*Original Article*

# PREVALENCE AND PERINATAL OUTCOMES IN GDM AND NON-GDM IN A RURAL PREGNANCY COHORT OF BANGLADESH

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**Abstract**

Gestational diabetes mellitus (GDM) or hyperglycemia in pregnancy is associated with adverse perinatal outcomes such as large for gestational age (LGA), excess fetal adiposity and cesarean delivery. This study addressed the prevalence of diabetes in pregnancy and to compare the perinatal outcomes between GDM and non-GDM in a rural pregnancy cohort of Bangladesh. Ten villages were purposively selected in a rural area about 100 km off Dhaka City. A population census was conducted. A randomized sample of married women of age 15-45y was drawn from the census data. These women having either regular menstruation (non-regnant) or cessation of menstruation for ≥24weeks (pregnant) were considered eligible. Both the pregnant and non-pregnant women were invited to volunteer the study. Weight, height, waist- and hip-girth and blood pressure were taken. Fasting blood sample was collected for the estimation of plasma glucose (FPG), triglycerides (TG), cholesterol (chol), high-density lipoprotein (HDL). FPG >5.1 mmol/L was taken as cut-off for hyperglycemia in non-pregnant and gestational diabetes mellitus (GDM) for the pregnant women. The biophysical characteristics were compared between pregnant and non-pregnant; and then GDM and non-GDM. Only the pregnant women were taken as a pregnancy cohort. The cohort had follow-up from 24wks of pregnancy through 28 post-natal days. Results The census yielded 23545 (m / f=11896 / 11649) people of all ages. The married women of age 15-45y were 4526. Of them, 2100 were randomly selected for investigation and 1585 (75.5%) volunteered. The overall prevalence (95% CI) of hyperglycemia (FPG >5.1 mmol/L) was 18.5% (16.7 – 20.3). The prevalence of GDM was 8.9% (7.0 – 10.8) and non-GDM was 19.8% (18.8 – 20.8). The BMI and WHR were significantly higher in the pregnant than non-pregnant women; whereas, there was no significant difference between GDM and non-GDM group. The prevalence rates of abortions, stillbirths, hospital delivery, cesarean delivery, hospital stay ≥7days, puerperal sepsis and neonatal death did not differ between GDM and non-GDM subjects significantly. The prevalence of GDM in rural Bangladesh is comparable with any other population with higher prevalence of GDM. The prevalence of hyperglycemia was found significantly higher in the non-pregnant than the pregnant women. The anthropometric measures did not differ significantly between GDM and non-GDM though FPG was found significantly higher in the former. Compared with the non-GDM the GDM subjects had no significantly higher fetomaternal morbidity and mortality possibly due to non-sedentary habit, non-obesity, non-dyslipidemia or may be due to inherent genetic makeup. A well designed study in a larger sample may explain our findings.

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**Key words:** Gestational diabetes, adverse outcomes, pregnancy cohort, rural community

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Acronyms: BP, blood pressure; SBP, DBP systolic, diastolic BP (mmHg); BMI, body mass index (wt in kg/ht in met sq); CI, 95% confidence interval; FPG, fasting plasma glucose (mmol/L); chol, total cholesterol; GDM, gestational diabetes mellitus (FPG >5.1mmol/L); HDL, high-density lipoprotein; TBA, trained birth attendant; TG, triglycerides; WHR, waist-girth/ hip-girth.

## Background

American Diabetes Association (ADA) observed that about 4% of all pregnancies are complicated by GDM in USA.[1] Depending on the ethnicity and diagnostic criteria the prevalence of gestational diabetes mellitus (GDM) may range from 1 to 14%.[1,2] It was also reported that fasting plasma glucose (FPG) exceeding 5.8 mmol/l in pregnancy was found to be related to risk of intrauterine death.[2] For the Asian population, a history of unexplained perinatal loss was attributed to GDM almost twice as compared with the non-diabetic pregnancies.[3] Multiparous women showed very high prevalence of GDM (~13%).[3] Moreover, incidence of congenital malformations is higher in pregnancies with diabetes than those without.[4,5] It was also reported that low maternal birth weight was associated with a two-fold higher risk for GDM.[6]

For Bangladesh, it seems important to determine the prevalence of GDM for several reasons. Firstly, Bangladeshi women showed higher prevalence of IGT than their male counterpart.[7] Secondly, compared with the other Southeast Asian Region (SEAR), Bangladesh is known to have higher birth rate and higher prevalence of multiparous women.[8] It is also reported that multiparity contributes to the development of glucose intolerance.[9] Thirdly, the prevalence of infant mortality is also high in Bangladesh.[8] Fourthly, high prevalence of cardiovascular morbidity and mortality in the SEAR may be due to higher risk among the offspring of mother with gestational diabetes.[10] Finally, though not documented, frequency of congenital malformations and low birth weight and fetal loss appears to be higher in Bangladesh.

It was also observed that treatment of gestational diabetes reduced serious perinatal morbidity and also improved the woman's health-related quality of life;[11] and untreated gestational diabetes mellitus carried significant risks for perinatal morbidity in all disease severity levels.[12] Timely and effective treatment did substantially improve outcome. More recent report demonstrated that the adverse perinatal outcomes are significantly higher among those diagnosed in the first trimester despite early identification and management implying greater severity of GDM.[13]

Considering the above-mentioned factors one can postulate the importance of assessing the prevalence of GDM in the population. A single study was carried out, which reported a high prevalence of GDM (6.8%).[14] However, there has been no follow-up report and outcome of these GDM subjects. This study addressed to determine the prevalence of GDM and determine the outcomes of these pregnancies like fetal loss, congenital anomalies, perinatal morbidity and mortality.

### *Research design and methodology*

This observational study was duly approved by the Ethical Review Committee (ERC) of Diabetic Association of Bangladesh.

This population-based prospective cohort of pregnant women was selected from the rural communities of ten villages having most typical rural characteristics. The rural people of the study area maintain traditional lifestyle. The *characteristics of rural life* defined for this study are the livelihood primarily related to agrarian activities (ploughing, plantation, irrigation, harvesting, fisheries, poultry etc.). The rural women are actively involved in these agricultural physical works.

### *Sample size determination*

For the denominator we conducted a local census of the study area, which included age, sex, education, occupation, family income and marital status. This first phage information provided us the socio-demographic information of the eligible participants.

The study was conducted in purposively selected ten villages with a total population of 22000 in Nandail under the district of Mymensingh. According to Bangladesh Bureau of Statistics there were 150 eligible couple (married women of age 15-45y) per 1000 population in Bangladesh [BBS].[15] Thus, 3300 eligible participants were expected in a population of 22000. This estimation was based on the prevalence rate of pregnancy (5 per thousand women) through personal communication from an ongoing "JivitA project" in

Rangpur, where 65000 married women of reproductive age have been followed up since 2001. Additionally, we considered the prevalence of diabetes (T2DM), impaired fasting glucose (IFG) and gestational diabetes (GDM) were 4.0%, 13.0% and 6.8% in the rural population.[14,16] Considering all these data we estimated at least 125 subjects could have been detected as diabetes with pregnancy and GDM. The stepwise selections of the pregnant women are depicted in Figure 1.

*Data collection*

Population census including sampling and investigation was performed stepwise as shown in Figure-1. The census data and other clinical variables were computerized and the eligible participants (pregnant and non-pregnant women) were selected. All married women of age 15 – 45y with history of regular menstruation (non-pregnant) or cessation of menstruation for ≥24 weeks (pregnant) were considered eligible. Both the pregnant and non-pregnant women were invited to volunteer the study. Primary amenorrhea and gestational amenorrhea over 34 wks were excluded.

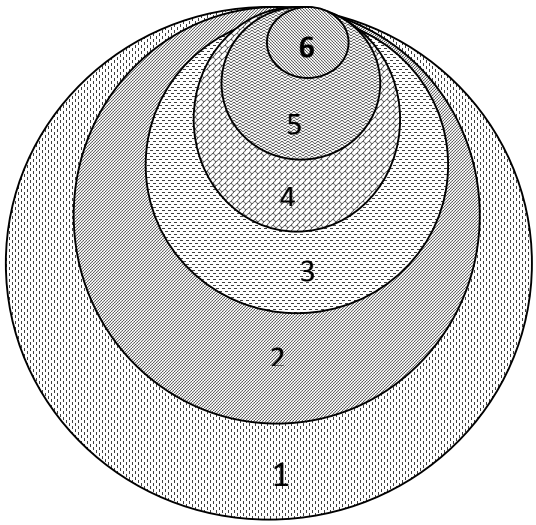


**Fig-1.** *Stepwise selection of the target (pregnant women) population starting from census.*
*Census of the rural population in ten villages yielded 23545 people of all ages [1] → Females of all ages were 11649 [2] → Females of reproductive (15 – 45y) age were 5644 [3] → of them, married women were 4526 [4] → From this group 2500 were selected randomly from the computerized census data for investigation → Only 1848 voluntered [5] → Of these respondents, 224 had amenorrhea > 12weeks accepted as pregnant [6] and the rest 1624 had regular menstrual cycle (non-pregnant).*
*Screening of hyperglycemia (FPG > 5.1 mmol/L) was found 8.9% in the Pregnant and 19.8% in the non-pregnant group*

A physician who had special training in gynecology and obstetrics was assigned locally full time to conduct investigations and to supervise the local field workers mainly trained birth attendant (TBA), assigned to each village, specially trained for follow up and collection of data on pregnancy outcomes e.g. abortions, stillbirths, hospital delivery, cesarean delivery, puerperal sepsis and neonatal death, used to maintain home-visit regularly for follow-up and keep the physician informed using cell phone. Based on the follow up reports the physician used to visit the participants either at home or at nearby community clinic (CC) for the assessment of the progression or termination of pregnancy and perinatal outcomes.

The diagnosis of pregnancy was made on the basis of clinical findings: (i) a history of amenorrhoea, (ii) an enlarging uterus, (iii) nausea or vomiting, (iv) breast tenderness, (v) Montgomery's tubercles, (vi) quickening, and (vii) other signs, e.g. fundal height, chloasma, linea nigra, striae, fetal heart sound, palpation of fetus.[17]

We discussed the study objectives and procedural details with the randomly selected eligible pregnant and non-pregnant participants. The participants who agreed to volunteer were registered. After registration she was interviewed for social, clinical, drug, family, menstrual and obstetrical history. The investigation included anthropometry (height, weight, waist- and hip-girth, blood pressure, fasting plasma glucose (FPG) and lipids (total cholesterol, Triglycerides, high-density lipoprotein).

All these above mentioned variables (biophysical characteristics) were compared between pregnant and non-pregnant women. For the pregnant group, the comparisons were made between GDM and non-GDM.

Only the pregnant women were taken as a pregnancy cohort. The cohort had follow-up from 24wks of pregnancy through 28 post-natal days.

*Diagnostic criteria*

We used diagnostic criteria of gestational diabetes mellitus (GDM) revised by American Diabetes Association Diabetes (ADA, 2013).[18,19] According to ADA criteria OGTT is recommended noting

"The diagnosis of GDM is made when any of the following plasma glucose values are exceeded: [*Fasting: ≥92 mg/dl (5.1 mmol/l); 1 h: ≥180 mg/dl (10.0 mmol/l); 2 h: ≥153 mg/dl (8.5 mmol/l)*]". So, we accepted the fasting plasma glucose value >5.1mmol/l for diagnosing GDM.

Data analysis – The prevalence rates of GDM are shown in simple percentages and presented with 95% confidence interval (CI). The biophysical characteristics are given in mean with standard deviation SD). The Chi-sq tests were used to determine the association between hyperglycemia and pregnancy and outcomes.

## Results

The census of the study area of ten villages yielded 23545 (m/f = 11896 / 11649) people of all ages. The age groups found below 15y, 15 – 45y and over 45y were 8621 (36.6%), 11146 (47.3%) and 3778 (16.0%), respectively [table1]. Of the total 5644 females of age-group 15 – 45years, 4526 were married. Of them, 2500 were randomly selected for investigation and 1848 (74%) agreed to volunteer. The pregnancy was confirmed in 240 and the rest 1608 were found non-pregnant. Finally, it was possible to investigate 223 of the 240 pregnant and 1362 of the 1608 non-pregnant women.

The prevalence of pregnancy was found 9.3, 76.1 and 14.7% in the age groups <19, 20-34 and >35y, respectively. The comparisons of anthropometric and

**Table-1:** *Distribution of census population by age, sex and marital status*

| Age group (y) | Male n(%) | Female n (%) | Total n (%) |
|---|---|---|---|
| <15 | 4372(50.7) | 4249(49.3) | 8621(36.6) |
| 15-45 | 5502(49.4) | 5644(50.6)¶ | 11146(47.3) |
| >45 | 2022(53.5) | 1756(46.5) | 3778(16.0) |
| Total | 11896(50.5) | 11649(49.5) | 23545(100) |
| **Marital status** | | | |
| Unmarried | 6617(55.6) | 5280(44.4) | 11897(50.5) |
| Married | 5356(48.2) | 5745(51.8) | 11101(47.1) |
| Widower/widow | 86(10.8) | 712(89.2) | 798(3.4) |
| Total | 11896(50.5) | 11649(49.5) | 23545(100) |

¶ - target population→married women (n=4526)

**Table-2:** *Comparison of characteristics between pregnant(n=223) and non-pregnant(n=1362) women*

| Variables | Pregnant (n=224) | | Non-pregnant (n=1362) | | p |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | |
| Age (y) | 26.5 | 5.9 | 30.3 | 7.7 | <0.001 |
| Weight (kg) | 57.7 | 12.8 | 47.9 | 9.4 | <0.001 |
| Height (cm) | 151 | 12 | 155 | 8.9 | <0.001 |
| Waist (cm) | 81.2 | 5.7 | 71.5 | 9.7 | <0.001 |
| Hip (cm) | 91.6 | 7.1 | 84.2 | 8.2 | <0.001 |
| Body mass index (wt /ht$^2$) | 24.0 | 2.5 | 19.8 | 3.4 | <0.001 |
| Waist-to-hip ratio | 0.89 | 0.06 | 0.84 | 0.08 | <0.001 |
| Systolic BP (mmHg) | 101 | 12 | 112 | 20 | <0.001 |
| Diastolic BP (mmHg) | 70.9 | 8.0 | 72.4 | 12.6 | ns |
| Fasting plasma glucose (mmol/L) | 4.6 | 2.7 | 4.8 | 2.2 | ns |
| Triglycerides (mg/dl) | 122 | 48 | 114 | 55 | .044 |
| Tot cholesterol (mg/dl) | 135 | 26 | 141 | 45 | ns |
| High density lipoprotein-c (mg/dl) | 38.0 | 5.2 | 37.03 | 4.1 | .002 |
| Hyperglycemia (FPG>5.1) | 8.9% | | 19.8% | | 0.001 |
| 95% confidence interval | 7.0 –10.8 | | 18.9 –20.8 | | |

SD – standard deviation; p – after unpaired t test

Table-3: *Comparison of characteristics between pregnant women with and without GDM (FPG >5.1 vs. FPG <=5.1 mmol/l).*

| Variables | GDM (n=20) | | Non-GDM (n=204) | | p |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | |
| Age (y) | 29.7 | 5.3 | 26.2 | 5.9 | .011 |
| Weight (kg) | 54.8 | 9.8 | 58.1 | 13.1 | ns |
| Height (cm) | 152 | 7 | 151 | 13 | ns |
| Waist (cm) | 82.4 | 8.5 | 81.2 | 5.3 | ns |
| Hip (cm) | 92.3 | 9.0 | 91.6 | 6.9 | ns |
| Body mass index (wt /ht$^2$) | 23.6 | 3.5 | 24.2 | 2.3 | ns |
| Waist-to-hip ratio | 0.89 | 0.09 | 0.88 | 0.05 | ns |
| Systolic BP (mmHg) | 113.5 | 14.2 | 99.8 | 11.8 | <0.001 |
| Diastolic BP (mmHg) | 72.5 | 9.1 | 70.7 | 7.9 | ns |
| Fasting plasma glucose (mmol/L) | 6.2 | 2.4 | 4.2 | 0.4 | <0.001 |
| Triglycerides (mg/dl) | 126 | 76 | 122 | 44 | ns |
| Tot cholesterol (mg/dl) | 143 | 45 | 135 | 23 | ns |
| High density lipoprotein-c (mg/dl) | 36.9 | 3.6 | 38.1 | 5.3 | ns |

Non-GDM – Fasting plasma glucose <5.1 mmol/l;
GDM – Fasting plasma glucose >5.1 mmol/l.
SD – standard deviation; p – after unpaired t-test

**Table-4:** *Comparison of feto-maternal morbidities/ complications between GDM and non-GDM*

| | Non-GDM (n=204) | GDM (n=20) | Chi sq |
|---|---|---|---|
| Abortion | 5 (2.5) | 1 (5.0) | ns |
| Stillbirth | 4 (1.96) | 1 (5.0) | ns |
| Advised Hospital delivery[1] | 60 (29.4) | 9 (45.0) | ns |
| Caesarian section | 26 (12.75) | 4 (20.0) | ns |
| Hospital stay (>5days) | 19 (9.3) | 5 (25.0) | ns |
| Neonatal death | 5 (2.45) | 1 (5.0) | ns |
| Puerperal sepsis | 11 (5.39) | 2 (10.0) | ns |

Parenthesis indicates percentage;
ns – not significant after Yates' correction of Chi sq-test.
1 – Field level health workers and Trained Birth attendant (TBA)

biochemical characteristics between pregnant and non-pregnant women were shown in table 2. As expected, anthropometric variables (BMI, WHR) were significantly higher in the pregnant women than their non-pregnant counterparts ($p < 0.001$). In contrast, both systolic and diastolic blood pressure was found significantly lower in the pregnant women ($p < 0.001$). Interestingly, there was no significant difference of fasting plasma glucose between them though the prevalence (95% CI) of hyperglycemia (FPG >5.1mmol/l) was found significantly higher in the non-pregnant than the pregnant women [19.8% (18.9 – 20.8) vs. 8.9% (7.0 – 10.8)].

The anthropometric and biochemical characteristics were also compared between pregnant women with and without hyperglycemia (FPG > 5.1mmol/l vs. FPG < =5.1, i.e. GDM vs. non-GDM) [table 3]. The characteristics of the GDM did not differ from non-GDM significantly, though only difference was found in FPG as the two groups were based on FPG. The feto-maternal morbidities (complications) were compared between these two groups in table 4. The striking observation was that there were no significantly higher morbidities, as anticipated, in the GDM than non-GDM group. Five pregnancies ended in abortions – one (5%) in the GDM and 5 (2.5%) in the Non-GDM, but statistically not significant. About 45% from the GDM and 29.4% from the non-GDM group were referred to Emergency Obstetrical Care (EOC) of Nandail Upo-zila Health complex for delivery. Stillbirth was reported 5% in GDM and 1.96% in non-GDM group, statistically not significant. Cesarean delivery was undertaken in 20% of GDM and 12.8% of non-GDM group, though statistically not significant. One neonatal death occurred in the GDM group but it was proved to be a road traffic accident. The infant got head injury and died within hours. Hospital-stay for more than 7 days was found higher in GDM than their non-GDM counterparts (25% vs. 9.8%). The proportion of puerperal sepsis also did not differ between GDM and non-GDM (15% vs. 7.3%). Although the proportion of adverse outcomes, mentioned above, were found more in the GDM than non-GDM these were not statistically significant.

## Discussion

Undoubtedly, this pregnancy cohort in a rural setting is a unique study. It has been a common impression that prevalence of hyperglycemia was more in the gestational women. There are reports that hyperglycemia in pregnancy are detrimental to pregnancy outcomes.[4-6] This pregnancy cohort showed that the pregnant women had lower FPG and significantly lower prevalence of hyperglycemia. In addition, contrary to the other findings suggesting unfavorable outcomes in GDM, this study observed no significant adverse outcome among the GDM subjects compared with the non-GDM subjects. It is not clear why there was no excess morbidity or mortality in the GDM women. This may due to inadequate number in the GDM group for comparison as against a larger number of the non-GDM women (20 vs. 204). May be there are some other factors that remain to be identified.

Currie ML *et al* observed that physical activity in the first half of pregnancy may reduce the occurrence of large for gestational age (LGA) and also low birth weight (LBW).[20,21] Regarding physical activity there is a similar report by Hans S *et al*.[21] These pregnant women were actively involved in agrarian works. Usually, they are exposed to moderate to heavy physical activity during harvesting season. Thus, physical activity might have reduced the adverse pregnancy outcomes. Adiposity and dyslipidemia have been incriminated as the unfavorable outcomes of GDM in several studies in China and Japan.[22-24] Our study subjects with GDM were neither obese nor dyslipidemic. Possibly, these two factors (non-adiposity and non-dyslipidemia) might have played some role preventing adverse pregnancy outcomes. Genetic factor may also be taken into consideration for not giving rise to unfavorable pregnancy outcomes in the

GDM.[25,26] More primitive life style of the agrarian work for generations and inherent genetic makeup might have prevented increased fetomaternal morbidity and mortality of the GDM. An additional consideration may also be taken into account is the cut-off value. The value (FPG > 5.1mmol/l) taken for this study may not be appropriate for our population.

The study experienced some limitations. We could investigate only once for history, anthropometry and collection of blood sample for screening of fasting plasma glucose and lipids. The interim pregnancy period could not be monitored for glycemic fluctuations if any. A single screening test for GDM may not reflect the entire period of metabolic status in pregnancy. Thus, there might be some errors in assessing the metabolic status related to pregnancy outcomes. Further study may be undertaken considering such weakness that we experienced in this study. Had we got the facility for assessing HbA1c or monitoring plasma glucose in subsequent months we could have better conclusions.

## Conclusions

The prevalence of GDM is comparable with other study reports. The prevalence of hyperglycemia was found significantly higher in the non-pregnant than the pregnant women. Despite significantly higher values of anthropometric measures in the pregnant than the non-pregnant women FPG did not differ between the two. In contrast, the anthropometric measures did not differ significantly between GDM and non-GDM though FPG was found significantly higher in the former. Compared with the non-GDM the GDM subjects had no significantly higher adverse outcomes possibly due to non-sedentary habit, non-obesity, non-dyslipidemia or may be due to inherent genetic makeup. Or, the cut-off value (FPG > 5.1mmol/l) taken for this study may not be appropriate for the study population. A well designed study in a larger sample may explain our study findings.

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