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CLINICAL ARTICLE

Outcomes of pregnancy with gestational diabetes mellitus

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ABSTRACT

Objective: To compare pregnancy outcomes between women with gestational diabetes mellitus (GDM) and those with low-risk pregnancies during implementation of the GDM practice guideline. **Methods:** In a retrospective study, data were compared between women with singleton pregnancies complicated by GDM and control women with singleton low-risk pregnancies who delivered at Maharaj Nakorn Chiang Mai Hospital, Thailand, between January 2002 and December 2012. All pregnant women were screened and managed for GDM as recommended by the National Diabetes Data Group. **Results:** During the study period, 1350 pregnancies with GDM and 20421 low-risk pregnancies met the study criteria and were included in the GDM group and the control group, respectively. The incidence of fetal macrosomia—the main outcome—was significantly higher in the GDM group ($n = 270$, 20.0%) than in the control group ($n = 2776$, 3.6%; adjusted odds ratio 1.48, 95% confidence interval 1.28–1.71; $P < 0.001$). The incidences of cesarean delivery, cephalopelvic disproportion, pregnancy-induced hypertension, and shoulder dystocia were also significantly higher in the GDM group (all $P < 0.05$). **Conclusion:** Despite the practice guideline, adverse pregnancy outcomes including fetal macrosomia, cesarean delivery, and pregnancy-induced hypertension, were significantly higher among women with GDM. The findings warrant an effective audit system or improved adherence to the guideline.

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1. Introduction

Gestational diabetes mellitus (GDM) is defined as carbohydrate intolerance of variable severity with onset or first recognition during pregnancy. It is one of the most common medical complications of pregnancy [1]. The prevalence of GDM depends on race, ethnic origin, maternal age, and the criteria of diagnosis [2]. According to the database of the study hospital (Maharaj Nakorn Chiang Mai Hospital, Chiang Mai, Thailand), the prevalence of gestational diabetes is approximately 7%, which is similar to that in the USA [2,3].

Many reports show that GDM is associated with an increase in adverse fetal and neonatal outcomes such as fetal macrosomia, birth injury, neonatal hyperbilirubinemia, hypoglycemia, idiopathic respiratory distress syndrome, and perinatal mortality [3–6]. Furthermore, it is also related to maternal complications such as pregnancy-induced hypertension (PIH), cesarean delivery, and an increased risk of type 2 diabetes later in life [3–6].

The appropriate management to prevent serious complications includes education in controlling blood sugar, prenatal care, diet control, proper use of medication, and exercise [7–9]. In Thailand, there have been few studies on pregnancy outcomes among women with GDM. Boriboonhirunsarn et al. [10] reported no severe maternal or fetal

morbidity among patients with GDM who received treatment in accordance with hospital guidelines. They also showed that ethnic origin, race, culture, and lifestyle might affect overall obstetric outcomes among these women. At the study hospital, pregnant women have been screened and managed for GDM as recommended by the National Diabetes Data Group (NDDG) for more than 10 years. Nevertheless, pregnancy outcomes among women with GDM attending the study hospital have not been thoroughly explored.

The aim of the present study was therefore to compare obstetric outcomes between women with GDM and women with low-risk pregnancies who delivered at Maharaj Nakorn Chiang Mai Hospital, a tertiary center in northern Thailand, during implementation of the practice guideline for GDM recommended by the NDDG.

2. Material and methods

In a retrospective cohort study, data were assessed from all women who delivered at Maharaj Nakorn Chiang Mai Hospital, Chiang Mai, Thailand, between January 1, 2002, and December 31, 2012. Ethical approval for the study was obtained from the institutional review board. Informed consent was not obtained from the patients owing to the retrospective design of the study, which was based on computerized data with anonymous selection.

The computerized obstetric database of the hospital was assessed to identify both pregnancies complicated with GDM and control pregnancies, and the medical records were reviewed. The inclusion criteria for the GDM group were: 1) a diagnosis of GDM during pregnancy, on

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the basis of a 100-g oral 3-hour oral glucose tolerance test, as recommended by NDDG, including two or more venous plasma glucose levels meeting or exceeding the threshold values (fasting, 105 mg/dL; 1-hour, 190 mg/dL; 2-hour, 165 mg/dL; 3-hour, 145 mg/dL); 2) attendance at the prenatal care clinic and delivery at the study hospital; 3) singleton pregnancy; and 4) no other medical complications. The control group included all pregnant women who delivered during the same period and met the following inclusion criteria: 1) singleton pregnancy; 2) no medical complications; 3) attendance at the prenatal care clinic and delivery at the study hospital; and 4) no fetal chromosomal or structural anomalies. Records with incomplete data on maternal and fetal outcomes were excluded from the study.

During the study period, all women underwent GDM screening and management in accordance with the risk-based protocol recommended by NDDG [11]. In brief, GDM was screened and diagnosed as follows. For women with an average risk of diabetes (aged ≥ 30 years), a 50-g glucose challenge test was carried out at 24–28 weeks of pregnancy. Women with a positive result—defined by a plasma glucose level of 140 mg/dL or more—then underwent a 100-g oral glucose tolerance test. By contrast, women at high risk of GDM owing to fetal macrosomia or GDM in previous pregnancy, previous unexplained fetal death, a body mass index (calculated as weight in kilograms divided by the square of height in meters) of more than 25, family history of diabetes, or glycosuria were screened at their first visit. If the test was negative, they were screened again at 24–28 weeks of pregnancy. Pregnant women with GDM were advised about using diet control and/or insulin therapy to maintain their fasting and 2-hour postprandial blood glucose levels at less than 105 mg/dL and 120 mg/dL, respectively.

Baseline characteristics of the study population, including maternal age, weight, parity, occupation, education and number of prenatal care visits, were recorded. The primary outcome was the incidence of fetal macrosomia, defined as a birth weight heavier than the 90th percentile for each gestational age. Secondary outcomes included rates of spontaneous abortion, PIH, preterm delivery (<37 weeks of gestation), fetal growth restriction (birth weight <10 th percentile for gestational age), cesarean delivery, cephalopelvic disproportion, stillbirth, shoulder dystocia, and low Apgar score (<7) at 5 minutes.

Statistical analysis was performed via SPSS version 21.0 (IBM, Armonk, NY, USA). Baseline demographic data were compared between the two groups using Student *t* tests for quantitative data and χ^2 tests for categorical data. Comparisons of the incidence of pregnancy outcomes between the two groups were performed by using logistic regression analysis. $P < 0.05$ was considered to be statistically significant.

3. Results

Of 25255 deliveries during the study period, 1350 pregnant women with GDM (categorized as the study group) and 20421 low-risk pregnant women (categorized as the control group) met the inclusion criteria and were included in the analysis (Fig. 1). The demographic data of both groups are presented in Table 1. Maternal age, weight, parity, and number of prenatal visits were significantly higher in the GDM group than in the control group. The mean maternal ages of the study and control groups were 32.57 ± 5.29 and 27.39 ± 7.04 years, respectively ($P < 0.001$). The maternal weights of the study group and control groups were 56.77 ± 9.95 and 55.57 ± 10.13 kg, respectively ($P < 0.001$). Overall, 764 (56.6%) women in the study group and 8581 (42.0%) women in the control group were multiparous. The other baseline data, such as education level and occupation, were not significantly different between the two groups. Most women had a low level of education and approximately half in each group were employed.

The rate of fetal macrosomia was significantly higher in the GDM ($n = 270$, 20.0%) than in the control ($n = 2776$, 13.6%) group (adjusted odds ratio [OR] 1.48, 95% confidence interval [CI] 1.28–1.71; $P < 0.001$). The mean birth weight of the GDM group was significantly higher (3024 ± 607 vs 2941 ± 590 g, $P < 0.001$), whereas gestational age

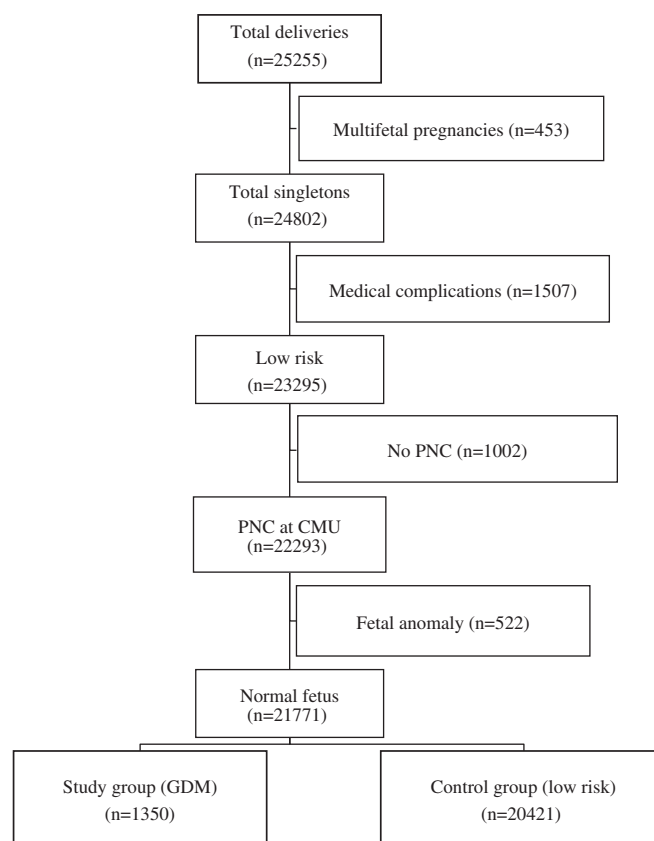


Fig. 1. Flow of patients through the study. Abbreviations: PNC, prenatal care; CMU, Chiang Mai University; GDM, gestational diabetes mellitus.

at delivery was similar. Notably, the prevalence of PIH in the GDM group ($n = 151$, 11.2%) was twice as high as that in the control group ($n = 1325$, 6.5%; adjusted OR 1.67, 95% CI 1.39–2.00; $P < 0.001$). Furthermore, the incidences of shoulder dystocia, cephalopelvic disproportion, and cesarean delivery were also significantly higher in the GDM group than in the control group, with adjusted ORs of 7.84, 4.56 and 1.36, respectively. The percentages of stillbirth, abortion, low Apgar

Table 1

Comparison of baseline characteristics between the study groups.^a

Characteristic	GDM group (n = 1350)	Low-risk group (n = 20421)	P value
Age, y	32.57 \pm 5.29	27.39 \pm 7.04	<0.001
Maternal weight, kg	56.77 \pm 9.95	55.57 \pm 10.13	<0.001
Number of prenatal visits	10.17 \pm 3.6	8.93 \pm 3.49	<0.001
Parity			<0.001
Nulliparity	586 (43.4)	11 829 (57.9)	
Multiparity	764 (56.6)	8581 (42.0)	
Gestational age at delivery, wk	37.7 \pm 2.6	37.8 \pm 3.0	0.231
Birth weight, g	3024.2 \pm 607.2	2941.7 \pm 590.4	<0.001
Education level			0.090
University or higher	376 (27.9)	5665 (27.7)	
Secondary school	254 (18.8)	4073 (19.9)	
Primary school or lower	552 (40.9)	7769 (38.0)	
Occupation			0.157
Agriculture	45 (3.3)	681 (3.3)	
Housewife	49 (3.6)	741 (3.6)	
Government officer	119 (8.8)	1656 (8.1)	
Employee	704 (52.1)	10468 (51.3)	
Private business	119 (8.8)	1545 (7.6)	
Commercial	260 (19.3)	4237 (20.7)	
Other	54 (4.0)	1093 (5.4)	

Abbreviation: GDM, gestational diabetes mellitus.

^a Values are given as mean \pm SD or number (percentage), unless indicated otherwise.

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