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The risk factors for gestational diabetes mellitus: A retrospective study

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ABSTRACT

Objective: To investigate the risk factors for developing GDM among Taiwanese pregnant women.
Design: A retrospective cohort and case-control study.
Setting: At a medical centre in Southern Taiwan.
Participants: The hospitalised pregnant women who were diagnosed with either GDM or normal glucose tolerance (NGT) between 1997 and 2011. The glucose tolerance test results were interpreted according to criteria established by the National Diabetes Data Group for GDM. Participants were divided into either a GDM group (case group) or a normal glucose tolerance (NGT) group (control group) in order to determine the risk factors for GDM.
Measurements: With a retrospective chart review, data regarding demographics, a family history of diabetes, history of gestation, and physiological index for pre- and postpregnancy periods were collected. χ^2 tests and independent t tests were used to examine the correlations between demographic characteristics and GDM. Stepwise multivariate logistic regression was used to determine the factors associated with GDM.
Findings: The results of the comparison between the GDM group ($n=106$) and the NGT group ($n=406$) showed that the risk factors for GDM were maternal age, education, a family history of diabetes, and prepregnancy body mass index (BMI).
Key conclusion and implication for practice: Older age, lower levels of education, a family history of diabetes, and higher prepregnancy BMI were significant risk factors for GDM. In addition to performing risk factor assessment, health care providers should proactively promote the importance of GDM screening to pregnant women at their first antenatal visit.

Introduction

Gestational diabetes mellitus (GDM) is a major global public health concern, with prevalence increasing yearly. Women with diabetes have high risk to give birth to giant babies and to suffer from mortality (Ryan, 2013). GDM can result in serious maternal, foetal, and neonatal health implications, including preeclampsia, shoulder dystocia, macrosomia, neonatal hypoglycaemia, etc (Mitanchez, 2010). The reported prevalence of GDM worldwide ranges from 2% to 6%; the prevalence of GDM in India, the Middle East, and Sardinia ranges from 10% to 22% (Galtier, 2010). Asian women appear to be at a higher risk of developing GDM than non-Hispanic white women (Savitz et al., 2008). The prevalence of GDM in China was 4.3% (Yang et al., 2009), and a recent study reported a GDM prevalence of up to 7.4% in Taiwan (Lin et al., 2009). Non-Hispanic Asian/Pacific Islander women were 2.26-fold more likely to develop GDM compared with non-Hispanic white women

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(Hunsberger et al., 2010). GDM not only adversely affects maternal and child health but also increases the resulting medical costs (Chen et al., 2009). Several studies have reported that women with a history of GDM are at an increased risk of type 2 diabetes (Golden et al., 2009) and cardiovascular diseases (King et al., 2009). Therefore, health care providers should understand the risk factors for GDM and provide pregnant women with preventive care and early intervention.

Maternal age is widely considered one of the risk factors associated with GDM (Dode and Santos, 2009). The risk of developing GDM increases with maternal age and an increasing prepregnancy body mass index (BMI) (Dode and Santos, 2009). The results of a study demonstrated that women with lower levels of education had a higher risk of developing GDM than that of women with higher levels of education (van der Ploeg et al., 2011). However, another study found no association between GDM and education in Chinese pregnant women (Yang et al., 2009). Numerous studies have demonstrated that women with a family history of diabetes had a higher risk of developing GDM than that of those without (van Leeuwen et al., 2010; Rhee et al., 2010). Dode and Santos (2009) reviewed relevant literature and discovered that, of the 23 articles addressing the associations between GDM and parity, only five present positive associations. Most studies have indicated that a short stature was positively associated with GDM (Dode and Santos, 2009); however, we cannot rule out the possibility of selection bias on these studies. Despite the high prevalence of GDM in Asia, few studies have focused on the risk factors for GDM, and information about factors associated with GDM among the Asian population is limited. Additional research is required to validate previous research on the factors associated with GDM. Therefore, the purpose of this study was to investigate the risk factors for developing GDM among Taiwanese pregnant women.

Methods

Design

This study used a retrospective chart review to collect data. The glucose tolerance test results were interpreted according to criteria established by the National Diabetes Data Group for GDM. A case-control study was conducted to determine the risk factors for GDM. Participants were divided into either a GDM group (case group) or a normal glucose tolerance (NGT) group (control group).

Participants and procedure

In our study, the inclusive criteria were women who were diagnosed with GDM, and gave birth and were discharged from the study hospital. The exclusive criteria involving women's medical records indicated incomplete glucose tolerance test, women with a diagnosis of type 1 diabetes or type 2 diabetes before pregnant. The minimum sample size for logistic regression was calculated according to a artificial milk (Hsieh et al., 1998) with the study results of Yang et al. (2009). If the statistical power $(1-\beta)$ was 0.80, α was 0.05, and the number of participants in the control group was triple for the number of participants in the case group, the minimum sample size was 123 participants in the case group and 369 participants in the control group.

This study was conducted at a medical centre in Southern Taiwan. Prior to data collection, the study was reviewed and approved by the institutional review board of the study hospital (KMUHIRB-2012-03-08(I)). Data were collected from the medical records of hospitalised women who delivered in and then were discharged from the study hospital between 1997 and 2011 with the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnostic codes of 648 ($n=188$) and 650 ($n=678$). A total of 866 medical records of patients met the inclusion criteria, of which 122 could not be retrieved. After reviewing the available medical records of 744 pregnant women, we excluded 197 women who lacked data on the glucose tolerance test, antenatal visits, or child delivery. Furthermore, we excluded 10 women with a diagnosis of type 1 diabetes, 14 with type 2 diabetes, and 11 with impaired glucose tolerance. Eventually, 512 patients, 106 whose first diagnosis was GDM and 406 whose first diagnosis was NGT, were included in the analysis (Fig. 1).

Data analysis

Descriptive statistics were used to present the demographic characteristics of the participants. χ^2 tests and independent t tests were used to examine the correlations between demographic characteristics and GDM. Stepwise multivariate logistic regression was used to analyse the risk factors for GDM. IBM SPSS Statistics Version 20 (Mandarin Chinese Edition) was used for data filing and analysis.

Findings

The results of comparing the GDM group ($n=106$) with the NGT group ($n=406$) showed significant differences ($p<.05$) in mean age, education, employment status, a family history of diabetes, parity, body height, and prepregnancy BMI (Table 1).

The results of the univariate logistic regression analysis indicated that the risk of developing GDM increased by 13% (95% confidence interval [CI]: 1.07–1.19, $p<.001$) for every year of maternal age, that women with an education level of junior college or below had a 3.28-fold higher risk (95% CI: 2.11–5.10, $p<.001$) of GDM than that of women with an education level of university or above, and that unemployed women had a 1.93-fold higher risk (95% CI: 1.25–2.99, $p=.003$) of GDM than that of employed women. Additionally, women with a family history of diabetes exhibited a 7.16-fold higher risk (95% CI: 4.50–11.41, $p<.001$) of GDM than that of women without a family history of diabetes; multipara had a 1.93-fold higher risk (95% CI: 1.24–3.02, $p=.004$) of GDM than that of primipara. The risk of GDM was reduced by 5% (95% CI: 0.91–0.99, $p=.008$) for every 1-cm increase in body height; and the risk of GDM increased by 35% (95% CI: 1.26–1.46, $p<.001$) for every 1 kg/m^2 increase in prepregnancy BMI (Table 2).

The results of the stepwise multivariate logistic regression analysis indicated that only four variables (age, education, a family history of diabetes, and prepregnancy BMI) were entered into the model. After adjusting for other variables, we determined that the risk of developing GDM increased by 10% (95% CI: 1.04–1.17, $p=.002$) for every year of maternal age; women with an education level of junior college or below had a 3.59-fold higher risk (95% CI: 2.07–6.21, $p<.001$) of GDM than that of women with an education level of university or above; women with a family history of diabetes showed a 6.79-fold higher risk (95% CI: 3.92–11.76, $p<.001$) of GDM than that of women without; and the risk of GDM increased by 29% (95% CI: 1.19–1.41, $p<.001$) for every 1 kg/m^2 increase in prepregnancy BMI. To summarise, age, education, a family history of diabetes, and prepregnancy BMI were significant predictors of GDM (Table 3).

Discussion

The results indicate that Taiwanese women's age, education, family history of diabetes, and prepregnancy BMI were risk factors