



## Study of Maternal and Fetal Outcomes in Gestational Diabetes Mellitus

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### Article History:

Received on: 10 May 2021

Revised on: 15 Jun 2021

Accepted on: 17 Jun 2021

### Keywords:

Awareness,  
Gestational Diabetes  
Mellitus,  
KAP,  
Maternal and Fetal  
Outcomes,  
Pregnant Women

### ABSTRACT

Gestational Diabetes Mellitus (GDM) is one of the most common medical complication in pregnancy and is a severe and neglected threat to maternal and child health. The objective of this study is to investigate risk factors, and maternal and fetal outcomes of GDM. This helps us understand if every pregnant woman should be made aware of GDM and its control measures, to reduce its incidence and complications associated with it. This was a hospital-based prospective observational study carried out for 6 months, in in-patients of the Obstetrics and Gynaecology Department. 65 subjects were recruited based on our inclusion and exclusion criteria. Consent was collected. Necessary details were gathered using the self-designed data collection form and validated questionnaires. Based on the data collected, descriptive and inferential statistics were performed. According to our study major risk factors identified were increased maternal age, multigravida, high BMI, and poor knowledge, attitude, and practice (KAP) towards GDM. The most common maternal complication observed was maternal distress 55 (84.61%). The most common fetal complication was low APGAR score at 1 min 20 (30.77%). A moderate positive correlation was observed between the level of knowledge and practice towards GDM which was statistically significant. According to our study there are modifiable risk factors including high BMI and poor knowledge about the disease. Pregnancies complicated with GDM are associated with adverse maternal and fetal outcomes. Thus, there is a need to create awareness about GDM and its control measures, among pregnant women and women planning for pregnancy.

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ISSN: 0975-7538

DOI: <https://doi.org/10.26452/ijrps.v12i3.4795>

Production and Hosted by

IJRPS | [www.ijrps.com](http://www.ijrps.com)

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### INTRODUCTION

Gestational Diabetes Mellitus is one of the most common medical complications in pregnancy and is a severe and neglected threat to maternal and child health (IDF, 2020a). According to American Diabetes Association, Gestational Diabetes mellitus (GDM) is defined as any degree of glucose intolerance with onset or initial diagnosis during pregnancy. Risk factors for developing GDM include increased maternal age, multigravida, obesity, increased stress, family history of diabetes, personal history of GDM, previous macrosomic infant, and high-risk ethnicities. Poor knowledge, atti-

tude, and practice towards GDM can complicate the pregnancy and can lead to adverse outcomes. GDM not only causes immediate maternal complications like hypertensive disorders, hypothyroidism, need for cesarean section, IUGR, PROM, abortion, polyhydramnios, etc. and neonatal complications like hypoglycemia, respiratory distress, macrosomia, Jaundice, large for gestational age, and stillbirth, but also increases the risk of future type 2 diabetes in mother as well as the baby (Mayo Clinic, 2020; Goldman *et al.*, 1991).

There is no specific prevention for gestational diabetes but more healthy habits like eating healthy foods, being active and fit, adopted before pregnancy can be a benefit. Worldwide there are many guidelines with recommendations for appropriate management strategies for GDM. Most guidelines recommend screening all patients for GDM at 24-28 weeks of gestation. GDM can be diagnosed using Fasting Blood Sugar reading (FBS), Glucose Challenge Test (GCT), or Oral Glucose Tolerance Test (OGTT). According to the American College of Obstetricians and Gynaecologists (ACOG), once a patient is diagnosed with GDM, they should receive a proper diet plan and exercise counseling. It is estimated that 70-85% of cases, can be controlled with lifestyle modifications alone (GDMA1). If treatment targets are not met, pharmacotherapy should be initiated (GDMA2). Insulin is generally the recommended first-line therapy as it does not cross the placenta. Glyburide and Metformin are both pregnancy category B drugs that make them safe and effective for a long-term use.

The global prevalence of GDM varies widely, from 1% to 28%, depending on population characteristics (e.g. maternal age, socioeconomic status, race/ethnicity, or body composition), screening methods, and diagnostic criteria (Nguyen *et al.*, 2018). According to International Diabetes Federation, in 2019, there were an estimated 223 million women (20-79 years) living with diabetes. This number is projected to increase to 343 million by 2045. 16.2% of live births had some form of hyperglycemia in pregnancy. An estimated 84% were due to gestational diabetes. 1 in 6 births were affected by gestational diabetes. It is important for women with diabetes in pregnancy or GDM to carefully control and monitor their blood glucose levels to reduce the risk of adverse outcomes during pregnancy (IDF, 2020a). According to IDF (2020b), the prevalence of GDM in India is 28.5% and live births affected by Hyperglycaemia in pregnancy are 6,013,834.9 (IDF, 2020b). These numbers explain the need for our study.

The purpose of the study is to identify the most significant factors that are responsible for developing Gestational Diabetes Mellitus, to assess the knowledge of the subject regarding the same, their attitude and practice towards the treatment and its control measures, and to understand the maternal and fetal outcomes due to GDM. This helps us understand if it is important that every pregnant woman should be made aware of GDM and its control measures, so as to reduce the incidence of GDM and complications associated with it.

## MATERIALS AND METHODS

### Study Site

The study was conducted at ESIC-MC-PGIMSR Rajajinagar, Bengaluru, a 500 bedded hospital.

### Study Ethics

Ethical approval was obtained from the Institutional Ethics Committee of ESIC-MC-PGIMSR Hospital Rajajinagar, Bengaluru.

### Subject recruitment and study population

Pregnant women aged 18-40 years with an initial diagnosis of any level of glucose intolerance during pregnancy with a period of gestation of 36-40 weeks admitted to the in-patient wards of the department of obstetrics and gynaecology, who were willing to participate in the study and who had signed the written informed consent were included in the study. Subjects with a history of Hypertension and Thyroid disorders and subjects with multiple pregnancy were excluded in order to understand if GDM can increase the risk of development of such co-morbid conditions. Informed consent was taken by all the study participants.

### Source of Data

Different sources of data used were:

1. Patient Case Sheet, patient and patient bystander: All necessary details were collected through these sources including diagnosis, lab reports, medications, etc.
2. Doctor in charge: Doctors were requested to clear any queries regarding the case, if any.

### Study Materials

#### Self-designed Case Report Form

Data collection was done by using a self-designed data collection form to collect details like patient demographics, diagnosis, gestational age, gravidity, etc.

### KAP questionnaires

KAP serves as an educational diagnosis of the community. A self-designed questionnaire with 15 items was administered to evaluate the knowledge, attitude, and practice of subjects towards GDM. It contains 3 parts, Part 1- Knowledge on GDM, Part 2- Attitude towards GDM, and Part 3- Practice towards controlling measures of GDM. The questionnaires were developed in English as well as local language based on relevant articles.

Part 1 consists of 5 Questions regarding Knowledge on GDM which includes definition, risk factors, treatment, and long-term complications and its impact on mother and child health. For each question, subjects were given three wrong and one right option. In Part 2, subjects were asked questions about their attitude towards GDM. Likert-scale was used to score questions on Attitude which included 6 statements. For Part 3, questions were regarding their practice towards controlling measures of GDM with yes or no options. Simple Binary Scoring System (SBSS) was used to score knowledge and practice questionnaires. The questionnaires mainly focused on various pregnancy-related aspects of GDM and diabetes-friendly practices for GDM.

All the self-designed questionnaires were validated by experts in the field [gynaecologist, statistician, and faculty members]. Appropriateness, use of jargon, and accuracy of all the questionnaires were checked. Questionnaires were modified based on the inputs and were used in a pilot study with 25 subjects to evaluate its reliability. After which it was used for the study based on the feedback received.

### Data Analysis

All the information obtained was entered into Microsoft excel and appropriate statistical analysis was performed.

### RESULTS

A total of 65 patients were enrolled in the study based on our inclusion and exclusion criteria. Our study findings include risk factors contributing to GDM, maternal outcomes of GDM, fetal outcomes of GDM.

#### Risk factors contributing to GDM

Majority of the subjects belonged to the age group of 25-32 years i.e. 30 subjects (46.15%), 23 subjects belonged to the age group of 32 -39 years (35.38%) followed by 12 subjects in the age group of 18-25 years (18.47%), as shown in Table 1. The mean age was found to be  $29.56 \pm 4.64$  years. This shows that increased maternal age increases the risk of GDM.

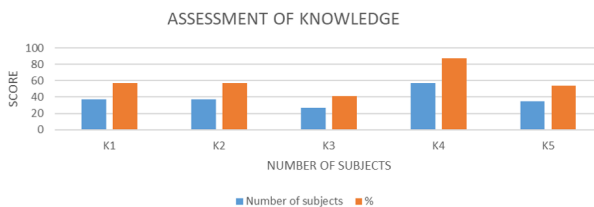


Figure 1: Distribution of response received for assessment of knowledge

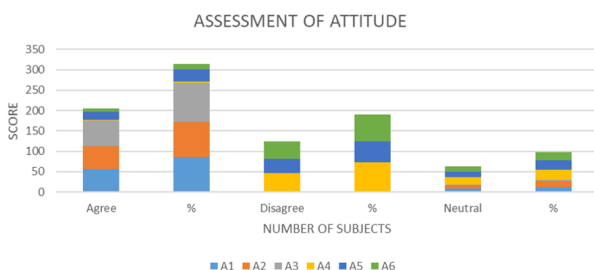


Figure 2: Distribution of response received for assessment of attitude

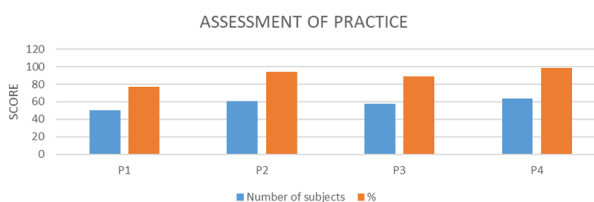


Figure 3: Distribution of response received for assessment of practice

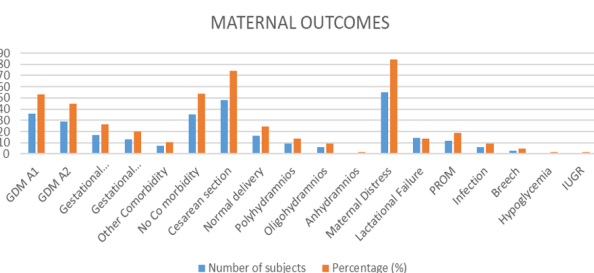


Figure 4: Distribution of maternal outcomes in subjects with GDM

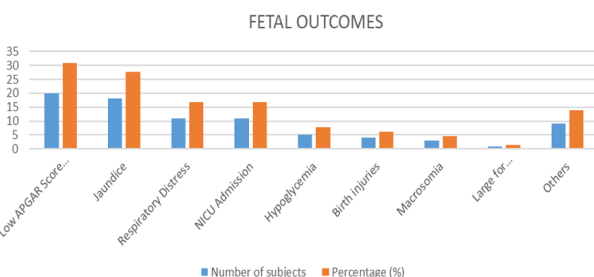


Figure 5: Distribution of fetal outcomes associated with GDM

**Table 1: Distribution of subjects according to age (years)**

Age Group	Number of Subjects	Percentage (%)
18-25	12	18.47
25-32	30	46.15
32-39	23	35.38
Grand Total	65	100

**Table 2: Distribution of subjects based on Body Mass Index (BMI)**

BMI Classification	BMI Range	Number of subjects	Percentage
Below Normal	17-19	3	4.61
Normal	19-25	35	53.84
Above Normal	25-40	27	41.53
Grand Total		65	100

**Table 3: Distribution of subjects based on gravidity**

Gravidity	Number of subjects	Percentage (%)
1(primigravida)	21	32.30
2-4 (multigravida)	44	67.69
Grand Total	65	100

**Table 4: KAP Questionnaire Score distribution**

Domain	Minimum score	Maximum Score	Mean $\pm$ SD
Knowledge	1	5	2.96 $\pm$ 1.33
Attitude	10	27	17 $\pm$ 3.19
Practice	1	4	3.58 $\pm$ 0.74
Overall KAP	13	34	23.55 $\pm$ 4.15

Majority of the subjects belonged to the BMI category Normal [19.5-25kg/m<sup>2</sup>] 35(53.84%) followed by 27 (41.53%) considered to be in the category of above normal with a range of 25-40 and 3 (4.61%) fall into the range of 17-19, considered as below normal, as shown in Table 2. Our findings indicate that increased BMI increases the risk of occurrence of GDM.

Out of 65 subjects, 44 subjects had multigravida (Gravidity:2 -4) (67.69%) and 21 subjects had Primigravida (Gravidity: 1) (32.30%), as shown in Table 3, which suggests that the risk of development of GDM increases with increased gravidity.

Poor knowledge, attitude, and practice can also act as a risk factor to GDM and its complications. Thus, we have assessed the KAP of subjects regarding GDM. Their knowledge represents their understanding of the disease which can greatly influence their approach towards management of the disease condition. Assessment of knowledge about GDM revealed that more than half of the subjects

37(56.9%) were aware of the normal range of General Random Blood Sugar (GRBS) levels and most of them 37(56.9%) also knew the Risk Factors for GDM whereas only 27(41.54%) of them agreed to the fact that GDM is a risk factor for future type 2 diabetes mellitus. The majority of the subjects 57(87.69%) knew the name of the drug they were taking for GDM but only half of the subjects 35(53.85%) knew the long-term health consequences for the child born to GDM mothers. The average score of the questionnaire on Knowledge was found to be 2.96  $\pm$  1.33 (Maximum=5), which implies that the subjects had fair knowledge about the disease and its management, as shown in Figure 1.

The attitude of the subject towards the management of GDM can have an enormous impact on maternal and fetal outcomes. Majority of the subjects 56(86.15%) agreed that regular checking of glucose is important, whereas 1(1.53%) disagreed, while 8(12.30%) had a neutral opinion and majority of them 56(86.15%) also agreed that regu-



lar medications will improve the disease condition, while 9(13.84%) had a neutral opinion for the same. Almost all subjects 63(96.92%) agreed that sweet/sugar reduction/restriction could control GDM, while the rest of them 2(3.08%) had a neutral opinion. Most of the subjects 46(70.77%) disagreed with a negative statement quoting that GDM should not be treated in pregnancy due to fear of risk to the baby, whereas 2(3.08%) agreed, while 17(26.15%) had a neutral opinion. Only half of the subjects 34(52.31%) disagreed with a negative statement quoting that emotional stress doesn't have any role in causing GDM during pregnancy, whereas 19(29.23%) agreed, while 14(21.54%) were neutral. Most of the subjects 43(66.15%) disagreed with a statement quoting 'I take any OTC Medications during pregnancy', whereas 9(13.85%) agreed, while 13(20%) had a neutral opinion. The mean score of the attitude section was found to be  $17 \pm 3.19$  (Maximum = 30), which infers that majority of the subjects had a positive attitude towards management of GDM, as shown in Figure 2.

Knowledge of correct practice and its application is important for higher therapeutic outcomes. Majority 50(76.92%) of the subjects had a regular practice of checking their blood sugar levels, almost all of the subjects 61(93.85%) tried to find out whether the medicines taken by them (OTC or prescribed) is safe during pregnancy, majority of the subjects 58(89.23%) followed the instructions regarding proper medicine use as prescribed and almost all of the subjects 64(98.46%) reduced sugar/sweet intake as advised by the doctor. The average score of the practice questionnaire was  $3.48 \pm 0.74$  (Maximum = 4), which shows that the majority of the subjects followed good practice to reduce the risk of complications associated with GDM. The detailed distribution of the practice score is shown in Figure 3.

The overall score of KAP was found in the range of 13 to 34 with an average score of  $23.55 \pm 4.15$ , while the minimum possible score was 6 and the maximum possible score was 39, detailed distribution is given in Table 4.

### Maternal Outcomes

Maternal outcomes in GDM were assessed and the outcomes are, more than half of the subjects 36(55.38%) developed GDM A1, and 29(44.61%) developed GDM A2. The most common comorbidity 17(26.15%) observed was gestational hypothyroidism, followed by gestational hypertension 13(20%), and other comorbidities 7(10.73%) whereas most of them 35(53.83%) did not develop any co-morbid conditions. Majority of the subjects

48(73.84%) underwent caesarean section while only 16(24.61%) underwent normal delivery. Most common complication observed was maternal distress 55(84.61%) followed by caesarean section 48(73.84%), lactational failure 14(13.4%), PROM 12(18.46%), polyhydromnias 9(13.85%), oligohydramnios 6(9.23%), infections 6(9.23%), anhydromnias 1(1.53%), IUGR 1(1.53%) and hypoglycemia 1(1.53%), as shown in Figure 4. This indicates that GDM can cause serious complications during and after pregnancy.

### Fetal Outcomes

Fetal outcomes in GDM were assessed and the outcomes are, the most common fetal complication was low APGAR score at 1 min 20(30.77%), followed by jaundice 18(20.69%), followed by respiratory distress 11(16.92%), NICU admissions 11(16.92%), hypoglycemia 5(7.69%), birth injuries 4(6.15%), macrosomia 3(4.62%), large for gestational age 1(1.53%) and other complications summed up to 9(13.8%), as shown in Figure 5. The majority of the neonates 45 (69.23%) had an APGAR score greater than 7 (Normal), followed by 20 (30.77%) subjects who had APGAR score between 4-6 (Mild asphyxia) at 1min. APGAR score of 5min was assessed and 65(100%) neonates had APGAR score >7 (Normal). The detailed distribution of subjects based on fetal outcomes is shown in Figure 5. Thus, our findings indicate that GDM not only increases the risk of complications to mother but also causes serious neonatal complications.

### DISCUSSION

Gestational Diabetes Mellitus carries a potential risk of adverse perinatal outcomes and a long-term risk of type 2 diabetes mellitus in both mother and child. Maternal age has an important influence on the development of Gestational Diabetes Mellitus. The subjects were categorized according to the age group, the mean age was found to be  $29.56 \pm 4.64$  years, majority of subjects were above 25 years(81.53%) which was comparable to the study done by Shukla A et al., where the majority of subjects (82%) were above 25 years of age and (18%) were below 25 years of age (Shukla *et al.*, 2017). A study in Mumbai by Dudhwadkar and Fonseca (2016), also stated that GDM affects older women more than younger ones, where the results showed maximum patients (56%) were in the age group of 26-30 years and 30% of patients were over 30 years of age. This indicates that increased age is associated with an increased risk of GDM and its complications.

In our study, out of 65 subjects, 44 subjects were

multigravida (Gravidity: 2-4) (67.69%) and 21 subjects were primigravida (Gravidity: 1) (32.30%), the results were similar to the study done by Shukla A et al., where the results were- 2<sup>nd</sup> gravida-5%, 2-4 gravidity- 8%, >4 gravidity-26% (Shukla *et al.*, 2017). According to the study done by Dudhwadkar R et al., maximum GDM patients (72%) were multigravida (Dudhwadkar and Fonseca, 2016). Hence it can be concluded that the incidence of GDM rises with increased gravidity.

The present study shows that the most common mode of delivery was Lower Segment Cesarean Section (LSCS) (73.84%), which was comparable with the study conducted by Singla M et al., where the number of LSCS performed was 60% (Singla *et al.*, 2016) and similar results were also seen in a study done by Shukla A et al., where (83.78%) subjects underwent LSCS (Shukla *et al.*, 2017). These findings were supported by the study done by Dudhwadkar R et al., where the incidence of LSCS in GDM patients was found to be 52% (Dudhwadkar and Fonseca, 2016). This indicates that GDM mothers are at increased risk of LSCS when compared to Non-GDM mothers.

Our study results show, overall good knowledge, attitude and practice of subjects towards disease condition, while under knowledge section, subjects had a fair knowledge about the disease which was comparable to study done by Shriraam Vetal., whose study results show only a small proportion of rural antenatal women (17.5%) had good knowledge about GDM (Vanishree Shriraam *et al.*, 2013). Using statistical analysis, a moderate positive correlation was observed between knowledge and practice which was statistically significant. This indicates that educating pregnant women about their health condition and guiding them about the right choices to practice during that period would have a great impact on healthy obstetric outcomes.

Our study results show that various comorbidities and maternal complications are associated with GDM, comparable results were obtained in a study performed by Gasim T et al., where the results were as follows, in the study, patients with GDM had a significantly higher incidence of pre-eclampsia [P<0.0001], pre-term delivery [P=0.0220], induction of labor [P<0.0001] and cesarean section [P=0.00019] (Gasim, 2012) and similar results were obtained in a study conducted by Singla M et al., where the common maternal complications observed were gestational hypertension (27.32%), stillbirth (14.7%), diabetic ketoacidosis (3%) and vaginal candidiasis (8.5%) (Singla *et al.*, 2016). According to Dudhwadkar R et al., pregnancy com-

plicated with GDM has adverse maternal and fetal outcomes, whose results show the incidence of pre-eclampsia (26%), hypothyroidism (6%), and polyhydramnios (20%) in GDM patients, which can complicate the course of pregnancy and has adverse effects on maternal and fetal outcomes (Dudhwadkar and Fonseca, 2016). Thus, all four studies indicate that women with GDM are at increased risk of adverse obstetric outcomes.

Mild asphyxia at 1 min was the most common fetal complication in our study which is very similar to the study conducted by Rowan J et al., where a significantly low APGAR score is consistent in infants of diabetic mother (Rowan *et al.*, 2008). Followed by jaundice as another most common fetal complication of our study, which can be supported by the study done by Singla *et al.* (2016), whereas in a study done by Shukla A et al., macrosomia was the most commonly observed complication (Shukla *et al.*, 2017). In our study, there was no fetal death, but NICU admissions followed by respiratory distress were seen as the second most common complication. The above findings suggest that there should be a proper preparation for neonatal resuscitation at the time of childbirth in pregnancies complicated with GDM.

### Limitations

The sample size and duration of the study was less. The data was collected from a single hospital and thus may not represent patterns across the city/country.

Could not determine long-term health consequences of GDM due to lack of follow-up. There was a lack of follow-up because of lockdown due to pandemic situation.

### CONCLUSION

The study showed that there are modifiable (increased BMI and poor KAP) and non-modifiable (increased maternal age and multigravida) risk factors. As GDM can be sometimes controlled by few lifestyle changes, modifiable risk factors should be controlled like reducing weight and our study also implies that having just good knowledge, attitude and practice is not enough to reduce the occurrence of complications, GDM mothers should have the right guidance, thorough knowledge, best attitude and practice to lessen the severity of associated complications, which is possible with clinical activities like medication review, patient counseling and patient-centered care. If not provided with the right assistance at an initial stage, GDM subjects might have to suffer its complications, which can

be serious in a few. GDM not only complicates pregnancy but also has long-term consequences on the health of both mother and baby.

#### ACKNOWLEDGEMENT

We thank Dr. Renuka Ramaiah, HOD of Obstetrics and Gynaecology and the management of ESIC for permitting us to conduct our study and for providing all the required facilities for successful completion of the study. We thank Dr. Gangaboraiah A, Professor of Statistics, Department of Community Medicine, KIMS, Bengaluru, for contributions to statistical analysis of our study. We extend our thanks to our HOD Mr. Binai K Sankar for his guidance and support.

#### Conflict of Interest

The authors declare that there is no conflict of interests regarding the publication of this paper.

#### Funding Support

The authors declare that they have no funding support for this study.

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