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Prevalence of Gestational Diabetes in Iran: A Systematic Review and Meta-analysis

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Abstract

Background: Gestational diabetes mellitus (GDM) is the most common complication of pregnancy and an important public health concern. Several studies have investigated the prevalence of gestational diabetes in different parts of Iran with different results.
Objectives: The present study aimed to review studies on gestational diabetes prevalence and estimate the prevalence of gestational diabetes in Iran.
Methods: A search on gestational diabetes mellitus and related synonyms was conducted using global and national databases, including PubMed, Science Direct, Scopus, Web of Sciences, Google Scholar, SID, IranMedex, Magiran, Irandoc, Medlib. Moreover, gray literature and reference checks and a library search were conducted. Keywords included: prevalence, Iran, gestational diabetes mellitus (GDM), and their synonyms. The inclusion criteria were observational studies (cross-sectional, prospective cohorts, and retrospective cohorts) published in Persian or English between 2000 and 2020 on the prevalence or incidence of gestational diabetes in Iran, a sample size of more than 100 people, and availably of full texts. The selected articles were thoroughly reviewed, and after quality assessment, the required information was extracted and included in the meta-analysis.
Results: From 907 articles, 48 were included in the meta-analysis according to the inclusion criteria, which included 51,259 patients with an average age (standard deviation) of 27.05 years (1.83). The overall prevalence of GDM in Iran was 10% (11,9: 95% confidence interval). The prevalence of GDM had increased in recent years, from 4% before 2005 to 16% in 2016 to 2020 (20,12: 95% CI). There was significant heterogeneity between studies, and the I-square index was 98%.
Conclusion: The prevalence of gestational diabetes in Iran is slowly increasing. The increasing prevalence of gestational diabetes can seriously threaten the health of mothers, fetuses, and newborns in the near future.

Keywords: prevalence, gestational diabetes, meta-analysis, Iran

Introduction

Gestational Diabetes Mellitus (GDM) is defined as glucose intolerance that occurs for first time or in first identified during pregnancy. Gestational diabetes can lead to various complications and threats for the mother and fetus [1,2]. Mothers with gestational diabetes are at risk for gestational hypertension, preeclampsia, premature birth, and cesarean section [3]. In these women, the risk of gestational diabetes during the next pregnancy will be 40%, and glucose intolerance is more common in the next pregnancies in obese women.

Moreover, after labor, the risk of type 1 or type 2 diabetes and cardiovascular risk factors such as dyslipidemia, hypertension , abdominal obesity, and metabolic syndrome increases in the future [4].

Infants born to mothers who have gestational diabetes are at higher risk of macrosomia, birth injuries, congenital malformations, hyperbilirubinemia, neonatal hypoglycemia, and type 2 diabetes in the future [5]. In several studies, this pregnancy complication has been demonstrated to be asymptomatic and complex. Therefore, health policymakers should be pay more attention to its early diagnosis, prevention, and control during pregnancy through healthy nutrition and physical activity [6-8]. Today, the prevalence of diabetes has significantly increased, so that it's estimated that 382 million are suffering from diabetes all around the world, and by 2030, it is forecast to become the fifth cause of death in the world. Different countries use different diagnostic criteria to determine the prevalence of gestational diabetes [9]. Based on these criteria, estimates of GDM prevalence worldwide range from 1% to 14% [10]. In Iran, the prevalence of this pregnancy complication is different in different geographical regions due to differences in the climate, ethnicity, nutrition, and physical activities, which is evident in various studies. The reported prevalence of this disease varies from 1.3 to 18.8 percent [11]. Due to the high heterogeneity among the results and the importance of prevention and treatment of gestational diabetes, a major burden on the health systems, the assessment of the prevalence of GDM is necessary for monitoring and planning thorough research projects. The preventive measures include self-care training and increased care during pregnancy to reduce its complications. Considering the issue's importance, we aimed to conduct a systematic review and meta-analysis of all studies on the prevalence of gestational diabetes in Iran. Hitherto, the prevalence of gestational diabetes in Iran has been investigated in 3 previous systematic reviews [10,12,13]. These studies had limitations such as not including a meta-analysis, flaws in the study design (including review studies), skipping the important stage of quality assessment of the primary studies, not considering the repetition in all three stages of article selection and quality assessment and extracting data, and not considering the resolution of disagreements. In addition, the last meta-analysis conducted in this field was published in 2015, and the search period was until 2012, while since then, many studies on the prevalence of gestational diabetes in different regions of Iran have been published. Therefore, more articles were included in this meta-analysis compared to previous systematic review studies indicates the importance of conducting this study.

Methods

Search strategy:

The present study is a systematic review and meta-analysis designed to investigate the prevalence of gestational diabetes in Iran. This study is based on a search in national and global databases. National databases, including SID, IranMedex, Magiran, Irandoc, and Medlib, and international databases, including Google Scholar, Science Direct, Scopus, PubMed, and Web of Sciences, were searched. Also, other sources (Gray literature), including hard copies of magazines, thesis, and the references of the selected articles, were examined. The search was carried out using the keywords "prevalence," "Iran", "GDM", "Gestational diabetes mellitus", "Diabetes, Pregnancy-induced", "Gestational diabetes", "Pregnancy-induced diabetes", "Diabetes mellitus, gestational" (according to the MeSH thesaurus system) and their Persian equivalents through an advanced search strategy which combined these terms with AND and OR operators. Using these keywords, all Persian and English articles published between 2000 and 2020 were searched in the mentioned databases. For example, in the PubMed database, the following search syntax was used:

[("gestational diabetes mellitus" OR "diabetes, pregnancy-induced" OR "pregnancy-induced diabetes" OR "gestational diabetes" OR "diabetes mellitus, gestational" OR GDM) AND prevalence AND Iran]

Inclusion and exclusion criteria:

The inclusion criteria are observational studies (cross-sectional, prospective, and retrospective cohorts) in Persian or English published between the years 2000 and 2020 on the prevalence or incidence of gestational diabetes in Iran, having a sample size of more than 100 people, and the access to the full text. It should be noted that there

was no restriction on the type and method of screening for gestational diabetes. Exclusion criteria included duplicate reporting of results in other articles, abstracts, review articles, interventional studies, case reports, posters, and letters to the editor.

Study selection and quality assessment:

Study selection was performed by two authors independently using the inclusion and exclusion criteria check list. Initially, the title and abstract of the articles were reviewed to screen for eligibility and relevance, and the unrelated ones were excluded. In the next step, the full text of the articles was carefully read, and those had a weak (poor) correlation with the objectives of the study and not meeting the inclusion criteria were discarded. The reason for the rejection of the articles was recorded. Disagreements were resolved by the authors' discussion. The percentage of agreement between the two authors was 89%, and the Kappa statistics for checking reliability was 72% with $P<0.001$.

The quality assessment of the selected articles was performed by two authors using the Joanna Briggs Institute (JBI) critical appraisal tool. The JBI checklist is a standard tool for evaluating articles designed by the JBI Institute to critically evaluate descriptive studies [14]. The checklist used in this study includes nine items. This tool contains questions that include all aspects of the methodology, such as the compatibility of the study population with the target population and generalizability, determination of sample size and quantitative adequacy, sampling method, description of samples and setting, response rate or non-response rate, and statistical analysis methods. It should be noted that the authors modified this 9-question instrument according to the purpose of the study, and items 6 and 7, referring to the "validity and reliability of the tool" used in the articles," were excluded, and seven items were included [15]. These questions were irrelevant as in the studies conducted to investigate the prevalence or rate of GDM, the diagnostic tool for diabetes mellitus, oral glucose tolerance test in two stages or one stage at 24-28 weeks of pregnancy, was based on national guidelines. Before 2012, a two-step method was used, in which the GCT (Glucose Challenge Test) screening test was performed first, and the blood sugar levels were measured after consuming 50 grams of oral glucose, and if the result was equal to or higher than 140 mg/dl in the second stage, GTT (Glucose Tolerance Test) diagnostic test was performed using 100 grams of oral glucose. In this manner, fasting blood sugar was measured first, and then blood sugar was measured one, two, and three hours after consuming the glucose solution. If two of the following were detected, the mother was diagnosed with gestational diabetes: fasting blood sugar less than 95, one-hour glucose less than 180, two-hour glucose less than 155, and three-hour glucose less than 140 mg/dl. However, since the summer of 2012, the national guidelines for diagnosing gestational diabetes were changed from a two-stage method to a single-stage one. In the one-step OGTT (Oral Glucose Tolerance Test) method, fasting blood sugar and blood sugar levels are measured one and two hours after consuming 75 grams of oral glucose. Normal values include fasting sugar of less than 92, one-hour glucose of less than 180, and two-hour glucose less than 153 mg/dl. If one of the mentioned items are abnormal, the diagnosis of gestational diabetes is made. For this reason, the prevalence of gestational diabetes in some studies was reported based on a two-stage method and in more recent ones with a single-stage method [16].

Studies with 6 or 7 points were classified as high-quality studies, 5 points as medium quality, and 4 or less points as low-quality studies [17-19]. Disagreements were resolved through discussion.

The selected articles were fully reviewed, and the required information was extracted by two independent authors using tables in Microsoft Office Excel software. Again, the cases of disagreement were resolved by discussion and dialogue between the authors. A checklist of the necessary information, including the name of the author or authors, the year of publication, study location, study design, sample size, the average age of participants, parity, diagnostic criteria for gestational diabetes, gestational age and the points of quality assessment was prepared for data evaluation.

Heterogeneity and publication bias:

The Chi-square test was used to evaluate the statistical heterogeneity, the I^2 (I-squared) statistical index to assess the inconsistency through studies result, and the tau-square statistical index to evaluate the variance between

studies. Although the statistical index I^2 is not suitable for the statistical evaluation of the heterogeneity of prevalence studies, unfortunately, no alternatives existed. [20,21].

Subgroup analysis was used for the investigation of the reasons for heterogeneity. In addition, meta-regression was used to evaluate the effect of the mothers' mean age on prevalence heterogeneities. A Forest Plot was used to illustrate the study findings, and a Funnel Plot was used to examine the publication bias.

Ultimately, a meta-analysis was performed to calculate the prevalence of gestational diabetes in Iranian pregnant women. RevMan (Review Manager) version 5.2 and Stata software version 16 were used for meta-analysis and determining the desired outcome's prevalence. The results were reported using the random-effect model with 95% confidence interval [22].

Results

In the initial search, 907 studies were found, of which 860 studies were from national and global databases, and 47 were detected in searching conferences, theses, and other sources. Of the 907 studies, 216 articles were excluded due to duplication, and 613 were not related to our objective based on the titles and abstracts. Then the full text of the remaining 78 articles was reviewed, and 30 studies did not meet the eligibility criteria (Figure 1). Finally, we included 48 studies (Table 1) which reported the prevalence of gestational diabetes in a meta-analysis, which included 51,259 patients with a mean (standard deviation) age of 27.05 years (1.83). Among 51,259 samples, 4,671 participants had gestational diabetes [16,23-69]. Most studies on the prevalence of gestational diabetes were conducted in the Tehran province (15 studies out of 48 studies).

Table 1: Characteristics of Selected and Studied Articles in the Study

Author(year)	province(city)	parity	Age (mean)	study design	sample size	Type of screening	gestational age	Quality assessment
shahdadi(2016)	Zabol	NR	26.2	Cross-Sectional	363	OGTT (one-step)	24-28w	Low
khooshideh(2008)	Zahedan	multi/primi	NR	Prospective	400	OGTT (one-step)	24-28w	Low
Mirfeizi(2010)	Karaj	multi/primi	28.27	Cross-Sectional	668	GCT/GTT (two-step)	24-28w	Medium
Moradi(2015)	Kerman (Rafsanjan)	multi/primi	27.72	Cross-Sectional	290	OGTT (one-step)	24-32w	Low
Nazari-Robati(2016)	Kerman (Shahdad)	multi/primi	26.12	Cross-Sectional	160	GCT/GTT (two-step)	NR	Low
Hashemi-Nazari(2018)	Kermanshah	multi/primi	28	Retrospective Cohort	1010	OGTT (one-step)	24-28w	High
Rahimi(2017)	Kermanshah	multi/primi	27.97	Cross-Sectional	1272	OGTT (one-step)	24-28w	High
Rahimi(2010)	Kermanshah	multi/primi	26.7	Cross-Sectional	1720	GCT/GTT (two-step)	24-28w	High
Dorostkar(2015)	Hameden (Razan)	NR	NR	Cross-Sectional	493	OGTT (one-step)	24-28w	Low
Zanganeh(2018)	Hamedan	multi/primi	30.6	Cross-Sectional	620	OGTT (one-step)	24-30w	Low
Borzouei(2018)	Hamedan	NR	26.8	Cross-Sectional	534	OGTT (one-step)	24-28w	Medium
Vakili(2016)	Yazd(Meibod)	multi/primi	26.6	Cross-Sectional	1209	OGTT (one-step)	24-28w	Low
Vakili(2014)	Yazd	multi/primi	26.55	Cross-Sectional	400	GCT/GTT (two-step)	24-28w	Medium
Soheilykhah(2010)	Yazd	multi/primi	27	Prospective	1071	GCT/GTT (two-step)	24-28w	Low
Rahimi(2004)	Ardebil	multi/primi	24.7	Cross-Sectional	601	GCT/GTT (two-step)	24-28w	Low
Hadaegh(2004)	Bandarabas	multi/primi	24.9	Cross-Sectional	800	GCT/GTT (two-step)	24-28w	Medium
Karimi(2003)	Boushehr	NR	25.27	Cross-Sectional	910	GCT/GTT (two-step)	24-28w	Low

Hedayati(2012)	Birjand	multi/primi	27.6	Cross-Sectional	980	GCT/GTT (two-step)	24-28w	Medium
Agah(2017)	Sabzevar	multi/primi	27.6	Cross-Sectional	609	OGTT (one-step)	24-28w	Low
Keshavarz(2003)	Semnan (Shahrood)	multi/primi	NR	Cross-Sectional	1310	GCT/GTT (two-step)	24-28w	Low
Parham(2018)	Qom	multi/primi	27.19	Cross-Sectional	4988	OGTT (one-step)	24-28w	Medium
Mohammadzadeh(2013)	Gorgan	multi/primi	27.2	Cross-Sectional	1276	GCT/GTT (two-step)	24-28w	Low
Behboudi-Gandevani(2011)	Tehran	multi/primi	32.45	Prospective Cohort	1804	GCT/GTT (two-step)	24-28w	Low
Garshasbi(2008)	Tehran	multi/primi	26.9	Prospective Cohort	1804	GCT/GTT (two-step)	24-28w	Low
Garshasbi(2005)	Tehran	NR	NR	Cross-Sectional	1200	GCT/GTT (two-step)	24-28w	Low
Hematyar(2008)	Tehran	NR	27.6	Cross-Sectional	5107	OGTT (one-step)	24-28w	Low
Mokhlesi(2014)	Tehran	multi/primi	NR	Prospective Cohort	1033	GCT/GTT (two-step)	24-28w	Low
Hossein-nezhas(2007)	Tehran	multi/primi	NR	Cross-Sectional	2416	GCT/GTT (two-step)	24-28w	Low
Kashanizadeh(2006)	Tehran	multi/primi	23.7	Process Research	246	GCT/GTT (two-step)	24-28w	Medium
Pirjani(2016)	Tehran	multi/primi	28.70	Prospective Cohort	256	OGTT (one-step)	24-28w	Low
Ekhtiari(2016)	Tehran	multi/primi	30.5	Cross-Sectional	271	OGTT (one-step)	24-28w	Low
Navaee(2002)	Tehran	multi/primi	24.7	Prospective	820	GCT/GTT (two-step)	20-28w	Medium
Atashzadeh-shoorideh(2006)	Tehran	multi/primi	26.03	Cross-Sectional	2221	GCT/GTT (two-step)	26	High
Kamali(2003)	Tehran	multi/primi	NR	Cross-Sectional	450	OGTT (one-step)	24-28w	Low
Niroomand(2019)	Tehran	multi/primi	26.4	Cross-Sectional	1117	OGTT (one-step)	24-28w	High
Shirazian(2009)	Tehran	multi/primi	-	Prospective	924	OGTT (one-step)	24-28w	Medium
Shirazian(2008)	Tehran	multi/primi	-	Prospective Cohort	670	OGTT (one-step)	24-28w	Low
Manafi(2013)	Urmia	NR	24.34	Cross-Sectional	250	GCT/GTT (two-step)	24-28w	Low
Ghasemi kaklar(2018)	Urmia	NR	27.84	Cross-Sectional	301	GCT/GTT (two-step)	24-28w	Low
Goli(2013)	Esfahan	multi/primi	27.2	Cross-Sectional	2014	GCT/GTT (two-step)	24-28w	Medium
Hosseini(2018)	Esfahan	multi/primi	29.2	Prospective Cohort	929	OGTT (one-step)	24-28w	Medium
Tabatabayi(2007)	Esfahan	multi/primi	25.54	Cross-Sectional	1112	GCT/GTT (two-step)	24-28w	Medium
Shahbazian(2016)	Ahvaz	NR	28.43	Prospective	750	OGTT (one-step)	24-32w	Low
Shahbazian(2011)	Ahvaz	multi/primi	26.6	Cross-Sectional	678	GCT/GTT (two-step)	24-28w	Low
Asnafi(2007)	Babol	multi/primi	24.69	Cross-Sectional	401	GCT/GTT (two-step)	24-28w	Medium
Bouzari(2013)	Babol	NR	NR	Cross-Sectional	1004	GCT/GTT (two-step)	24-28w	Low
Ghadiri(2018)	Sari	multi/primi	NR	Cross-Sectional	627	GCT/GTT(two-step) and OGTT(one-step)	24-28w	Medium
Bayat(2020)	Zanjan	multi/primi	NR	Cross-Sectional	1340	OGTT (one-step)	24-28w	Low

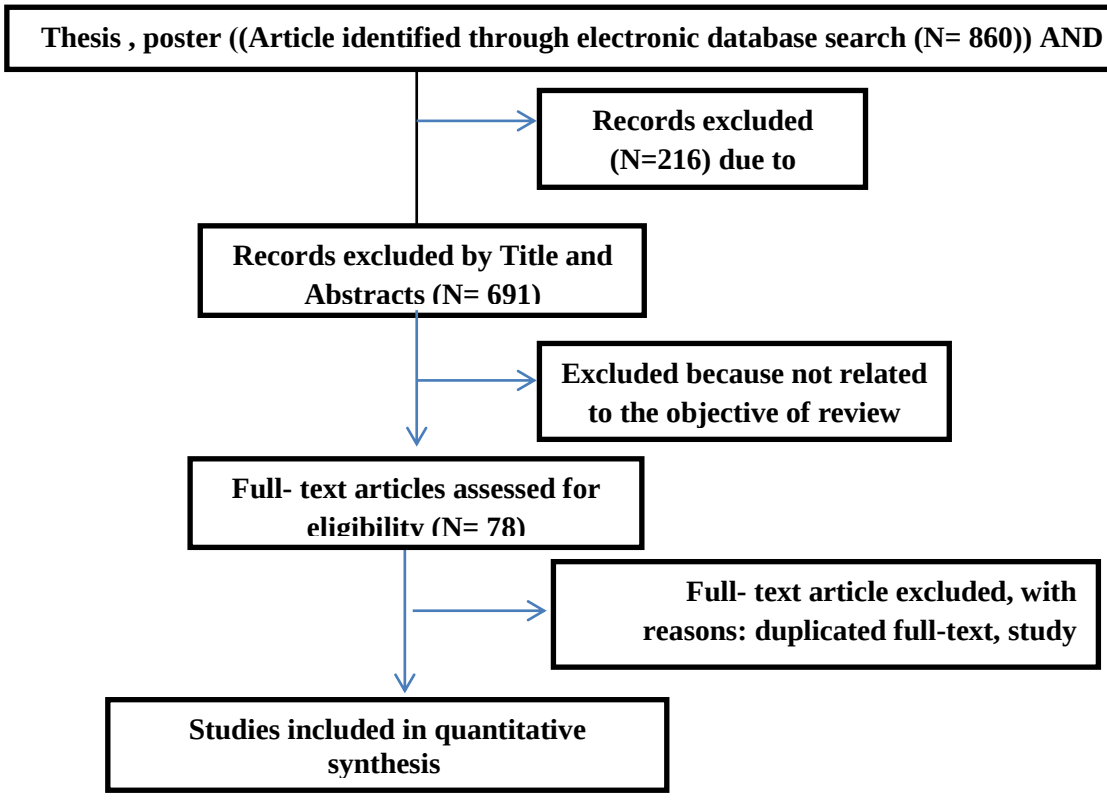

Figure1: A Flow Diagram Showing the Phases of Development Through the Meta-Analysis

The total prevalence of gestational diabetes among Iranian pregnant women was 10% (11, 9: 95% confidence interval). The prevalence of gestational diabetes in 2005 and before was 4% (2.6: 95% confidence interval), but it increased during subsequent years and reached to 6% from 2006 to 2010 (5.8: 95% confidence interval). And then went to 9% (11, 7: 95% confidence interval) in the years 2011 to 2015, and finally, 16% (20, 12: 95% confidence interval) in the years 2016 to 2020 (Figure 2).

The prevalence of gestational diabetes in cross-sectional and retrospective studies was 10% (8-11: 95% confidence interval), and its incidence in prospective studies was 11% (8-15: 95% confidence interval) (Figure 3).

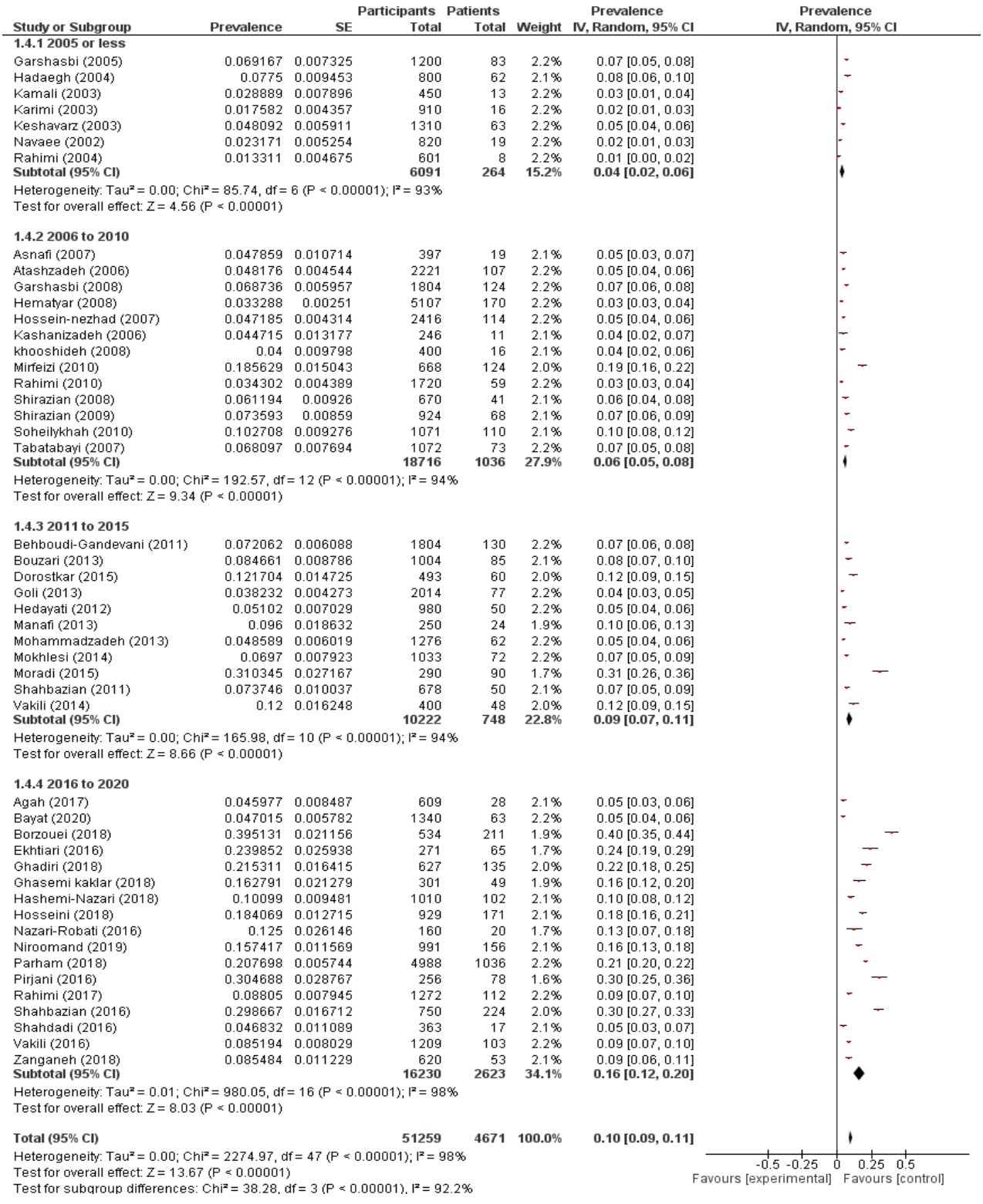

Figure2: Forest plot of GDM Prevalence by Year Among Iranian Pregnant Women

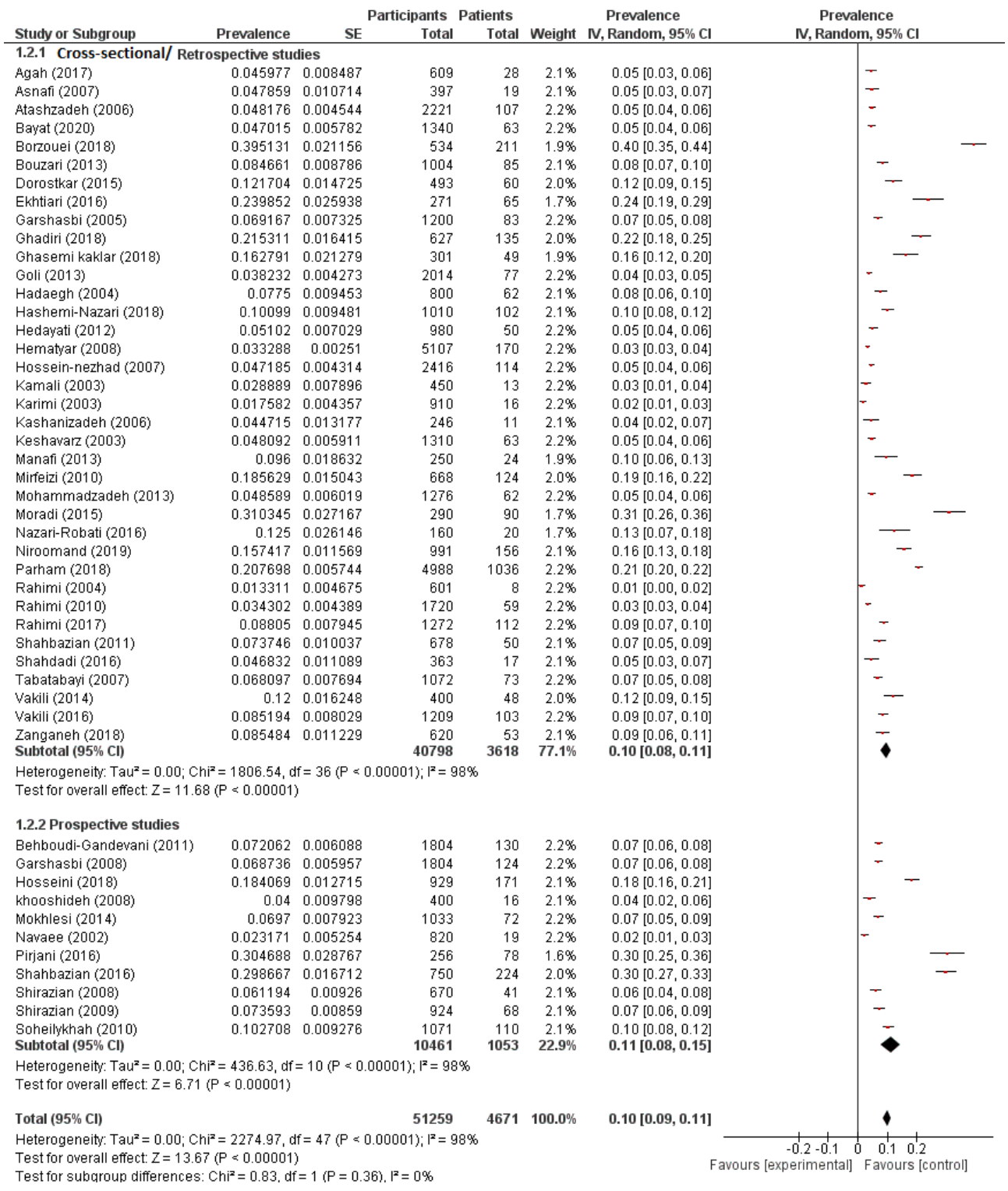

Figure3: Forest Plot of GDM Prevalence by Design of the Studies

The screening and diagnosis method for gestational diabetes in 26 studies out of 48 studies was the old two-step method, where the first screening was done with 50 grams of oral glucose. If the blood sugar was equal to or higher than 140 one hour later, the diagnostic test with

100 Grams of oral glucose was conducted, and blood sugar levels were measured while fasting. Then, the glucose levels were measured one, two, and three hours after consuming the glucose solution. If at least two of the concentrations were equal or higher than the set limit, the was considered as gestational diabetes. By using the two-step method, the prevalence of GDM was calculated as 7%. In 21 studies, a new one-step method was used, and the prevalence rate was 14% with this method. In a one-step method, fasting blood sugar was measured one hour and two hours after the intake of 75 grams of oral glucose. When a blood sugar higher than the determined limit was recorded, a diagnosis of gestational diabetes was made. Both methods were used in only one study, which showed the highest prevalence rate (22%). (Table 2).

48 included studies underwent quality assessment using the modified JBI checklist and were divided into three categories based on their quality: 5 studies (10.42%) had high quality, 14 studies (29.17%) had medium quality, and 29 studies (60.41%) had low quality. All studies were included in the meta-analysis [70,71]. The prevalence of gestational diabetes was investigated based on different qualities of studies. The results were different, and moderate-quality studies reported higher gestational diabetes prevalence. (Table 2).

Table 2: Subgroup Analysis of Prevalence of GDM

	prevalence	95% CI	P-Value	I^2	P-Value
Quality of studies					
High	0.08	0.05-0.12	P<0.001	97%	P<0.001
Medium	0.12	0.08-0.16	P<0.001	99%	P<0.001
Low	0.09	0.08-0.10	P<0.001	97%	P<0.001
Year of the studies					
2005 or less	0.04	0.02-0.06	P<0.001	93%	P<0.001
2006-2010	0.06	0.05-0.08	P<0.001	94%	P<0.001
2011-2015	0.09	0.07-0.11	P<0.001	94%	P<0.001
2016-2020	0.16	0.12-0.20	P<0.001	98%	P<0.001
Location of studies					
Tehran and central cities	0.10	0.08-0.11	P<0.001	98%	P<0.001
West and north western cities	0.11	0.07-0.15	P<0.001	98%	P<0.001
South and southern west cities	0.15	0.07-0.023	P= 0.002	99%	P<0.001
North and eastern north cities	0.09	0.05-0.13	P<0.001	96%	P<0.001
East and southern east cities	0.05	0.04-0.06	P<0.001	0	P= 0.66
Design of studies					
Retrospective studies	0.10	0.08-0.11	P<0.001	98%	P<0.001
Prospective studies	0.11	0.08-0.15	P<0.001	98%	P<0.001
Screening type of studies					
One step screening	0.14	0.11-0.17	P<0.001	99%	P<0.001
Two step screening	0.07	0.06-0.08	P<0.001	94%	P<0.001
Both method	0.22	0.18-0.25	P<0.001	--	--

There was considerable heterogeneity among the included studies. The Chi-square test results for heterogeneity were highly significant (p less than 0.00001), and the I-square statistic was 98%. Despite the significant heterogeneity, Tau-square was zero. In order to decrease the heterogeneity, the studies were divided into subgroups based on the year, study design, geographical areas, quality, and type of screening; the I-square statistic in these subgroups was finally reduced to 93%, which was not significant. A funnel plot was used to evaluate the publication bias, which proved the presence of publication bias (Figure 4).

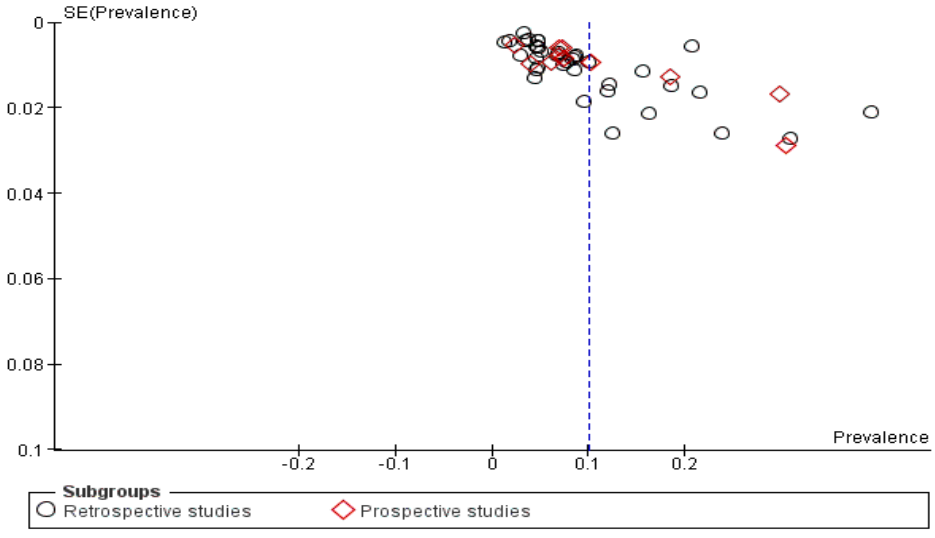

Figure4: Funnel Plot was used to Evaluate Publication Bias

Discussion

The results of this review showed that the prevalence of gestational diabetes in Iranian pregnant women was 10% (0.09-0.11: 95% confidence interval), which indicates that it had increased in recent years in Iran, and from 4% before 2005 reached to 16% in the years 2016 to 2020. In a study conducted by Jafari Shabiri on the prevalence of gestational diabetes in Iran, an increased prevalence was reported, which is consistent with the results of this study. Nonetheless, in this study, the prevalence of gestational diabetes was reported as 3.4%, which is lower compared to ours. This indicates an increase in the prevalence of GDM [10]. In another study by Almasi on the prevalence of gestational diabetes in Iran, this prevalence was reported as 5.88, which indicates a gradual increase in the rates of gestational diabetes in Iran [12]. The prevalence of gestational diabetes is growing in all developed and developing countries, and it is estimated that its increase will continue in the future. This can be attributed to the rise in the population, the sedentary urban lifestyle, and the increase in female obesity. Therefore, the management of this complication of pregnancy will be challenging [72]. The prevalence of diabetes has been reported at 3.65% in Canada, 3.63% in Australia, 1.8% in America, and 3.6% in Japan [73,74]. According to the World Health Organization reports, globally, 7-10% of women have gestational diabetes [75], and in the Asian regions, including Iran, this prevalence is 11.5% [1].

The results of this study showed that a highest prevalence of gestational diabetes was recorded in the south and southwest regions of Iran, and the east and southeast regions had the lowest prevalence. This might be due to race, ethnicity, and lifestyle differences in different parts of Iran. However, as the GDM incidence among different ethnic groups in Iran has not been investigated, this should be mentioned with caution. Also, factors such as screening and diagnostic methods can play an important role in the assessment of gestational diabetes.

In the included articles, there were two GDM screening and diagnosis methods. One was a new one-step screening method by measuring fasting blood sugar one hour and two hours after receiving 75 grams of oral glucose. The other one was the conventional two-step method, where the first step was the intake of 50 grams of oral glucose and measuring blood sugar one hour later. If the values are equal to or higher than 140, the second step followed: testing with 100 grams of oral glucose and measuring blood sugar one, two, and three hours later. The results of this study showed that the prevalence of gestational diabetes determined with the new method was higher than with the old method (14% vs. 7%). In the group in that both methods were used, the prevalence of

gestational diabetes was higher (22%). Although a wide range of recommendations and expert-approved guidelines for the diagnosis of gestational diabetes exist, there is no consensus in this regard. Obstetricians and endocrinologists use both screening methods and diagnostic criteria, and even differences exist between different regions of one country. Screening methods vastly vary and include fasting plasma glucose measurement, random glucose measurement, oral glucose challenge test, one or two steps, 75 g or 100 g of glucose, test duration for 2 or 3 hours, glucose threshold values, and whether 1 or 2 high glucose values are used for diagnosis. Although the recommendations of the International Association of Diabetes and Pregnancy Study Groups (IADPSG) are the first evidence-based guidelines for the diagnosis of GDM and are globally used, there is a paucity of information about the effectiveness in improving fetal outcomes and are often based on expert opinion, and are universally accepted [76].

This study showed that the GDM prevalence was higher in middle-quality studies, and the I^2 index was similar in high-quality and low-quality studies (I2=97%). Therefore, the quality of the studies did not affect the reported prevalence of gestational diabetes.

This study showed that the prevalence of GDM in prospective studies was slightly higher than in retrospective studies (11% vs. 10%). Moreover, no heterogeneity differences were observed between prospective and retrospective studies. Since the prevalence is related to the incidence and duration of the disease and considering this short duration in pregnancy, the prevalence was lower than the incidence despite the high incidence.

There was strong evidence of heterogeneity among the results of the included studies (I^2=98%), which may be attributed to the large number of primary studies (48 studies) and large sample size (51,259 participants) included in the meta-analysis. Because when the sample size is small, the power of the Chi-square test is low. In contrast, when the sample size is high like this study, the test has high power for detecting a small measure of heterogeneity that may be clinically unimportant. Another reason could be the existence of the significant differences in the results of the included studies.

Since information from all regions of a country is needed for decision-making at a macro-level, more extensive studies should be conducted in the culturally-different areas of the country. Generally, based on the results of this study, it can be concluded that the prevalence of gestational diabetes in Iran is gradually increasing. The increasing rate of gestational diabetes can be a serious warning that threat the health of maternal, fetal, and infants in the near future, which should be focused by special attention particularly by policy makers and health planner who plan preventive and controlling programs.

As the prevalence of GDM is higher in older women, policies should target older women and those with a history of diabetes, family history of diabetes, abortion, and genetic disorders, as well as pre-pregnancy weight loss in overweight women. This can reduce the rate of gestational diabetes in the country.

Our study investigated the prevalence of gestational diabetes in Iran, but the articles were from only 20 provinces (out of 31). This means that the required information was unavailable for the other 11 provinces, and the results of studies in some areas could have been more reliable due to the small sample sizes.

Another limitation of this study was that many analyzed papers were students' theses, many unpublished as articles with no available full text of this thesis is not available.

Another limitation of this study is that only 10.42% of the original studies were of high quality, which increases the possibility of information bias. In addition, a high proportion of the studies were conducted in the Tehran province, which again increased the risk of selection bias.

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 increasing with a mild slope in Iran, which indicates a major challenge for the health of mothers, fetuses, and infants. Hence, policy-makers should pay more attention to this issue.

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.

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Conflict of interest
The authors have no conflicts of interest to declare.

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