

## Maternal and fetal outcome in gestational diabetic women

Received: 4/2/2017

Accepted: 11/9/2017

Roshna Anwar Aziz\*

Chro Najmaddin Fattah\*

### Abstract

**Background and objective:** Gestational diabetes mellitus affects 7% of all pregnancies. It is defined as glucose intolerance that begins or is first diagnosed during pregnancy. It is crucial to detect women with gestational diabetes mellitus because the condition can be associated with several maternal and fetal complications. This study aimed to determine the maternal and fetal outcome of gestational diabetes mellitus in maternity teaching hospital in Sulaimani city, Kurdistan, Iraq.

**Methods:** This prospective observational study had involved 100 pregnant women with gestational diabetes mellitus. Data were collected from 1st January 2014 to 1st July 2014.

**Results:** Most women were in the age group 30-39 years (57%) and were multigravida (75%). Regarding women's BMI, 69% of women had a BMI of  $>30$  kg/m<sup>2</sup>. Most of the women delivered by cesarean section (68%). Also, 63% delivered term baby  $\geq 37$  weeks. Of the women who used insulin, 30.6% delivered babies  $>4$  kg. Complications occurred in 10%, 12.9%, and 11.1% of women who treated by diet, insulin, and the group used metformin then insulin, respectively.

**Conclusion:** The results conclude that pregnant women with gestational diabetes mellitus have increased the risk of hypertension in pregnancy, preterm delivery, and cesarean section. Increasing age, family history of diabetes, increasing parity, and increase in BMI are a risk factor for developing gestational diabetes mellitus. Also, most of the maternal complications occurred in those women who were on metformin. The occurrence of macrosomia was low in the treated cases of gestational diabetes mellitus.

**Keywords:** Gestational diabetes; Risk factors; Maternal and fetal outcome.

### Introduction

Gestational diabetes mellitus (GDM) is defined by glucose intolerance of variable severity with the onset of first recognition during pregnancy. GDM occurs in around 7% of pregnancies; however, its incidence varies according to nutritional habits and differences in genetic patterns between populations. In long-term, GDM women are prone %20-%50 to develop type 2 diabetes mellitus in 5 years after delivery.<sup>1</sup> Currently, there is no agreement within the international community on the glucose levels used to screen and diagnose GDM. WHO defines GDM as the joint category of diabetes (fasting glucose  $\geq 7.0$  mmole /L [126mg/d L] or 2-hour glucose  $\geq 11.1$  mmole/L [200mg /d L] and

impaired glucose tolerance 2/hour glucose  $>7.8$  mmole/L [140mg/d L]). A woman is considered high risk if she meets one or more criteria: (history of GDM, Obesity BMI  $>30$ , glycosuria, strong family history of diabetes, prior poor obstetrical outcome stillbirth, birth defect.<sup>2</sup> The OGTT is a diagnostic test in which the woman is given 100g glucose load after an overnight fast of 8 to 14 hours. The woman is instructed not to smoke and to sit for the duration of the test.<sup>3</sup> The diagnostic criteria are those recommended by the Fourth International Workshop-conference on GDM.<sup>4</sup> The 75 g two-hour OGTT is the diagnostic test recommended by the WHO organizations. The diagnosis is made when the fasting glucose level is greater than 126mg/dl

\* Department of Obstetrics and Gynecology, Faculty of Medical School, University of Sulaimani, Sulaimani, Iraq.

(7.0mmol/L) and 2 hours glucose is greater than 200mg/dl (11.1mmol/L).<sup>5</sup> The basic objectives of medical nutrition therapy are to provide adequate nutrition for the mother and fetus, provide sufficient calories for appropriate maternal weight gain, maintain normoglycemia, and avoid ketosis.<sup>6</sup> Physical exercise has been proposed as part of treatment for GDM based on the fact that, in adults, an improvement in physical fitness increase insulin sensitivity, improves glucose control and reduces the need for insulin.<sup>7</sup> Regular aerobic exercise during pregnancy appears to maintain or improve physical fitness. Healthy pregnant and postpartum women get at least 150 minutes per week of moderate-intensity aerobic activity, such as brisk walking. Monitoring glucose levels may also alter the progression of the condition in women with gestational diabetes. One study showed that daily monitoring of pregnant women treated with diet allows identification of those who could benefit from treatment with a hyperglycemic agent, which may lead to a reduction in the rates of macrosomia.<sup>8</sup> Women with 1-hour postprandial blood glucose levels within the normal range experience fewer incidences of neonatal hypoglycemia, macrosomia, and cesarean delivery.<sup>9</sup> Although the majority of women will achieve adequate glycemic control with diet and exercise alone, 30-40% require pharmacological treatment.<sup>10</sup> When choosing therapies with patients, physicians should always consider efficacy, safety, and patient acceptance. This study aimed to determine the maternal and fetal outcome of GDM patients in Maternity Teaching Hospital in Sulaimani city, Kurdistan, Iraq

## Methods

This study was conducted in Maternity Teaching Hospital in Sulaimani city, from 1<sup>st</sup> January to 1<sup>st</sup> July 2014. A total number of 100 pregnant women diagnosed with gestational diabetes (GDM) were included in this study. Data collected from those women who were in labour and admitted

to labour ward and any pregnant lady admitted to the ward for controlling blood sugar, and already diagnosed with GDM by 75 gram GTT (details of GTT given in introduction) Detailed information about present pregnancy, family history, past obstetrical history, information about regime of treatment taken. Mode of delivery and if there were any maternal and fetal complications were recorded. Gestational age at birth (the gestational age was calculated from the last menstrual period and confirmed by early ultrasound reports before 20 weeks). The BMI calculated from women's weight in the antenatal cards at booking in early pregnancy (till 12 weeks) and the high. Follow up of studied women and their neonatal outcomes till six weeks after delivery by the phone call. Two main outcomes in GDM women were recorded in this study. First, the maternal outcome included the mode of delivery, and the relationship of maternal complications to the type of treatments. Second, fetal outcome included the weight of the baby, Apgar score in first and fifth minutes, admission to NCU, and any fetal complications (an indication of admission). Inclusion criteria included singleton pregnancy, both primigravida, and multigravida from 24 weeks-42 weeks. Exclusion criteria included women with diabetes before pregnancy, and twin pregnancy, previous cesarean section, medical disease complicated were excluded from the study

## Statistical Analysis:

All data then analyzed using the statistical package for the social sciences (version 20 software) computer program. Statistical analysis included descriptive statistics like tables and figures. Chi-square test was used for qualitative variables. In this analysis, the statistically significant association was determined. All *P* values were based on 2-sided tests, and *P* equal or <0.05 was considered statistically significant.

**Ethical Consideration:**

Ethical considerations for the study has been obtained from Maternity Teaching Hospital in Sulaimani city. Verbal consent was taken from all participants in this study.

**Results**

About 75% of women were the housewife. The family history of diabetes mellitus was in %60 of women. The mean age  $\pm$  SD of women in this study was  $33.3 \pm 5.6$ .

Only %25 of women were primigravida. The mean  $\pm$  SD BMI of women was  $32.0 + 5.5 \text{ kg/m}^2$ . There was no history of a miscarriage in 75% of women, and no history of the dead fetus in 77% of the studied women. Most of the women (69%) had a BMI of more than  $30 \text{ kg/m}^2$ . The parity was from 1- 4 in most of the studied women (57%), while parity from 5-7 were (18%) as shown in Table 1.

**Table 1:** Demographic and obstetric characteristics of studied women.

Variables		Number	%
Age of studied women (Years)	<25	6	6
	25-30	24	24
	30-39	57	57
	$\geq 40$	13	13
Previous history of Gestational Diabetes Miletus GDM Total =75 cases	Positive	37	49.3
	Negative	28	37.3
	Not known	10	13.3
Associated disease	No associated disease (no PIH,PET,GDM)	67	67
	Preeclampsia	18	18
	Pregnancy Induced Hypertension PIH	15	15
Parity	Prim gravid	25	25
	Para/1-4	57	57
	Para /5-7	18	18
BMI, $\text{kg/m}^2$	<25	5	5
	25-29.9	26	26
	>30	69	69

The mean + SD of gestational age at the time of delivery was 36.8 + 1.9 weeks, ranged from 28 to 41 weeks. The mean + SD of the first time of diagnosis was 26.3 + 3.2 weeks, ranged from 24 to 34 weeks (Table 2). In studied women, 37% were delivered before 37 weeks of gestation whereas, 63% of women delivered their

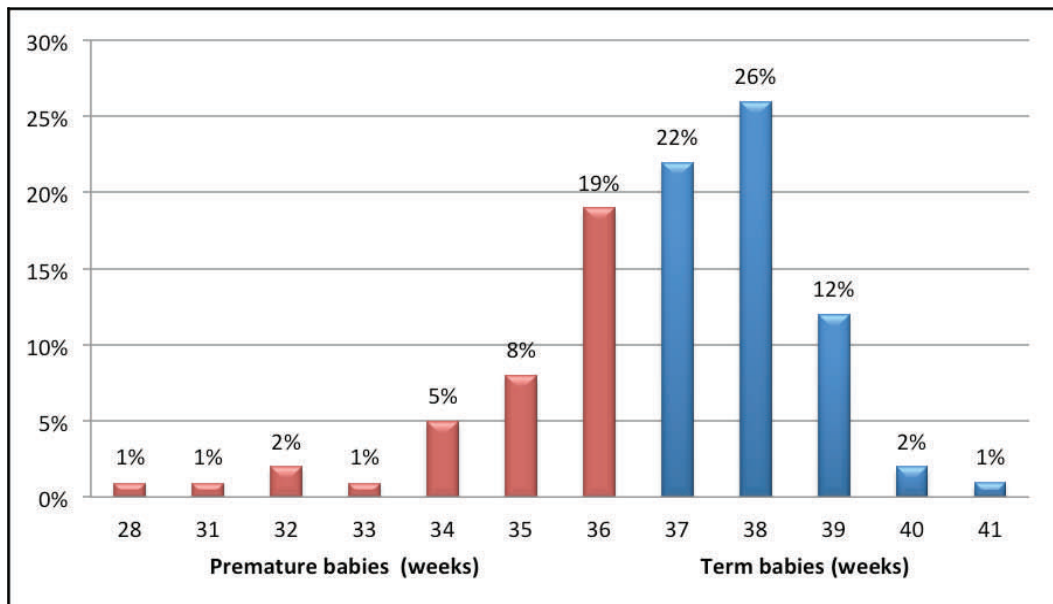
baby after 37 weeks of gestation (Figure 1). The studied women used four regimens for treatment of gestational diabetes; 62% of studied women on insulin therapy, 20% of women on diet regime, 9% on metformin tablets, and 9% used of metformin then insulin (Table 3).

**Table 2:** Gestational age at the time of delivery and gestational age upon diagnosis of gestational diabetes.

Findings	Mean $\pm$ SD	Range
Gestational age at birth (weeks)	36.8 $\pm$ 1.9	28 – 41
Gestational age at diagnosis (week)	26.3 $\pm$ 3.2	24 – 34

**Table 3:** Type of treatment in GDM of studied women.

Type of treatment in gestational diabetes	No	%
Insulin	62	62
diet regime	20	20
Metformin	9	9
Metformin then insulin	9	9



**Figure 1:** Preterm and term babies below and above 37 weeks.

The amount of liquor by ultrasound in studied women. Polyhydramnios presented in 61%, adequate liquor 31%, and oligohydramnios in 8% (4% oligohydramnios and 4% severe oligohydramnios) as shown in Table 4. Of the studied women, 68% delivered by C/S, while 32% delivered vaginally. Maternal complications occurred in 16% of women (post-partum hemorrhage in 5%, type 2 diabetes in 5%, wound infection in 2%, rupture uterus in 2%, and

open bladder in 2%), while 84% of women had no maternal complications. Fetal complications occurred in 39% of women. Also, 61% of women had no fetal complications. The commonest five fetal complications included hypoglycemia (8%), intrauterine fetal death (IUFD) (8%), heart disease mainly congenital heart disease (7%), respiratory distress syndrome (5%), and neonatal death (4%) as shown in Table 5.

**Table 4:** Amount of liquor by ultrasound in studied women.

Amount of liquor by U/S	Number	%
> 25 (polyhydramnios) cm	61	61
5 – 25 (adequate liquor) cm	31	31
3 – 4 (oligohydramnios) cm	4	4
0 – 2 (severe oligohydramnios) cm	4	4
25 (borderline amount) cm	0	0

**Table 5:** Mode of delivery, maternal outcome and fetal complication in studied women.

Variable	Number	%
Mode of delivery	Cesarean section	68
	Vaginal delivery	32
Maternal outcome	No complication	84
	Postpartum hemorrhage	5
	Type 2 Diabetes Mellitus	5
	Wound infection	2
	Rupture uterus	2
	Open bladder	2
Fetal outcome	No fetal complication	61
	Hypoglycemia	8
	IUD	9
	Heart disease	7
	Respiratory distress syn	5
	Neonatal death	5
	Shoulder dystocia	3
	Stillbirth	2
<b>Total</b>	<b>100</b>	<b>100</b>

The mean  $\pm$  SD Apgar score in the 1<sup>st</sup> minute was  $6.4 \pm 2.5$ . The mean  $\pm$  SD Apgar score in 5<sup>th</sup> minute was  $8.2 \pm 3.1$ . The mean  $\pm$  SD duration of admission of babies in NCU was  $16.9 \pm 24.0$  hours. Also, 69.4% of the babies had a birth weight  $<4$  kg while only 30.6% had the birth weight of baby  $>4$  kg (Table 6). Table 7 shows the relationship between the type of treatment and the mode of

delivery. Around 89% of women who were treated by metformin delivered by C/S and only 11.1% delivered vaginally. The association between the mode of delivery and type of treatment was statistically significant ( $P < 0.05$ ). The study did not find a statistically significant association between the type of treatment and the occurrence of fetal weight.

**Table 6:** Fetal outcome of studied women.

Fetal outcome	Mean $\pm$ SD	Range
Apgar score 1	$6.4 \pm 2.5$	0 – 8
Apgar score 5	$8.2 \pm 3.1$	0 – 10
$>4$ kg	<b>30.6</b>	<b>30.6</b>
$\leq 4$ kg	69.4	69.4
Duration in NCU (hour)	$16.9 \pm 24.0$	0 – 96

**Table 7:** Type of treatment and association with mode of delivery and fetal weigh.

Mode of delivery	Type of treatment Number (%)								P value
	Diet		metformin		Insulin		Metformin then Insulin		
	No	%	No	%	No	%	No	%	
Vaginal	11	(55.0)	1	(11.1)	16	(25.8)	4	(44.4)	0.038
Cesarean section	9	(45.0)	8	(88.9)	46	(74.2)	5	(55.6)	
Total	20		9		62		9		
Fetal weight									
$\leq 4$ kg	15	(75.0)	6	(66.7)	43	(69.4)	5	(55.6)	0.771
$> 4$ kg	5	(25.0)	3	(33.3)	19	(30.6)	4	(44.4)	0.771
Total	20		9		62		9		

## Discussion

There are many risk factors for GDM. One of these risk factors are the positive family history of diabetes mellitus (DM). The result of this study demonstrated that there was an association of positive family history of diabetes with GDM, in this study %60 of women had GDM with a positive family history of DM. This is in agreement with Williams et al.,<sup>11</sup> found that family history of diabetes in a first-degree relative conferred a significantly increased risk of GDM, This also agreed with studies done by Chan et al.,<sup>12</sup> reported that a positive family history is an isolated risk factor for women over 30 years. In this study we found that age was an important risk factor that associated with more chance of GDM so that the risk of GDM in women over 30 years was 3.28 times more than women 25 years, the results are consistent with most of the studies.<sup>13</sup> In a study conducted by Hadaegh et al.,<sup>14</sup> the relative risk of gestational diabetes in 35-39 years old group was 15 times more than age groups under 20 years. Among other interfering risk factors for GDM is high BMI which is an independent risk factor, significantly associated with our study. In this study % 69, women with BMI > 30 kg/m<sup>2</sup> had GDM, %26 with BMI between 25-30kg/m<sup>2</sup> and only % 5 was <25 of women has GDM. This agreed with the study done by Sudhanshu et al.<sup>15</sup> in that %73 of the patient of GDM had a BMI >30 kg/m<sup>2</sup>. Zokaie et al.<sup>16</sup> found in their study that chance of developing GDM in overweight and the obese group were 2.91 and 3.69 more times, respectively. This was consistent with the meta-analysis results of Torloni et al.<sup>17</sup> In our study, most of the women 68% were delivered by C/S while only 38% of women were delivered vaginally. This is agreed with Casey et al.<sup>18</sup> reported that The rate of cesarean delivery was increased significantly with gestational diabetes mellitus. The high rate of cesarean section is may be due to that in GDM induction of labor is usually followed by cesarean section.<sup>19</sup> As there is

increased the chance of stillbirth in GDM despite modern management,<sup>20</sup> the presence of fasting hyperglycemia >5.8 mmol/l may be associated with an increase in the risk of intrauterine fetal death during the last 4-8 weeks of gestation.<sup>20</sup> Perinatal complications are preventable with good glycemic control and early induction of labor but at the cost of a higher cesarean section rate.<sup>19</sup> Mother's psychological stress from death or bad outcome of previous infants and previous cesarean section were also seen to be responsible for increased cesarean delivery in GDM.<sup>21,22</sup> The operation itself is associated with several maternal morbidities, particularly wound infection and dehiscence, postpartum infection and bleeding, and deep venous thrombosis, as well as the need for the future cesarean section with a subsequent pregnancy.<sup>23</sup> These are exacerbated by the presence of obesity.<sup>23,24</sup> Data are sparse for the complications of cesareans among GDM women and obese women.<sup>24</sup> In the infant, elective delivery in late preterm or early term infants has been associated with an increase in both respiratory distress syndrome and transient tachypnea of the newborn.<sup>25</sup> Several studies in India,<sup>26</sup> Pakistan<sup>27,28</sup> and also in Saudi Arabia<sup>29</sup> have reported increased risk for gestational hypertension and preeclampsia in pregnancies complicated by gestational diabetes.<sup>26</sup> Preeclampsia was noticed to be associated with GDM in another study conducted in Bangladesh<sup>26</sup> which is in agreement with our findings, that 33% of GDM women were associated with (PET, PIH). In our study the rate of cesarean delivery was high with 68% of whole delivery, 14.8% of whole C/S done because of GDM women associated with (PIH+PET). This is agreed with the study done by Thomas et al.<sup>30</sup> study the rate of cesarean delivery was high with 93% of whole delivery, 14.41% of women were complicated with PIH, 3.60% of the women were complicated with oligohydramnios and 2.70% were complicated with

polyhydramnios. This agreed with our study in that 15% of women were complicated by PIH, 18% of women were complicated by preeclampsia, 8% were complicated by oligohydramnios but not agreed with Thomas et al. study in that 61% of women were complicated with polyhydramnios. In the study of Gandhi et al.<sup>31</sup> metformin treatment was compared to dietary therapy in 592 GDM patients. The incidence of fetal macrosomia and birth weight >90 percentile was lower in the metformin group than in the diet group. This result is in agreement with our study which found that 25% of women who delivered macrocosmic babies were on diet regime while only 23.3% of women delivered macrocosmic babies were used metformin. Moore et al.<sup>32</sup> reported that stillbirth in women who on metformin lesser than women who were on insulin. This finding agrees with our study; we found that we had no stillbirth in women who were on metformin while the rate of stillbirth in women who used metformin then insulin were 11.1 % and whose on diet regime 5%. In the study by Rowan *et al.*,<sup>33</sup> the rate of preterm delivery was higher in metformin-treated mothers. This does not agree with our study in that preterm delivery higher in insulin-treated mothers. In fact, there were more preterm births in the insulin group than in the metformin group in the study of Mesdaghinia et al.<sup>34</sup> In the study by Rowan *et al.*,<sup>33</sup> the rate of neonatal hypoglycemia was lower in the metformin group compared to the insulin group. Consistent with this result, the incidence of neonatal hypoglycemia was higher in insulin-treated patients in our study. This is also agreed with the study done by Kristiina Tertti et al.,<sup>35</sup> in which neonatal hypoglycemia was higher in insulin-treated patients. The cesarean section rate was not reported by Rowan *et al.*<sup>33</sup> Alani ET al.<sup>36</sup> found that there is no significant difference between mode of delivery and type of treatment. This is not in agreement in our study in that C/S more in those women who use insulin than

another regime of treatment. We recommend screening, diagnosis, and treatment of GDM are to be put into the national antenatal program so that 5-8% of the risk pregnancy from GDM, can be identified. Thus, measures are to be taken to avoid preventable consequence on the mother and fetus/newborn. Also, a detailed history should be taken from pregnant women at their first antenatal visit regarding the risk factors for GDM, to offer early screening if needed to prevent maternal and fetal complication. Finally, women with GDM should be followed after delivery in order to monitor hyperglycemic status, to do GTT at six weeks post-partum and so advised accordingly.

### Conclusion

The results conclude that hypertension, cesarean section, and preterm delivery were more prevalent and higher in the women with GDM. Most of the maternal complications occurred in those women who were on metformin. The occurrence of large for gestational age was low in the treated cases of GDM. The fetal complication, macrosomia, and neonatal death were more prevalent in women who were treated with insulin. The risk of GDM increases with an increase in maternal age, family history of diabetes, multiparity, and increasing BMI.

### Competing interests

The authors declare that they have no competing interests.

### References

1. Bellamy I, Casas JP, Hingorani AD, Williams D. Type 2 diabetes after gestational diabetes a systematic review and meta-analysis. *Lancet* 2009; 373:173–9.
2. American Diabetes Association. Gestational diabetes mellitus. *Diabetes Care* 2004; Suppl 1:S88–90.
3. Jovanovic L. Medical management of pregnancy complicated by diabetes. 3<sup>rd</sup> ed. Alexandria, Va. American Diabetes Association; 2000.
4. Metzger BE, Coustan DM. Organizing Committee. Summary and recommendations of the Fourth International Workshop-Conference on Gestational Diabetes Mellitus. *Diabetes Care* 1998; Suppl2:B161–7.



5. Schmidt MI, Matos MC, Reichelt AJ, Forti Ac, de Lima L, Duncan BB. Prevalence of gestational diabetes mellitus-do the new WHO criteria makes a difference? Brazilian Gestational diabetes study group. *Diabetes Med* 2000; 17:376–80.
6. Jovanovic-Peterson L, Peterson CM. Nutritional management of the obese gestational diabetic pregnant woman. *J Am Coll Nutr* 1992; 11:246–50.
7. Colberg SR, Sigal RJ, Fernhall B, Regensteiner JG, Blissmer BJ, Rubin RR, et al. American College of Sports Medicine; American Diabetes Association. Exercise and type 2 diabetes. *Diabetes Care* 2010; 33(12):2692–6.
8. Hawkins JS, Casey BM. Labor and delivery management for women with diabetes. *Obstet Gynecol Clin North Am* 2007; 34:323–34.
9. De Veciana M, Major CA, Morgan MA, Asrat T, Toohey JS, Lien JM, et al. Postprandial versus preprandial blood glucose monitoring in women with gestational diabetes mellitus requiring insulin therapy. *N Engl J Med* 1995; 333:1237–41.
10. Jovanovic LG. Using meal-based self-monitoring of blood glucose as a tool to improve outcomes in pregnancy complicated by diabetes. *Endocr Pract* 2008; 14:239–47.
11. Williams CB, Iqbal S, Zawacki CM, Yu D, Brown MB, Herman WH. Effect of selective screening for gestational diabetes. *Diabetic Care* 1999; 22:418–21.
12. Chan LY, Wong SF, Ho LC. Diabetic family history is an isolated risk factor for gestational diabetes after 30 years of age. *Acta Obstet Gynecol Scand* 2002; 81(2):115–7.
13. Botto LD, Moore CA, Hobbs CA, Correa A1, Gilboa SM, Besser LM, et al. Diabetes mellitus and birth defects. *Am J Obstet Gynecol* 2008; 199(3):237.
14. Hadaegh F, Khairandish M, Shafei R, Taohidi M. The prevalence of gestational diabetes in pregnant women in Bandar Abbas. *Iran J Endocrinol Metab* 2004; 6(3):225–34.
15. Sudhanshu SN, Karuna D, Subhalaxmi D, Sujata M, Sidhartha D. Screening of Gestational Diabetes Mellitus with 75gm OGTT and its effects on Feto-maternal Outcome. *Diabetic Care* 2014; 2(1C):340–2.
16. Zokaie M, Majlesi F, Rahimi-Foroushani A, Esmail-Nasab N. Risk factors for gestational diabetes mellitus in Sanandaj, Iran. *Chron Dis J* 2014; 2(1):1–9.
17. Torloni MR, Betran AP, Horta BL, Nakamura MU, Atallah AN, Moron AF, et al. Prepregnancy BMI and the risk of GDM. *Obes Rev* 2009; 10(2):194–203.
18. Casey BM, Lucas MJ, Mcintire DD, Leveno KJ. Pregnancy outcomes in women with gestational diabetes compared with the general obstetric population. *Obstet Gynecol* 1997; 90(6):869–73.
19. Peled Y, Perri T, Chen R, Pardo J, Bar J, Hod M. Gestational diabetes mellitus--implications of different treatment protocols. *J Pediatr Endocrinol Metab* 2004; 17(6):847–52.
20. Wood SL, Jick H, Sauve R. The risk of stillbirth in pregnancies before and after the onset of diabetes. *Diabet Med* 2003; 20(9):703–7.
21. Agarwal MM, Punnose J, Dhatt GS. Gestational diabetes implications of variation in post-partum follow-up criteria. *Eur J Obst Gyn Repr Biol* 2004; 113:149–53.
22. Declercq E, Barger M, Cabral H. Maternal outcomes associated with planned primary cesarean births compared with planned vaginal births. *Obstet Gynecol* 2007; 109(3):669–77.
23. Kennare R, Tucker G, Heard A, Chan A. Risk of adverse outcomes in the next birth after a first cesarean delivery. *Obstet Gynecol* 2007; 109.
24. Kjos S, Berkowitz K, Kung B. Prospective delivery of reliably dated term infants of diabetic mothers without determination of fetal lung maturity: Comparison to historical control. *J Mat Fetal Neonat Med* 2002; 30:313–21.
25. Buchanan TA, Xiang AH. Gestational diabetes mellitus. *J Clin Invest* 2005; 115(3):485–91.
26. Ahkter J, Qureshi R, Rahim F, Moosvi S, Rehman A, Jabbar A, et al. Diabetes in pregnancy in Pakistani women: prevalence and complications in an indigenous South Asian community. *Diabet Med* 1996; 13(2):189–91.
27. Munim S, Chaudhury N, Jamal K, Khan FA. Outcome of abruptio placentae in normotensive and hypertensive patients in Aga Khan University Hospital, Pakistan. *J Obstet Gynecol Res* 1997; 23(3):267–71.
28. El Mallah KO, Narchi H, Kulaylat NA, Shaban MS. Gestational and pre-gestational diabetes: comparison of maternal and fetal characteristics and outcome. *Int J Gynaecol Obstet* 1997; 58(2):203–9.
29. Robin V, Binny T, Moza AI H, Abdul R, Mona AI S, Ayesha AS, et al. The prevalence, risk factors, maternal and fetal outcomes in gestational diabetes mellitus. *Int J Drug Dev Res* 2012; 4(3):356–68.
30. Gandhi P, Bustani R, Madhuvrata P, Farrell T. Introduction of metformin for gestational diabetes mellitus in clinical practice: has it had an impact? *Eur J Obst Gyn Repr Biol* 2012; 160:147–50.
31. Moore LE, Briery CM, Clokey D, Martin RW, Williford NJ, Bofill JA, et al. Metformin and insulin in the management of gestational diabetes mellitus: preliminary results of a comparison. *J Reprod Med* 2007; 52:1011–5.
32. Rowan J, Hague W, Gao W, Battin M, Moore M. MiG Trial Investigators. Metformin versus insulin for the treatment of gestational diabetes. *N Engl J Med* 2008; 358:2003.
33. Mesdaghinia E, Samimi M, Homaei Z, Saberi F, Moosavi S, Yaribakht M. Comparison of newborn outcomes in women with gestational diabetes mellitus treated with metformin or insulin: A randomized blinded trial. *Int J Prev*

Med 2013; 4(3):327–33.

34. Terti K, Ekblad U, Vahlberg T, Rönnemaa T. Comparison of metformin and insulin in the treatment of gestational diabetes: A retrospective, case-control study. *Rev Diabet Stud* 2008; 5(2):95–101.
35. Balani JHS, Rodin A, Shetata H. Pregnancy outcomes in metformin treated women with gestational diabetes. *Diabetologia* 2008; 51(Suppl 1):S467.