



## Prevalence and Risk Factors of Gestational Diabetes in Iran: A Systematic Review and Meta-Analysis

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### Abstract

**Background:** Gestational Diabetes (GD) is one of the major public health issues. The purpose of the present study was to perform a systematic review and meta-analysis to assess the risk factors and prevalence rate of this disorder in Iran.

**Methods:** This systematic review and meta-analysis article was prepared using the databases of Science Direct, PubMed, Scopus, Magiran, Iranmedex and SID, Google search engine, Gray Literature, reference lists check and hand searching using keywords such as "prevalence", "gestational diabetes mellitus", "GDM", "risk factor\*", "Iran" and "Postpartum Diabetes". The selected papers were fully reviewed and the required information for the systematic review was extracted and summarized using extraction table in Microsoft Office Excel software.

**Results:** Twenty-four of 1011 papers were quite relevant to the objectives of the review so they were included. The mean age of the participants was  $29.43 \pm 4.97$  yr and the prevalence of GDM was 3.41% (the highest and the lowest prevalence rates were 18.6% and 1.3% respectively). Among the influential factors mentioned in the literature, potential causes of GDM are gestational age, history of gestational diabetes, family history of diabetes, body mass index, abortions and parity, and history of macrosomia.

**Conclusion:** Considering the high prevalence of postpartum diabetes and its related factors in Iran, strategic planning for disease prevention and reduction is inevitable.

**Keywords:** Prevalence, Gestational diabetes, Risk factors, Iran

### Introduction

Chronic diseases are considered as the major public health problems of today's world (or within contemporary societies). Diabetes is one of the most important metabolic dysfunctions which is often asymptomatic in the early stages that mani-

fest as chronic hypoglycemia which causes damage to body organs while increasing blood sugar levels (1-5). One of the main forms of diabetes is gestational diabetes mellitus (GDM) defined as glucose intolerance that occurs for the first time

or is first identified during pregnancy (6-10). Women with gestational diabetes who have elevated fasting blood glucose levels appear to be exposed to an increased risk for fetal macrosomia and perinatal complications if no treatments are provided (11). The assessment of the disease prevalence depends on area of study, population, differences in data collection methods, using random selection method for choosing potential participants for research and diagnostic criteria used (12, 13). The main method of GDM is using a 50-g nonfasting one-hour glucose challenge test between 24 and 28 weeks' gestation. For women with a positive screening test, the 100-g three-hour oral glucose tolerance test is executed to diagnose gestational diabetes (14, 15).

A number of worldwide studies have reported different prevalence rate of gestational diabetes prevalence varying from 1% to 14% (16-21). The differences are more evident in studies conducted in Iran where the reported prevalence of the disease differed greatly from 1/3 to 18/8 (12, 22). The cumulative incidence of diabetes ranges from 2.6% to over 70% in studies that examined women 6 weeks postpartum to 28 years postpartum (23).

Due to the high heterogeneity among the study results and the importance of prevention and treating gestational diabetes, which constitutes a major burden for health care service systems, the accurate determination of GDM prevalence is necessary using appropriate research methodology and summarizing the influencing factors for better monitoring and better planning. Given the importance of the subject, it was decided to perform a systematic review and meta-analysis of all relevant studies conducted in Iran on the prevalence and risk factors for GDM.

## **Materials and Methods**

In this systematic review and meta-analysis in which we used the databases of Science Direct, PubMed, Scopus, Magiran, Iranmedex and SID, Google search engine, Gray Literature, reference lists check and manual journal searching (such as:

J Obstet Gynaecol Can, Arch Gynecol Obstet, Diabet Med, World J Diabetes, and etc.) was also conducted, using keywords such as "prevalence", "gestational diabetes mellitus", "GDM", "risk factor\*", "Postpartum Diabetes", and "Iran". These databases were searched in both English and Persian papers published between 1985 and 2012. The inclusion criteria of the articles were the studies that were conducted to determine the prevalence of GDM, investigated the various aspects of the epidemiology of GDM, and conducted in Iran. Excluded studies were those that were presented in conferences, case reports, and intervention studies.

The selected papers extracted from the databases were assessed by two investigators using checklists. Discrepancies between the two raters were referred to the third investigator. First, the titles of all articles were reviewed to screen for eligibility and those found to be inconsistent with the objectives of the study were excluded from the survey. In the later stages, the abstracts and full text articles were examined to identify and exclude those that did not satisfy the inclusion, or had a weak correlation with the objectives of the study. The initial search resulted in 1011 articles. After excluding irrelevant ones and those that were alike in various databases or had poor correlation with the objectives of the review, 24 articles were enrolled in this study. The process of entering the meta-analysis is shown in Fig.1. The selected papers were fully reviewed and the required information for the systematic review was extracted and summarized using extraction table in Microsoft Office Excel software. Comprehensive Meta-analysis (CMA) version 2.0 (Englewood, NJ, USA) software was used to estimate and conduct a meta-analysis to determine the prevalence of the disorder. Forest plot diagrams were used to illustrate the study findings in which the area of each square was proportionally sized to signify the sample size and the lines drawn in each square represented 95% confidence interval for the prevalence rate of gestational diabetes in each of the studies. Funnel plot was used to examine the publication bias.

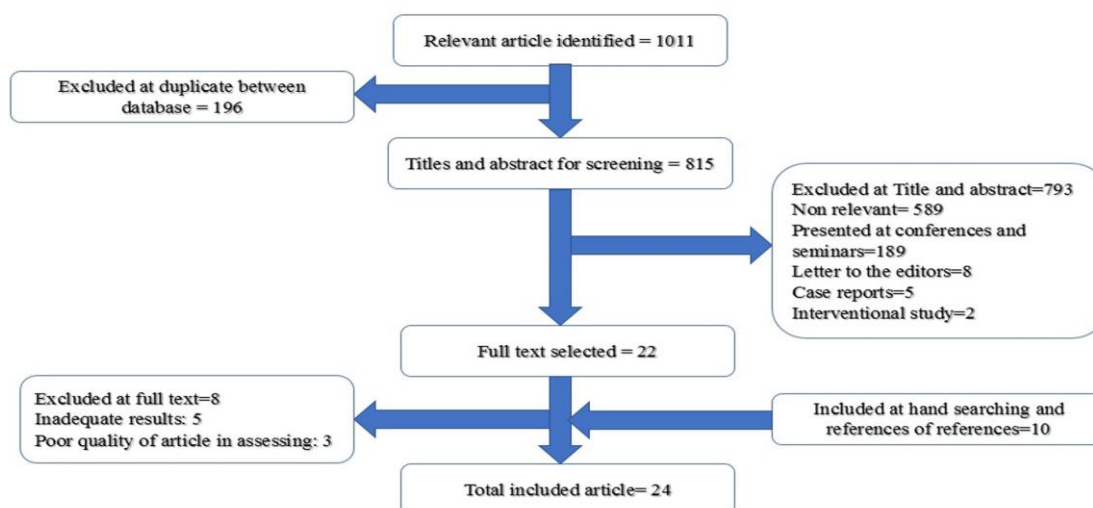


Fig. 1: Flow diagram of the searches and inclusion process

## Results

Overall, 24 out of 1011 papers were quite relevant to the objectives of the review so they were included (Table 1). In Iran, Tehran Province had the highest frequency of conducted studies (10 out of

the 24 studies). Overall 26,203 samples were evaluated in these articles (mean age=29.43±4.97). Mass screening was used in 14 of 24 reviewed papers. The screening test in 3 articles was 75 g over 1-hour while it was 50 g over 1-hour at the others.

Table 1: Characteristics of selected and studied articles in the study

No.	Reference number	Sample size	Mean age	Type of screening	Week of pregnancy	GDM Prevalence %
1	43	980	27.6±5.2	Random classification	24-28	5.1
2	44	1720	30.9±5.2	Random screening	24-28	3.43
3	45	678	30±5.3	Public method	24-28	4.3
4	46	1112	25.54±5.03	Public	24-28	6.76
5	47	668	28±4	Clustering-Multi stage	24-28	18.6
6	48	2416	25.29±5.49	Public	24-28	4.7
7	49	1310	30±5.2	Public	24-28	4.8
8	50	820	29±6	Multi stage randomized sampling	20-28	3.59±2.3
9	51	2221	27.44±5.85	Randomized and clustering	26	(3.9-5.7)4.8
10	52	800	28.2±5.6	Public	24-28	(4.7-8.4)6.3
11	53	910	25.27±5.46	Public	24-28	(1.01-2.84)1.75
12	54	1209	21.11±1.85	Public	24-28	(1.5-3.2)2.23
13	55	84	31±6.89	Public	24-28	(5.85-20.8)11.9
14	56	5107	30.4±5	Census	24-28	(2.80-3.78)3.3
15	57	401	24.69±5.31	Public	24-28	(2.81-7.15)4.7
16	58	1200	29.1±5.14	Public	24-28	(5.55-8.5)6.9
17	59	—	—	Public	24-28	1.3
18	60	246	23.7±1.3	Public	24-28	(2.25-7.89)4.4
19	61	450	—	Public	24-28	(1.54-4.89)2.9
20	62	970	29.12±5.14	Public	—	-----
21	63	670	—	—	24-28	3.3
22	64	200	31.35±3.80	All who have at least a risk factor CDM.	24-28	<b>10</b>
23	65	601	29.62±6.7	—	24-28	1.3
24	66	1430	—	—	—	7.3

The highest and lowest prevalence reported were 18.6% and 1.3% in, respectively, Karaj and Ardebil. Among the influential factors mentioned in the literature, potential causes of GDM are gestational age, history of gestational diabetes, family history of diabetes, body mass index, abortions and parity, history of macrosomia. Out of 24 pa-

pers, two articles were excluded due to methodological and statistical problems and 22 were entered in meta-analysis using CMA software. Forest plot Fig. 2 shows the GDM incidence, confidence interval 95% and weight coefficient of each of these 22 studies.

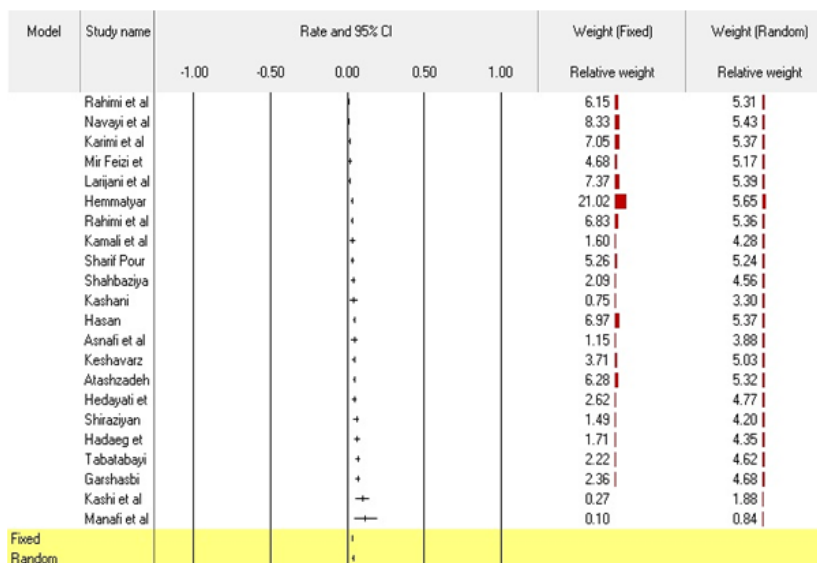


Fig.2: The prevalence of gestational diabetes mellitus in Iran with CI 95% (Fixed model of meta-analysis)

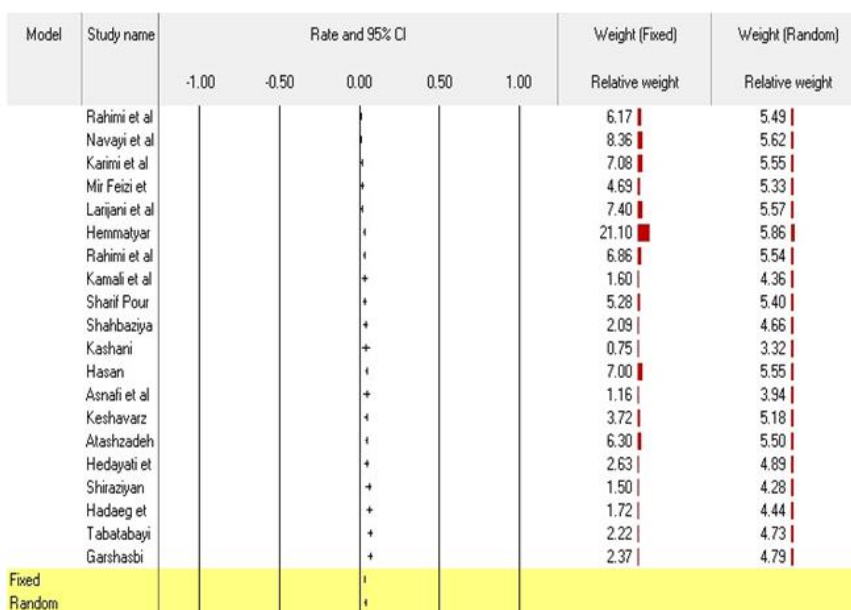


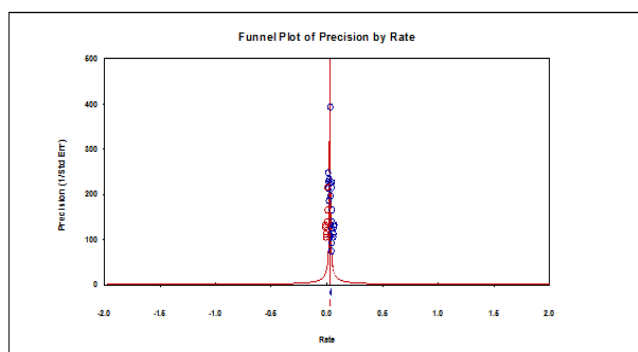
Fig.3: The prevalence of gestational diabetes mellitus in Iran with CI 95% (Fixed model of meta-analysis after excluded two heterogenic studies)

Fixed model of meta-analysis showed that the prevalence of postpartum diabetes was 0.034 with a standard error of 0.001 (Q-Value= 180.795, I-Squared=88.385).

In this stage, the studies by Kashi and Manafi were excluded from the meta-analysis as were considered outliers and it was repeated without these two surveys. The results are represented in Forest plot Fig. 3.

After excluding two studies with outliers, results showed that prevalence of diabetes after pregnancy is 0.034 with standard deviation of 0.001. In addition, we found that Q-value=167.049 and I-squared=88.625.

Funnel plot was used to evaluate the publication bias, which is shown in Fig.4.



**Fig.4:** Funnel plot was used to evaluate the publication bias

## Discussion

Gestational diabetes can cause side effects for both pregnant mother and her fetus but proper management of it can prevent complications (24). The prevalence of GDM is growing in all developed and developing countries (16) and it is estimated that its increase will continue in coming years due to increasing mean age of population, urban sedentary lifestyle and increasing the number of obese women (25). Effective planning, firstly, requires accurate knowledge of the disease prevalence and associated factors. The results of the present study, showed the prevalence of GDM to be 3.4% (the highest and lowest incidence rate were 18/6% and 1/3%, respectively).

The researchers rated the following to be the most important risk factors in gestational diabetes: history of gestational diabetes, family history of diabetes, body mass index, abortions and parity, and history of macrosomia.

The prevalence of GDM was estimated as 3.4%. This rate is lower compared to 3.9% reported by Janghorbani and Anjazad (12). This difference could be due to the adopted method of calculating and estimating the prevalence in these two studies. In the aforesaid study, the incidence was calculated using arithmetic means but in the present survey, it has been calculated through meta-analysis of the results using the software and considering the impact of the number of samples which can be more accurate and reliable in our method. During 1992 and 2007, Nikoo Khoshniyyat and colleagues (26) performed another review study on 18 articles and only noted GDM prevalence range (1.3% to 10%) but without any estimation of it. Their estimated incidence range (1.3 to 18) was lower than the range recommended in the present study representing increase in GDM prevalence. GDM varies in prevalence in different parts of the world that shows great heterogeneity so that ranged between less than 1 percent to about 14 percent in different areas (lowest was less than 1% in a study conducted in Singapore and Tanzania (27, 28) and highest was 14% in India (18). Incidence rates of this disease in Canada, Turkey, Japan and China were reported to be 12.8% (29), 1.23% (30), 2.9% (31), and 2.31% respectively (32). Significant differences in different countries and even within each of them can be due to differentiation in races and cultures. So it has been reported to be more prevalent among black race as well as Asian, Arab and Chinese women than Caucasian is and European women. The preferred screening and diagnostic methods and their accuracy and even cut off points for gestational diabetes can play a significant role in this regard (33-36). Despite the rich diversity of cultures and races in Iran in the present survey, the incidence of GDM among different ethnic groups and cultures has not been examined. Therefore, it cannot be firmly concluded that the differences in

various regions are due to the diversity in ethnicities and cultures.

The factors such as age over 30 years, previous history of GDM, family history of diabetes, high body mass index, history of abortion and genetic disorders, are widely recognized as the effective risk factors on the prevalence of GDM (37-42) which is consistent with the results of our reviewed literatures. Yet across the studies, there is more consistency among the results related to GDM risk factors than the prevalence rate differences. Therefore we can rely on the findings of the conducted studies then more effective GDM prevention and reduction programs can be implemented, including the programs for improving the culture and planning for reducing childbirth age (considering the high prevalence of GDM in older women), planning further care of the women with history of diabetes, family history of diabetes, abortion and genetic disorders as well as weight loss planning during and even before pregnancy for the overweight women.

Our study showed the prevalence of GDM data in 14 provinces of Iran (Tehran, Ardebil, West Azarbaijan, Semnan, Isfahan, Ilam, South Khorasan, Bandarabbas, Mazandaran, Gilan, Khuzestan, Karaj, Yazd and Kermanshah). This means that similar information is not available for other 17 provinces. Furthermore, the results of some of the studies conducted in these provinces are not valid and reliable due to the low number of samples and methodological problems that indicates the information gap in this area. Since decision-making in macro-level necessarily requires information from all regions of a country so it is recommended to perform more studies with larger sample sizes along with sound methodological principles to allow estimating the prevalence of GDM in Iran's provinces.

One of the main limitations of this study was the missing of complications assessment, as far as the complications of GDM is the most prominent result of this condition. One of the other limitations of this study was limitations of research databases, because many of the epidemiological researches in field of GDM are conducted as theses of students in different ranks, which are not pub-

lished as valid articles and are just reported to research councils of universities.

## Conclusion

GDM is usually associated with an increased risk for a number of complications during pregnancy and postnatal period for the mother and her offspring. According to present study prevalence of GDM is relatively high which might be attributed to different factors. These with other problems such as emotional-psychological disorders and care spending lead us to consider gestational diabetes as one of the major health problems in the world requiring effective prevention and control strategies. In this regard having accurate and reliable information on the prevalence and influential causes for planning and decision making and intervening seem essential for this group of patients, thus the results of the present study can be used in these areas.

## Ethical considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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