Scholars Journal of Applied Medical Sciences
Abbreviated Key Title: Sch J App Med Sci
ISSN 2347-954X (Print) | ISSN 2320-6691 (Online)
Journal homepage: https://saspublishers.com

OPEN ACCESS

Gynaecology and Obstetrics

Gestational Diabetes and Its Effects on Neonatal Outcome- A Prospective Cohort Study

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DOI: 10.36347/sjams.2022.v10i12.006 | **Received:** 22.10.2022 | **Accepted:** 30.11.2022 | **Published:** 03.12.2022

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Abstract **Original Research Article**

Introduction: Gestational diabetes mellitus is a common chronic disease in pregnancy that impairs the health of several million women worldwide. Gestational diabetes mellitus (GDM) is a condition characterized by carbohydrate intolerance with the onset or first recognition during pregnancy. ***Aim of the study*:** The aim of this study was to examine the effects of gestational diabetes mellitus on the risk of adverse neonatal outcomes. ***Methods:*** This was a prospective cohort study and was conducted in the Department of Gynaecology and Obstetrics of Kushtia General Hospital, Kushtia, Bangladesh during the period from January, 2021 to January, 2022. There was total 100 women in our study. This study was conducted among pregnant women with gestational diabetes mellitus. The study population was categorized into two; namely, women with GDM and women without GDM. ***Result:*** In total 100 patients from both the groups completed the study. In our study we found the mean ± SD age of pregnant mothers with GDM was (30.01 ± 5.00) and non-GDM (27.05 ± 5.04) in years. The mean± SD of MUAC for women with GDM (26.59 ± 4.11) and for non-GDM (24.35 ± 2.74). The mean± SD of hemoglobin women with GDM was (12.39 ±1.77) and for non-GDM (12.73 ±1.75) which is significantly higher compared to women with GDM. ***Conclusion:*** In our study, we found that the incidence of adverse neonatal outcomes was higher among newborns from mothers with GDM than among women without GDM. GDM independently increased the risk of composite adverse neonatal outcome, fetal macrosomia, LGA, preterm birth, low Apgar score at first and fifth minute. However, GDM does not confer an increased risk of LBW and SGA.

Keywords: Neonatal outcome; Gestational diabetes mellitus; Low Apgar score; Macrosomia; Preterm birth.

INTRODUCTION

Gestational diabetes mellitus is a common chronic disease in pregnancy that impairs the health of several million women worldwide [1, 2]. Gestational diabetes mellitus (GDM) is a condition characterized by carbohydrate intolerance with the onset or first recognition during pregnancy [3]. Formally recognised by O'Sullivan and Mahan in 1964, gestational diabetes mellitus is defined as hyperglycaemia first detected during pregnancy [4, 5]. With the incidence of obesity worldwide reaching epidemic levels, the number of pregnant women diagnosed as having gestational diabetes mellitus is growing, and these women have an increased risk of a range of complications of pregnancy [6]. In 2008, the Hyperglycaemia and Adverse Pregnancy Outcome (HAPO) study recruited a large multinational cohort and clarified the risks of adverse outcomes associated with hyperglycaemia. The findings of the study showed that maternal hyperglycaemia independently increased the risk of preterm delivery, caesarean delivery, infants born large for gestational age, admission to a neonatal intensive care unit, neonatal hypoglycaemia, and hyperbilirubinaemia [7]. Mothers with GDM are expected to have other comorbidities such as hypertension (HTN). In fact, they are at an increased risk of the development of gestational HTN or preeclampsia (odds ratio [OR] 1.5) [8]. The comorbidities can affect the outcome. Hypertriglyceridemia in gestational diabetes has been found to have a positive correlation with birth weight which in turn is related to neonatal complications [9]. GDM is associated with an increased risk of complications for both the mother and the child. The

rate of preeclampsia and cesarean section is increased in the mother and the risk of macrosomia is increased in the newborn [10]. The benefit of blood glucose control during pregnancy has primarily been noted in the reduction of certain neonatal complications such as macrosomic babies and shoulder dystocia [11]. Gestational Diabetes Mellitus (GDM) occurs in 2-9% of pregnant women worldwide and is defined as "any degree of glucose intolerance with onset or first recognition during pregnancy" [12]. The prevalence of GDM is rising worldwide and has been reported in the range of 3%–14%; globally, and in the range of 3%–5% in North America, Europe, and Australia [13-16]. GDM is a major cause of pregnancy-related maternal morbidities [17]. Infants of women with diabetes mellitus (DM) have an increased risk for both large for gestational age (LGA) and preterm birth (PTB) compared with infants born to women without DM [17, 18]. Consequently, the diagnosis of GDM includes both previously undiagnosed abnormality of glucose tolerance, and glucose intolerance related to the pregnancy alone which disappears postpartum. However, a definitive diagnosis can only be made in the postpartum period. In this study we aimed to examine the effects of gestational diabetes mellitus on the risk of adverse neonatal outcomes among women with pregnancy and newborn mothers.

Objective of the study

The objective of the study was to examine the effects of gestational diabetes mellitus on the risk of adverse neonatal outcomes.

METHODOLOGY & MATERIALS

This was a prospective cohort study and was conducted in the Department of Gynaecology and Obstetrics of Kushtia General Hospital, Kushtia, Bangladesh during the period from January, 2021 to January, 2022. There was total 100 women in our study. This study was conducted among pregnant women with gestational diabetes mellitus. The study population was categorized into two; namely, women with GDM and women without GDM. These are the following criteria to be eligible for the enrollment as our study participants: a) Women who were aged >= 18 aged years old; b)Women who had singleton pregnancy of 20 -23+6 weeks of gestation during commencement time; c) Women with no known pre-existing or overt diabetes mellitus (DM); d) Women who were willing to take routine ANC services; e) Women who plan to give birth at the selected public health facilities & followed until delivery And a) Women who took medications that may affect glucose metabolism such as steroids, β-adrenergic agonists, anti-psychotic drugs, b)Women with any history chronic or acute illness such as renal or pancreatic diseases, ischemic heart disease; c) Women who had pre-existing or overt diabetes; d) Women with illness other than GDM (i.e. malaria, medical emergency); e) Women with any previous surgical history were excluded from our study. Gestational diabetes mellitus was diagnosed using a two-hour 75g oral glucose tolerance test strategy with recent criteria. Multivariable log-binomial model was used to identify the effects of gestational diabetes mellitus on the risk of adverse neonatal outcomes which includes macrosomia, low birth weight, large for gestational age, small for gestational age, preterm birth, low Apgar score at the first minute, low Apgar score at fifth minute, and composite adverse neonatal outcome.

Statistical Analysis

The results obtained were statistically analyzed and compared between the two groups of the study. Baseline characteristics of the study participants were expressed in mean ± standard deviation. Comparison of mean was done by unpaired t test. The statistical analysis was performed using SPSS version 25 computer software for windows 10. Statistical significance was considered at P< 0.05. All clinical and biochemical data of study subjects were expressed as means ± standard deviations. Independent sample t-tests were conducted to assess the relationship between the studied variables.

RESULT

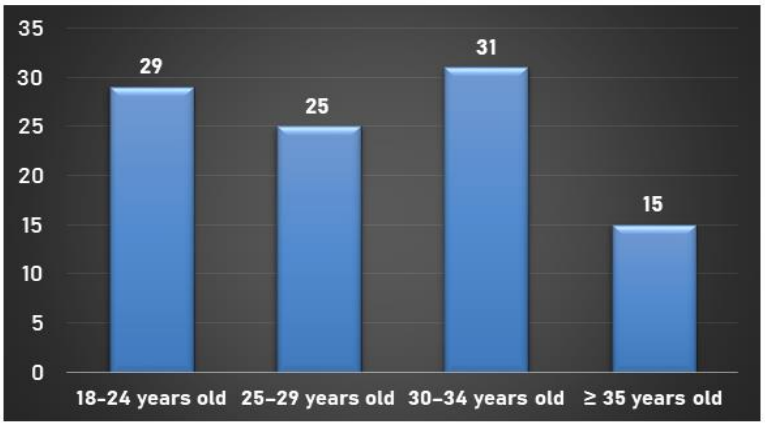

Figure-1: Age distribution among our study people

Table-1: Maternal, socio-demographic and life style characteristics women who gave birth stratified by GDM status (n = 100)

Variables	Overall		GDM		Non-GDM		P-Value
	N=100	**%**	**(n=50)**	**%**	**(n=50)**	**%**	
Maternal age (years)	27.73 ± 5.25		30.01 ± 5.00		27.05 ± 5.04		0.001
18-24	29	29%	7	14%	22	44%	0.001
25–29	25	25%	11	22%	14	28%	0.001
30–34	31	31%	21	42%	10	20%	0.001
≥ 35	15	15%	11	22%	4	8%	0.001
Educational level							
Not formal education	17	17%	9	18%	8	16%	0.001
Primary education	53	53%	21	42%	22	44%	0.001
Secondary education and above	40	40%	20	40%	20	40%	0.001
Employment status							
Employed	34	34%	18	36%	16	32%	0.001
Unemployed	66	66%	32	64%	34	68%	0.001
MUAC	24.74 ± 3.14		26.59 ± 4.11		24.35 ± 2.74		0.001
MUAC < 28 cm	61	61%	17	34%	28	56%	0.001
MUAC ≥ 28 cm	39	39%	33	66%	22	44%	0.001
Hemoglobin (g/dl) **	12.67 ±1.75		12.39 ±1.77		12.73 ±1.75		0.054
Anemic status							
Normal	65	65%	29	58%	36	72%	0.107
Anemia	35	35%	21	42%	14	28%	0.107
Dietary diversity status							
Adequate	54	54%	19	38%	35	70%	0.001
Inadequate	46	46%	31	62%	15	30%	0.001
Level of physical activity							
High	42	42%	20	40	22	44	0.001
Moderate	35	35%	17	34%	18	36%	0.001
Low	23	23%	13	26%	10	20%	0.001
Antenatal depression							
Yes	45	45%	30	60%	15	30%	0.001
No	55	55%	20	40%	35	70%	0.001

Abbreviations: Hb=hemoglobin g/dl= GDM =gestational diabetes mellitus gram per deciliter MUAC=mid upper arm circumference cm=centimeter

Figure-2: The prevalence of adverse neonatal outcomes among our study subjects

Table-2: The effects of gestational diabetes mellitus on the risk of adverse neonatal outcomes

Neonatal outcomes	GDM		Non-GDM		P-value
	N=50	%	N=50	%	
Fetal macrosomia (≥4000 g)	24	48%	12	24%	0.001
Large for gestational age	31	62%	19	38%	0.001
Low birth weight (< 2500 gm)	18	36%	12	24%	0.157
Small for gestational age	11	22%	9	18%	0.002
Preterm birth (< 37 weeks)	21	42%	14	28%	0.001
Low Apgar score 1st minute	31	62%	19	38%	0.004
Low Apgar score 5th minute	28	56%	13	26%	0.003
Composite neonatal adverse outcome	42	84%	38	76%	0.001

Abbreviations: GDM =gestational diabetes mellitus gm=grams CRR= crude relative risk ARR= adjusted relative risk CI=confidence interval gm=grams Apgar= Appearance, Pulse, Grimace, Activity, and Respiration

In this study Figure 1 shows the age distribution of our study people. The highest prevalence 31% was seen among women aged between 30-34 years old and the lowest prevalence was 15% aged between >= 35 years old. Followed by 25% & 29% was seen aged between 25-29 years and 18-24 years old respectively. In table 1 we showed the maternal, socio-demographic and life style characteristics women who gave birth stratified by GDM status. We found the mean ± SD age of pregnant mothers with GDM was (30.01 ± 5.00) and non-GDM (27.05 ± 5.04) in years. The mean± SD of MUAC for women with GDM (26.59 ± 4.11) and for Non-GDM (24.35 ± 2.74). The mean± SD of hemoglobin women with GDM was (12.39 ±1.77) and for non-GDM (12.73 ±1.75) which is significantly higher compared to women with GDM. Higher proportion of anemia and overweight and obesity were observed among women with GDM compared to those with normal glucose profile. Moreover, higher proportion of women with GDM had low level of physical activity, inadequate dietary diversity, and antenatal depression. In here. Figure 2 shows the prevalence of neonatal outcomes among our overall participants. We found Fetal macrosomia was 36% , Large for gestational age was 50%, Low birth weight under 2500 gm was 30%, Small for gestational age was 20%, Preterm birth less than 37 weeks was 35%, Low Apgar score 1st minute was 50%,Low Apgar score 5th minute was 41% & Composite neonatal adverse outcome was 80% among our study people. In table 2we showed the effects of gestational diabetes mellitus on the risk of adverse neonatal outcomes. The prevalence of macrosomia was seen 48% & 24% in women with GDM or Non-GDM respectively. The highest prevalence(62%) of LGA was seen in women with GDM than without GDM (38%). Low birth rate of newborn babies was seen higher in women with GDM (36%). SGA was found 22% & 18%; preterm birth was 42% & 28 in women with GDM & without GDM respectively. The prevalence of low Apgar score at the first minute & low Apgar score at the fifth minute in women with GDM was 62% & 56%. The prevalence of low Apgar score at the first minute & low Apgar score at the fifth minute in women without GDM was 38% & 26%. Overall, the risk of composite neonatal adverse outcome was 84% higher among newborns from women with GDM compared to women without GDM (76%).

DISCUSSION

The highest prevalence 31% was seen among women aged between 30-34 years old and the lowest prevalence was 15% aged between >= 35 years old. Followed by 25% & 29% was seen aged between 25-29 years and 18-24 years old respectively (Figure 1). In other study (Muche *et al.*,) found < 25 12.7% & 31.3% aged under 25 years old; 25.4% & 36.9 % aged between 25–29 years old; 33.9% & 21% aged between 30–34 years old and 28% & 61% aged above 35 years old among women with GDM & without GDM respectively [19]. In our study we found the mean ± SD age of pregnant mothers with GDM was (30.01 ± 5.00) and non-GDM (27.05 ± 5.04) in years. The mean± SD of MUAC for women with GDM (26.59 ± 4.11) and for Non-GDM (24.35 ± 2.74). The mean± SD of hemoglobin women with GDM was (12.39 ±1.77) and for non-GDM (12.73 ±1.75) which is significantly higher compared to women with GDM. Higher proportion of anemia and overweight and obesity were observed among women with GDM compared to those with normal glucose profile. Moreover, higher proportion of women with GDM had low level of physical activity, inadequate dietary diversity, and antenatal depression (Table 1). In other study (Muche *et al*.,) found the mean age of pregnant mothers with GDM was 30.01 (SD ± 5.01 and non-GDM 27.05 (SD ± 5.04) years. Higher proportion of anemia and overweight and/or obesity were observed among women with GDM compared to those with normal glucose profile [19]. In this study we found Fetal macrosomia was 36%, Large for gestational age was 50%, Low birth weight under 2500 gm was 30%, Small for gestational age was 20%, Preterm birth less than 37 weeks was 35%, Low Apgar score 1st minute was 50%,Low Apgar score 5th minute was 41% & Composite neonatal adverse outcome was 80% among our study people (Figure 2). In other study (Muche *et al*.,) found the proportion of composite adverse neonatal outcome among mothers with and without GDM was 51.7% and 25.8%, respectively. The incidence of fetal

macrosomia, LGA, preterm birth, low Apgar score at the first minute and fifth minute was significantly higher among newborns from mothers with gestational diabetes mellitus than among newborns from mothers without gestational diabetes mellitus. However, there were no significant differences in the incidence of LBW (P=0.482) and SGA (P =0.612) among newborns in the GDM group compared to those without GDM [19]. The prevalence of macrosomia was seen 48% & 24% in women with GDM or Non-GDM respectively. The highest prevalence (62%) of LGA was seen in women with GDM than without GDM (38%). Low birth rate of newborn babies was seen higher in women with GDM (36%). SGA was found 22% & 18%; preterm birth was 42% & 28 in women with GDM & without GDM respectively. The prevalence of low Apgar score at the first minute & low Apgar score at the fifth minute in women with GDM was 62% & 56%. The prevalence of low Apgar score at the first minute & low Apgar score at the fifth minute in women without GDM was 38% & 26%. Overall, the risk of composite neonatal adverse outcome was 84% higher among newborns from women with GDM compared to women without GDM (76%) (Table 2). In other studies (Abu-Heija *et al*., & Pintaudi *et al*., & Billionnet *et al*.,) also found evidences from their researches that GDM was an independent risk for adverse neonatal outcome [20-22]. Another previous studies (Djomhou *et al*., & Bajracharya *et al*., & Cho *et al*.,) proved that GDM was associated with increased risk of macrosomia [23-25]. Similarly, the Hyperglycemia and Adverse Pregnancy Outcome (HAPO) study found that elevated glucose levels were highly predictive of LGA (HAPO, 2009). A higher risk of preterm birth from gestational diabetes mellitus mothers was observed compared to those without gestational diabetes mellitus. This was in line with previous studies from (Ju *et al*., & Bener *et al*., & Hedderson *et al*.,) which established a direct association between GDM and preterm birth [26-28]. In contrast, a study conducted in Cameroon (Djomhou *et al*.,) indicated a non-significant difference in preterm birth by GDM status. This difference may be attributable to different cut-off points used to determine blood glucose level and the impact of glycemic control. This might be due to high blood sugar level, which might lead to going into labor early and delivering before the due date [23].

Limitations of the study

We could only study the women who visited at the outpatient departments Kushtia General hospital within a short study period. In our study we did not investigate information about the obstetric characteristics of women who gave birth and newborns of mothers stratified by GDM status. After evaluating once those women we could follow-up them only till their delivery and have not known other possible interference that may happen in the long term with these women.

Conclusion and Recommendations

In our study, we found that the incidence of adverse neonatal outcomes was higher among newborns from mothers with GDM than among women without GDM. GDM independently increased the risk of composite adverse neonatal outcome, fetal macrosomia, LGA, preterm birth, low Apgar score at first and fifth minute. However, GDM does not confer an increased risk of LBW and SGA. Therefore, our findings have important implications for the early prevention of pregnant women with GDM to improve the effects of GDM on neonatal outcomes. Hence, a further study with a prospective and longitudinal study design needs to be done by health professionals to identify the preventions of gestational diabetes mellitus among pregnant women to improve neonatal outcomes.

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