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Research Article

Gestational Diabetes Mellitus

Comparison of Maternal and Perinatal Outcome Of Gestational Diabetes Mellitus With And Without Preeclampsia Patient

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Background: Gestational diabetes mellitus (GDM) and preeclampsia share many risk factors, e.g., gestational weight gain. Gestational diabetes mellitus (GDM) and preeclampsia are two dangerous pregnancy complications and their coexistence further increases adverse maternal and perinatal outcomes.

Objective: This study was carried out for comparison of maternal and perinatal outcomes of gestational diabetes mellitus with and without preeclampsia patients.

Methods: It was a cross-sectional analytical study. Patients were divided into 2 groups: group I (n=75) included GDM with preeclampsia and group II (n=75) included GDM without preeclampsia. Data was collected by history taking, examinations and required investigations and recorded in a predesigned data collection instrument. Data were processed and analyzed using computer software SPSS version 22.

Results: The majority, 66.7% among the respondents of group I did not have anemia, 30.7% had mild and only 2.7% had moderate anemia. 86.7% of the respondents of group II did not have anemia, 12.0% had mild and only 1.3% had moderate anemia which was statistically significant ($p<0.05$). Mean BMI in both groups I (31.87± 5.93) and II (31.16 ± 4.72) was not statistically significant ($p\geq0.05$). Of all (100.0%) of group I and group II most of the respondents, 90.7% had LUCS and none of group I, only 9.3% in group II had NVD both were statistically significant ($p=.013$). A non-significant difference was observed in regards to maternal outcome where group I, had 16.0% oligohydramnios, 4.2% polyhydramnios and 1.3%, PPH, in group II had 12%, oligohydramnios, 4.2% polyhydramnios and none of PPH. In group I majority, 64.0% had preterm delivery and in group II, 41.3% had preterm delivery which was statistically significant. In group I, 5.3% and none of group II had an IUD which was statistically significant ($p<0.05$) no significant difference was observed in regards to asphyxia whereas in group I asphyxia of babies was higher (10.7%) than that of group II, 4.0%.

Conclusion: Preeclampsia is one of the leading causes of maternal and perinatal morbidity and mortality worldwide. In GDM with preeclampsia LUCS, preterm delivery and IUD were higher in comparison to patients in GDM without preeclampsia.

Keywords: Gestational Diabetes Mellitus, Maternal Mortality, Maternal Outcome, Neonatal Outcome

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Introduction

Gestational diabetes mellitus (GDM) is the most frequently encountered endocrine disorder in pregnancy and is associated with adverse outcomes if remains undiagnosed or untreated. It is defined as glucose intolerance of variable severity with onset or first recognized during the present pregnancy. The prevalence of GDM is 9.7% according to the WHO criteria and 12.9% according to the ADA (American Diabetic Association) criteria in Bangladesh. South Asians are more prone to have diabetes at an earlier age and thus more vulnerable to GDM [1].

GDM is associated with macrosomia, which may subsequently lead to shoulder dystocia and birth trauma in addition to an increase in the rate of Caesarean sections. Globally, researchers are concerned about an increase in the prevalence of gestational diabetes mellitus (GDM) [2]. Middle Eastern countries range from 13.9% in Qatar to 7% in Iran in comparison to the United States, where the prevalence ranges from 3.47% to 7.15% [3]. GDM is associated with adverse fetal and maternal outcomes. Adverse fetal outcomes include congenital anomalies, trauma during birth, macrosomia and perinatal mortality. Adverse maternal outcomes include increased rates of caesarean section and increased lifetime risk of developing type 2 diabetes. Pre-eclampsia is a disorder of pregnancy characterized by the onset of high blood pressure and often a significant amount of protein in the urine [4].

When it arises, the condition begins after 20 weeks of pregnancy. In severe cases of the disease, there may be red blood cell breakdown, a low blood platelet count, impaired liver function, kidney dysfunction, swelling, shortness of breath due to fluid in the lungs, or visual disturbances. Pre-eclampsia increases the risk of undesirable outcomes for both the mother and the fetus. If left untreated, it may result in seizures at which point it is known as eclampsia [5,6]. Risk factors for pre-eclampsia include obesity, prior hypertension, older age, and diabetes mellitus. It is also more frequent in a woman's first pregnancy and if she is carrying twins. It takes place only in the presence of the placenta even without the fetus (hydatidiform mole), and typically improves postpartum. Hypoperfusion and ischemic conditions show the abnormal placenta.

PE is known to originate from disordered vascular development of the placenta which further widely spreads anti-angiogenic factors into the maternal circulation and causes systemic endothelial cell dysfunction and microangiopathy. Upon kidneys, these endothelial damages result in glomerular endotheliosis and proteinuria in which the endothelial cells of the glomerulus swell and endothelial fenestrations are lost [5]. Pre-eclampsia affects 2-8% of pregnancies worldwide. In Bangladesh, the prevalence of GDM is 9.7% [7]. Hypertensive disorders of pregnancy (which include pre-eclampsia) are one of the most common causes of death due to pregnancy. They resulted in 46,900 deaths in 2015. Pre-eclampsia usually occurs after 32 weeks; however, if it occurs earlier it is associated with worse outcomes. Women who have had pre-eclampsia are at increased risk of heart disease and stroke later in life [8].

Preeclampsia is classified into preeclampsia without severe features and preeclampsia with severe features. Severe preeclampsia is characterized by severe hypertension (≥160/110 mmHg) or end-organ injury. Preeclampsia and cardiovascular disease share many risk factors such as age, elevated BMI, family history and certain chronic diseases. Lowered blood supply to the fetus in pre-eclampsia causes lowered nutrient supply, which could result in intrauterine growth restriction (FGR) and low birth weight. The fetal origins hypothesis states that fetal undernutrition is linked with coronary heart disease later in adult life due to disproportionate growth [9]. Pre-eclampsia leads to a mismatch between the maternal energy supply and fetal energy demands and can lead to FGR in the developing fetus. Infants with FGR are prone to have poor neuronal development and an increased risk for adult disease according to the Barker hypothesis. In addition to coronary artery disease (CAD), type 2 diabetic mellitus (T2DM), cancer, osteoporosis, and numerous psychiatric conditions, FGR is associated with adult disorders of the fetus [10]. The risk of pre-eclampsia and the development of placental dysfunction has also been shown to be recurrent cross-generationally on the maternal side and most likely on the paternal side. Pre-eclampsia was 50% more likely to occur in fetuses born to moms who were born short for gestational age (SGA), and it was three times as common in fetuses delivered to both SGA parents [11].

Although the identification of underlying risk factors for preeclampsia is different some identified risk factors are documented like nulliparity, family history, preeclampsia in previous pregnancy, multiple gestation, pregestational diabetes mellitus, chronic hypertension, chronic renal disease and some autoimmune diseases. The development of GDM originates from insulin resistance, and that of preeclampsia is related to abnormal placentation leading to reduced placental perfusion. Dyslipidemia plays a significant role in the pathogenesis of both diseases [12].

Preeclampsia and GDM share similar risk factors, such as obesity-related dyslipidemia [13]. Common risk factors that may contribute to the increase of gestational diabetes, are maternal age >35 years, BMI >30kg/m2, prior history of GDM, previous macrosomic baby (weight >4.5kg), prior history of unexplained stillbirth, family history of diabetes (1st degree), and PCOS [14].

Materials and Methods

Study design: Cross-sectional analytical study.

Place of study: This study was carried out in the Department of Obstetrics and Gynaecology, Bangladesh Institute of Research & Rehabilitation for Diabetes, Endocrine & Metabolic Disorders (BIRDEM), General Hospital, Dhaka, Bangladesh.

Study population: Pregnant women between 25-40 years of age attending the antenatal clinic in the Department of Obstetrics and Gynaecology, BIRDEM General Hospital, in their third trimester of pregnancy, were included in this study.

GDM with preeclampsia (Group-I): GDM with preeclampsia in their third trimester admitted for pregnancy termination under the Department of Obstetrics and Gynecology, BIRDEM was recruited as group I.

GDM without preeclampsia (Group II): GDM without preeclampsia in their third trimester, admitted for pregnancy termination under the Department of Obstetrics and Gynecology, BIRDEM was recruited as group II.

Period of study: One year from IRB (Institutional Review Board) approval date 26-12-2021.

Sample size determination: The sample size was determined by the following formula.

$$n = \frac{P_1 (1-P_1) + P_2 (1-P_2)}{(P_1 - P_2)^2} X (Z\alpha + Z_\beta)^2$$

Therefore, the total calculated sample size was, n = 190

Due to time and resource constraints 150 data were collected and divided into 2 groups; (Group I-75 and Group II=75).

Sampling method: Purposive sampling was done according to the availability of the patients who fulfilled the inclusion criteria.

Selection Criteria:

Inclusion Criteria:

- GDM was diagnosed by WHO criteria.
- GDM with Preeclampsia patient
- GDM without Preeclampsia patient
- Age 25-40 years.

Exclusion Criteria:

- Pregnancy with diabetes mellitus
- Pregnancy with congestive cardiac failure,
- Pregnancy with chronic liver disease,
- Pregnancy with endocrinopathy,
- Pregnancy with an autoimmune disorder and
- Pregnancy with renal disease.

Study Procedure:

This cross-sectional analytical study was conducted in BIRDEM, from January 2022- December 2022 after getting IRB clearance. The study population was pregnant women of 25-40 years attending the Department of Obstetrics and Gynecology, BIRDEM and getting admitted to the hospital fulfilling the inclusion and exclusion criteria. A total of 150 pregnant women were included in the study, among them 75 with GDM complicated by preeclampsia were in one group (Group I, n-75) and the remaining 75 GDM patients without preeclampsia were in another group (Group II, n-75).

All participants were in the 3rd trimester of pregnancy, primi or multigravida and with a single fetus. The purpose and procedure of the study were discussed with the patients. Written consent was taken from those who agreed to participate in the study. Ethical committee clearance was obtained from the institution.

A thorough clinical examination was done on all the subjects. After delivery simultaneously, data was collected for maternal outcome and fetal outcome. For every subject separate data collection sheet was prepared.

Data was collected from the patients on variables of interest using the structured design by interview, observation, clinical examination, haematological investigations and from history sheet of patients.

Blood collection: Maternal blood samples were drawn from the antecubital vein (in an arm without intravenous infusion ongoing). 5 millilitres of blood was drawn with proper aseptic precautions. The blood sample was transferred into a clean, dry test tube and taken to the laboratory.

Blood pressure (BP): As a baseline clinical examination, after 10 minutes of rest, BP was measured on the right arm at the level of the heart in a sitting posture/lateral decubitus with an average-sized cuff following all standard procedures. Blood pressure was measured again after 4-6 hours interval and the average was used for the analysis.

Safety precaution: Universal precaution was obtained. Gloves, lab coats, and safety glasses were worn when handling all human blood products. Disposable plastic, glass, paper and gloves that contact with blood were placed in a biohazard bag. Non-disposable material at the end of the working day was disinfected. Washing hands thoroughly was done after the removal of personal protective devices used in handling specimens and kit reagents.

Data Analysis: Statistical analyses were carried out by using the Statistical Package for Social Sciences version 22.0 for Windows (SPSS Inc., Chicago, Illinois, USA). Continuous variables were expressed as mean ±standard deviation and categorical variables as frequencies and percentages n (%). The chi-square test was used to analyze the categorical variables and shown in the cross-tabulation. The mean difference between groups was analyzed by unpaired t-test for continuous variables. P values <0.05 are considered as statistically significant.

Results

A total of 150 pregnant women were included in this study and then they were divided into two groups. Group I comprised pregnant women (75 respondents) diagnosed with GDM with preeclampsia and Group II comprised pregnant women (75 respondents) diagnosed with GDM without preeclampsia. The findings of the study are presented in tables.

Table 1: Distribution of the respondents according to socio-demographic characteristics by group (GDM with preeclampsia -75, GDM without preeclampsia 75)

Socio-demographic variables	Group I (N=75)	Group II (N=75)	p-value
Age (in years)			
<35 years	56 (74.7)	63 (84.0)	nsa
≥ 35 years	19 (25.3)	12 (16.0)	
Mean ± SD	31.19± 4.24	31.19± 4.24	nsc
Education qualification			
S.S.C.	38 (50.7)	23 (30.7)	≤0.02a
H.S.C	37 (49.3)	52 (69.3)	
Occupation			
Housewife	56 (74.7)	64 (85.3)	nsa
Service	19 (25.3)	11 (14.7)	
Monthly Family Income			
lower middle and below	58 (77.3)	61 (81.3)	nsa
higher middle and above	17 (22.7)	14 (18.7)	

aChi square test was done to measure the level of significance, unpaired t-test was done to measure the level of significance, ns = not significant.

Table 1 states the distribution of the respondents according to socio-demographic characteristics by group where the mean age of the respondents was similar in both group I and group II which was (31.19 ± 4.24) years. The majority of them were housewives in both groups I, 74.7% and group II, 85.3% and were from lower middle and below-income families both in group I, 77.3% and group II, 81.3% which were not statistically significant (p≥0.05). In group II majority, 69.3% were educated up to HSC and only, 30.7. % completed SSC which was statistically significant (p <.02).

Table 2: Distribution of the respondents according to menstrual and obstetrics characteristics by group (GDM with preeclampsia = 75, GDM without preeclampsia= 75)

Parameter	Group I (N=75)	Group II (N=75)	p-value
Menstrual cycle			
Regular	41 (54.7)	47 (62.7)	nsa
Irregular	34 (45.3)	28 (37.3)	
Gestational age (in weeks)			
Mean ± SD	35.55 ± 1.74	36.05 ± 1.77	nsc
Gravida			
Primigravida	23 (30.7)	27 (36.0)	nsa
Multigravida	52 (69.3)	48 (64.0)	

A c hi-square test was done to measure the level of significance.
c Unpaired t-test was done to measure the level of significance.
ns = not significant.

The majority, 62.7% of the respondents in group II had regular menstrual cycles and only, 37.3% had irregular menstrual cycles. The majority, 69.3% of group I was multigravida and only, 30.7% were primigravid. The mean gestational age was in both group I (35.55 ± 1.74) week and group II (36.05 ± 1.77) week. There were no significant differences between the two groups regarding the variable (p>0.05) (Table 2).

Table 3: Distribution of the respondents according to personal history by group (GDM with preeclampsia = 75, GDM without preeclampsia= 75)

Parameter	Group I (N=75)	Group II (N=75)	p-value
Weight gain			
Excessive weight gain	41 (54.7)	47 (62.7)	nsa
Normal weight	34 (45.3)	28 (37.3)	
Smoking			
Smoker	1 (30.7)	0 (0.0)	nsb
Nonsmoker	74 (98.7)	75 (100.0)	

A chi-square test was done to measure the level of significance.
b Fisher's exact test was done to measure the level of significance.
ns = not significant.

No significant difference was observed in terms of weight gain and smoking between the two groups (p≥0.05) (table 3).

Table 4: Distribution of the respondents according to BMI by group (GDM with preeclampsia = 75, GDM without preeclampsia= 75)

BMI (kg/m²)	Group I (N=75)	Group II (N=75)	p-value
Normal (18.5-24.9)	6 (8.0)	9 (12.2)	nsa
Overweight (25.0-29.9)	28 (37.3)	24 (32.4)	
Obese (>30)	41 (54.7)	41(55.4)	
Mean ± SD	31.87± 5.93	31.16± 4.72	nsc

AChi square test was done to measure the level of significance.
cUnpaired t-test was done to measure the level of significance.
ns = not significant. Table 4 denotes that the mean BMI in both groups I (31.87± 5.93) and II (31.16 ± 4.72) and the finding was statistically non-significant (p≥0.05).

A chi-square test was done to measure the level of significance.

Table 5: Distribution of the respondents according to Physical examination by group (GDM with preeclampsia = 75, GDM without preeclampsia= 75)

	Group I (N=75)	Group II (N=75)	p-value
Anaemia			
Absent	50 (66.7)	65 (86.7)	≤0.02a
Mild	23 (30.7)	9 (12.0)	
Moderate	2 (2.7)	1 (1.3)	

Regarding anaemia in Group I mild anaemia was higher, 30.7% than that of Group II, 12.0% and this finding was statistically significant (P<0.02) (table-5).

Table 6: Distribution of the respondents according to sonographic findings by group (GDM with preeclampsia = 75, GDM without preeclampsia= 75)

	Group I (N=75)	Group II (N=75)	p-value
Fetal movement			
Present	71 (94.7)	75 (100.0)	<0.05b
Absent	4 (5.3)	0 (0.0)	
Fetal heart sound	147.35 ± 12.14	144.92±26.92	nsc

B Fisher's exact test was done to measure the level of significance.
c Unpaired t-test was done to measure the level of significance.
ns = not significant.

In group I, 5.3% and none of group II had absent fetal movement which was statistically significant (p<0.05) (table-6).

Table 7: Distribution of the respondents according to the mode of delivery by group (GDM with preeclampsia = 75, GDM without preeclampsia= 75)

Mode of delivery	Group I(N=75)	Group II(N=75)	p-value
LSCS	75 (100.0)	68 (90.7)	≤0.02a
NVD	0 (0.0)	7 (9.3)	

A chi-square test was done to measure the level of significance.

A significant difference was observed in regards to mode of delivery where all (100.0%) among group I and in group II most of the respondents (90.7%) had LSCS and only, 9.3% in group II had NVD (p≤0.02) (table-7).

A chi-square test was done to measure the level of significance.
b Fisher's exact test was done to measure the level of significance.
Ns= not significant.

No significant difference was observed regarding maternal outcomes between group I and group II (Table 8).

Table 8: Distribution of the respondents according to maternal complication by group (GDM with preeclampsia = 75, GDM without preeclampsia-75)

Maternal complication	Group I (N=75)	Group II (N=75)	p-value
PPH			
Yes	1 (1.3)	0 (0.0)	nsb
No	74 (98.7)	75 (100.0)	
Puerperal sepsis			
Yes	0 (0.0)	2 (2.7)	nsb
No	75 (100.0)	73 (97.3)	
Oligohydramnios			
Yes	12 (16.0)	9 (12.0)	nsa
No	63 (84.0)	66 (88.0)	
Polyhydramnios			
Yes	3 (4.2)	3 (4.2)	nsa
No	68 (95.8)	68 (95.8)	

Table 9: Distribution of the respondents according to perinatal complication by group (GDM with preeclampsia - 75, GDM without preeclampsia= 75)

Perinatal complication	Group I (N=75)	Group II (N=75)	p-value
FGR			
Yes	11 (14.7)	6 (8.0)	nsa
No	64(85.3)	69 (92.0)	
IUD			
Yes	4 (5.3)	0(0.0)	<0.05b
No	71 (94.7)	75 (100.0)	
Preterm			
Yes	48 (64.0)	31 (41.3)	<0.05a
No	27 (36.0)	44 (58.7)	
Birth weight (mean ± SD)	2.56±0.60	2.68±0.63	nsc
LGA			
Yes	4 (5.3)	5 (6.7)	nsa
No	71 (94.7)	70 (93.3)	
Asphyxia			
Yes	8 (10.7)	3 (4.0)	nsa
No	67 (89.3)	72 (96.0)	
ARDS			
Yes	4 (5.3)	3 (4.0)	nsa
No	71 (94.7)	72 (96.0)	
Hyperbilirubinemia			
Yes	7 (9.3)	9 (12.0)	nsa
No	68 (90.7)	66 (88.0)	
Hyperglycemia			
Yes	7 (9.3)	1 (1.3)	nsa
No	68 (90.7)	74 (98.7)	
Hypoglycemia			
Yes	4 (5.3)	0 (0.0)	nsb
No	71 (94.7)	75 (100.0)	
NICU admission			
Yes	25 (33.3)	21 (28.0)	nsa
No	50 (66.7)	54 (72.0)	

A chi-square test was done to measure the level of significance.

b Fisher's exact test was done to measure the level of significance.

c Unpaired t-test was done to measure the level of significance.

Ns= not significant.

A significant difference was observed in regards to perinatal outcome where in group I majority, 64.0% had preterm delivery and in group II 41.3% had preterm delivery. In group I, 5.3% and none of group II had IUD which was statistically significant ($p<0.05$). A significant difference was observed in regards to perinatal outcome where in group I majority, 64.0% had preterm delivery and in group II 41.3% had preterm delivery. A nonsignificant difference was observed in regards to asphyxia where in group I majority, 10.7% and in group II 4.0% had asphyxia in babies. In group I, 33.3% and in group II 28.0% had NICU which was statistically non-significant ($p\geq0.05$) (table-9).

Discussion

The hospital-based cross-sectional analytical study was carried out to compare maternal and perinatal outcomes of gestational diabetes mellitus with and without preeclampsia patients. This study was carried out in the Department of Obstetrics and Gynecology of BIRDEM General Hospital, Dhaka. A total of 150 pregnant women were included in this study and then they were divided into two groups. Group I comprises pregnant women (75 respondents) diagnosed with GDM with preeclampsia and Group II comprises pregnant women (75 respondents) diagnosed with GDM without preeclampsia. In the present study, the mean age of the respondents was similar in both group I and group II which was (31.19 ± 4.24) years. A study reported a mean age of 27.65 ± 5.04 years which was almost similar to the present study [15]. The majority of the respondents in the present study, were housewives in both group I, 74.7% and group II, 85.3% and were from lower middle- and below-income families in group I, 77.3% and group II, 81.3% which were not statistically significant ($p\geq0.05$). In group II majority (69.3%) were educated up to HSC and only, 30.7. % completed SSC which was statistically significant ($p=0.013$). A study showed insignificant differences in the distribution of the major epidemiological factors [16] which almost supports the findings of the present study. In this study majority, 62.7% of the respondents in group II had regular menstrual cycles and only, 37.3% had irregular menstrual cycles. The majority, 69.3% of group I was multigravida and only, 30.7% were primigravid.

The mean gestational age was almost similar in both group I (35.55 ± 1.74) week and group II (36.05 ± 1.77) week. All these findings were not statistically significant (p≥0.05). A study revealed that PE is most commonly developed in primiparas (p<0.05). The majority, 66.7% among the respondents of group I did not have anemia, 30.7% had mild and only 2.7% had moderate anemia. Similarly, the majority, 86.7% among the respondents of group II did not have anemia, 12.0% had mild and only 1.3% had moderate anemia. All these findings were statistically significant (P<0.05). A study reported anaemia, and edema, 56.7% in the second half of gestation in pregnancy complicated with preeclampsia [17]. A significant difference was observed in regards to mode of delivery where all (100.0%) among group I and in group II most of the respondents, 90.7% had LSCS and only, 9.3% in group II had NVD (p=.013). A similar study reported that 82% of patients were delivered by Caesarean section in GDM with pre-eclampsia and 72% of patients were delivered by Caesarean section in GDM without pre-eclampsia group [18]. Another study stated that in GDM with pre-eclampsia, 80% and in GDM without pre-eclampsia, 66.7% were delivered by LUCS Jesmin et al., [19] which supports the finding of this study. In the present study, in group I 5.3% and none of group II had absent fetal movement which was statistically significant (p<0.04).). In group I majority had oligohydramnios, 16.0%, followed by polyhydramnios, 4.2% and PPH, 1.3%. A similar study reported that oligohydramnios were higher in GDM with preeclampsia compared to that in GDM without preeclampsia [18]. In this study in group I majority (64.0%) had preterm delivery and in group II 41.3% had preterm delivery. In group I, 5.3% and none of group II had IUD which was statistically significant (p<0.05). In a similar study preterm delivery (<37 weeks of gestation) was higher among GDM with preeclampsia group, 55% compared to GDM without preeclampsia, 32% group. Term delivery was 45% vs 68% between the two groups. The distribution was highly significant (p<0.001) [18].

Conclusions

Gestational diabetes mellitus and preeclampsia are prevalent in mothers attending antenatal clinics and are associated with an increased risk of pregnancy and delivery complications.

The rate of lower uterine caesarean section, preterm delivery and IUD were significantly higher among preeclampsia with GDM in comparison to patients without preeclampsia. As preeclampsia contributes to the high mortality and morbidity of both mothers and neonates in our country proper antenatal care must be given to all pregnant women to prevent and screen for preeclampsia. Identifying factors associated with the occurrence of preeclampsia in women with GDM especially those that are controllable, by optimizing treatment and management might improve maternal and perinatal outcomes.

Limitation: There are some facts to be considered which might affect results.

- The study was conducted with a small sample size. So, it may not be adequate to represent the whole population.
- This is a single-centered study. The study population was selected from one selected hospital in Dhaka city, so the results of the study may not reflect the exact picture of the country.
- The present study was conducted over a very short period due to time constrain.

Recommendations: Further multicentered studies with larger sample sizes for longer periods may be carried out. Measures should be taken for GDM as well as preeclamptic patients through behavioural change communication (BCC) regarding antenatal care, danger signs, delivery plans etc., involving both public and private sectors.

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