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The Prevalence and Risk Factors for Gestational Diabetes Mellitus in the Expecting Outpatients of Mashhad University of Medical Sciences, Iran (2018-2017)

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ABSTRACT

Introduction: Diabetes is the most common metabolic disorder during pregnancy. Given the importance of the screening and treatment of gestational diabetes for the prevention of maternal and fetal complications, the present study aimed to evaluate the prevalence of gestational diabetes mellitus in the pregnant women covered by Mashhad University of Medical Sciences, Iran.

Methods: This study was conducted on the women with pregnancy intention or confirmed pregnancy, referring to the health centers affiliated to Mashhad University of Medical Sciences during March 2017-September 2018. The patients with gestational diabetes mellitus were identified based on the latest WHO criteria in 2013. Data were collected on the conducted experiments and recorded in the integrated health information system (SINA). Data analysis was performed in SPSS version 25 using Chi-square and logistic regression.

Results: During the study period, 2,710 women (4.3%) were diagnosed gestational diabetes mellitus. The mean age of the patients was 28.56±56.379 years. In terms of the influential factors, significant correlations were observed between gestational diabetes mellitus and family history of diabetes (OR=4.278; P<0.0001), history of gestational diabetes mellitus (OR=3.880; P<0.0001), body mass index (OR=2.302; P<0.0001), history of macrosomia (OR=1.656; P<0.003), history of recurrent miscarriage (OR=1.759; P<0.007), and preeclampsia (OR=1.914; P<0.045).

Conclusion: According to the results, the prevalence of diabetes in Mashhad city (4.3%) seems to be slightly lower than other areas. Special attention must be paid to the pregnant women with the influential factors of gestational diabetes mellitus through selective screening based on the risk factors of the disease.

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Introduction

Gestational diabetes mellitus (GDM) is a form of carbohydrate intolerance with variable severity, which initially occurs or is diagnosed during pregnancy. Since pregnancy is associated with major changes in the concentration of various hormones that act as stressors, the increased secretion of the placental hormones affecting the functions against insulin (particularly in the second half of pregnancy) could increase the blood glucose in many pregnant women, which in turn may lead to various maternal and fetal outcomes. The high prevalence of obesity in all age groups, including the women of the reproductive age, has also escalated the issue.

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Today, blood glucose in many pregnant women has been reported to be on the rise (1). As diabetes is asymptomatic, the necessity of its identification and determining the screening policies require an adequate knowledge of the prevalence of GDM in the community. The global prevalence of GDM remains unknown although it has been estimated in various studies depending on the sample population and applied diagnostic tests. In the United States, the prevalence of GDM has been reported to be 8.5% (2). In Iran, few studies have evaluated the prevalence of GDM, proposing different statistics. In 2012, 21 articles were extracted on the GDM prevalence in Iran during 1992-2008, and the results were presented through a systematic review and meta-analysis, which indicated the mean prevalence of 4.9% (3). Another systematic review in this regard was carried out during 1992-2011, showing the prevalence of 5.88% in Iran (4).

Due to the economic development, lifestyle changes, and young population in Iran, a large proportion of this population are the women of the reproductive age who are susceptible to GDM. Since the disease is associated with numerous complications (5, 6), GDM and its maternal and fetal complications must be prevented through advancing the diagnosis, blood sugar control of pregnant women, and provision of specific care. In addition to adverse pregnancy outcomes, GDM in women is associated with postpartum type II diabetes mellitus. Since it is essential to identify and properly control GDM, it is also important to recognize the effective risk factors for the disease (1). Some of the known GDM risk factors include the age of more than 25 years, obesity (body mass index [BMI] of >30 kg/m2), family history of diabetes (first-degree relatives), history of fetal macrosomia delivery (weight of >4 kg), history of stillbirth/two spontaneous abortions, and history of the glucose tolerance disorder (1). By identifying the high-risk individuals who have the risk factors for GDM, an important step could be taken toward reducing the complications of this growing metabolic disease in the community.

The present study aimed to evaluate the prevalence of GDM in the pregnant women covered by Mashhad University of Medical Sciences, Iran.

Methods

The study protocol was approved by the Ethics Committee for Medical Research affiliated to Mashhad University of Medical Sciences in Mashhad, Iran (code: IR.MUMS.MEDICAL.REC.1397.348)

The sample population of the study included the pregnant women covered by the health centers affiliated to Mashhad University of Medical Sciences during March 2017-September 2018. The women referring to the health centers were followed-up by health care providers for examination and screening. All the women received a fasting blood sugar test upon referral. Based on the results, if the fasting blood glucose level was ≥126 mg/dl, the diabetic subject would be excluded from the study. The non-diabetic pregnant women were screened for GDM during weeks 24-28 of gestation and examined based on the World Health Organization (WHO) criteria on OGTT testing with 75-gram glucose. If a minimum of one abnormal blood glucose test result was reported (fasting glucose of ≥92 g, blood glucose of ≥180 mg/dl after one hour or blood glucose ≥153 mg/dl after two hours), GDM diagnosis would be considered definitive, and the necessary measures would be taken (1, 7).

Data were collected regarding the conducted tests and the number of the risk factors for GDM and recorded in the SINA in the form of an electronic file. The SINA electronic health record has been implemented in Razavi Khorasan province since April 2016, in which the health and demographic information of all the populations referring to comprehensive health care centers are registered by trained, experienced, and qualified experts. The data are also mined by relevant experts considering possible errors for research applications. Notably, the data of the patients remain strictly confidential.

The present study was carried out in two sections. Initially, a descriptive-analytical study was conducted regarding the prevalence of GDM and the demographic factors of the participants. This section involved the complete enumeration of the pregnant women referring to the health centers covered by Mashhad University of Medical Sciences during the study period. In the second section, a case-control study was performed regarding the influential factors in GDM based on a study by Andrew Collier (8), which was used to calculate the sample size. The sample size was determined to be 1,991 in the case group. Considering the probability that some statistics would be completely inaccurate, the number of the samples increased to 2,000. In order to obtain more accurate results, the number increased to 4,000 control subjects. The sample selection for both groups was completely random.

$$n = \frac{(z_{1-\alpha/2} + z_{1-\beta})^2 (p_1(1-p_1) + p_2(1-p_2))}{(p_1 - p_2)^2}$$

Statistical Analyses

Data analysis was performed in SPSS version 25 after data mining. Descriptive statistics (central

tendency and dispersion index) were calculated to evaluate the prevalence of GDM in the pregnant women covered by Mashhad University of Medical Sciences. In the second section of the study, the risk level was calculated for each variable using Chi-square at the significance level of less than 0.05, 95% confidence interval (CI), and 20% type II error (test power: 80). In addition, the univariate regression was used to determine the odds ratio (OR) of the underlying factors with the CI.

Results

Demographic Characteristics

During the study period, the data of 62,901 pregnant women were collected, 2,710 of whom (4.3%) had GDM. By nationality, the majority of the patients (98%) were Iranian. The patients were categorized into three age groups, with the majority (51.4%) aged 25-34 years. Based on the age risk index for GDM, more than 70% of the participants were aged 25-45 years, and the mean age of the participants was 28.6±56.379 years.

The subjects were also categorized by place of residence, with the largest number living in rural area and on the outskirts of Mashhad city. As the majority of the participants lived in rural areas, more than 85% had elementary school to high school diploma education. In addition, 2.5% of the patients were illiterate (Table 1).

Table 1. Frequency of Demographic Characteristics

Variables	Quantity	Frequency (%)	Intergroup Diabetes Frequency (%)	Intragroup Diabetes Frequency (%)
Age (year) 24>	18,441	29.3	16.8	2.5
25-34	32,342	51.4	53.2	4.5
35<	12,118	19.3	30.1	6.7
Nationality Iranian	61,624	98	97.1	4.3
Non-Iranian	1,277	2	2.9	6.2
Place of Residence Rural	22,428	35.7	30	3.6
Urban (less than 20,000 population)	5,224	8.3	5.4	2.8
Urban (20,000-50,000 population)	8,690	13.8	13.7	4.3
Urban 50,000-500,000 population)	3,771	6	7.5	5.4
Mashhad City	3,476	5.5	6.3	4.9
Mashhad Outskirts	19,312	30.7	37.2	5.2

Influential Factors in GDM (case-control study)

The examination of the case and control groups revealed the influential factors in GDM, which included the family history of diabetes, history of GDM, history of recurrent miscarriage, birth weight of more than 4,000 grams, history of multiple births, history of stillbirth, history of preeclampsia/eclampsia, and history of chronic hypertension. Among these factors, the family history of diabetes, history of GDM, weight gain, history of macrosomia, and history of recurrent miscarriage were significantly correlated with GDM (P<0.01) (Table 2).

Table 2. Correlation of Study Variables and Risk of GDM

Variable	Crude Odds Ratio	Significance Level
Family History of Diabetes	4.278 (1.843-9.929)	<0.001
History of GDM	3.880 (2.722-5.530)	<0.001
Weight Gain and Obesity	2.302 (2.059-2.574)	<0.001
History of Macrosomia	1.656 (1.194-2.297)	0.003
History of Recurrent Miscarriage	1.759 (1.180-2.621)	0.007
History of Preeclampsia	1.914 (1.035-3.539)	0.045
History of Multiple Births	1.633 (0.971-2.748)	0.069
History of Stillbirth	1.368 (0.870-2.150)	0.187
History of Chronic Hypertension	1.432 (0.737-2.784)	0.291
History of Eclampsia	1.274 (0.493-3.291)	0.622

Discussion

With the growing prevalence of diabetes risk factors (e.g., obesity, maternal age, family history of diabetes), the rate of GDM has also increased. Today, high blood sugar levels are observed in numerous pregnant women, and the rate is on the rise each year. The use of various diagnostic criteria could change the prevalence of this issue. In addition, there is currently no international consensus on the diagnosis of GDM and its diagnostic threshold. The WHO 2013 criteria have been used as the threshold for GDM diagnosis (7). Based on this criterion, the prevalence of GDM in the present study was estimated at 4.3%, which has been reported variously in some studies. The prevalence of GDM in the present study clearly differed from the other studies conducted in Iran and other countries, while the prevalence of GDM in the eastern regions of Iran seems to be similar to the current research (9).

Table 3. Role of Influential Factors in GDM in Various Studies (internal/external)

City Country/	Author	BMI	History of GDM	Family History of Diabetes	History of Macrosomia	History of Recurrent Miscarriage	History of Pre-eclampsia	History of Multiple Births	History of Still-birth	History of Chronic Hyper-tension	History of Eclampsia
Tehran (1992-1994)	Larijani (25)	✓		–						–	
Tehran (2000-2001)	Hemmatya (26)	✓		✓	–	–	–		–		
Kurdistan	Shah-Gheybi (27)	✓		✓		✓			✓	✓	
Bandar Abbas	Hadaegh (28)	✓		–	✓	–	–		–	–	–
Ahvaz	Shahbazian(29)		✓		✓	✓			–		
Shiraz	MohammadBeygi (30)	✓	✓	✓	✓		✓		✓	✓	
Hamedan (rural)	Soheilizadeh (31)	✓	✓		✓		–		✓		
Babol	Bouzari (32)	✓		✓	✓	✓	✓		✓	✓	
Birjand	Hedayati (33)	✓	✓	✓	–	–			–		
Isfahan	Goli (34)	✓	✓	✓	–	–	–		✓		
Gorgan	Mobasheri (11)	✓		✓	✓	–			–	✓	
Meybod (Yazd)	Vakili (35)	✓	✓	✓	–	–			–	–	
Hamedan	Zanganeh (12)	✓		✓		✓			–		
Kermanshah	Rahimi (13)	✓	✓	✓	✓	✓	–				–
Zabol	Shahdadi (9)	✓								–	
Scotland	Andrew Collier (8)	✓			–						
South Korea	Bo Kyung Koo(24)		✓				✓				
Haryana (India)	Rajesh Rajput (16)	✓	✓	✓							
Palau (Brazil)	Mindy S. Sugi (21)	✓									
Medina (Saudi Arabia)	Eman Alfadhi (36)	✓	✓	✓	–	✓	–		–	✓	
Beijing (China)	Wei-Wei Zhu (22)	✓		✓	–						
Riyadh (Saudi Arabia)	Hayfa Wahabi (19)	✓			✓		–		✓	✓	
Nairobi	Mauren Adoy (20)	✓		✓							
Pakistan	Sadia Fatima (37)	✓		✓							
Punjab (India)	Maxim Anand (17)	✓		✓		✓					
This study	Saeedi	✓	✓	✓	✓	✓	✓	–	–	–	–

Table cells with a check mark (✓) indicate a significant correlation, cells with a dash sign (-) indicate no significant correlation, and empty cells show no studies on variable.

In the studies conducted in Scotland (8) and West Kenya (10), the prevalence of GDM is lower, while the rate reported in Ilam (3), Zabol (9), Gorgan (11), Isfahan (4), Hamedan (12), Kermanshah (13), and Shahdad in Iran (14), while in the United States (2), Germany (15), India (Haryana) (16), Punjab (17), Greenland (18), Saudi Arabia (19), Nairobi (20), Brazil (21), China (22), Taiwan (23), and South Korea (24), the prevalence is reported to be higher compared to the present study (Figure 1).

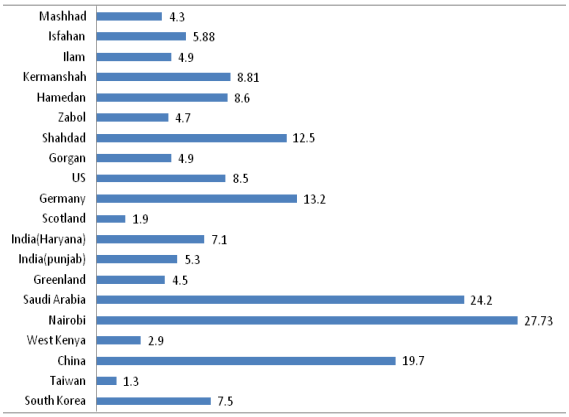

Figure 1. Prevalence of GDM in Various Studies (internal/external)

In terms of the influential factors in GDM, the findings of the current research indicated significant correlations between the family history of diabetes (OR=4.278), history of GDM (OR=3.880), BMI (OR=2.302), history of preeclampsia (OR=1.914), history of recurrent miscarriage (OR=1.759), and history of macrosomia (OR=1.656) with the incidence of GDM in the comparison of the case and control groups. On the other hand, the comparison of the case and control groups indicated no significant associations between the history of multiple births (OR=1.633), history of chronic hypertension (OR=1.432), history of stillbirth (OR=1.368), and history of eclampsia (OR=1.274) with the prevalence of GDM.

The review of the national and international studies in this regard demonstrated that variables such as increased age and BMI, history of GDM, and history of diabetes in first-degree relatives are significantly correlated with the prevalence of GDM. Other variables such as macrosomia, recurrent miscarriage, preeclampsia, chronic hypertension, and stillbirth have also been significantly associated with GDM in some studies, while no such correlations have been denoted in others.

Some differences were observed between the current research and previous studies in this regard. Firstly, some studies have been conducted in different geographical contexts with diverse genetic backgrounds, dietary habits, and lifestyles. A small percentage of the studied populations have been non-Iranian, and the clearly higher prevalence of GDM has been reported in various ethnicities and nationalities. Secondly, the strength of the present study was to examine a large number of participants and a wide range of pregnant women receiving prenatal care. Apart from the different age groups, the subjects had diverse socioeconomic statuses and education levels (Table 3).

Limitations of the Study and Suggestions

This study was performed on the patient population referring to the health centers covered by Mashhad University of Medical Sciences. Considering the frequency of age, place of residence, and education levels in the participants, the majority were residents of the rural areas and suburbs of Mashhad, which is considered to be a limitation. Therefore, it is suggested that the electronic health system be installed and made available in the private sector and other parts of the health system in the future, so that more accurate information could be extracted from urban areas as well.

Conclusion

Considering that the frequency and risk factors of GDM vary in different regions of Iran and the world, access to updated information in this regard is paramount. By providing of a new insight into the risk factors of GDM, health authorities will be able prioritize the demand and provide better planning to diminish the burden of GDM complications. Similar investigations could help identify the type and target group of interventions in the community. Consequently, the limited resources in the health system could be invested properly.

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Conflict of Interest

The authors declare no conflict of interest.

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