational diabetic mellitus	4 (0.4)	6 (0.7)	
Hypertension	14 (1.6)	19 (2.1)	0.380
Family history of diabetic mellitus	246 (27.3)	217 (24.1)	0.118
Hypothyroid	5 (0.6)	9 (1.0)	0.283
Hyperthyroid	4 (0.4)	6 (0.7)	0.526



Table 2 Maternal outcomes between CC criteria and IADPSG criteria.

	2 Steps				1 Step				P:CC cohort VS IADPSG cohort
	All (N=900) n (%)	DM (N=102) n (%)	Non DM (N=798) n (%)	P-value (N=900) n (%)	All (N=138) n (%)	DM (N=762) n (%)	Non DM n (%)	P- value	
Gestational age at delivery (weeks)									
<34	6 (0.7)	2 (2.0)	4 (0.5)	0.139	8 (0.9)	1 (0.7)	7 (0.9)	0.114	0.848
34-36+6	59 (6.6)	9 (8.8)	50 (6.3)		61 (6.8)	15 (0.9)	46 (6.0)		
≥37	835 (92.8)	91 (89.2)	744 (93.2)		831 (92.5)	122 (88.4)	709 (93.0)		
Route of delivery									
Normal delivery	407 (45.2)	35 (34.3)	372 (46.6)	0.069	371 (41.2)	42 (30.5)	329 (43.2)	0.038	0.004
Vacuum extraction	45 (5.0)	4 (3.9)	41 (5.1)		27 (3.0)	6 (4.3)	21 (2.8)		
Forceps extraction	4 (0.4)	1 (1.0)	3 (0.4)		1 (0.1)	0 (0)	1 (0.1)		
Cesarean section	444 (49.4)	62 (60.8)	382 (47.9)		501 (55.7)	90 (65.2)	411 (53.9)		
Postpartum hemorrhage	18 (2.0)	17 (2.1)	1 (1.0)	0.376	24 (2.7)	5 (3.6)	19 (2.5)	0.302	0.349
Pregnancy induce hypertension									
Severe PIH	13 (1.4)	4 (3.9)	9 (1.1)	0.138	18 (2.0)	3 (2.2)	15 (2.0)	0.003	0.574
Non severe PIH	21 (2.3)	3 (2.9)	18 (2.3)		15 (1.7)	7 (5.1)	8 (1.0)		
Eclampsia	1 (0.1)	0 (0)	1 (0.1)		0 (0)	0 (0)	0 (0)		
Gestational hypertension	20 (2.2)	4 (3.9)	16 (0.2)		22 (2.4)	6 (4.3)	16 (2.1)		
Infection	12 (1.3)	2 (2.0)	10 (1.3)	0.402	17 (1.9)	6 (4.3)	11 (1.4)	0.034	0.349
Vaginal tear (3 <sup>rd</sup> -4 <sup>th</sup> degree)	4 (0.4)	0 (0)	4 (0.5)	0.618	4 (0.4)	1 (0.7)	3 (0.4)	0.487	0.637
Length of stay (days, mean±SD)	3.5 ± 2.4	3.9 ± 1.8	3.5 ± 2.4	0.011	3.4 ± 2.5	4.0 ± 5.1	3.3 ± 1.6	0.008	0.180
Insulin treatment	13 (1.4)	13 (12.7)	0 (0)	0.000	20 (2.2)	19 (13.8)	0 (0)	0.000	0.219

Table 3 Neonatal outcomes between CC criteria and IADPSG criteria.

	2 Steps				1 Step				P:CC cohort VS IADPSG cohort
	All (N=900) n (%)	DM (N=102) n (%)	Non DM (N=798) n (%)	P-value (N=900) n (%)	All (N=138) n (%)	DM (N=762) n (%)	Non DM n (%)	P- value	
Birth weight (grams, mean±SD)	3164.6 ± 463.3	3293.6 ± 624.1	3148.1 ± 436.3	0.004	3116.3 ± 438.9	3222.4 ± 428.5	3097.1 ± 438.3	0.005	0.027
Large for gestational age	177 (19.7)	28 (27.5)	149 (18.7)	0.027	169 (18.8)	46 (33.3)	123 (16.1)	0.000	0.632
Small for gestational age	22 (2.4)	4 (3.9)	18 (2.3)	0.232	20 (2.2)	1 (0.7)	19 (2.5)	0.162	0.755
Birth injury	3 (0.3)	1 (1.0)	2 (0.3)	0.303	4 (0.4)	2 (1.4)	2 (0.3)	0.113	0.500
APGAR score									
1 min <7	17 (1.9)	1 (1.0)	16 (2.0)	0.408	18 (2.0)	5 (3.6)	13 (1.7)	0.127	0.864
5 min <7	0 (0)	0 (0)	3 (0.4)	0.697	1 (0.1)	0 (0)	2 (0.3)	0.717	0.688
Respiratory distress syndrome	27 (3.0)	8 (7.8)	19 (2.4)	0.007	33 (3.7)	5 (3.6)	28 (3.7)	0.605	0.431
Neonatal hypoglycemia	98 (10.9)	45 (44.1)	53 (6.6)	0.000	143 (15.9)	66 (47.8)	77 (10.1)	0.000	0.002
Neonatal hyperbilirubinemia	79 (8.8)	11 (10.8)	68 (8.5)	0.278	100 (11.1)	19 (3.8)	81 (10.6)	0.175	0.098
NICU admission	42 (4.7)	10 (9.8)	32 (10.0)	0.015	53 (5.9)	9 (6.5)	44 (5.8)	0.426	0.146
Fetal death	1 (0.1)	0 (0)	1 (0.1)	0.887	1 (0.1)	0 (0)	1 (0.1)	0.847	0.750
Neonatal death	0 (0)	0 (0)	0 (0)	NA	0 (0)	0 (0)	0 (0)	NA	NA

NA, not applicable

Table 4 Comparison of maternal outcomes in GDM.

	2 Steps (N=102) n (%)	1 Step (N=138) n (%)	P value
Gestational age at delivery (weeks)			
< 37	11 (10.8)	16 (11.6)	0.844
> 37	91 (89.2)	122 (88.4)	
Route of delivery			
Normal delivery	35 (34.3)	42 (30.4)	0.780
Operative vaginal delivery	5 (4.9)	6 (4.3)	
Cesarean section	62 (60.8)	90 (65.2)	
Postpartum hemorrhage	17 (2.1)	5 (3.6)	0.195
Pregnancy induce hypertension	11 (10.8)	16 (11.6)	0.844
Infection	2 (2.0)	6 (4.3)	0.261
Vaginal tear (3 <sup>rd</sup> -4 <sup>th</sup> degree)	0 (0)	1 (0.7)	0.575
Length of stay (days, mean±SD)	3.9 ± 1.8	4.0 ± 5.2	0.790
Insulin treatment	13 (12.7)	19 (13.8)	0.818

Table 5 Comparison of neonatal outcomes in GDM.

	2 Steps (N=102) n (%)	1 Step (N=138) n (%)	P-value
Birth weight (grams, mean±SD)	3293.5 ± 624.1	3222.4 ± 428.5	0.296
Large for gestational age	28 (27.5)	46 (33.3)	0.329
Small for gestational age	4 (3.9)	1 (0.7)	0.105
Birth injury	1 (1.0)	2 (1.4)	0.612
APGAR score			
1 min <7	1 (1.0)	5 (3.6)	0.193
5 min <7	0 (0)	0 (0)	NA
Respiratory distress	8 (7.8)	5 (3.6)	0.153
Neonatal hypoglycemia	45 (44.1)	66 (47.8)	0.569
Neonatal hyperbilirubinemia	11 (10.8)	19 (3.8)	0.490
NICU admission	10 (9.8)	9 (6.5)	0.244
Fetal death	0 (0)	0 (0)	NA
Neonatal death	0 (0)	0 (0)	NA

NA, not applicable



## Discussion

Diagnosis of GDM on the basis of oral glucose tolerance test has been changed from 2-step, a hundred gram glucose, to 1-step 75 gram. The result of this study shows the higher rate of diagnosis from 11.3 % (95 %CI 9.2 – 13.9) by CC criteria to 15.3 % (95 %CI 12.9 – 17.7). The prevalence of GDM varies among studies reported from various regions of the world. Most of the studies had shown higher prevalence when screening using IADPSG criteria<sup>(6-8)</sup>. Higher rate of GDM detection was also found in this study by the increasing was only from 13.9 % to 15.3 %. Previous studies, they found the higher prevalence 13.44 % using IADPSG to screen GDM compared to CC criteria 2.59 %<sup>(6)</sup>, 12.4 % to 4.6 %<sup>(7)</sup>, 35.5 % to 10.6 %<sup>(8)</sup>. Another report in the year 2014 showed 3.5-fold increase in GDM prevalence and also showed cost-saving<sup>(8)</sup>. The difference of the prevalence of GDM also depends upon either screening all pregnant women or selective screening using parameters of high risk recommended. Using selective screening, as has been used for this study, the rate of detection would be lower, some GDM might be missed. Other factor to be considered is the age of pregnant woman at screening, age > 30 years was used in the study, some other hospitals and some reports age of 25 years or more has been used<sup>(1)</sup>. Using older age for screening some GDM could be missed. Cost-effective should be considered as more women have to be screening.

Prevalence of GDM increases in women with obesity, older age, their life-style. Pre pregnancy BMI was significantly higher in one step group which could affect the result of increasing prevalence in this group.

Improvement of maternal and neonatal outcomes had been reported in several studies.<sup>(9-10)</sup>, we found only route of delivery was significantly

different. More cesarean delivery found in one step group, the pregnancy complications were not different, management of GDM, indications and other reasons for cesarean delivery could make the difference in the rate of operation. However, when the maternal outcomes of women with GDM were compared no statistically difference was found. More detection of GDM by using IADPSG criteria for screening does not yield the difference of maternal outcomes. For neonatal outcomes, overall, there were significantly different in terms of birth weight, LGA and hypoglycemia. More mean birth weight and LGA found in two step group, and more hypoglycemia in one-step group. Analysis of women with GDM, there was no significantly difference.

Screening of GDM is still an important procedure during antenatal care, adopting IADPSG criteria for screening increase the rate of detection GDM which allows more GDM pregnant women to receive proper management. As there is an increasing prevalence of GDM in younger maternal age, the maternal age to be screened should be considered in each hospital, in each society. Cost-effectiveness studies of one-step IADPSG for screening and diagnosis of GDM is suggested.

This study was limited by its retrospective design. The population in this study was sampled from different periods of time. Furthermore, some confounders could not be controlled. A randomized controlled trial with cost-effectiveness analysis is recommended for further study.

In conclusion, the application of the IDAPSG criteria for diagnosis GDM increased the prevalence from 11.3 % to 15.3 %. No significant changes of the pregnancy outcomes.

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### What is already known on this topic?

Gestational diabetes mellitus (GDM) is an importance women health problems, it increases risk of maternal and fetal complication. Diagnosis of GDM on the basis of oral glucose tolerance test has been changed from 2-step, a hundred grams glucose, to 1-step 75 gram. IADPSG criteria for screening increase the rate of detection GDM.

### What this study adds?

The application of the IDAPSG criteria for diagnosis GDM increased the prevalence but no significant changes of the pregnancy outcomes.

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