Risk factors for gestational diabetes mellitus in Sanandaj, Iran

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Abstract

Original Article

BACKGROUND: Gestational diabetes mellitus (GDM) is defined as any degree of glucose intolerance that is detected for the first time during the most recent pregnancy. It can lead to serious complications for mother and infant. The current study aimed to determine the important risk factors for GDM in Sanandaj, Iran during 2010-2011.

METHODS: This was a case-control study in which 220 people were chosen for each group from referees to the healthcare centers and diabetes center in Sanandaj. Data were collected through interviews and review of medical records. Data analysis conducted using chi-square test and logistic regression.

RESULTS: In the present study, diabetic mothers were older and more obese than non-diabetic mothers. In the logistic regression, variables such as familial history of diabetes in first-degree relatives, history of gestational diabetes, age ≥ 30 years, history of stillbirth, history of macrosomia, and body mass index above 30 were considered as the most important independent risk factors for gestational diabetes respectively. However variables such as smoking, blood pressure, and history of infant death showed no statistical significant difference between the two groups.

CONCLUSION: The most important risk factors for developing GDM included history of diabetes among relatives (family history), mothers with a history of gestational diabetes, and history of macrosomia. Therefore, controlling these factors can reduce the incidence of diabetes during pregnancy.

KEYWORDS: Gestational Diabetes, Risk Factors, Logistic Regression

Introduction

Diabetes is the most common metabolic disorder which has been the seventh leading cause of death in the United States in 2007.[1] It will be the seventh leading cause of death in the world in 2030[1,2] and the most common metabolic disorder affecting pregnancy.[1,3-5] According to different studies, prevalence of gestational diabetes mellitus (GDM) in Iran is consistent with the international level and varies from 2 to more than 10%.[6] Increase in gestational diabetes in recent years in all ethnic groups is possibly related to the lifestyle factors in general population (sedentary lifestyle and dietary changes).[6-8] Advanced maternal age during pregnancy is another reason for this increase.[4,9] Abnormal glucose metabolism during pregnancy could have adverse outcomes for both mother and baby,[10] and is among strong risk factors for adverse pregnancy outcomes and increases morbidity and mortality during

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childbirth.[11] In addition to recurrence risk of gestational diabetes in subsequent pregnancies, there is a chance for developing the disease in their later years of life.[11] Consequently 35 to 60% of the patients will develop diabetes over the next 10 to 20 years.[1] Offspring of diabetic mothers (ODM) are at higher risk of developing diabetes.[12]

In meta-analysis of over 110 articles on gestational diabetes, Shannon has reported the following risk factors which are associated with gestational diabetes: Maternal obesity (> 120% of ideal body weight), first-degree relative history of diabetes, previous history of microcosmic babies, history of stillbirth, unexplained infant death, age over 35 years, glucosuria (two or more than two times) during recent pregnancy, and eventually race and ethnicity.[13]

In a systematic review of 41 articles on diabetes risk factors by Souza, many variables including past obstetric history of mother's low birth weight, maternal short stature, history of smoking, high parity, race, low levels of physical activity, weight gain during pregnancy, and socio-economic factors had contradictory results and are still not unanimously agreed upon.[14] In most national studies, role of risk factors such as miscarriage, stillbirth, abnormal birth history, and history of hypertension and preeclampsia results have shown contradictory outcomes.[15-19] According to the National Center for Disease Control, guidelines warning signs after screening of pregnant mothers include the history of stillbirth, history of two or more spontaneous abortions, history of high-birth-weight baby 4 kg or more, first-degree family history of diabetes and obesity equal to or greater than 30 kg/m^{2} mean body mass index (BMI) before pregnancy.[20] Owing to the importance of GDM and its adverse consequences for mother and baby, as well as contradictory information about risk factors for gestational diabetes throughout the world including Iran, and insufficient measurement of the variables related to gestational diabetes in the country level, and because no comprehensive study in this field has been conducted in the Kurdish population, this study aimed to determine the risk factors for GDM in Sanandaj during 2010 to 2011.

Materials and Methods

This was a case-control, non-matched population-based study done in 2010 to 2011 in pregnant women referred to the health and diabetes center in Sanandaj, Iran. The minimum sample size required for this study was considered based on exposure in controls (P0 = 0.15) and cases (P1 = 0.26). With regard to the odds ratio (OR) equal or more than 2 for each risk factor, with a confidence level of 95% and the power 80% (β = 80), 208 cases were enrolled in the study. In this study, case and control groups were defined early in the study. Cases were chosen among pregnant women who according to their GDM screening and based on the national guidelines their positive test results were available in their patient records. Controls were pregnant women who were considered healthy based on the gestational diabetes screening tests records. Among health records at health centers in Sanandaj during 2010 to 2011, and according to the figure 1, samples were selected. Then, after applying the following exclusion criteria, 220 patients were selected; history of overt diabetes mellitus, history of taking medications that affect glucose metabolism such as corticosteroids, endocrine disorders such as connective tissue disease, toxic goiter and active thyroid, and evidence of no laboratory tests such as glucose tolerance test (GTT) in patient file record.

After determining distribution in separate health centers, controls were selected based on the registered records of pregnant women in centers using simple random sampling. Finally, 220 controls were chosen from selected health centers after applying the following exclusion criteria in the control group; laboratory evidence suggestive of GDM, overt diabetes, exposure to endocrine disorders and impaired glucose metabolism, history of taking medication that impairs glucose metabolism, and incomplete records despite maternal interviews for extraction of variables.
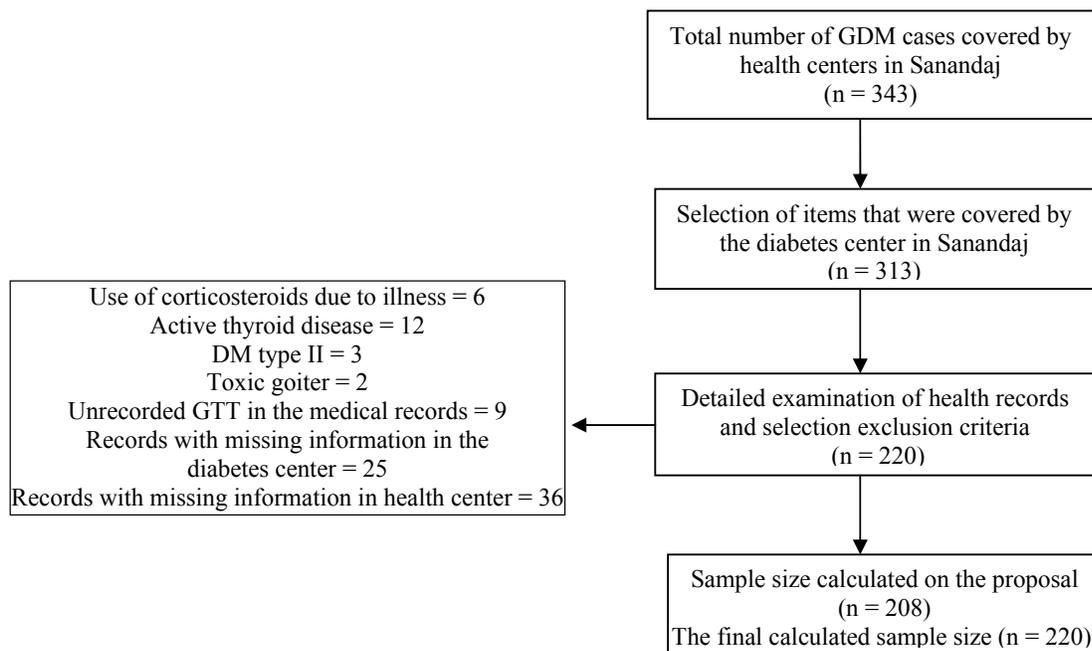
Figure 1. Sampling flowchart
GDM: gestational diabetes mellitus
DM: Diabetes mellitus

While reviewing health records of mothers in the health centers and their medical records in the diabetes center, telephone interviews with mothers were conducted by the researcher in order to extract information and control the recorded data. In this study, mothers were classified into three age groups i.e. less than 25 years, 25 to 30 years and over 30 years. Mothers' body mass index (BMI) before the pregnancy were divided into three groups; normal, pre-pregnancy (less than 25), overweight (30-25) and obese (greater than 30). Mother's education level was divided into three groups; less than primary education, guidance and high school, diploma or higher. Smoking habit divided into never used to smoke, active smoker and quit smoking. Previous history of macrosomia and birth records of infants greater than 4000 grams, history of gestational hypertension with blood pressure greater than 140/90 mmHg measured twice with an interval of more than 6 hours without proteinuria and after week 20 of gestation. In this study, history of polyhydroamnious was

defined as increased fluid volume more than 2000 cc according to ultrasound report.

After data collection, data were entered into SPSS for Windows (version 16.0, SPSS Inc., Chicago, IL, USA) and were analyzed. Chi-square test and calculation of crude OR were used for univariate analysis. To remove the effect of confounding variables, variables with a significance level of less than 0.25 entered into the logistic regression analysis. Then, after calculation of OR, value less than 0.05 was considered as a significance level.

Results

The mean age of the study subjects and control group were 32.27 ± 5.41 and 27.29 ± 5.41 years, respectively. In this study, 91.4% of the cases were in the age group 25 years and over. Mothers with gestational diabetes were older and fatter than healthy mothers (Table 1).

Table 2 shows comparison of variables including educational status, smoking, number of pregnancies (of 3 or more) and height of case and

control groups

Table 1. Mean quantitative variables related to demographic characteristics of women participating in the study

Variables	Case (n = 220) (Mean ± SD)	Control (n = 220) (Mean ± SD)
Maternal age	32.27 ± 5.41	27.29 ± 5.06
Mother BMI	28.16 ± 3.92	25.68 ± 4.01
Systolic blood pressure	108.97 ± 11.43	108.25 ± 9.26
Diastolic blood pressure	68.90 ± 8.8	68.52 ± 8.45
Weight gain during pregnancy	10.22 ± 3.20	12.50 ± 3.47
Parity	1.48 ± 1.08	1.29 ± 0.93

BMI: Body mass index

Compared with healthy mothers, mothers who developed GDM were among those who had the following risk factors; family history of diabetes, previous history of gestational diabetes, history of macrosomia, history of stillbirth, history of infertility, abnormal birth history, two or more previous miscarriages, and history of gestational hypertension. The difference between the two groups regarding maternal employment variables, smoking, history of hypertension, and history of infant death with an unknown cause

was not statistically significant (P > 0.05) (Table 2 and Table 3).

After entering the univariate analysis significant risk factors into regression model, age over 30 years, having a BMI 25 or more, family history of diabetes in relatives, history of gestational diabetes, macrosomia and history of stillbirth remained in the model (P < 0.05), finally, results showed that women over age 30, maternal overweight, mothers who had a history of diabetes in their first-degree relatives, those who have a history of gestational diabetes, mothers with a history of macrosomia, and finally, mothers with a history of stillbirth had a higher chance of getting gestational diabetes. (Table 4).

Discussion

The results of our study showed that family history of diabetes in first-degree relatives, was identified as the most important risk factor (OR = 7.18). Family history of diabetes in relatives increases the risk of gestational diabetes which was considered as an important risk factors in the studies done by Kanadys in Poland[21] and Rahimi

Table 2. The relationship between demographic variables and recent pregnancies in study subjects

Variables	Case (n = 220) [%]	Control (n = 220) [%]	OR (CI)	P
Age groups				
Age group under 25 year	19 (8.6)	79 (35.9)	1	-
Age group older than 30 years	134 (60.9)	58 (26.4)	9.60 (5.33-17.29)	< 0.001
Age group between 30-25 years	67 (30.5)	83 (37.7)	3.35 (1.85-6.08)	< 0.001
BMI groups				
BMI under 25	42 (19.1)	98 (44.5)	1	-
BMI over 30	84 (38.2)	35 (15.9)	5.60 (3.28-9.56)	< 0.001
BMI between 25-30	94 (42.7)	87 (39.6)	2.52 (1.58-4.01)	< 0.001
Education				
Secondary and higher education	69 (31.4)	80 (36.4)	1	-
Guidance and secondary education	34 (15.5)	54 (24.5)	2.16 (1.29-3.60)	0.003
Primary and lower education	117 (53.1)	86 (39.1)	1.57 (1.03-3.41)	0.035
Smoking	3 (1.4)	1 (0.5)	3.02 (0.312-29.33)	NS (P = 0.315)
Mother's occupation (housewife)	198 (90)	200 (90.9)	-	NS (P = 0.935)
Maternal height ≤ 150 cm	16 (7.3)	4 (1.8)	4.23 (1.39-12.88)	0.001
Weight gain ≥ 11 kg	113 (62.08)	86 (44.79)	2.01 (2.01-4.50)	0.001
Number of deliveries ≥ 3	48 (28.1)	15 (6.8)	3.81 (2.06-7.04)	0.001
Parity ≥ 3	129 (58.6)	123 (55.9)	1.11 (0.76-1.63)	NS(P = 0.563)
Having high blood pressure	6 (2.7)	2 (0.9)	3.05 (0.610-15.31)	NS (P = 0.154)

OR: Odds Ratio; CI: Confidence interval; BMI: Body mass index; NS: Non significant

Table 3. Relationship between maternal related variables in previous pregnancies of study subjects

Variables	Case (n = 220)	Control (n = 220)	OR (CI)	P
Family history of diabetes	74 (%33.6)	24 (%10.9)	4.14 (2.49-6.87)	< 0.001
Previous history of gestational diabetes	27 (%14.9)	5 (%2.8)	5.99 (2.25-15.95)	<0.001
Previous history of macrosomia	26 (%14.7)	4 (%2.4)	6.93 (2.36-20.32)	<0.001
History of stillbirth	29 (%16.4)	4 (%2.4)	7.88 (2.70-22.97)	< 0.001
History of infertility	32 (%14.5)	10 (%4.5)	3.57 (1.71-7.46)	< 0.001
History of congenital malformation	9 (%5.1)	1 (%0.6)	8.78 (1.10-70.12)	0.014
History of 2 ≥ previous miscarriages,	11 (%8.6)	2 (%1.6)	5.64 (1.22-25.99)	0.013
History of gestational hypertension	12 (%6.6)	3 (%1.7)	4.09 (1.13-14.76)	0.02
History of infant deaths with unknown cause	7 (%4.0)	3 (%1.8)	2.22 (0.56-8.74)	NS (P = 0.241)

OR: Odds Ratio; CI: Confidence interval; NS: Non significant

Table 4. Analysis of multivariable associated with diabetes in pregnancy using unconditional logistic regression

Variables	OR	95% (CI)	P
Age group 25-30 years	1.40	0.29-6.79	0.674
Age over 30 years	5.77	1.27-26.10	0.023
BMI between 25-30	2.91	1.16-7.30	0.023
BMI over 30	3.69	1.40-9.68	0.008
Family history of diabetes in relatives	7.18	2.94-17.55	0.001
Maternal history of gestational diabetes	6.25	1.52-25.74	0.011
History of macrosomia	5.27	1.12-24.67	0.035
History of stillbirth	5.63	1.33-23.86	0.019

OR: Odds Ratio; CI: Confidence interval; BMI: Body mass index

et al. in Kermanshah.[22] These results have already been obtained in the literature[5] and many other prospective[23-25] and cross-sectional studies are already in the literature.[26,27] But some of the studies done inside Iran did not find any significant association between the history of diabetes in first degree-relatives and GDM[15,18,28,29], which could be due to high prevalence of type II diabetes in these communities.

In the fifth international conference on diabetes, the history of GDM as a variable in the previous pregnancies was as a risk factor of gestational diabetes.[9] In our study after history of diabetes in the first degree relatives, history of GDM as a variable was mentioned as the second important risk factor in GDM (OR = 6.25). This variable remained in the model in other studies of regression determining diabetes during pregnancy (OR = 5.09- 21.93).[7,18,22,30-32]

In a study conducted by Cheung et al., the risk factors for GDM women born in the four Asian countries, i.e. China, the Philippines, Sri Lanka and Vietnam showed that history of GDM was the only significant risk factor in all four groups

(OR = 14.5).[33] The study of Tabatabaei on pregnancy and diabetes did not show any statistical significant association between this variables and GDM.[15]

In our study, increasing age was associated with more chances of gestational diabetes so that the risk of gestational diabetes in women over 30 years was 5.77 times more than women under 25 years. The results are consistent with most of the national and international studies.[3,6-8,13,29,34-36] In a study done by Hadaegh et al. in Bandar-Abbas, relative risk of gestational diabetes in 35-39 year old group were 15 times more than age groups under 20 years.[29] In a study conducted by Tabatabaei, with every year increased in maternal age, the risk became 1.18 times more.[15] Although several studies have reported age as a risk factor for gestational diabetes, each reported a different age number.[21,32,37,38] Perhaps age difference of the demographic profile, young population and pregnancy in the lower age group in developing countries comparing to developed ones is one of the reasons for age differences in various

studies. In a study done in Lithuania and Philippines, There was no statistical significant association between age and GDM.[35,39] The possible explanation for this could be socio-cultural desire of these people to family formation in lower age groups compared with western countries, leading to fewer numbers of marriages above 30 years in these studies.

History of stillbirth in the diabetes protocol of Iranian Center for Non Communicable Disease Management has been listed as a risk factor for gestational diabetes.[20] This variable was among other significant factors that increased the chances of GDM to 5.63 times more, and was consistent with some international and national studies.[13,19] However, in some national studies,[16-18,22] there was no statistical significant association between stillbirth and gestational diabetes. In this study, history of two and more than two abortions after doing univariate tests was identified as risk factor for gestational diabetes. However, after entering into the logistic regression model, no significant association was found with gestational diabetes. This finding was in accordance with the results of national and international researchers.[17,19,30,35,40,41] The conflicting results could be due to inclusion of one miscarriage (instead of at least two miscarriages), as a risk factor in some studies.[22]

In the diabetes management Protocol of the Iranian non-communicable diseases center and literature,[5] macrosomia is one of the most important risk factor for GDM. In our study, history of macrosomic infants was recognized as an independent risk factor for gestational diabetes which increased the risk of diabetes by 5.27 times. Finding was consistent with the results of many other studies.[7,13,16-19,21,40,42,43] Furthermore, in Mirfeizi et al. study in Karaj, macrosomia has been suggested as the most important risk factor for GDM (OR = 10.47).[40] However, in other national and international studies, there was no association between macrosomia and GDM.[22,28,30,39]

Among other interfering risk factors is high BMI which is an independent risk factor, significantly associated with our study. Chances of developing gestational diabetes in overweight and obese group were 2.91 and 3.69 more times, respectively than those who had a BMI less than 25. This was consistent with the meta-analysis results of Torloni et al.[42]

Some cohort studies have suggested that smoking is among the risk factors that is related to the gestational diabetes,[23,44,45] although some other studies (national and international), showed inconsistent results.[32, 46-49] In our study, association between smoking and gestational diabetes was not significant. These differences are supposed to represent the following points in the studies: Studies' lack of power, difference in diagnostic methods, different definitions of exposure time (such as categorizing woman who smoke just one cigarettes as smokers), different controls for confounding factors as well as change in smoking habits as a result of pregnancy or giving wrong information about smoking habits because of under recognized adverse effects of smoking during pregnancy.[14,45,47-49] A cross sectional study in Scandinavian countries[50] showed that smoking more than 10 cigarettes per day during pregnancy affect glucose homeostasis and cause GDM. This study has been confirmed by others.[23]

Among the strengths of this study was that the researcher used standard definitions of protocols of Non-Communicable Disease Prevention Center and office of Iranian Mothers Health Organization, which was due to the variety in definitions of variables in other studies. In order to minimize the information bias, researcher collected the data himself. Considering the fact that abortion is introduced as risk factor for GDM in some studies,[16,21,22] and stillbirths is introduced as risk factor for GDM in other studies,[13,19] therefore it is possible that this problem can be due to lack of correct differentiation between stillbirths and abortion at the time of data registration. Therefore, it is suggested that in future studies particularly in retrospective ones, accuracy of abortion and stillbirths be checked in

the time of data collection. It can be noted that one of the limitations of this study was limiting samples to those who were supported by the health centers or province diabetes center which caused a relative decrease in our study's population-based findings. However, this can be disregarded owing to high coverage of diabetes screening at these two centers during pregnancy.

Conclusion

In this study, after identifying significant independent risk factors for GDM in Kurdish ethnicity, for the first time most important risk factors for developing GDM identified as the history of diabetes among first-degree relatives (family history), mothers with a history of gestational diabetes, and history of macrosomia.

Therefore, it is recommended that detected risk factors in this study be prioritized for education of mothers who are willing to have birth. In addition, these risk factors should be considered more in screening and follow-up of mothers at risk of GDM to prevent any adverse effects of the disease in mothers and their children.

Conflict of Interests

Authors have no conflict of interests.

Acknowledgments

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