Prevalence of gestational diabetes mellitus by applying the International Association of the Diabetes and Pregnancy Study Groups criteria for diagnosis among Saudi women in King Salman Hospital in Tabuk-Kingdom of Saudi Arabia

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ABSTRACT

Objectives: The global prevalence of gestational diabetes mellitus (GDM) is between 1% and 14%, which is associated with adverse maternal, fetal and neonatal outcome. Saudi Arabia is one of the countries with high GDM prevalence. The aim of this study was to assess the prevalence of GDM using IADPSG and to investigate the associated risk factors that contribute to it. Methods: A cross-sectional study at King Salman Hospital was conducted from January 2014 to January 2015. A total number of 850 files of women who had undergone 75g glucose tolerance test (OGTT) between 24 and 28 weeks of gestation were randomly selected. The information including maternal demographic, parity, maternal BMI, obstetric and medical history; previous diagnosis of GDM and family history of Diabetes mellitus was collected from these cases. Later, women were divided into two groups; those having GDM and other not having GDM. The research was approved by both the committees of King Salman Hospital and the University of Tabuk. Results: Overall prevalence for GDM using the IADPSG criteria among the 850 women was found to be 50.7%. The fasting plasma glucose was the most common abnormal value seen in OGTT among women diagnosed with GDM. High BMI, older age, high Parity, Previous history of GDM and family history of diabetes mellitus were observed among women with GDM group and not with those without GDM, especially when using fasting blood glucose criteria. Conclusion: High prevalence of GDM was observed by applying the IADPSG criteria. There was a significant difference among the risk factors for both groups like high BMI, older age, high Parity, Previous history of GDM and family history of diabetes millets.

Keywords: Gestational diabetes mellitus, IADPSG diagnostic criteria, risk factors for GDM, prevalence of GDM.

INTRODUCTION
Gestational diabetes mellitus (GDM) is a common endocrine disorder, which can be identified as glucose intolerance, which usually diagnosed during pregnancy. About 90% of diabetic Cases during pregnancy are attributed to GDM, with a prevalence of 1-14%, depending on the studied population and the diagnostic tests used (Al-Rubeaan et al., 2014).

GDM is associated with adverse maternal, fetal and neonatal effects such as preeclampsia, cesarean delivery, macrosomia, birth injuries, respiratory distress syndrome, hypoglycemia and jaundice (American Diabetes Association, 2004). Various studies have revealed that there are high-risk of developing type 2 diabetes (approximately 70% of cases) for the mothers diagnosed with GDM (Kim et al., 2002). Furthermore, it was identified that their children are more prone to obesity and may develop diabetes at later stages of life (Buchanan et al., 2014). There are different risk factors associated with abnormal glucose metabolism in women, which include: increase maternal age, high parity, obesity, physical inactivity, the presence of polycystic ovary, history of GDM and macrosomic baby (Al-Rubeaan et al., 2014; Ben-Haroush et al., 2004).

International Association of diabetes and pregnancy Study Group (IADPSG, 2010) has recommended new diagnostic cutoff values for GDM, which are based on the OGTT, glucose values that were associated with adverse outcomes in Hyperglycemia and Adverse Pregnancy Outcome (HAPO) study. According to the IADPSG recommendations, the screening and diagnosis of GDM was based on a single-step strategy. Tests were performed at 24-28 weeks of gestation in women who were not diagnosed with overt diabetes previously. The OGTT was performed in the morning after an overnight fast, minimum of 8 hours. The diagnosis of GDM is made when any of the following plasma glucose values were met or exceeded:

- Fasting: ≥ 92mg/dl (5.1 mmol/L).
- 1h: ≥ 180mg/dl (10.0 mmol/L).
- 2h: ≥ 153 mg/dl (8.5 mmol/L).

Based on this criterion, fasting plasma glucose threshold for the GDM diagnosis was lowered to 92mg/dl (5.1 mmol/L) (McIntyre et al., 2008).

International Association of Diabetes and Pregnancy Study Groups Consensus Pane (2010). This was adopted by the (American Diabetes Association, 2011). Prevalence of GDM in different countries has increased significantly after adopting the new diagnostic criteria (Wei and Yang, 2011; Moses et al., 2011). The prevalence of GDM has increased from 10.3 to 30.1 in Mexico (Reyes-Muñoz et al., 2012) 30.5% in Norway, and 37.7% in UAE (Jenum et al., 2012; Agarwal et al., 2014).

In the Gulf region, Saudi Arabia was identified as one of the countries with high prevalence of Diabetes Miletus with a prevalence of 23.87% (Mageed et al., 2014). In relation to the GDM, in Saudi Arabia, the incidence rate varies between 3.8% and 12.5% according to the American Diabetes Association Standards (ADA, 2000) and WHO criteria (Al-Rowaily et al., 2010). However, (AL-Rubeaan et al., 2014), in a population-based, cross-sectional study that was conducted at the national level in the Kingdom of Saudi Arabia during the period 2007-2009 concluded that “The Saudi Abnormal Glucose Metabolism and Diabetes Impact Study” SAUDI-DM Study using the new IADPSG criteria, found that the overall GDM prevalence is about 36.6% in the country. The study also identified the weaknesses in antenatal screening; using which only one out of nine cases of GDM are detected. The major risk factors identified in the study with the Saudi population include previous history of GDM, macrosomic baby, obesity and age more than 30 years (Al-Rubeaan et al., 2014). Overweight and obesity are considered as key risk factors for developing diabetes with a prevalence of 25%-50% relating to overweight and 13%-50% relating to obesity (Alhayas et al., 2011). In Saudi Arabia the prevalence of obesity in women is about 33.5% (Memish et al., 2014). Obesity by itself is associated with adverse pregnancy out comes, and when combined with GDM, it will have a greater impact and can result in adverse pregnancy outcome (Wahabi et al., 2014).

The aim of this study was to assess the prevalence of GDM using IADPSG diagnostic criteria and to investigate the risk factors that could contribute to the occurrence of GDM among the sample population in King Salman Military Hospital in Tabuk region.

**SUBJECTS AND METHODS**

**Study setting and participants**

It was a cross-sectional study. Files of all pregnant women during the period between January 2014 and January 2015, who had undergone 75g glucose tolerance test (OGTT) between 24-28 weeks of gestation, in antenatal clinic at King Salman Hospital, were collected. A total of 850 files were randomly selected and the related women were recruited. Simple randomization technique was used in this process. The following information was extracted from the cases: maternal demographic, parity, maternal BMI, obstetric and medical history, previous diagnosis of GDM and family history of Diabetes mellitus. All women who had undergone 75g OGTT were distributed into two groups, those diagnosed with GDM, and those not diagnosed with GDM.

The study was reviewed by Institutional Review Board of King Salman Military Hospital and was approved with Ethical ID Approval Number: 0080.
Table 1. Classification of the studied population according to the IADPSG criteria of fasting blood glucose (≥5.1) and analysis of different variables among them

<table>
<thead>
<tr>
<th>Variables</th>
<th>Have GDM N(%)</th>
<th>Don't have GDM N(%)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mother age (yrs) x(±SD)</td>
<td>31.4(5.6)</td>
<td>29.5(6.2)</td>
<td>.000*</td>
</tr>
<tr>
<td>BMI (%) x(±SD)</td>
<td>32.7(7.1)</td>
<td>30(6.4)</td>
<td>.000*</td>
</tr>
<tr>
<td>Parity (≥3)</td>
<td>22(6.7)</td>
<td>16(3.1)</td>
<td>.018*</td>
</tr>
<tr>
<td>Have previous history of GDM N(%)</td>
<td>40(12.3)</td>
<td>40(7.6)</td>
<td>.024*</td>
</tr>
<tr>
<td>Have previous history of big baby N(%)</td>
<td>0(0)</td>
<td>1(.2)</td>
<td>1.00</td>
</tr>
<tr>
<td>Have family history N(%)</td>
<td>140(42.9)</td>
<td>154(29.4)</td>
<td>.000*</td>
</tr>
</tbody>
</table>

# Chi-square test with Fisher's exact was applied (due to small sized cells)

Inclusion and exclusion criteria

Inclusion Criteria

- Women with Singleton pregnancy, attending the antenatal clinic at King Salman Hospital.

Exclusion criteria

- Women with pre-existing diabetes.
- Women with multiple pregnancies.

Sampling

The total number of deliveries per year in King Salman Hospital is estimated to be between 7500 to 8000 deliveries per year. The sample size was calculated based on 80% power and 95% confidence level. Therefore 850 women's files were randomly selected for review in this study.

Statistical analysis

Mean ± standard deviation, frequencies and percentages were used for descriptive analysis. Student t-test and Chi-square were used to test for detecting significance in difference among quantitative and qualitative data respectively.

RESULTS

The overall prevalence for ever-positive IADPSG criteria for GDM was found to be 50.7%. Furthermore, the prevalence of GDM based on IADPSG criteria was found to be 38.4% for fasting, 21.35% for one hour and 20.6% for two hours individual value conditions. Fasting plasma glucose was the most common abnormal value observed among the women diagnosed with GDM. Significant observations were made by comparing the characteristics of women diagnosed with and without GDM in the study. The results are presented in Tables 1, 2 and 3.

The characteristics of the two groups with IADPSG criteria of fasting are presented in Table 1. The women with gestational diabetes diagnosed using IADPSG criteria of fasting blood glucose (≥5.1), were significantly older (mean age 31.4 versus 29.5 years, P-value = 0.000) compared to women without GDM. Women in both groups have high BMI, however, women with GDM are weighed more than women without GDM with (mean BMI 32.7 vs. 30, P-value = 0.000). Parity was higher in mothers with GDM. About 6% of women diagnosed with GDM had parity ≥ 3 when compared to women without GDM, accounting to only 3.1% of the total women without GDM (P-value= 0.018).

Previous history of GDM (12.3% vs. 7.6%, p <0.024) and family history of diabetes millets (42.9 % vs. 29.4%, p <.000) was observed to be significantly more in women with GDM compared to those without GDM. The history of pervious deliveries of babies weighing more than 4kg was not of much difference when the two groups are compared. (Table 1). The characteristics of the two the groups with IADPSG criteria for one hour 75mg OGTT (≥10) are presented in Table 2 below. Women diagnosed with GDB were significantly older when compared to the group of women without GBD (mean age 32 vs. 29.7 years, P-value = 0.000). Women in both groups have heavier BMI. However, women with GDM are significantly heavier than women without GDM (mean BMI 32.7 vs. 30.6, P .000). The previous history of GDM was significantly more in women with GDM compared to those without GDM (13.8 vs. 8.2 5, p <0.024). However, no significant difference in the aspects of the family history of DM (diabetes mellitus) and history of pervious deliveries of babies more than 4kg was found while comparing the two groups.

The characteristics of the two groups with IADPSG criteria for two hours 75mg OGTT (≥8.5) are presented in Table 3. Women with gestational diabetes were significantly older compare to the group without GBD.
### Table 2. Classification of the studied population according to the IADPSG criteria of 1 hour 75mg OGTT (≥10) and analysis of different variables among them

<table>
<thead>
<tr>
<th>Variables</th>
<th>Have GDM N(%)</th>
<th>Don't have GDM N(%)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mother age (yrs)</td>
<td>32(5.9)</td>
<td>29.7(6)</td>
<td>.000*</td>
</tr>
<tr>
<td>x(±SD)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI (%)</td>
<td>32.5(6.8)</td>
<td>30.6(6.8)</td>
<td>.001*</td>
</tr>
<tr>
<td>x(±SD)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parity (≥3)</td>
<td>12(6.6)</td>
<td>26(3.4)</td>
<td>.152</td>
</tr>
<tr>
<td>The previous history of GDM N(%)</td>
<td>25(13.8)</td>
<td>55(8.2)</td>
<td>.022*</td>
</tr>
<tr>
<td>The previous history of big baby N(%)</td>
<td>0</td>
<td>1(.1)</td>
<td>1#</td>
</tr>
<tr>
<td>The previous history of CS N(%)</td>
<td>48(26.5)</td>
<td>126(18.8)</td>
<td>.023*</td>
</tr>
<tr>
<td>The family history N(%)</td>
<td>71(39.2)</td>
<td>223(33.3)</td>
<td>.139</td>
</tr>
</tbody>
</table>

# Chi-square test with Fisher’s exact was applied (due to small sized cells)

### Table 3. Classification of the studied population according to the IADPSG criteria of 2 hours 75mg OGTT (≥8.5) and analysis of different variables among them

<table>
<thead>
<tr>
<th>Variables</th>
<th>Have GDM N(%)</th>
<th>Don't have GDM N(%)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mother age (yrs)</td>
<td>32.2(5.9)</td>
<td>29.7(5.9)</td>
<td>.000*</td>
</tr>
<tr>
<td>x(±SD)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI (%)</td>
<td>31.7(6.4)</td>
<td>30.8(7)</td>
<td>.139</td>
</tr>
<tr>
<td>x(±SD)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parity (≥3)</td>
<td>7(4)</td>
<td>31(4.6)</td>
<td>1.00</td>
</tr>
<tr>
<td>The previous history of GDM N(%)</td>
<td>24(13.7)</td>
<td>56(8.3)</td>
<td>.029*</td>
</tr>
<tr>
<td>The previous history of big baby N(%)</td>
<td>0</td>
<td>1(.1)</td>
<td>1#</td>
</tr>
<tr>
<td>The family history N(%)</td>
<td>76(43.4)</td>
<td>218(32.3)</td>
<td>.006*</td>
</tr>
</tbody>
</table>

# Chi-square test with Fisher’s exact was applied (due to small sized cells)

(mean age 32.2.4 vs. 29.7 years, P-value = 0.000). No significant difference was found in the aspect of BMI between women with GDM and women without GDM (mean BMI 31.7 vs. 30.8, P 1.000). The previous history of GDM was significantly more in women with GDM compared to those without GDM with (11.9 vs. 8.3, p-value <0.029). Family history of DM (diabetes mellitus) was significantly high in women with GDM when compared to women without GDM (43.3% vs. 32.3%, P-value = 0.006).

### DISCUSSION

The aim of the current study was to explore the potential impact of applying IADPSG guidelines for the screening and diagnosis of GDM and the analysis of risk factors for the development of GDM among the selected participants. Global prevalence of GDM varies between 1-14% (Lapolla et al., 2011). However, in Saudi Arabia, GDM prevalence varies between 12.5%-36.6%. The use of different criteria for GDM diagnosis is one of the major reasons of this variation and ambiguity (Al-Rubeaan et al., 2014; Al-Rowaily et al., 2010). In this study, overall prevalence of GDM using IADPSG criteria was found to be 50.7%, (431 women out of 850 were diagnosed with gestational diabetes). The prevalence rates observed in this study was similar to those found in Al-Rubeaan and Agarwal groups (36.6% and 45.3%) (Al-Rubeaan et al., 2014; Agarwal et al., 2015).

Fasting blood glucose level criteria as a single abnormal value was associated with highest prevalence of GDM when compared to one/two hour’s abnormal values (38.4% VS 21.3% and 20.6%). As the results suggests, it might be reasonable to perform fasting blood glucose as an initial step for screening and diagnosis, while reserving a Full OGTT for those with a non-conclusive fasting blood glucose (Sacks et al., 2012). It was observed that the prevalence of GDM was found to be associated with increasing maternal age, higher BMI, higher parity, previous history of GDM and family history of diabetes. It is a significant observation, which can lead to the further research studies using the associated variables and their comparisons with the prevalence of GDM.

Another significant observation made in the study was that an increase maternal age was significantly associated with the increased prevalence of GDM. Similar observations were made in the previous studies (Rajput et al., 2013; Mohan et al., 2016). The mean age...
of women with GDM in this study was 31.2 ± 5.8 years, which is similar to the mean age of women with GDM observed in the study conducted by Al-Rubeaan et al. (2004). This prevalence is expected to increase in the country as big family is a norm and conceiving up to 40 years is common custom among the women in Saudi Arabia.

As identified in the previous studies, obesity is an important risk factor in the development of GDM (Rajput et al., 2013; Mohan et al., 2016). Similar results were found in this study. It is observed that women with higher BMI had higher prevalence of GDM. Another significant observation was that higher parity (≥3) was higher among women with GDM compared to women without GDM. While some studies show conflicting results regarding the association of parity with high prevalence of GDM (Seshiah et al., 2004; Zargar et al., 2004) other studies failed to do so (Rajput et al., 2013). Counseling pregnant ladies during antenatal visits about the increasing activity levels, healthy food habits, GDM and its impact on themselves and their fetuses, and precautionary steps for decreasing prevalence of GDM can help in the effective management of GDM.

It was observed that family history of diabetes mellitus was significantly associated with higher prevalence of GDM, which is in-line with other similar studies with slight variations (Rajput et al., 2013; Mohan et al., 2016). However, in Al-Rubeaan et al. (2004) study, family history was not significantly different between the 2 groups, while the history of macrosomic babies was significantly associated with higher prevalence of GDM, which was not observed in this study, the present findings are in agreement with the American Diabetes Association Guidelines in which delivering a baby weighing 9 lb or more is no longer listed as an independent risk factor for the development of pre-diabetes and type 2 diabetes (ADA., 2017). A significant association between history of GDM in previous pregnancies and development of GDM in the index pregnancy was observed in this study that concurs with different studies involving different ethnicity (Al-Rubeaan et al., 2004; Mohan et al., 2016).

CONCLUSION

There are significant observations in this study that is related to various factors surrounding the GDM. Summarizing the results, it can be stated that the high prevalence of GDM and various risk factors were observed in this study. The high prevalence of GDM can reflect high prevalence of Type 2 diabetes, as result of obesity and sedentary lifestyle pattern of the people in Saudi Arabia. Universal screening is the best strategy for the diagnosis GDM in the Saudi Arabian community. While different risk factors for GDM development were identified, BMI emerged as adjustable risk factors which should be focused upon to reduce GDM prevalence.

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