

## **A review on the prevalence of gestational diabetes mellitus (GDM) in different regions of Iran**

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### **Abstract**

**Background:** According to the importance of the screening and treatment of gestational diabetes mellitus (GDM) in preventing adverse maternal and fetal complications, awareness of GDM prevalence in different parts of Iran seems to be necessary.

**Methods:** We reviewed studies which have been assessed the prevalence of gestational diabetes mellitus in different regions of Iran. For collecting data, online resources and local databases were searched and researchers in this field were questioned.

**Results:** The information was available in 11 out of 30 provinces of Iran. Collectively 18 surveys were assessed from 1992 to 2007. The prevalence of GDM ranged between 1.3% and 10%.

**Conclusion:** A wide range of GDM prevalence was reported in different regions of Iran. For enhancement the accuracy of evaluations of the GDM prevalence, also to facilitate the comparison of data, it is suggested to apply similar protocols for definition and screening of GDM in local researches of different regions of the country.

**Keywords:** Prevalence, Gestational Diabetes Mellitus, Iran

## Introduction

Gestational diabetes mellitus (GDM) is defined as impaired glucose tolerance which recognized or begun for the first time during the pregnancy [1]. GDM is the most prevalent disease during the pregnancy and approximately occurs in 2-5 % of all pregnancies [2]. Its prevalence ranges from 1-14% in different countries [3]. The least prevalence has been reported from Singapore and Tanzania (<1%) and the most in Pima Indians which was more than 14 %. [2]. The prevalence in Quebec (Canada) was 12.8% [4], in north east of Turkey was 1.23 % [5], in Japan was 2.9 % [6] and in China was 2.31 % [7]. The diversity in the prevalence of GDM in different countries are resulted from differences in ethnicity and race of population and also the methods and cut off points which are used in screening and diagnosis [8, 9]. Gestational diabetes mellitus leads to increase incidence of postpartum diabetes in mother and some adverse maternal and fetal ramifications during the pregnancy and the postpartum period [10-15]. It may be possible to prevent many maternal and fetal complications by strategies such as timely screening methods and managing blood glucose in afflicted pregnant women. There are two methods for GDM screening: Universal and Selective. American Diabetes Association and the Society of Obstetricians and Gynecologists of Canada suggest the selective screening method [16, 17]; however, some other studies suggest the Universal method with regards to reducing the cost of diabetes complications [18].

According to the importance of the screening and treatment of gestational diabetes mellitus (GDM) in preventing adverse maternal and fetal complications, awareness of GDM prevalence in different parts of Iran seems to be necessary.

For detecting the ethnical and racial differences in incidence and prevalence of GDM in different regions and recognizing

the provinces which needs more consideration in this field and planning thorough strategies for screening and diagnosis, the studies from different regions of Iran should be evaluated. Because of diversity in the reported GDM prevalence from different studies, it seems necessary to pay more attention to the methodology of studies and design the same protocols.

Accordingly, the aim of the present study was to review epidemiological studies on GDM prevalence in different regions of Iran.

## Methods

For collecting data, online resources and local databases were searched and researchers in this field were questioned. These resources were: Scopus, Pubmed, Irandoc, Iranmedex, SID, dissertations and articles. The key words according to MESH were gestational diabetes AND prevalence AND Iran. We applied the articles which were published in Persian or English languages and used the Persian dissertations which had reasonable quality regarding the population size, study design, screening and diagnosis methods.

Inclusion Criteria were descriptive, cross sectional studies which were done between 1992-2007 with at least 100 participants and assessed the prevalence of GDM in women with 20 to 28 weeks gestational age from different provinces, had used of GCT (Glucose Challenge Test) screening test with cut off points of blood glucose  $\geq 130, 135$  or  $140$  mg/dl. Also, they had been applied oral glucose tolerance test with 100 gram or 75 gram glucose with Carpenter and Coustan or NDDG Criteria. There was no limitation on the style of screening and all surveys which have performed selective or universal screenings were included.

Collectively, 18 studies and dissertations were found between 1992 and 2007 [19-36]. Six studies were done in Tehran which five were from urban areas [19-23] and one was done in suburbs of Tehran [24]. Twelve other surveys were done in other different provinces. Four dissertations were

excluded out of these 18 studies because of didn't apply GCT and OGTT tests [28, 32, 33, 36].

The limitation of this article was inability of comparing the results of studies due to applying different screening and diagnostic methods, unequal sample size, and diversity of participant gestational ages. The accepted screening and diagnostic methods were GCT 50g1h and OGTT 100g3h. The time of screening was different in selected studies, but all except one was between 24-28 weeks of gestational age. In addition, the cut off points for screening and diagnosis were different. The cut off point for positive GCT were serum glucose  $\geq 130$  or 135 or 140 mg/dl and positive OGTT were defined as using Carpenter and Coustan criteria or National Diabetes Data Group (NDDG) criteria [17].

## Results

Except one study in Tehran, in which the women were screened in 20-28 weeks of gestational age, participants of other studies were evaluated in 24-28 weeks [19, 24]. The study design in majority was cross sectional or descriptive. All applied the universal screening except two studies: Kashi et al. in Sari used selective screening test in women with at least one risk factor for gestational diabetes, And Kashanizadeh et al. in Tehran was selectively screened the 24-28 weeks pregnant women who had no risk factor for GDM (age $>$ 25, being overweight before pregnancy, family history of diabetes, personal history of GDM, macrosomic newborn in previous pregnancies, intrauterine death, polycystic ovary syndrome and polyhydramnios were defined as risk factors for GDM) [22, 25]. In most of studies, the screening test was GCT 50g1h and the cut off points were  $\geq 140$  or 130. Just in Babol, it was targeted at greater than 135 [25]. Among studies, four dissertations were excluded. These dissertations were done in Kerman,

Shahrud, Yazd and Kermanshah, and they didn't apply GCT and OGTT test [28, 32, 33, 36]. Almost all studies performed OGTT by 100 gram glucose and using Carpenter & Coustan or NDDG criteria, however, Kamali et al. used OGTT by 75 gram glucose and the ADA diagnostic criteria [11, 23]. Three studies – Atashzadeh in Tehran, Garshasbi in Tehran and Hadaegh in Bandarabbas – had been used Merck Glucose for screening tests [19, 20, 30].

There were various exclusion criteria in reviewed studies which are as following: presence of mental disorders [19], history of taking medications which interact with glucose metabolism such as corticosteroids [19,29,30,35], presence of lipodystrophy and ataxia-telangectasia, malnutrition [19], chronic liver diseases [30,35], thyroid diseases [29,30], history of medical and systemic disease [23,29], hypertension [30], connective tissue disorders [30,35] multiparity and abortion , pregnancy complications which necessitate urgent termination [27], and history of overt diabetes before pregnancy [19,20,21,23,26,27,30,31,34,35]. The latter was frequent exclusion criterion in almost all studies. The prevalence of positive GCT has been assessed in ten out of 14 reviewed studies in addition to the GDM prevalence [20,22,24,25,26,29,30,31,34,35] (Table-1). Kashanizadeh et al. in Tehran evaluated GDM in 246 pregnant women without any risk factors for GDM and they exclusion criteria were: age  $\geq 25$  years, over-weight before pregnancy, macrosomia, polycystic ovary syndrome, polyhydramnios, intrauterine death, family history of diabetes and previous history of GDM. In aforementioned study, researcher assessed pregnant women at 24-28 weeks by using GCT. Fifty Out of 246 participants from 2001 to 2004 (20.3%) had positive GCT and in overall the prevalence of GDM were 4.4 % [22].

**Table 1. Data summary of GDM prevalence studies in Iran**

Province	City (reference)	Gestational age (weeks)	Screening Type	Screening Method	GCT <sup>1</sup> Criteria	Diagnostic Method	OGTT <sup>2</sup> Criteria	Prevalence of GCT % (n)	Prevalence of GDM <sup>3%</sup>	Study Year
<b>Tehran</b>	Tehran [19]	26	universal	50g1h	≥ 130	100g3h	Carpenter & Coustan <sup>4</sup>	-----	4.8	2000-2001
	Tehran [20] <sup>†</sup>	24-28	universal	50g1h	≥ 130	100g3h	Carpenter & Coustan NDDG <sup>5</sup>	(377/1200)	6.9 3.6	2001-2002
	Tehran [21]	24-28	universal	50g1h	≥ 130	100g3h	Carpenter & Coustan	-----	4.7	1992-1994
	Tehran [22]	24-28	Without any risk factor	50g1h	> 140	100g3h	Carpenter & Coustan	(50/246)	4.4	2001-2004
	Tehran [23]	24-28	universal	75g2h	-----	75g2h	FBS≥95 1h≥180 2h≥155	-----	2.9	2001-2002
	Tehran Villages [24]	20-28	universal	50g1h	≥ 140	100g3h	NDDG	12.9	2.3	-----
<b>Mazandaran</b>	Sari [26]	24-28	with at least one risk factor	50g1h	≥ 130	100g3h	Carpenter & Coustan	32.5	10	-----
	Babol [25]	24-28	universal	50g1h	≥ 135	100g3h	Carpenter & Coustan	11	4.7	2002-2003
<b>Semnan</b>	Shahrud [27]	24-28	universal	50g1h	≥ 130	100g3h	Carpenter & Coustan	-----	4.8	1999-2000
	Shahrud [28] <sup>*</sup>	-----	-----	-----	-----	-----	-----	-----	1.64	2003
<b>Ardabil</b>	Ardabil [29]	24-28	universal	50g1h	≥ 140	100g3h	NDDG	10.6	1.3	2003
<b>Hormozghan</b>	Bandarabbas [30] <sup>†</sup>	24-28	universal	50g1h	≥ 130	100g3h	Carpenter & Coustan	31.6	8.9	2002-2003
							NDDG		6.3	
<b>Kerman</b>	Kerman [36] <sup>*</sup>	-----	-----	-----	-----	-----	-----	-----	90.8	1997-1998
<b>Bushehr</b>	Bushehr [31]	24-28	universal	50g1h	≥ 140	100g3h	-----	6.9	1.75	1998-2000
<b>Yazd</b>	Yazd [32] <sup>*</sup>	3 <sup>rd</sup> trimester	-----	FBS,2hp pBS	FBS>105,2 hpp> 120	-----	-----	-----	3.7	1995
<b>Kermanshah</b>	Kermanshah [33] <sup>*</sup>	24-28	universal	50g1h	FBS>95(2 times) - GCT≥ 140	-----	-----	0.7	-----	2002-2003
<b> Lorestan</b>	Khorrabad [34]	24-28	universal	50g1h	≥ 140	100g3h	NDDG	(11/102)	6.86	2003
<b>Isfahan</b>	Isfahan [35]	24-28	universal	50g1h	≥ 130	100g3h	Carpenter & Coustan	25	6.76	2002-2004

1.GCT= Glucose Challenge Test , 2.OGTT= Oral Glucose Tolerance Test , 3.GDM = Gestational Diabetes Mellitus, 4.Carpenter & Coustan = FBS ≥ 95, 1h ≥180, 2h ≥155, 3h ≥140, 5. NDDG = National Diabetes Data Group (FBS ≥105, 1h ≥190, 2h ≥165, 3h ≥145 mg/dl), Excluded due to not applying standard methods, † In these studies both diagnostic criteria (Carpenter & Coustan and NDDG) were mentioned

Larijani et al in Tehran (1992-1994) evaluated the prevalence of GDM in young women. In this research, risk factors were defined as: age 25 years or older, belonging special ethnical groups which proved high GDM prevalence, family history of GDM, past history of GDM, macrosomia or any obstetrics complications, glycosuria and obesity. Among 2416 individuals, 1209 women were younger than 25 years old, and by applying the  $GCT \geq 130$  mg/dl and Carpenter and Coustan criteria, the prevalence in young women were 2.23% and it was estimated to be 4.7% in all age groups of sample population [21]. Also, the prevalence of GDM in 2221 women at 26 weeks gestational age in Tehran by using the same screening and diagnostic criteria as Larijani study, were 4.8% (CI 95%: 3.9%-5.7%) [19]. In this study, age more than 30, history of macrosomia or any maternal abnormalities, family history of diabetes, history of abortion, multiparity (more than 5) and stillbirth were classified as risk factors. The prevalence of GDM in 450 women in another study in Tehran (2001-2002) by using OGTT with 75 gram oral glucose and ADA Criteria was 2.9 % [11, 23]. In suburbs of Tehran, 820 women at 20-28 weeks of gestational age were examined by  $GCT \geq 140$  and positive GCT was 12.9%; furthermore, the prevalence of GDM according to NDDG Criteria was 2.3% [24].

In 2001-2002, Garshasbi et al in Tehran compared Carpenter and Coustan and NDDG criteria in estimating the prevalence of GDM in 1200 pregnant women. Risk factors were obesity, glycosuria and the history of GDM and family history of diabetes mellitus. From 1200 participants, GCT with cut off point of 130 was positive in 377 women. The prevalence of GDM by Carpenter and Coustan and NDDG criteria were 6.9 % (Positive Predicted Value: 22%) and 3.6 % (Positive Predicted Value: 11.6%), respectively [20]. Furthermore, Hadaegh et al in Bandar abbas (2002-2003) investigate the prevalence of GDM in 800

women by these two methods. The prevalence of positive GCT was 31.6 % (CI 95%: 28.2%-35.2%) and the prevalence of GDM by Carpenter and Coustan and NDDG were 8.9% (CI 95%: 6.9%-11.3%) and 6.3 % (CI 95%: 4.7%-8.4%), respectively. However, risk factors were as following: family history of diabetes, past medical history of eclampsia and preeclampsia, hydramnios, abortion, stillbirth, neonatal death, hypertension, GDM and multiparity (more than 5) [30].

In Shahrud (1999-2000) and Isfahan (2002-2004) studies, the target groups were at 24-28 weeks and the cut off point for GCT was 130 mg/dl with using Carpenter and Coustan diagnostic criteria. Risk factors in Shahrud were defined as: age more than 30 years, family history of diabetes mellitus in at least one of the first degree relatives, obesity with  $BMI \geq 30$ , past history of macrosomia, fetus or neonate anomalies, stillbirth, abortion, neonatal death with unknown cause, hydramnios, hypertension, preeclampsia and glycosuria. The GDM prevalence was 4.8% in 1310 pregnant women in Shahrud. In Isfahan study, the defined risk factors were family history of diabetes mellitus in first degree relatives, age, gravidity, BMI, past history of problematic pregnancies and height. In Isfahan, the overall prevalence of GDM was 6.76 % (CI 95%: 5.27%-8.25%) [27,35]. The prevalence of positive GCT by cut off point of 140 mg/dl, and the prevalence of GDM by NDDG criteria in 601 women from Ardabil were 10.6 % and 1.3 %, respectively. The prevalence of positive GCT and GDM in 910 women from Bushehr was 6.9% and 1.75%, respectively. The history of overweight (more than 67.5 kg) before pregnancy, family history of diabetes in first degree relatives, past history of macrosomia, hypertension, GDM, stillbirth or any abnormality or death after birth were defined as risk factor in Bushehr [29, 31]. There were two studies in Mazandaran province; the first one was performed in Sari which selectively examined 200 women at 24-28 weeks of gestational age

who had at least one risk factor for GDM. Age  $\geq 25$  years old, past medical history such as repetitive abortion (more than 2 times), preeclampsia, GDM, macrosomia (more than 4 kg), fetal anomalies and stillbirth, BMI before pregnancy  $\geq 25$  kg/m<sup>2</sup>, family history of diabetes mellitus in first relatives were mentioned as risk factors and the cut off point for GCT were 130 mg/dl or more, the diagnostic criteria were Carpenter and Coustan criteria. There were 32.5% of women with at least one risk factor had positive screening test and 10% diagnosed as GDM [26]. Another study in Mazandaran (Babol, 2002-2003) proposed risk factors as following: intrauterine fetal

death (IUF), macrosomia, age more than 25 years old, obesity before pregnancy or within first trimester (more than 90 kg) and family history of diabetes in first relatives. Among 401 women, 11% of patients by GCT  $\geq 135$  mg/dl had positive screening test and by using Carpenter and Coustan criteria, the GDM prevalence was 4.7% [25]. Among 102 pregnant women who were visited during time period of three months in one of the private clinics in 2003 in Khorram abad in Lorestan province, 11 individuals with cut off point of 140 mg/dl had positive screening test and the prevalence of GDM by NDDG criteria was reported 6.86% [34] (Figure-1).

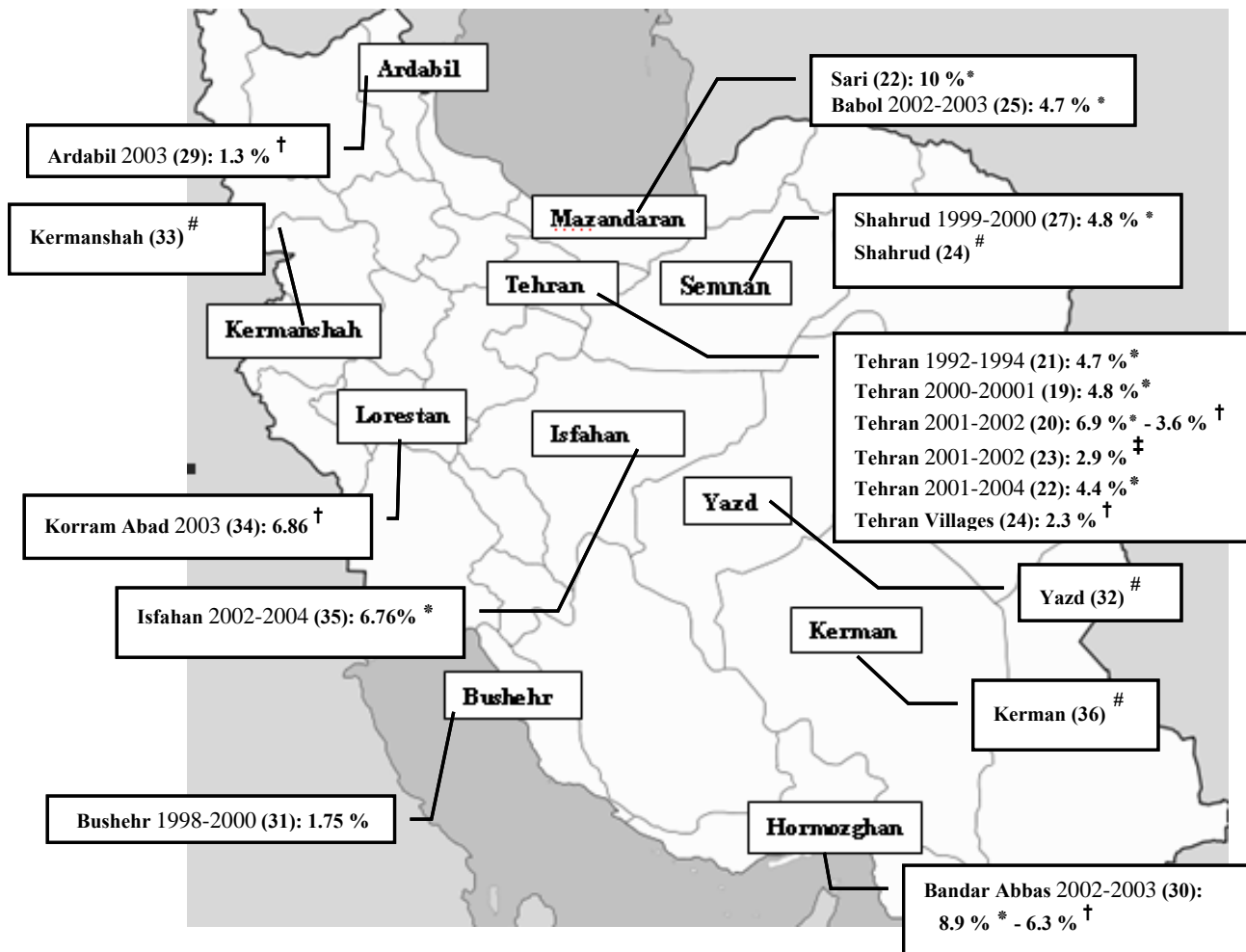


Figure 1 – Iran’s map of GDM prevalence

( ): The Reference Number , \* Diagnosed with Carpenter & Coustan Criteria , † Diagnosed with NDDG Criteria , ‡ Diagnosed with 75 gram Oral glucose Tolerance Test and ADA Criteria , # These articles due to not applying the standard methods eliminated.

## Conclusion

According to 14 studies from 1992-2007, the prevalence of GDM ranged between 1.3% to 8.9% in different regions of Iran.

Recently researchers in Iran have been targeted on different aspects of GDM. For instance, increasing hypertensive disorders in GDM patients or association of some factors such as vitamin D deficiency, low Sex Hormone-Binding Globulin and high serum Leptin concentration with GDM and also about cost and effectiveness of GDM screening methods [37-41]; But, among 30 provinces in Iran, the information about prevalence of GDM was available only in 11 provinces (Tehran, Mazandaran, Semnan, Ardabil, Hormozghan, Kerman, Bushehr, Yazd, Kermanshah, Lorestan, and Isfahan). In fact, there were not precise available data on the prevalence of GDM from 19 provinces in Iran. The dissertations which were done in Yazd, Kermanshah, Kerman and one of the studies from Semnan were excluded because they didn't apply the standard screening and diagnostic methods [28,32,33,36].

It seems that ethnicity may play an important role as a determinant factor for affliction of GDM, partly describes varied reported prevalence in different regions of the world. There are some studies in other countries which reveal the effects of ethnicity and race on prevalence of GDM [8, 9], however, other factors such as varied screening methods and diagnostic criteria beside ethnicity are important factors. Dooley et al. in their study emphasized on the importance of ethnicity besides maternal age and obesity in comparing the prevalence of gestational diabetes in various populations. In their research, the risk of GDM in black and Hispanic women was higher than whites [42]. It is also

demonstrated that Asians (China, Japan, Taiwan, Korea, Vietnam, Thailand, Malaysia, and Laos residents) had more risk to have GDM in comparing with whites, even with lower BMI values. In one study, Asians and Arabic women (Iranians also are categorized in Arabic group) had abnormal GTT to extents more than Caucasians [43]. Esakoff et al. discussed different cut offs for GDM screening based on ethnicity to minimize the false positive rates and maximize the sensitivity of Glucose challenge test. In this study, the prevalence of GDM in overall was 6.3% and with regards to ethnicity, it was greater in Asians with 9.7%, then 7% in Latinas, 4.3% in African Americans, and 4.1% in whites [8]. It seems that Asians especially south central residents, are more susceptible for GDM [9, 44].

In summary, the aim of this study was reviewing studies on GDM prevalence in different parts of Iran. One of the shortcomings of this review was defect in comparing the prevalence of GDM reported in different studies due to unequal sample size, varied screening methods and diagnostic criteria. For enhancement the accuracy of prevalence estimations in different provinces and also for facilitation the comparison of findings and resulting policy makings, it is suggested to apply similar protocols for screening and diagnosis of GDM. According to variety in reported prevalence of GDM in different regions, it may be better to use universal screening in all regions of Iran to help making better decisions about screening methods in the future.

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