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The correlation between the prevalence of gestational diabetes mellitus and maternal age in Southern China

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Abstract

Objectives: The present study aimed to survey the prevalence of gestational diabetes mellitus (GDM) in Southern China and further to analyze the correlation between the prevalence of GDM and maternal age.

Methods: A retrospective cross-sectional study was carried out at the Southern Medical University Affiliated Maternal & Child Health Hospital of Foshan, Foshan, China between January and April 2020. Oral glucose tolerance tests (OGTT) was performed, using a 75 g glucose load and venous samples were drawn at 0 h, 1 h and 2 h at 24–28 weeks of gestation. GDM was diagnosed by International Association of Diabetes and Pregnancy Study Groups (IADPSG) criteria.

Results: The prevalence of GDM was 14.87% by IADPSG criteria. The incidence of GDM outcome increased and plasma glucose levels remained high among the age subgroups (<20, 20–24, 25–29, 30–34, 35–39, ≥40 years old) in pregnant women. Moreover, the levels of plasma glucose levels after OGTT kept rising among the pregnant women with non-gestational diabetes mellitus (non-GDM). Furthermore, pregnant women were inclined to have abnormal plasma glucose values at 1 h and 2 h than initial fasting plasma glucose (FPG) after OGTT as the age increased.

Conclusions: Our findings demonstrate that the incidence of GDM outcome and plasma glucose levels increase as the maternal age increase.

Keywords: age; gestational diabetes mellitus (GDM); prevalence; Southern China.

Introduction

Gestational diabetes mellitus (GDM) is defined as carbohydrate intolerance with first onset or recognition during pregnancy [1]. The Hyperglycemia and Adverse Perinatal Outcomes (HAPO) study revealed that all degrees of hyperglycemia are linked linearly to obstetric complications, including macrosomia, preeclampsia, cesarean section, birth trauma and diabetes mellitus later during the lifespan [2, 3]. Fortunately, screening for and managing GDM could mitigate many of these complications.

According to the latest report of American Diabetes Association (ADA), up to 15–20% of all pregnant women suffer from GDM [4]. In China, an additional 90 million women, roughly equivalent to the population of Germany, will eligible to have a second child owing to the universal two-child policy adopted. However, approximately 60% of them were 35 years old or older, which may lead to increased risk of complications in pregnancy and pose more challenges to protect maternal and child health.

In 2010, the International Association of Diabetes and Pregnancy Study Groups (IADPSG) proposed new guidelines for screening and diagnosis of diabetes during pregnancy, which have been widely accepted and adopted in China since 2011 [5]. It was proposed that GDM is diagnosed if any of the following values is met or exceeded in the 75 g oral glucose tolerance test (OGTT): fasting plasma glucose (FPG) ≥5.10 mmol/L, 1 h-postprandial glucose (PG) ≥10.00 mmol/L, or 2 h PG ≥8.50 mmol/L [6].

Accumulating evidence indicates that maternal age is an independent risk factor for GDM and can be used as an early predictor for GDM [7]. Nevertheless, limited studies are available on the prevalence of GDM in Southern China and its association with maternal age. Therefore, the aim of this study was to survey prevalence of GDM and the correlation between GDM and maternal age in Southern China.

Materials and methods

Study population

Data of 3,530 singleton pregnant women were obtained retrospectively from laboratory information system and obstetric records during
January to April 2020 in our hospital (Southern Medical University Affiliated Maternal & Child Health Hospital of Foshan, Foshan, China). Subjects who have already diagnosed with pre-gestational diabetes or have family history of diabetes were excluded. All pregnant women received prenatal medical examination regularly at obstetrics clinic and underwent universal screening for GDM by 75 g OGTT between 24 and 28 weeks of gestation according to the IADPSG 2010 [6].

**Laboratory analysis**

OGTT was performed at 24th–28th weeks of pregnancy after overnight fast (at least 8 h). Venous blood was collected using fluoride-oxalate tubes and plasma glucose was determined by the glucose oxidase-peroxidase method using an automated analyzer AU5800 (Beckman, Fullerton, CA). The intra and inter-assay coefficients of variation (CV) for the glucose range from 1.21–2.33%.

**Statistical analysis**

Data were described as mean (SD) or frequency where appropriate. Statistical analysis was performed using Statistical Package for the Social Sciences (version 22.0) software (SPSS, Inc., Chicago, IL, USA). p<0.05 was considered statistically significant.

**Results**

A total of 3,530 pregnant women were included in this study and we identified that 525 (14.87%) women were diagnosed with GDM through a 75 g OGTT performed at 24–28 weeks. The baseline characteristics of subjects are described in Table 1 according to glucose tolerance status. As expected, pregnant women with GDM were older than pregnant women who did not have GDM (32.25 [4.88] vs. 29.14 [4.75], p<0.05). The GDM group also demonstrated higher levels of plasma glucose, including initial FPG (4.74 [0.71] vs. 4.27 [0.30], p<0.05), 1 h PG (10.04 [1.62] vs. 7.21 [1.35], p<0.05) and 2 h PG (6.35 [0.97] vs. 8.83 [1.63], p<0.05) after OGTT.

Previous studies revealed that established risk factors for GDM are advanced maternal age. Our results also showed that as the maternal age increased, the incidence of GDM outcome increased, with the highest incidence occurring in gravidas ≥40 years old (Figure 1). Moreover, the levels of FPG, 1 h PG and 2 h PG after performed OGTT kept rising among the maternal age subgroups in pregnant women with non-gestational diabetes mellitus (non-GDM). The same situation also turn up in pregnant women with GDM, except FPG levels of <20 and 20–24 years old subgroups (Figures 2 and 3).

Figure 4 showed that the detailed breakup of patients diagnosed as GDM by OGTT. According to the IADPSG criteria, 143 women (4.05%) had a FPG value ≥5.10 mmol/L, 303 women (8.58%) had a 1 h PG value ≥10.00 mmol/L and 303 women (8.58%) had a 2 h PG value ≥8.50 mmol/L. It was also observed that these were 53 women (1.50%) having abnormal OGTT values by all the three cut points.

Furthermore, our data further indicated that as the maternal age growing, pregnant women met the diagnostic criteria of GDM based on IADPSG with some regularity. As shown in Figure 5, the proportion of plasma glucose levels at 1 h and 2 h exceeding the diagnostic criteria increased markedly while the rate of GDM diagnosis by plasma glucose values at 0 h reduced as the age increased.

**Discussion**

GDM is one of the common medical conditions associated with pregnancy with potentially serious health consequences for mother and offspring both in the short and long term [8, 9].

**Table 1:** Characteristics of 3,530 pregnant women according to glucose tolerance status.

|                | Non-GDM | GDM | p-Value |
|----------------|---------|-----|---------|
| n, %           | 3,005 (85.13) | 525 (14.87) |         |
| Age, years     | 29.14 ± 4.75 | 32.5 ± 4.88 | <0.001 |
| FPG, mmol/L    | 4.27 ± 0.30 | 4.74 ± 0.71 | <0.001 |
| 1 h PG, mmol/L | 7.21 ± 1.35 | 10.06 ± 1.62 | <0.001 |
| 2 h PG, mmol/L | 6.35 ± 0.97 | 8.83 ± 1.63 | <0.001 |
| <20 years, n, %| 32 (1.06) | 1 (0.19) |         |
| FPG, mmol/L    | 4.18 ± 0.35 | 5.5 |         |
| 1 h PG, mmol/L | 6.28 ± 1.49 | 7.7 |         |
| 2 h PG, mmol/L | 5.54 ± 0.95 | 6.7 |         |
| 20–24 years, n, %| 427 (14.21) | 20 (1.81) |         |
| FPG, mmol/L    | 4.21 ± 0.29 | 4.73 ± 0.60 | <0.001 |
| 1 h PG, mmol/L | 6.7 ± 1.32 | 9.42 ± 1.77 | <0.001 |
| 2 h PG, mmol/L | 5.98 ± 0.90 | 8.18 ± 1.66 | <0.001 |
| 25–29 years, n, %| 1,458 (48.52) | 144 (27.43) |         |
| FPG, mmol/L    | 4.25 ± 0.29 | 4.65 ± 0.65 | <0.001 |
| 1 h PG, mmol/L | 7.08 ± 1.30 | 9.66 ± 1.58 | <0.001 |
| 2 h PG, mmol/L | 6.24 ± 0.95 | 8.66 ± 1.60 | <0.001 |
| 30–34 years, n, %| 648 (21.56) | 187 (35.62) |         |
| FPG, mmol/L    | 4.29 ± 0.30 | 4.71 ± 0.64 | <0.001 |
| 1 h PG, mmol/L | 7.35 ± 1.31 | 9.94 ± 1.42 | <0.001 |
| 2 h PG, mmol/L | 6.47 ± 0.96 | 8.66 ± 1.42 | <0.001 |
| 35–39 years, n, %| 387 (12.88) | 134 (25.52) |         |
| FPG, mmol/L    | 4.32 ± 0.30 | 4.86 ± 0.84 | <0.001 |
| 1 h PG, mmol/L | 7.83 ± 1.28 | 10.65 ± 1.75 | <0.001 |
| 2 h PG, mmol/L | 6.8 ± 0.91 | 9.28 ± 1.87 | <0.001 |
| ≥40 years, n, % | 53 (1.76) | 39 (7.43) | <0.001 |
| FPG, mmol/L    | 4.37 ± 0.27 | 4.79 ± 0.77 | <0.002 |
| 1 h PG, mmol/L | 8.07 ± 1.17 | 10.26 ± 1.52 | <0.001 |
| 2 h PG, mmol/L | 6.84 ± 0.82 | 9.15 ± 1.37 | <0.001 |

FPG, fasting plasma glucose; 1 h PG, plasma glucose of 1 h after OGTT; 2 h PG, plasma glucose of 2 h after OGTT; GDM, gestational diabetes mellitus group; Non-GDM, non-gestational diabetes mellitus group. t-test.
Gao et al. showed that the pooled prevalence of GDM in mainland China was 14.8% by meta-analysis according to IADPSG criteria, which was a systematic review including both English and Chinese literature database. A total of 25 papers were included in this meta-analysis, involving 79,064 Chinese subjects. In addition, the author also revealed that the age could significantly increase incidence of GDM by means of subgroup analysis [10]. In our study, we found that GDM affects 14.87% of pregnant women in Southern China, according to the IADPSG criteria. In accordance with previous studies, we also demonstrated that women who developed GDM were older. In addition, the prevalence of GDM increased as maternal age growing and the incidence of pregnant women ≥40 years old was up to 42.39%.

Besides, the plasma glucose levels of three cut points after performed OGTT kept rising among the maternal age subgroups in almost all the pregnant women, which further proved that maternal age was an established risk factor for GDM. Previous studies also found that even with a normal blood glucose level, the risk of suffering adverse pregnancy outcomes is greater with an increase in blood glucose level [6]. These observations suggested that the prevalence of GDM in Southern China merited our close attention and we should focus to protect maternal and child health.

Further analysis also revealed that most of pregnant women with GDM have two or three abnormal plasma glucose values after OGTT instead of one. Furthermore, pregnant women were more inclined to have abnormal plasma glucose values at 1 h and 2 h than initial FPG in Southern China. It suggested that the Chinese were more likely to have abnormal postprandial plasma glucose. However, the dietary and lifestyle factors may explain this.
phenomenon. As we all know, rice is the staple of the Southern Chinese diet. Recent prospective cohort studies indicated that carbohydrate intake, particularly from white rice, linked to increased type 2 diabetes risk in Chinese adults [11–13]. Besides, the study from Kadoorie Biobank of 461,211 participants in China indicated that adherence to a healthy lifestyle including with some degree of replacement of rice with wheat, may substantially lower the burden of T2DM in the Chinese population [14].

However, our study has few limitations that need to be acknowledged. First, this study only analyzes the correlation between the prevalence of GDM and maternal age in Southern China rather than further investigate its impact on pregnancy outcome. Second, the body mass index (BMI) which was a traditional risk factor for GDM didn’t take into account in this assay. Finally, being a single-center and small-sample study performed in Southern China, which may cause inevitable geographic disparity of study conclusion. Further multi-center studies with large population are necessary to confirm our findings.

**Conclusions**

In this work, we showed that GDM affects 14.87% of pregnant women in Southern China, according to the IADPSG criteria. Our findings also reveal that the incidence of GDM outcome and plasma glucose levels increases as the maternal age increases. Much more attention should be taken to the management of blood glucose, especially pregnant women in advanced maternal age.

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**Informed consent:** Informed consent was obtained from all individuals included in this study.

**Ethical approval:** Research involving human subjects complied with all relevant national regulations, institutional policies and is in accordance with the tenets of the Helsinki Declaration (as revised in 2013), and has been approved by the authors’ institutional review board.

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