Journal of Advances in Medicine and Medical Research

23(10): 1-9, 2017; Article no.JAMMR.34149
ISSN: 2456-8899
(Past name: British Journal of Medicine and Medical Research, Past ISSN: 2231-0614, NLM ID: 101570965)

Gestational Diabetes Mellitus: Risk Factors and Perinatal Outcomes in Abha, Saudi Arabia

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

Article Information

DOI: 10.9734/JAMMR/2017/34149
Editor(s):
(1) Mohamed Essa, Department of Food Science and Nutrition, Sultan Qaboos University, Oman.
Reviewers:
(1) Jean Baptiste Niyibizi, Pan African University, Kenya.
(2) F. Chukwunyere Chibuike, Federal Medical Centre, Abeokuta, Nigeria.
(3) D. Atere Adedeji, Achievers University, Nigeria.
(4) Magdy Abdelrahman Mohamed, Sohag University, Egypt.
Complete Peer review History: http://www.sciencedomain.org/review-history/20881

Original Research Article

Received 15th May 2017
Accepted 2nd September 2017
Published 8th September 2017

ABSTRACT

Objective: This study aimed to assess the risk factors associated with gestational diabetes mellitus (GDM) and evaluate its maternal-neonatal outcomes in pregnancies among Saudi women.

Materials and Methods: A one-year retrospective case-control study of Saudi women was conducted at the Abha Maternity and Pediatric Hospital, in Saudi Arabia. All pregnant Saudi women diagnosed with GDM at the time of the study were matched with healthy pregnant women and their newborn babies. Information including socio-demographic data, family history, obstetric history, maternal complications, and neonatal outcomes were collected and recorded from their medical records.

Results: A total of 289 women (159 cases and 130 controls) and their newborn babies were included in the study. Higher rates of maternal and neonatal complications were observed in the GDM group. The factors of advanced maternal age, BMI, family history of diabetes, and previous history of GDM were the main significant factors associated with the development of GDM. Cesarean section, polyhydramnios, and preterm labor were the most common pregnancy outcomes (P<0.001), while hyperbilirubinemia and hypoglycemia were the most common neonatal complications (P<0.001).

Conclusion: The findings confirmed that GDM is a medical disorder of pregnancy that is

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associated with undesirable maternal and fetal outcomes. Pregnant women at risk for GDM should be identified, and high-quality prenatal care should be offered in order to minimize the complications of GDM both for the mother and the neonate.

Keywords: Gestational diabetes mellitus; pregnancy; risk factors; macrosomia; low birth weight.

1. INTRODUCTION

Gestational diabetes mellitus (GDM) is a glucose intolerance of variable degree, with an onset or first recognition during pregnancy [1]. It affects approximately 1–14% of all pregnancies, and the rate has risen steadily over the past decade [2]. Saudi Arabia has been reported to have an incidence of abnormal glycemic control among 9–13% of all pregnancies, based on the region and the diagnostic criteria used [3]. The factors that have been identified to influence the risk of GDM among the mothers reported by Bhat and colleagues (2010) include obesity, positive family history of diabetes, treatment for infertility, history of stillbirth, delivery of a large infant (>4 kg), prematurity, preeclampsia, diabetes in previous pregnancy, and advanced maternal age [4]. It is therefore essential that these mothers are diagnosed during pregnancy and that they have regular follow-up monitoring for the identification and treatment of any complications [5].

Though improved outcomes have been reported over the past few years, controversy continues surrounding the condition of pregnant women with GDM. The major morbidities associated with infants of mothers having GDM include respiratory distress, growth restriction, polycythemia, hypoglycemia, hypocalcaemia, and congenital malformations [6].

Despite the confirmed high prevalence of diabetes mellitus in Saudi Arabia, only a few studies have addressed this and the effect of maternal diabetes on pregnancy outcomes in the country. Similar to other parts of the world, diabetes during pregnancy in Saudi Arabia affects a significant proportion of pregnant women and can have lasting health impacts on both the mother's and baby's health. With this in mind, the present study was conducted to compare the maternal–neonatal complications of GDM and assess the risk factors and outcomes associated with it, in order to improve maternal and infant health and to create healthcare interventions for the prevention and control of GDM among the Saudi population.

2. MATERIALS AND METHODS

This is a retrospective case-control study that was carried out among pregnant Saudi women between April 2013 and March 2014 at the Abha Maternity and Pediatric Hospital (AMPH), a tertiary care hospital. The case group comprised 159 women diagnosed on the basis of the glucose tolerance test (GTT) as having GDM. Meanwhile, 130 age-matched healthy pregnant women without GDM who were delivered at the same time as the case group were selected as the control group. Both the GDM and controls were at a gestational age of 20 weeks or more and carrying singleton pregnancies. Women with a diagnosis of diabetes before pregnancy, multiple pregnancies, breech presentation in labor, and/or the presence of chronic diseases were excluded.

A custom-designed questionnaire was used to record the patients' information, including socio-demographic data, obstetric and family history, maternal–neonatal complications, and outcomes as indicated in their medical files. At the time of booking, women were screened for GDM based on fasting and random blood glucose levels. If the fasting blood glucose level was >105 mg/dL and the random blood glucose level was >140 mg/dL, the pregnant women were considered to have GDM. These GDM women then underwent a 75 g, two-hour oral glucose tolerance test (OGTT) for the confirmation of GDM in accordance to the International Association of the Diabetes and Pregnancy Study Groups (IADPSG) recommendations. Both the GDM and non-GDM groups were followed until delivery and their maternal and neonatal complications–outcomes were studied.

Ethical approval was deemed unneeded by the Institutional Review Board of College of Medicine, King Khalid University-Abha, Saudi Arabia. Data were analyzed using SPSS version 21.0 (IBM, New York). Data were presented as frequencies, percentages, and means ± standard deviations. Chi-square (χ^2) tests were performed for categorical data, while continuous data were analyzed using *t*-tests to assess statistical significance using two-tailed testing at the

P<0.05 level. Forward and backward stepwise logistic regressions, with GDM status as the dependent variable, were run with criteria of P values <0.05 for entry and >0.1 for removal of variables.

3. RESULTS

A total of 6,700 deliveries were conducted during the study period at the Department of Obstetrics and Gynecology, AMPH, providing 159 GDM mothers with newborn babies and 130 controls. The comparison of the maternal demographic characteristics of women with and without GDM is shown in Table 1. The majority of the cases and controls belonged to the 25–34 years age group (48% and 55%, respectively). The χ^2 test revealed a highly statistically significant association between age and GDM status, with standardized residuals analysis confirming that there were more GDM mothers in the older age group (*z*=2.0) and few controls in that group (*z* = -2.2). Significantly more control case mothers were in the younger age group (*z* = 2.1). The most frequent parity history was 2–4 deliveries (72, 45%; and 72, 55%, respectively). Incidence rates of cesarean delivery and assisted vaginal delivery were statistically higher in the GDM group than in the non-GDM group (*P*=.012).

Clinical risk factors for GDM are compared in Table 2. There was a strong association between BMI category and GDM status, *P*<0.001. Standardized residuals were all ≥2.9, confirming that a higher proportion of GDM mothers were in the overweight or obese categories. Hypertension, family history of diabetes mellitus, and macrosomia were also significantly more prevalent among pregnant women with GDM.

Table 3 shows the distribution of pregnancy outcomes, such as the induction of labor, polyhydramnios, preeclampsia, and preterm labor. The occurrence of each of these outcomes was higher in the GDM group than in the non-GDM group, with statistical significance of *P*<0.01. The most common outcome was delivery by cesarean section (61% and 22%, respectively).

The newborns' characteristics are shown in Table 4. The groups were similar in terms of mean gestational age at delivery (38.13 ± 1.81 vs. 38.71±1.53, *P*<0.05). There was a statistically significant association between birth weight category (low, normal, macrosomia) and whether or not women had GDM. The rate of low birth weight was significantly higher in women with GDM (17.6% vs. 7.7%; *P*=.006). Control cases were less likely to have low birth weight (standardized residual =-1.7), but also less likely to have macrosomia (standardized residual = -1.4). Collapsing the abnormal weight baby categories (low and macrosomia) into one category and re-running the χ^2 analysis produced a statistically significant association between birth weight category (normal, abnormal) and whether or not women had GDM, χ^2 (1) = 9.81, P=0.002. A non-parametric Mann-Whitney test for the difference between GDM women and control cases for birth weight failed to reach statistical significance, U = 9664.5, *z* = 1.49, P=0.135. The mean rank for the control cases was higher than the GDM mothers (150.2 and 140.8, respectively), indicating that control cases tended to have heavier babies. Additionally, the frequency of APGAR scores less than seven in one minute was greater among neonates from mothers with diabetes compared to those of non-GDM mothers with statistical significance of *P*<0.001.

Table 5 shows the neonatal outcomes in the study groups. Shoulder dystocia, neonatal intensive care unit (NICU) admissions, and neonatal complications were significantly higher in GDM women in comparison to non-GDM group (*P*<0.05). However, stillbirth was not significantly different between the two groups (P>0.05). Infants of GDM mothers had a significantly higher incidence of NICU admission than for infants born to mothers without GDM (*P*=0.011). Of those admitted to NICU, the babies of GDM mothers were admitted for a wider variety of reasons, such as phototherapy (15, 9.4%), followed by hypoglycemia (10, 6.3%), and perinatal distress (9, 5.7%). Hyperbilirubinemia was the most frequent neonatal complication (38, 23.9%) among babies born to mothers from both groups (13, 10.0%), followed by hypoglycemia (19, 11.9%) and macrosomia (7, 4.4%) in the GDM group, respectively (*P*<0.001). Standardized residuals analyses showed that hypoglycemia and hyperbilirubinemia were significantly more prevalent in GDM compared with control mothers.

The predictors for GDM in women and their neonates using multiple logistic regression analysis are shown in Table 6. Age on its own was a strong predictor and correlated well with GDM status, but when added to selected variables, it resulted in a statistically significant misfit (Hosmer-Lemeshow test, χ^2 (8) = 16.9, *P* =0.031), so this was removed from the final model. The odds ratios (ORs) for some of the variables are particularly high, notably for previous history of GDM and BMI, respectively (OR=14.0, *P*<0.001; OR=11.9, *P*<0.001).

Table 1. Maternal demographic characteristics

Variable	GDM N=159 (%)	Control N=130 (%)	X^2	*P* Value
Age distribution of mothers				
18–24	16 (10.1)	31 (23.8)		
25–34	77 (48.4)	71 (54.6)	17.66	<.001
35–45	66 (41.5)	28 (21.5)		
Occupation				
Housewife	140 (88.1)	111 (85.4)	.445	.506
Worker	19 (11.9)	19 (14.6)		
Number of parity				
1	47 (29.6)	41 (31.5)		
2–4	72 (45.3)	72 (55.4)	6.85	.033
>5	40 (25.2)	17 (13.1)		
Delivery outcome				
NSVD	98 (61.6)	100 (76.9)		
Cesarean	55 (34.6)	29 (22.3)	8.81	.012
Assisted	6 (3.8)	1 (0.8)		

Table 2. Clinical risk factors for gestational diabetes mellitus

Variable	GDM N=159 (%)	Control N=130 (%)	X^2	*P* Value
BMI				
<25 (normal)	61 (38.4)	113 (86.9)		
25–30 (overweight)	72 (45.3)	16 (12.3)	72.14	<.001
>30 (obese)	26 (16.4)	1 (0.8)		
Family history of diabetes mellitus	42 (26.4)	10 (7.7)	16.99	<.001
Previous history of GDM	36 (22.6)	4 (3.1)	22.95	<.001
Pregnancy induced hypertension	26 (16.4)	5 (3.8)	11.68	.001
Previous history of fetal death	8 (5.0)	1 (0.8)	4.30	.038
Previous history of prematurity	12 (7.5)	6 (4.6)	1.05	.305
Previous history of congenital anomaly	2 (1.3)	3 (2.3)	.464	.497
Previous history of macrosomia	14 (8.8)	0	12.02	.001
Recurrent UTI	30 (18.9)	9 (6.9)	8.74	.003

Table 3. Pregnancy outcomes in study groups

Variable	GDM N=159 (%)	Control N=130 (%)	X^2	*P* Value
Induction of labor	36 (22.6)	9 (6.9)	13.44	<.001
Polyhydramnios	51 (32.1)	13 (10.0)	20.21	<.001
Preeclampsia	34 (21.4)	5 (3.8)	18.84	<.001
Antepartum hemorrhage	7 (4.4)	0	5.86	.015
Postpartum hemorrhage	3 (1.9)	0	2.47	.115
Preterm labor	37 (23.3)	8 (6.2)	15.93	<.001
Premature rupture of membranes	29 (18.2)	13 (10.0)	3.90	.048
Cesarean section	55 (34.6)	29 (22.3)	43.55	<.001

Table 4. Neonatal characteristics of study groups

Variable	GDM N=159 (%)	Control N=130 (%)	X^2	*P* value
Gestational age at time of delivery (weeks) – mean ± SD	38.13± 1.81	38.71± 1.53	19.62	.020
Term at birth				
Preterm	37 (23.3)	8 (6.2)		
Full term	122 (76.7)	122 (93.8)	15.93	<.001
Birth weight				
Low birth weight (< 2500g)	28 (17.6)	10 (7.7)		
Normal birth weight (2500–4000g)	124 (78.0)	119 (91.5)	10.32	.006
Macrosomia (>4000g)	7 (4.4)	1 (0.8)		
Apgar score at 1 minute				
<7	77 (48.4)	13 (10)	49.25	<.001
>7	82 (51.6)	117 (90)		

Table 5. Neonatal outcomes in study groups

Variable	GDM N=159 (%)	Control N=130 (%)	X^2	*P* Value
Shoulder dystocia	7 (4.4)	0	5.86	.015
Stillbirth	3 (1.9)	1 (0.8)	.654	.419
NICU admission	35 (22.0)	14 (10.8)	6.42	.011
Cause of NICU admission				
Hypoglycemia	10 (6.3)	1 (0.8)		
Perinatal distress	9 (5.7)	7 (5.4)		
For phototherapy	15 (9.4)	5 (3.8)	10.07	.039
Respiratory distress syndrome	1 (0.6)	1 (0.8)		
Neonatal complications				
Hypoglycemia	19 (11.9)	1 (0.8)		
Hyperbilirubinemia	38 (23.9)	13 (10.0)		
Respiratory complications	3 (1.9)	3 (2.3)		
Congenital anomaly	2 (1.3)	1 (0.8)	34.57	<.001
Growth retardation	2 (1.3)	2 (1.5)		
Macrosomia	7 (4.4)	1 (0.8)		
Fetal bradycardia	0	2 (1.5)		

Table 6. Logistic regression analysis for the prediction of gdm for variables following selection by forward and backward regression (n=289)

Predictors	OR	95% C.I. for OR		*P* value
		Lower	Upper	
Delivery outcomes (Cesarean)	2.338	0.961	5.685	0.061
BMI	11.909	5.358	26.467	< 0.001
Previous GDM	14.017	3.326	59.079	< 0.001
Induction of labor	9.68	3.257	28.77	< 0.001
Polyhydramnios	7.971	3.061	20.757	< 0.001
Preterm delivery	4.418	1.193	16.359	0.026
Premature rupture of membranes	5.862	1.843	18.648	0.003
Birth head circumference	1.368	1.1	1.7	0.005
Apgar score at 1 min.	0.038	0.012	0.123	< 0.001
NICU admission	0.183	0.047	0.707	0.014

4. DISCUSSION

GDM is clearly recognized as an important disease entity with health implications that persist well beyond the gestational period [7]. It carries risks for both mothers and babies. Early studies have strongly indicated that untreated carbohydrate intolerance during pregnancy is associated with higher rates of maternal morbidity and perinatal mortality [8,9]. Comparing the outcomes with those of other studies reported in the literature, the findings of the present study confirmed that GDM patients have unwanted pregnancy outcomes.

In this study, 88% of the GDM pregnant women were housewives; this was found to correlate with a similar study in India, where 95% of GDM mothers were unemployed [10]. Moreover, 48% of the GDM mothers were between the ages of 25 and 34 years old; 41% were 35 to 45 years of age. Increasing maternal age was associated with higher incidence of GDM, which was in accordance with other studies [11,12] that have shown age >25 years to be a risk factor. Our study demonstrated an association between greater maternal age and risk of GDM (P<.001). Increasing parity was well presented in this study, where 45% of the GDM patients were multiparous, and this correlates well with another study conducted in Mecca, Saudi Arabia [13] wherein the majority (50%) was multipara.

This study has revealed that BMI $\geq$25 kg/m^2, a family history of diabetes, previous history of GDM, pregnancy-induced hypertension, previous history of fetal death, previous history of macrosomia, and recurrent UTI were important risk factors for the development of GDM. This result is in line with a study by Boriboonhirunsarn and colleagues [14] conducted at Siriraj Hospital, in Thailand, where they reported that BMI >25 kg/m^2 and family history of diabetes were the risk factors associated with GDM. Various authors have confirmed that not only obesity, but also overweight, greatly increases the risk of developing gestational diabetes [15,16]. The present study showed that overweight and obese women were more likely to develop GDM.

Moreover, Gilmartin [17] reported that women with GDM experience twice the number of UTIs that women who do not have GDM do, on account of the increased amount of glucose in the urine beyond the normal glycosuria that is present in pregnancy. This is consistent with the findings of the current study, which showed significant increases in UTIs among the GDM women than the non-GDM women (30, 18.9% vs. 9, 6.9%).

The current study revealed that the most common pregnancy outcomes found in GDM mothers were cesarean section (CS) (35%), followed by polyhydramnios (32%), preterm labor (23%), induction of labor (23%), and preeclampsia (21%). A significantly higher CS rate in the GDM patients, compared to the controls, was observed in this study. The CS rate of 35% in this study complies with the 33-41% found in some other reports [18,19]. However, the CS rate in this study was remarkably lower than the 45% found in a study by Sobande and colleagues [20] and the 50.5% in a report by Ghosh and Saha [21]. Cesarean delivery is a successful intervention used to decrease complications associated with gestational diabetes, such as elevated fetal weight and shoulder dystocia. Polyhydramnios was a common complication in this study, and there was a statistically significant difference in the rates between the groups studied. Sobande (2005), in his study, also found polyhydramnios to be the most common prenatal complication of GDM. Almost 23% of the deliveries in the study were preterm. A study done in Lahore, Pakistan [22] has shown 38% of GDM women delivered preterm. Also, another study by Hong and colleagues [23] reported an increased prevalence of preterm labors and CS in GDM women. The reason might be that preterm labor is associated with polyhydramnios. Other authors in the past [24,25] have pointed out high rates of labor induction (33–38%) among GDM patients, which is in contrast with the findings of this study (23%), although there was a highly significant association. Moreover, the incidence of preeclampsia in this study was high (21%), similar to the findings of Bhat and colleagues (2010), which highlighted the association of preeclampsia with GDM.

We found that women in the two groups have similar gestational age at the time of delivery. There were seven (4%) cases of macrosomic babies in the GDM group, as opposed to one (1%) in the non-GDM group. Macrosomia remains an important morbidity, because it is associated with increased risk for traumatic birth injury, obesity, and diabetes in later life [26]. The incidence of low birth weight babies born to GDM mothers was high in the present study (28, 17.6%). This can be explained by the babies born prematurely and, as a result, being of low birth weight, as Köck [27] reported. Furthermore, the babies delivered from the controls were slightly heavier than those from the GDM mothers, but the difference was not statistically significant using the Mann-Whitney test (*P*=0.135).

The incidence of 22% of neonates of GDM mothers being admitted to the NICU in this study was significantly higher than mothers without GDM (*P*=.011*).* The rate of NICU admission in this study (22%), was higher than the 16.4% reported in another study [28]. The most common reason for NICU admission was the need for phototherapy (9%), followed by hypoglycemia (6%). The present study showed that hyperbilirubinemia was the most common neonatal complication (23.9% of neonates developed jaundice). Further, another study reported hyperbilirubinemia as the most common neonatal complication in women with gestational diabetes, [22] which was in agreement with the findings of this study. This was followed by hypoglycemia, with an incidence of 12% in the current study. It was also found in 25–40% of infants of GDM mothers, [29] which is much higher than this study and the study conducted by Ostlund [30].

A stepwise logistic regression analysis (Table 6) revealed that previous history of GDM and BMI were the strongest predictors of GDM. Bian and colleagues [31] found similar results and concluded that women suffering from GDM during a previous pregnancy have a high risk of recurrent GDM. They also found BMI to be useful factor in predicting GDM [31].

5. CONCLUSION

In conclusion, this study proves that GDM is associated with increased incidence of poor maternal and neonatal outcomes. Increasing maternal age, BMI $\geq$25 kg/m^2, a family history of diabetes, previous history of gestational diabetes mellitus, and pregnancy-induced hypertension are strongly associated with an elevated risk for GDM that results in high CS rates, neonatal complications, and neonatal intensive care admissions. In order to avoid complications, screenings and appropriate treatments are imperative. More efforts should be focused on strict sugar control, ensuring a healthy pregnancy is necessary for both mother and child. However, there is also a need for large, controlled studies to confirm the risks of GDM for Saudi mothers and their babies.

CONSENT

It is not applicable.

ETHICAL APPROVAL

The author has obtained all necessary ethical approval from suitable Institutional or State or National or International Committee. This confirms either that this study is not against the public interest, or that the release of information is allowed by legislation.

COMPETING INTERESTS

Author has declared that no competing interests exist.

REFERENCES

1. Metzger BE, Coustan DR. Summary and recommendations of the fourth international workshop conference on gestational diabetes mellitus: The organizing committee. Diabetes Care. 1998; 21(Suppl 2):B161-7.
2. American Diabetes Association. Diagnosis and classification of diabetes mellitus. Diabetes Care. 2007;30:S45–S46.
3. Al-Rowaily MA, Abolfotouh MA. Predictors of gestational diabetes mellitus in a high-parity community in Saudi Arabia. East Mediterr Health J. 2010;16:636–41.
4. Bhat M, Ramesha KN, Sarma SP, Sowmini CV, Ganesh Kumar S. Determinants of gestational diabetes mellitus: A case control study in a district tertiary care hospital in south India. International Journal of Diabetes in Developing Countries. 2010;30(2):91–96.
5. Bener A, Saleh NM, Al-Hamaq A. Prevalence of gestational diabetes and associated maternal and neonatal complications in a fast-developing community: Global comparisons. International Journal of Women's Health. 2011;3:367–373.
6. Opara PI, Jaja T, Onubogu UC. Morbidity and mortality amongst infants of diabetic mothers admitted into a special care baby unit in Port Harcourt, Nigeria. Ital J Pediatr. 2010;36:77.
7. Bomback AS, Rekhtman Y, Whaley-Connell AT, et al. Gestational diabetes mellitus alone in the absence of

subsequent diabetes is associated with microalbuminuria: Results from the Kidney Early Evaluation Program (KEEP). Diabetes Care. 2010;33(12):2586–91.

8. Turok DK, Ratcliffe SD, Baxley EG. Management of gestational diabetes mellitus. Am Fam Physician. 2003;68(9): 1767-1772.
9. Langer O, Miodovnik M, Reece EA, Rosenn BM. The proceedings of the diabetes in pregnancy study group of North America 2009 conference. The J Matern-Fetal Neonat Med. 2010;23(3):196-198.
10. Bhat M, Ramesha KN, Sarma SP, Menon S, Ganesh Kumar S. Outcome of gestational diabetes mellitus from a tertiary referral center in south India: A case–control study. Journal of Obstetrics and Gynaecology of India. 2012;62(6):644-649. DOI:10.1007/s13224-012-0226-9.
11. Carolan M, Davey MA, Biro MA, Kealy M. Maternal age, ethnicity and gestational diabetes mellitus. Midwifery. 2012;28:778–83.
12. Kalra P, Kachhwaha CP, Singh HV. Prevalence of gestational diabetes mellitus and its outcome in western Rajasthan. Indian J. Endocrinol. Metab. 2013;17:677–680.
13. Almarzouki AA. Pregnancy outcome with controlled gestational diabetes: A single centre experience. Pak J Med Sci. 2012;28(5).
14. Boriboonhirunsarn D, Talungjit P, Sunsaneevithayakul P, Sirisomboon R. Adverse pregnancy outcomes in gestational diabetes mellitus. J Med Assoc Thai. 2006;89:s23-8.
15. Dahiya K, Sahu J, Dahiya A. Maternal and fetal outcome in gestational diabetes mellitus—A study at tertiary health centre in Northern India. Open Access Library Journal. 2014;1:1-5.
16. Sheshiah V, Balaji V, Balaji MS. Gestational diabetes mellitus in India. Journal of the Association of Physicians of India. 2004;52:707-711.
17. Gilmartin A “Bird” H, Ural SH, Repke JT. Gestational Diabetes Mellitus. Reviews in Obstetrics and Gynecology. 2008;1(3): 129-134.
18. Johns K, Olynik C, Mase R, Kreisman S, Tildesley H. Gestational diabetes mellitus outcome in 394 patients. J Obstet Gynaecol Can. 2006;28(2):122-127.
19. Sendag F, Terek MC, Itil IM, Oztekin K, Bilgin O. Maternal and perinatal outcomes in women with gestational diabetes mellitus as compared to nondiabetic controls. J Reprod Med. 2001;46(12): 1057-1062.
20. Sobande AA, Eskandar M, Archibong EI. Complications of pregnancy and foetal outcomes in pregnant diabetic patients managed in a tertiary hospital in Saudi Arabia. West Afr J Med. 2005;24:13–17.
21. Ghosh A, Saha SK. Adverse pregnancy outcomes in gestational diabetes mellitus – study in an apex hospital. Int. J Basic Appl. Med. Sc. 2012;2:204-208.
22. Perveen N, Saeed M. Gestational diabetes and pregnancy outcome: Experience at Shaikh Zayed Hospital. Mother and Child. 1996;34:83-8.
23. Hong JU, Rumbold AR, Wilson KJ, Crowther CA. Borderline gestational diabetes mellitus and pregnancy outcomes. BMC Pregnancy Childbirth. 2008;8:31.
24. Peticca P, Keely EJ, Walker MC, Yang Q, Bottomley J. Pregnancy outcomes in diabetes subtypes: how do they compare? A province-based study of Ontario, 2005-2006. J Obstet Gynaecol Can. 2009;3:487-496.
25. Tan PC, Ling LP, Omar SZ. The 50-g glucose challenge test and pregnancy outcome in a multiethnic Asian population at high risk for gestational diabetes. Int J Gynaecol Obstet. 2009;105(1):50-55.
26. Hod M, Merlob P, Friedman S, Schonfeld A, Ovadia J. Gestational diabetes mellitus: A survey of perinatal complications in the 1980s. Diabetes. 1991;40:74–78.
27. Köck K, Köck F, Klein K, Bancher-Todesca D, Helmer H. Diabetes mellitus and the risk of preterm birth with regard to the risk of spontaneous preterm birth. J Matern Fetal Neonatal Med. 2010;23:1004-1008.
28. Gasim T. Gestational Diabetes Mellitus: Maternal and Perinatal Outcomes in 220 Saudi Women. Oman Medical Journal. 2012;27(2):140-144.
29. Falls J, Millo L. Endocrine disorders of pregnancy. In: Bankowski BJ, Hearne AE, Lambrou NC, Fox HE, Wallach EE, editors. The Johns Hopkins manual of

gynecology and obstetrics. 2nd ed. Philadelphia: Lippincott Williams & Wilkins, AWolter Kluwer Company. 2002;162-75.

30. Ostlund I, Hanson U, Björklund A, Hjertber R, Eva N, Nordlander E, et al. Maternal and fetal outcomes if gestational impaired glucose tolerance is not treated. Diabetes Care. 2003;26(7):2107-2111.

31. Bian X, Gao P, Xiong X, Xu H, Qian M and Liu S. Risk factors for development of diabetes mellitus in women with a history of gestational diabetes mellitus. Chin Med J (Engl). 2000;113:759-762.

Peer-review history:
The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/20881