# Assessment of gestational diabetes in high-risk women attending Assiut University Women Health Hospital, Egypt

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**Background**
The prevalence of gestational diabetes mellitus (GDM) has increased dramatically worldwide in the last decades, but unfortunately it was not studied in Egypt.
**Objective**
The objective of the study is to assess the prevalence and the risk factors of GDM in Assiut City, Egypt and to assess the better management and follow-up of GDM comparing the results of treatment options on maternal and fetal outcomes.
**Patients and methods**
Our study was a prospective cohort study performed between June 2014 and June 2015. The study included 355 nondiabetic pregnant women at 24–28th weeks of gestation. A total of 242 cases had risk factors for GDM who underwent 75 g 2 h oral glucose tolerance test (OGTT). Diagnosis of GDM was carried out according to International Association of the Diabetes and Pregnancy Study Groups criteria. GDM cases were followed up and treatment was modified according to the targets for capillary blood glucose levels. Patients received an education program about the preferred food items and on the importance of physical activities, and if targets are not met within 1–2 weeks of initiation of lifestyle management, then those patients will be grouped into two groups: a group treated with metformin and another group treated with insulin. All participants were followed up till the end of pregnancy especially: maternal outcomes, for example preeclampsia and cesarean delivery. Also, fetal outcomes, for example macrosomia, hypoglycemia, hyperbilirubinemia, neonatal respiratory distress syndrome, and neonatal death. Follow-up of GDM cases was done at 6–12 weeks postpartum by OGTT 75 g glucose to detect progression to type 2 DM.
**Results**
Our study has shown that the prevalence rate of GDM was 12.4% among the studied group. Family history of DM was the most prevalent risk factor with a highly significant positive relation that occurred in 73.3% of GDM cases ($P<0.001$) compared with 32.5% in non-GDM cases. BMI more than 30 was another important risk factor demonstrated in our study as a significant association was found between prevalence of GDM and obesity (BMI $>30$) was found in 50% of women with GDM ($P<0.001$) compared with 21.2% in non-GDM cases. Of the studied group, 31.8% had no risk factors for GDM, which shows the importance of usinguniversal screening measures. The prevalence of GDM was higher in those living in urban areas (76.7 vs. 23.3%%), *P* value 0.045. Our study showed that the most common complications of GDM were cesarean section, which occurred in 33.3% of cases and preeclampsia, which occurred in 23.3% of cases. Regarding fetal complications, the most frequent complications were macrosomia that occurred in 23.35% of cases and hypoglycemia in newborn babies, which occurred in 16.7% of cases. The use of metformin lessened the occurrence of macrosomia in 27.3% of babies compared with 28.6% with the insulin group. Neonatal hypoglycemia occurred less with the use of metformin in 9.1% compared with 28.6% with insulin use. Also, in our study 23.3% (7/30) of GDM cases progressed to type 2 diabetes when 2-h OGTT 75 g glucose was done at 6–12 weeks postpartum. All of them had a family history of DM in first-degree relatives, obese with a BMI of above 30 and started insulin from the start of diagnosis.
**Conclusion**
The prevalence of GDM in high-risk women attending Assiut University Women Health Hospital was 12.4% and family history of DM was the most frequent risk factors for GDM. High prevalence of BMI more than 30, past history of previous GDM, and the increasing age of the pregnant women were other important risk

factors. Of the GDM women 31.8% had no definite risk factor and this enhances the need for universal screening of all pregnant women instead of selective screening for the high-risk group to pick up more and more cases with GDM. GDM women were more prevalent in urban than in rural areas. Our study showed that the most common maternal complications of GDM were cesarean section, preeclampsia, and postpartum progression to type 2 diabetes. Regarding fetal complications, the most frequent complications were macrosomia and hypoglycemia. Macrosomia occurred less with the usage of metformin compared with the insulin group. Neonatal hypoglycemia occurred less with the use of metformin compared with insulin use. Of the GDM cases 31.8% (7/30) progressed to type 2 DM when OGTT was done at 6–12 weeks postpartum and all of them had a family history of DM in first-degree relatives, obese with a BMI of above 30 and started insulin from the start of diagnosis.

**Keywords:**
Assiut, gestational diabetes mellitus, risk factors of gestational diabetes

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## Introduction

Gestational diabetes mellitus (GDM) is a glucose intolerance disorder that occurs or diagnosed for the first time during pregnancy. It is estimated by international diabetes federation (IDF) that in 2017, 21.3 million or 16.2% of women with live births had some form of hyperglycemia in pregnancy. An estimated 86.4% of those cases were due to GDM [1]. It is associated with an increased risk of short-term and long-term complications for the mother and the baby. Fetal morbidities include macrosomia, birth trauma, hypoglycemia, hyperbilirubinemia, polycythemia, and respiratory distress syndrome. Mothers may have a considerably elevated risk of preeclampsia, cesarean section (CS), and type 2 DM later on [2]. The highest prevalence was reported in the South-East Asian region followed by Middle East and North Africa, with a median estimate of 13%, whereas the lowest was in Europe, with a median prevalence of 5.8% [3]. Screening for GDM is usually conducted at 24–28 weeks of gestation because insulin resistance increases. There is no consensus regarding screening and diagnostic methods for GDM. Screening and diagnostic criteria can be either universal or risk based, a one-step or a two-step procedure. In our study, assessment of the prevalence of GDM in high-risk pregnant women was done using a one-step 75 g 2 h oral glucose tolerance test (OGTT) using the International Association of the Diabetes and Pregnancy Study Groups (IADPSG) criteria [4]. Well-documented risk factors for GDM include family history of diabetes, BMI more than 30, previous GDM, advanced maternal age, having a macrosomic baby, polycystic ovary, and history of twins [2].

## Aim

The aim of the study is to increase awareness about GDM and the importance of early detection in primary health-care providers and among population. To assess the prevalence and the risk factors of GDM in Assiut City, Egypt and also to assess the better management and follow-up of GDM, comparing the results of treatment options on maternal and fetal outcomes.

## Patients and methods

This was a pilot study as a part of the World Diabetes Foundation Project with Assiut University (WDF 13-797).

### Patients

The study was performed in Assiut University Hospital outpatient clinics, Women Health Hospital during the period between June 2014 and June 2015. Patients were recruited from daily follow-up outpatient clinics using the convenience sampling technique. Patients who met the eligibility criteria were informed about the study during their regular care visits.

#### *Inclusion criteria*

All nondiabetic pregnant women who attended the outpatient clinics of Women's Health Hospital of Assiut University Hospital.

Exclusion criteria were any cases of women with pregestational diabetics.

Data of the patients were collected after their consent to participate in the study and through semistructured questionnaires and interviews including age, parity, residence, occupation, history of previous gestational diabetes, history of previous macrosomic baby and family history of DM. Clinical examination and anthropometric measures including BMI were done.

Diagnosis of GDM was done at the first prenatal visit using standard diagnostic criteria: fasting plasma glucose more than 126 mg/dl, or OGTT 2-h plasma glucose more than 200 mg/dl, or classic symptoms with random blood glucose more than 200 mg/dl.

If the initial test was normal, then a 75 g (OGTT) is performed at 24–28 weeks of gestation. Women were advised to take their regular diet for 3 days and to come to the ANC clinic after observing overnight fast (at least 8 h but not for >14 h) for OGTT.

After estimating the fasting capillary glucose, all participants were subjected to OGTT with 75 g anhydrous glucose powder dissolved in 250–300 ml water to be consumed within 5–10 min. Time was counted from the start of the drink. While waiting after the intake of 75 g glucose, women were asked to avoid physical activity for the next 2 h.

The diagnosis of GDM was made when any one of the following plasma glucose values is exceeded: If the fasting plasma glucose is more than or equal to 92 mg/dl, 1-h value is more than or equal to 180 mg/dl, or if the 2-h value is more than or equal to 153 mg/dl [4].

A follow-up of blood glucose was done at every visit and modification of treatment accordingly, for example: preferably 1 h after a meal; targets for capillary blood glucose levels: fasting 90–99 mg/dl, 1 h after starting a meal of less than 140 mg/dl or2 h after starting a meal of less than 120 mg/dl.

Those with GDM should be followed up and encouraged for a lifestyle modification and received education program, which was carried out in the outpatient clinic and were advised about the preferred and nonpreferred food items and were encouraged to partake in physical activities. If targets are not met within 1–2 weeks of initiation of lifestyle management, the patients were continued on lifestyle modifications and had been grouped into two groups: one group treated with metformin and another group treated with insulin (persistently raised fasting blood glucose >95 mg/dl after 1–2 weeks of follow-up, patients' preference of insulin over metformin intake, failed to reach target blood glucose levels by metformin alone) A follow-up till the end of pregnancy was done regarding outcomes such as maternal outcomes, for example preeclampsia and cesarean delivery and also fetal outcomes such as macrosomia, hypoglycemia, hyperbilirubinemia, neonatal respiratory distress syndrome, and neonatal death. Follow-up of GDM cases was done at 6–12 weeks postpartum by OGTT 75 g glucose to detect progression to type 2 DM.

### Statistical analysis

Data were collected and analyzed using SPSS (Statistical Package for the Social Sciences, version 20; IBM, Armonk, New York, USA). Continuous data were expressed in the form of mean±SD while nominal data were expressed in the form of frequency (percentage).

### Ethical consideration

The study was approved by the Faculty's Ethics Committee and permission was obtained from the Ethics Committee, who assured that confidentiality would be maintained and ethical principles would be followed. Patients who met the eligibility criteria were informed about the study and their consents were obtained before the start of the study.

## Results

The present study included 355 pregnant women (at 24th–28th week of gestation), attending Assiut University Women Health Hospital from June 2014 to June 2015. It was found that 53.2% of the studied group were aged more than 25 years, more than half of them (55.5%) were from urban areas, and most of them were working. It was found that nearly half of the studied group had a parity of 3–4; 39.4% had less than 3 and 14.9% from the studied group had a parity of more than 5. It was found that most of the studied women were overweight and obese in 58.3 and 24.8%, respectively, while 16.9% of them had been with normal BMI.

The patients were questioned about the risk factors for GDM. It was found that more than one third of them had a family history of DM, nearly a quarter of them had a BMI of more than 30, with past history of GDM in 18.1% and past history of macrocosmic babies in 16.5%. In our studied group there was a history of polycystic ovary and twins in only 7.8 and 7.4%, respectively. It was found that about 31.8% of pregnant women had no definite risk factors for GDM.

No significant differences were found between screening of GDM by fasting or 1 or 2-h blood glucose testing in the studied group after screening by IADPSG criteria as shown in Table 1.

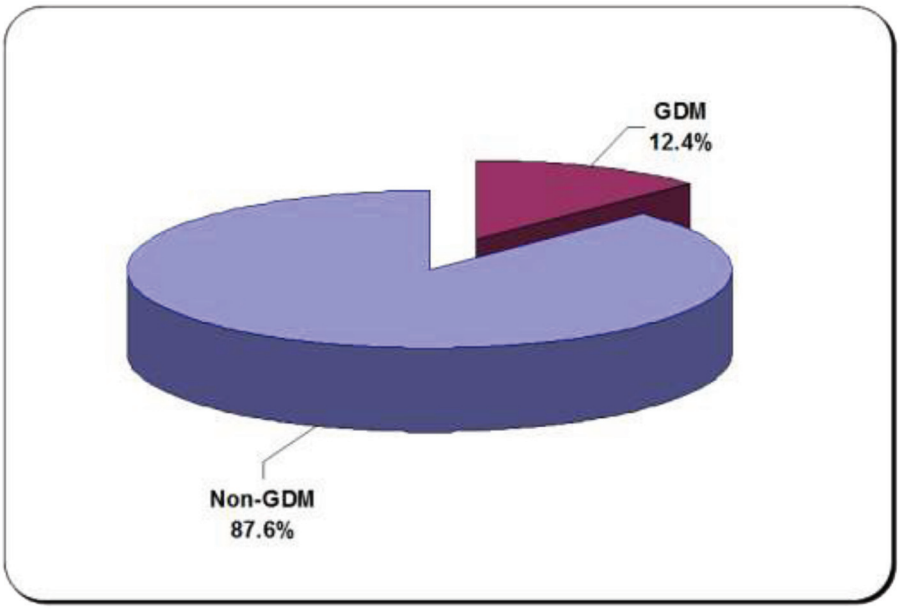
In this study it was found that 12.4% of pregnant women of between 24 and 28 weeks gestation were

**Table 1 Gestational diabetes mellitus among the studied group after screening by International Association of the Diabetes and Pregnancy Study Groups**

| | Fasting (≥92 mg/dl) [*n* (%)] | 1-h OGTT (≥180 mg/dl) [*n* (%)] | 2-h OGTT (≥153 mg/dl) [*n* (%)] | *P* value[a] | *P* value[b] | *P* value[c] |
|---|---|---|---|---|---|---|
| GDM (*N*=30) | 17 (56.7) | 21 (70) | 18 (60) | 0.499 | 0.861 | 0.616 |

GDM, gestational diabetes mellitus; OGTT, oral glucose tolerance test. [a]The difference in *P* value between fasting blood glucose and 1 h postprandial blood glucose. [b]The difference in *P* value between fasting blood glucose and 2 h postprandial. [c]The difference in *P* value between 1 h postprandial blood glucose and 2 h postprandial.

**Figure 1**




The percentage of diagnosed GDM patients among cases with risk factors. GDM, gestational diabetes mellitus.

**Table 2 Gestational diabetes mellitus characteristics according to personal data**

| | GDM (*N*=30) [*n* (%)] | Non-GDM (*N*=212) [*n* (%)] | *P* value |
|---|---|---|---|
| Age (years) | | | 0.788 |
| <25 | 6 (20.0) | 47 (22.2) | |
| ≥25 | 24 (80.0) | 165 (77.8) | |
| Residence | | | 0.045* |
| Rural | 7 (23.3) | 90 (42.5) | |
| Urban | 23 (76.7) | 122 (57.5) | |
| Occupation | | | 0.428 |
| Working | 27 (90.0) | 199 (93.9) | |
| Not working | 3 (10.0) | 13 (6.1) | |

GDM, gestational diabetes mellitus. *P* value is considered significant if less than 0.05. *Significant.

**Table 3 Gestational diabetes mellitus women, according to risk factors**

| | GDM (*N*=30) [*n* (%)] | Non-GDM (*N*=212) [*n* (%)] | *P* value |
|---|---|---|---|
| Family history of diabetes | 22 (73.3) | 69 (32.5) | 0.001* |
| BMI > 30 | 15 (50.0) | 45 (21.2) | 0.001* |
| Past history of PCO | 4 (13.3) | 15 (7.1) | 0.268 |
| History of twins | 2 (6.7) | 16 (7.5) | 0.863 |
| Past history of GDM | 8 (26.7) | 36 (17.0) | 0.198 |
| Past history of macrosomia | 7 (23.3) | 33 (15.6) | 0.296 |

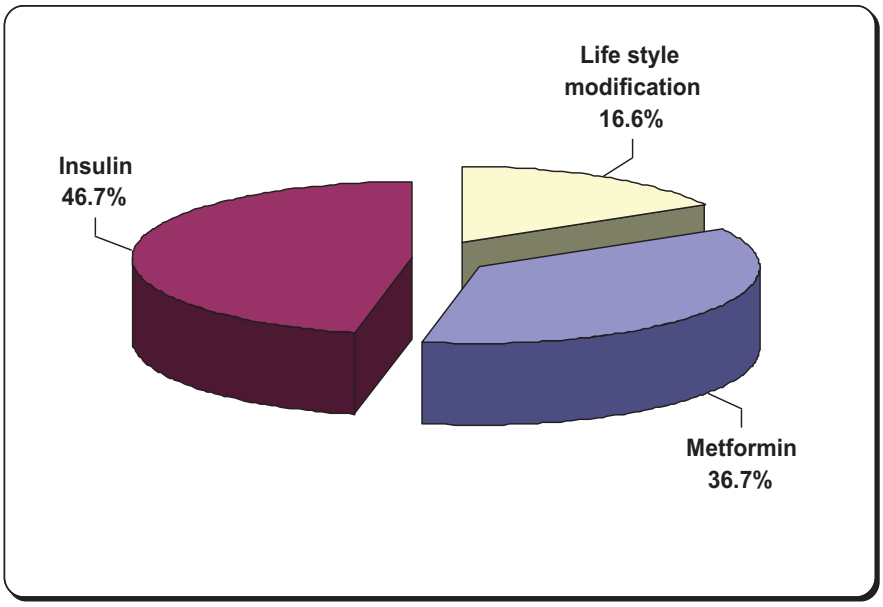
GDM, gestational diabetes mellitus; PCO, polycystic ovary. *P* value is considered significant if less than 0.05. *Significant.

positive for GDM when screened by 2-h 75-g OGTT as shown in Fig. 1.

Tables 2 and 3 show the difference between GDM patients and non-GDM patients regarding their age, residence, occupation, and risk factors for GDM. It was found that a high significant positive family history of diabetes occurred in 73.3% of GDM cases, followed by obesity which occurred in half of GDM cases .

All diagnosed GDM women offered lifestyle modification educational advices. In our study only 16.6% improved with lifestyle modification. The rest of the studied group was divided into two groups: one

**Figure 2**




Lines of management of the GDM. GDM, gestational diabetes mellitus.

**Table 4 Maternal and fetal complications**

| | *N*=30 [*n* (%)] |
|---|---|
| Maternal complications | |
| Preeclampsia | 7 (23.3) |
| CS | 10 (33.3) |
| Progression to type II DM (6–12 weeks follow-up) | 7 (23.3) |
| Fetal complications | |
| Macrosomia | 7 (23.4) |
| Hypoglycemia | 5 (16.7) |
| Stillbirth | 4 (13.4) |
| Jaundice | 3 (10.0) |
| Respiratory distress | 3 (10.0) |

CS, cesarean section; DM, diabetes mellitus.

group treated with insulin from the start (46.7%) and another group treated with metformin (36.7%) (Fig. 2).

Table 4 shows that the most common maternal complication was CS (33.3%), followed by preeclampsia in 23.3% while the most frequent fetal complication was macrosomia that occurred in 23.35% of cases, followed by hypoglycemia that occurred in 16.7% cases.

It was found that macrosomia was more frequent with the use of insulin (28.6%) in comparison to the use of metformin (27.3%). Also, neonatal hypoglycemia occurred in 28.6% of babies born to GDM mothers on insulin therapy compared with 9.1% on metformin as shown in Table 5, with no statistically significant results between insulin and metformin use regarding the incidence of macrosomia and hypoglycemia in newborn babies of GDM mothers due to small numbers of cases.

**Table 5 Effect of gestational diabetes mellitus therapy on fetal outcomes**

| | Metformin (*N*=11) [*n* (%)] | Insulin (*N*=14) [*n* (%)] | Lifestyle (*N*=5) [*n* (%)] |
|---|---|---|---|
| Macrosomia | 3 (27.3) | 4 (28.6) | 0 |
| Hypoglycemia | 1 (9.1) | 4 (28.6) | 0 |

It was found that 23.3% of GDM cases progressed to type 2 DM when followed up by OGTT 75 g glucose at 6–12 weeks postpartum; all the seven cases had a family history of diabetes in first-degree relatives, obese BMI of more than 30, all were of age above 25 years, and all were treated with insulin from the start of diagnosis.

## Discussion

The prevalence of diabetes in Egypt has significantly increased exceeding international rates. Egypt is now ranked the ninth highest in the world in terms of the disease. GDM is a glucose intolerance disorder that occurs or diagnosed for the first time during pregnancy. It is estimated by IDF that in 2017, 21.3 million or 16.2% women with live births had some form of hyperglycemia in pregnancy. An estimated 86.4% of those cases were due to GDM [1].

It is associated with an increased risk of short-term and long-term complications for the mother and the child. Fetal morbidities may include macrosomia, birth trauma, hypoglycemia, hyperbilirubinemia, polycythemia, and respiratory distress syndrome.

Mothers may have a considerably elevated risk of preeclampsia, CS, and type 2 DM later on [2]. The prevalence of GDM has increased dramatically worldwide in the last decades, but unfortunately it was not studied enough in Egypt, especially in Upper Egypt, where, in our knowledge, no previous studies were conducted on GDM prevalence. There are some regional differences in the prevalence of hyperglycemia in pregnancy, with the South-East Asian region having the highest prevalence at 24.2% compared with 10.4% in the Africa region. The vast majority (88%) of cases of hyperglycemia in pregnancy were in low-income and middle-income countries, where access to maternal care is often limited. The prevalence of DM as a major noncommunicable disease in Egypt is rapidly growing probably due to rapid sociodemographic changes [1].

The his study showed that the prevalence rate of GDM was 12.4% among the studied group that used the IADPSG criteria [4]. This result was in agreement with some studies conducted in the neighboring countries of Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and United Arab Emirates where the prevalence ranges from 10.1 to 24.9% [5].

However, these results were not in agreement with the studies in Nigeria [6], which reported an 8.3% prevalence of GDM. Also, a study conducted in Iran [7] reported 3.41% prevalence of GDM. This difference may be related to the difference in the diagnostic criteria used or the population studied.

Family history of diabetes in first-degree relatives is one of the most significant risk factors for GDM, which further emphasizes the role of genetics in susceptibility toward this disease [8]. In our study, it was found that the family history of DM was the most prevalent risk factor with a high significant positive relation that occurred in 73.3% of GDM cases ($P$=0.001) compared with only 32.5% in non-GDM cases. Our results come in parallel to the findings of many other studies [9–12]. Some studies have reported that the most significant risk factor for GDM was a family history of type 2 diabetes [13,14].

Obesity was another important risk factor demonstrated in our study, as a significant association was found between the prevalence of GDM and BMI more than 30 as 50% of women with GDM had a BMI more than 30 ($P$=0.001) compared with 21.2% in non-GDM cases. This was in concordance with other studies; a study had observed that the occurrence of GDM in women with BMI more than or equal to 30 $kg/m^2$ was four times higher than in women with normal body weight [15–18]. The high prevalence of obesity in our studied women could be explained by their sedentary lifestyle and lack of exercise.

In our study, it was found that age more than 25 years had no significant risk in GDM patients. Our study results were not in agreement with studies which had demonstrated that higher maternal age was significantly noticed in women with GDM [19–22].

In our study, it was found that about 31.8% of the studied group had no risk factors for GDM which shows the importance of universal screening measures. A previous study showed the same result [23].

In our study, the prevalence of GDM was significantly higher in those living in urban areas than in rural areas (76.7 vs. 23.3%%). This can be explained, as shown in a previous study, by the fact that there is a transition from rural to urban lifestyle with changes in eating habits, Western diet with increased consumption of fats, sugars, and refined carbohydrates, increased body mass, and decreased physical activity [24].

All diagnosed GDM women were offered educational advices on lifestyle modification. In our study, only 16.6% improved with lifestyle modification. This can be explained by a lack of compliance toward a healthy lifestyle, lack of exercises, and dietetic malpractices in spite of the continued healthy lifestyle educational advices in each follow-up visits.

Then the rest of the studied women were divided into two groups: a group treated with insulin from the start (46.7%) and another group treated with metformin (36.7%), in addition to lifestyle modifications. This was in parallel with the results of study, which showed that lifestyle advice alone does not achieve adequate glycemic control in up to 20% of women and needs to be supplemented with either oral hypoglycemic or subcutaneous insulin [25]. However this was not in agreement with a study in which the majority of cases (90%) were treated with medical nutrition and exercise, only 10% cases were given insulin [26].

Our study showed that the most common complication of GDM was CS, which occurred in 33.3% of cases. A previous study showed that CS rates were higher among women with GDM when compared with those without GDM (26.2%) [27]. Also, other studies have shown the rates of CS have increased to 25.1 [28] and 52% [29].

Our study showed that one of the most common maternal complications of GDM was preeclampsia, which occurred in 23.3% of cases, which was in agreement with previous studies [30]. However, preeclampsia occurred in 1.8% of women with GDM [27].

Regarding fetal complications, the most frequent complication was macrosomia that occurred in 23.35% of cases . This was in agreement with a study that showed that 40% babies were macrosomic at birth [29]. This was in disagreement with studies where the prevalence of macrosomia in GDM cases were 13.9 [27] and 3.88% [26]. Macrosomia had been frequent in our GDM cases due to the high prevalence of obesity among GDM cases and in those using insulin therapies.Our study showed that hypoglycemia in newborn babies occurred in 16.7% of cases, while the incidence of hypoglycemia in babies was 8% only in a previous study [29]. In our study, it was found that the incidence of macrosomia and hypoglycemia in newborn babies of GDM mothers was more with the use of insulin than metformin.

Our results were in agreement with a study known as metformin in gestational diabetes study; the results have been favorable to metformin. It has been reported that there is less incidence of hypoglycemia with the use of metformin in comparison to insulin regimes as in a previous study [31]. Furthermore, previous studies have shown that the incidence of neonatal hypoglycemia was less with metformin than insulin [32,33].

The present study was in disagreement with a study that showed a significant difference between both groups as regards fetal birth weight. Average birth weights were lower in the metformin-treated group, where the percentage of those with macrosomia were 3.4% in the metformin-treated group and 13.8% in the insulin group. The pooled results showed significant difference between the two groups as regards the rate of large for gestational age [34].

Insulin therapy could be difficult for pregnant women. As there are many barriers for the use of insulin in general and in GDM in particular due to multiple injection requirements, risk of hypoglycemia, and weight gain. Metformin decreases hepatic gluconeogenesis, improves peripheral and hepatic sensitivity to insulin, and does not induce hypoglycemia [35].

In our study, 23.3% of GDM cases progressed to type 2 diabetes by 2 h OGTT 75 g glucose, which was done at 6–12 week postpartum. This was in agreement with a study which showed that 34% was the rate of DM after 6–12 weeks postpartum [36]. Furthermore, a study of showed that 16.2% patients were found to have diabetes after 6–12 weeks follow up [29]. A high prevalence of progression of GDM cases to type 2 DM can be explained by increasing obesity, frequent incidence of family history of DM, and lack of compliance to lifestyle modification advices in the studied group.

## Conclusion

According to the IADPSG criteria, the prevalence of GDM in high-risk women attending Assiut University Women Health Hospital was 12.4% and in our locality it was found that family history of DM and the prevalence of obesity were the most frequent risk factors for GDM.

Of the GDM women 31.8% had no definite risk factor and this enhances the need for universal screening of all pregnant women instead of selective screening for the high-risk group to pick up more and more cases with GDM.

The most common maternal complications of GDM were CS and preeclampsia. Regarding fetal complications, the most frequent complication was macrosomia and hypoglycemia. The incidence of macrosomia and hypoglycemia in newborn babies of GDM mothers was more with the use of insulin than metformin.

### Limitations of our study

(1) More evaluation of GDM and follow-up in a larger number of patients is recommended.
(2) The limitation is that it covers only one center in Assiut University Hospital. The population does not coincide with the general makeup of GDM percentage because the study was done at a tertiary referral center.
(3) Further advanced studies among larger populations are required to generate more reliable data to prevent false positives and increase the specificity of the test.

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Nil.

### Conflicts of interest

There are no conflicts of interest.

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