Biomedical Research 2017; 28 (5): 2126-2130 *ISSN 0970-938X*
www.biomedres.info

Risk factor of gestational diabetes among healthy Chinese women: an observational study.

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Abstract

Objective: To identify predictive factors which helps in screening the healthy Chinese pregnant women who were at high risk of developing Gestational Diabetes Mellitus (GDM).

Materials and methods: Medical records of healthy Chinese pregnant women who had given birth to baby at department of obstetrics, University Hospital of Hubei, China in 2014-2015 were reviewed. We reviewed the records of each healthy postnatal women met WHO criteria for diagnosis of diabetes mellitus during their pregnancy (GDM case), and who were not diagnosed with GDM (control, non-GDM group), and data were analysed using univariate analysis.

Result: A total of 300 post natal women with GDM were compared with equal number of matched patients in each group was enrolled, and possible risk factor associated with GDM was assessed using validated questionnaire. Univariate analysis revealed that there was significant associated of increased body mass index, family history of GDM, history of stillbirth, miscarriages and abortion with development of GDM.

Conclusion: Increased body mass index, family history of GDM, history of stillbirth, miscarriages, abortion and psychological stress during pregnancy are key predictors of GDM among Chinese pregnant women. These prognostic factors help in screening the pregnant women who were at high risk of developing GDM. We encourage increasing awareness of risk factor of GDM, which could lead to decrease incidences of GDM among healthy pregnant women.

Keywords: Gestational diabetes mellitus, Healthy pregnant women, Diabetes mellitus.

Accepted on October 12, 2016

Introduction

The prevalence of diabetes mellitus is rapidly increasing worldwide, and it is anticipated to increase up to 366 million by 2030 [1]. Diabetes mellitus is becoming most common disease among developed countries including China. Due to increased financial evolution, increasing sedentary life style, and unhealthy dietary habits results in increasing prevalence of obesity which directly lead to development of diabetes mellitus [2-5].

Any grade of glucose intolerance detected during pregnancy is defined as Gestational Diabetes (GD) [1]. Currently, the prevalence of Diabetes Mellitus (GM) during pregnancy is also increasing in developed countries which lead to adverse pregnancy outcome, and neonatal morbidity and mortality [6]. Prevalence of Gestational Diabetes (GD) ranged from 2.4 to 21% during pregnancy [7,8] is varying country to country, which is due to different region of country, food habits and financial status [9]. Current clinical evidences suggest that the pregnant women with GD are at higher risk of developing DM, cardiovascular and kidney disease [10,11]. In china (Tianjin), the incidence of GD was 6.8% during 2008, which was increased from 2.3% which was reported in 1999 [12,13]. It has been reported that the children born from mother who had GD are at high risk of development of childhood obesity, uncontrolled high plasma glucose concentration, with increased chance of getting cardiovascular disease during puberty and early parenthood [14]. Earlier studies suggested that the prevalence of GD is high in Asian population due to increased age and obesity [15,16].

The risk of GDM in pregnant women can be prevented efficiently by modifying risk factor associated with GDM. Modifying the risk factor of GD results in healthy mother and baby. The most common identified risk factor among GD women is advanced age, high body mass index/obesity and family history of DM/GD [17]. A multinational epidemiology study reported that the risk of adverse maternal, foetal and neonatal outcomes increased after increasing maternal blood glucose level after second trimester of pregnancy [18]. There is no specific root cause of these complications; such

complication can be prevented by identifying risk factor of GD. Since the incidences of GD is growing in parallel to increasing cases of obesity and DM during in women with reproductive age [19], thus identification of risk factors helps to understand the risk factor responsible for causing GDM.

Since etiology of GD is remain imprecise in spite of several efforts to find the potential reasons, thus there was no established and effective methods to prevent the GD. Therefore, identification of risk associated with GD which helps to detect patients who require more attention to prevent incidence of GD is essential. Early identification of potential risk factors of GD helps in preventing diabetes during pregnancy, and thereby eliminates maternal and foetal abnormality in pregnant women. The objective of present study was to identify predictive factors that can be used in screening the pregnant women who were at high risk of developing GD, which help in reducing the incidence of GD related morbidity and mortality in pregnant women.

Materials and Methods

This retrospective case-control study was conducted at department of obstetrics, University Hospital of Hubei, China, and the medical records of Gestational Diabetes Mellitus (GDM) patients who had given birth in 2014-2015 were retrieved from computerized database of maternal and child health care centre of University Hospital of Hubei, China, and studied. All patients attending to department of obstetrics, University Hospital of Hubei, China were subjected to Oral Glucose Tolerance Test (OGTT) as per WHO recommendation using 75 gram of glucose. All pregnant women with 24-28 weeks of gestation were screened, and assessed fasting glucose (8-14 hour of fasting) followed by OGTT. The pregnant women were considered diabetic if fasting plasma glucose was ≥ 7.0 mmol/l, and plasma glucose level after 2-hour of OGTT was ≥ 11.1 mmol/l. The patients were diagnosed with GDM based on the results of fasting sample and/or the two-hour OGTT test. We have excluded the women who had complications during pregnancy such as pre-pregnancy diabetes mellitus and pre-eclampsia. Also women taking medication during pregnancy which could alter glucose metabolism were also excluded.

The women who were attending department of obstetrics, University Hospital of Hubei, China postnatal clinic (aged>18 year) with history of GDM as indicated in their medical records and agree to complete survey at post natal clinic of University Hospital of Hubei, China were sequentially enrolled and distributed in two groups: GDM group and non-GDM group, respectively. Approval of ethics committee was obtained from University Hospital of Hubei, China. Informed consent was obtained from each woman. After obtaining informed consent from each woman, a well-designed questionnaire was given to each participant to collect data related to risk factors associated with Gestational Diabetes Mellitus (GDM). The postnatal women who met WHO criteria for diagnosis of diabetes mellitus during their pregnancy with no history of any medical diseases prior to pregnancy, and had given birth in 2014-2015 were sequentially enrolled in GDM groups. In control group, women with no history of any medical diseases prior to pregnancy or diabetes mellitus during their pregnancy or women without pre-gestational diabetes were enrolled (matched with age and place of living). The following risk factor from each women were assessed included demography characteristics including weight during and before pregnancy; place of living; number of previous pregnancies; type of delivery; family history of GDM and number of years of schooling. Body mass index (kg/m^2) was calculated from weights and heights available on medical records of each participant. The questionnaire which was designed to collect data was validated by testing this questionnaire on 50 randomly selected pregnant women who attended our clinic. Before testing, questionnaire was reviewed by experts from researchers of obstetrics and gynaecology department of obstetrics, University Hospital of Hubei, China. Moreover, the developed questionnaire were tested statistically using Pearson test, the correlation coefficient was found statistically significant.

Data from each patient was coded and analysed using Graph Pad Prism statistical analysis software (version 6.0). Quantitative variable was presented as mean ± standard deviation, and data were compared using parametric/non-parametric statistical test based number of comparison group and distribution of data, using 2 sided statistical tests. Normality test (Kolmogorov-Smirnov test or Shapiro-Wilks test) will be used to check the distribution of data of quantitative data. Categorical variables was presented as absolute number and/or percentage of subjects in each category, and were compared using Chi-square or fisher exact test based on size of data, using 2 sided statistical tests. Potential risk factors were calculated for GDM groups and non- GDM groups using Chi-square or fisher exact test. The effect of individual independent risk factor in development of GDM was analysed by multivariate analysis. Odds Ratio (OR) with 95% Confidence Interval (CI) and p value was calculated using multiple logistic regressions.

Result

Medical records of 900 pregnant women who had given birth in 2014-2015 in our hospital were studied. Out of this, 300 women after delivery were diagnosed with gestational diabetes mellitus as per WHO criteria (GDM group). We have selected equal number of control pregnant women who were not diagnosed with GDM during their recent pregnancy (non-GDM group). Three hundred pregnant women who were diagnosed with gestational diabetes mellitus as per WHO criteria in their recent pregnancy in 2015-2016 were included in GDM group, and data were compared with the 300 pregnant women with no diagnosis of gestational diabetes mellitus. The average age of women at the time of baby birth was similar in both the groups. Pre-pregnancy weight was significantly higher in women of GDM group (83 [3.7]) when compared to women of non-GDM group (71 [3.6]). The mean (SD) age of women of GDM group was 29 (5.2), which was similar in patients with

non-GDM group (28 [4.3]) with no statistical significant difference between both the groups ($p<0.05$). Similar trend was observed when compared height among both the groups. However, the weight of pregnant women identified with GDM (89 [2.3]) was higher when compared with the women with no gestational diabetes mellitus (73 [2.7]). On comparing Body Mass Index (BMI), significantly higher proportion of overweight women (25-29 kg/m^2) was in GDM group as compared to non-GDM group. This indicates that the majority of women with GDM were overweight before pregnancy (Table 1). Number of year of education among women with GDM groups was less compared to non-GDM group, however, there was no statistical significant difference for number of year of education between both the groups ($p>0.05$). Moreover, significantly higher proportion of in GDM group was smoker (38%) when compared to non-GDM group (12%).

Table 1. *Demography and clinical characteristic of pregnant women admitted in department of obstetrics, University Hospital of Hubei, China during Jan-2014 to Dec 2015.*

Variables	Gestational diabetes mellitus Group (N=300)	Non- Gestational diabetes mellitus Group (N=300)
Age (year)		
More than 18	15%	5%
Between 19-34	65 %	90%
More than 35	20%	5%
Age (year), Mean (SD)	29 (5.2)	28 (4.3)
Pre-pregnancy weight (kg) Mean (SD)	83 (3.7)	71 (3.6)
Weight during pregnancy (kg) Mean (SD)	89 (2.3)	73 (2.7)
Pre-pregnancy BMI		
Overweight (25–29 kg/m2)	45%	5%
Non-Overweigh	55 %	95%
Smoking status		
Smoker	38%	12%
Non-Smoker	62 %	88%
Number of years of schooling (year)		
More than 8	18%	8%
Between 9-15	70 %	88%
More than 16	22%	4%

Values are expressed as % of subjects in each category except age and weight. N=Total number of subject in each group

More than 90% of women of GDM group had family history of diabetes, which was significantly higher when compared to women of non-GDM group (93% *vs* 14%). The risk of GDM was found more than double in women who had family history of diabetes when compared to women with no family history of diabetes. We also noticed that the women with history of miscarriages (at least one) were significantly higher in GDM group when compared women with non-GDM group (35% *vs* 9%). Moreover, proportion of women with history of stillbirth was significantly higher in GDM group when compared women with non-GDM group (38% *vs* 12 %). In GDM group, number of previous pregnancy was also higher (40% cases) when compared to non-GDM group (8% cases), the difference was statistically significant ($p<0.005$). Moreover, proportion of women with history of abortion was significantly higher in GDM group when compared women with non-GDM group (45% *vs* 5%, $p<0.001$). We also observed that the mental stress during pregnancy was significantly higher in non-GDM group than non-GDM group.

Univariate analysis revealed that there was significant associated of increased body mass index, family history of GDM, mental stress, history of stillbirth, history of miscarriages, and abortion with development of GDM in pregnant women. We noticed that the increased body mass index, family history of GDM, mental stress, history of stillbirth, history of miscarriages, and abortion had greater odd ratio than other risk factors. Increased BMI before pregnancy and history of C-section delivery was associated with development of GDM as Odd ratio of such risk factor was less (Table 2).

Table 2. *Prognostic factors for increased incidence of Gestational diabetes mellitus in pregnant women.*

Variable	Gestational diabetes mellitus Group (N=300)	Non-Gestational diabetes mellitus Group (N=300)	Odd ratio 95% CI P value
Family history of diabetes mellitus			
Present	93%	14%	15.54
Absent	7%	86%	5.82-41.49 <.0001
History of miscarriages			
Present	35%	9%	5.44
Absent	65 %	91%	2.44-12.10 <.0001
History of history of stillbirth			
Present	38%	12%	4.49
Absent	62 %	88%	2.17-9.28 <.0001
Number of previous pregnancy			
Present	40%	8%	7.66
Absent	60 %	92%	3.35-17.50 <.0001
History of abortion			

Present	45%	5%	15.54 5.82-41.49 <.0001
Absent	55 %	95%	
Work stress during pregnancy			
Present	40%	8%	7.66 3.35-17.50 <.0001
Absent	60 %	92%	
Family related stress during pregnancy			
Present	35%	9%	5.44 2.44-12.10 <.0001
Absent	65 %	91%	
History of C-section delivery			
Present	38%	3%	19.8172 5.86-66.9 <.0001
Absent	62 %	97%	
Weight during pregnancy			
Overweight (25-29 kg/m2)	62%	12%	11.9 5.79-24.7 <.0001
Non-overweight (20-24 kg/m2)	38%	88%	
Smoker (during pregnancy)			
Yes	54%	06%	18.39 7.37-45.8 <.0001
No	46%	94%	

Values are expressed as % of subjects in each category. P value calculated by chi-square test using univariate analysis. N=Total number of subject in each group.

Discussion

This was the first retrospective case control study to determine the risk factors of GDM among healthy Chinese pregnant women. We tried to identify the most significant risk factor of gestational diabetes in Chinese pregnant women. Several risk factors of GDM in previous studies have been identified, the common identified risk factor of GDM were increased age and body mass index [20]. We could not find significant association of age, height and place of living. Our finding revealed that there is positive association of increased BMI with the development of GDM; increased BMI is one key predisposed factor for GDM among pregnant women. Few earlier studies revealed that the level of education is also once of risk factor in developing GDM [21]. In contrast to this finding, our study suggested that there was no significant association between the levels of education and GDM.

Our finding showed that the pregnant women with increased BMI, family history of GDM, history of miscarriages, history of stillbirth and history of abortion were at higher risk of developing GDM. Univariate analysis revealed that the most common associated risk factors included BMI, family history of GDM, history of miscarriages (>1 once), increased pre-pregnancy weight, history of stillbirth, history of abortion and women with history of C-section delivery. Several lines of clinical evidences suggested history of stillbirth and GDM during their previous delivery were at high risk of developing GDM [18,22,23].

Our study results showed that the pregnant women with family history of diabetes were at higher risk of developing GDM; our finding is consistent with previous studies [24]. Our results showed positive relationship between family history of diabetes and risk of GDM in pregnant women. Our results recommended that the family history of diabetes is an alternative measure for hereditary factors that may be one of cause GDM in Chinese pregnant women. Women with family history of diabetes are one of the most common clinical risk makers of GDM compared to the biochemical indicators.

Our study showed that the incidence of GDM was significantly greater in women with higher stress compared to women with no stress during pregnancy. Our study results showed positive association of mental stress during pregnancy and development of GDM. We observed that the pregnant women with greater stress are at very high risk of developing GDM. Increased incidences of GDM in women with mental stress could be explained based on the facts that psychosocial strain. Role of psychological stress in developing GDM during pregnancy was well established [25]. Apart from psychological stress disorders, any kind of mental stress due to uneasy environment of office and home which may results in biological alterations in pregnant women lead to GDM. Moreover, prenatal stress may changes maternal physiology and immune function; this may also lead to increased risk of GDM.

In the past decades, many laboratory tests has been advised to discover the potential risk of developing GDM during pregnancy, however, such as lab investigations have inadequate sensitivity and costly which was difficult to afford. We suggest the family history of GDM, increased BMI, history of miscarriages, stress during pregnancy, history of stillbirth and history of abortion can be better screening tools to determine risk of GDM in pregnancy. The predictive factors such as body mass index and mental stress are amendable and avoidable risk factor of GDM, whereas family history of diabetes could not be modifiable, nonetheless very useful to identify the pregnant women who are at higher risk of GDM and need more attention. This help in reducing the incidence of GDM related morbidity and mortality in pregnant women. We encourage increasing awareness of risk factor of GDM, which could lead to decrease prevalence of GDM in pregnant women.

Conclusion

We suggest that the family history of GDM, increased body mass index during pregnancy, history of miscarriages, history of stillbirth, history of abortion and psychological stress during pregnancy is important predictors of GDM among Chinese pregnant women. These prognostic factors can be used in screening the pregnant women who were at high risk of developing GDM. This finding help in reducing the incidence of GDM related morbidity and mortality in pregnant women.

We encourage increasing awareness of risk factor of GDM, which could lead to decrease incidences of GDM among pregnant women.

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