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Association of Excessive, Normal and Inadequate Gestational Weight Gain with Maternal and Fetal Complications in Diabetic Mothers

Effat Aziz[1], Tasnia Sultana[2], Shahidul Islam[3*], Salma Akter[4], Rubab Sarmin[5], Mahzabin Husain[6], Jannatul Ferdous Chowdhury[7]

[1]Registrar, Department of Obstetrics and Gynecology, East West Medical College, Dhaka, Bangladesh
[2]Assistant Professor (CC), Department of Obstetrics and Gynecology, Ad-Din Akij Medical College, Khulna, Bangladesh
[3]Medical Officer, Pirgonj Upozilla Health Complex, Pirgonj, Rangpur, Bangladesh
[4]Assistant Registrar, Department of Obstetrics and Gynecology, 250 Bedded General Hospital, Sirajganj, Bangladesh
[5]Indoor Medical Officer, Department of Obstetrics and Gynecology, Sir Salimullah Medical College, Mitford Hospital, Dhaka, Bangladesh
[6]Assistant Surgeon, National Institute of Burn & Plastic Surgery, Dhaka, Bangladesh
[7]Medical Officer, Department of Obstetrics and Gynecology, Sarkari Karmachari Hospital, Dhaka, Bangladesh

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***Corresponding author:** Shahidul Islam
Medical Officer, Pirgonj Upozilla Health Complex, Pirgonj, Rangpur, Bangladesh

Abstract

Background: Gestational weight gain (GWG) is a key determinant of maternal and fetal outcomes, particularly in pregnancies complicated by diabetes. Both excessive and inadequate GWG have been associated with adverse outcomes, yet data on the impact of GWG in diabetic mothers in Bangladesh remain limited. This study aimed to evaluate the association between GWG and maternal and fetal complications in women with gestational diabetes mellitus (GDM) and pregestational diabetes mellitus (PGDM). ***Methods:*** A cross-sectional analytical study was conducted at the Department of Obstetrics and Gynecology, BIRDEM General Hospital, Dhaka, from August 2022 to June 2024. A total of 102 pregnant women at ≥37 weeks of gestation, including 51 with GDM and 51 with PGDM, were enrolled. Participants were categorized into excessive, normal, and inadequate GWG groups. Maternal and fetal complications, as well as mode of delivery, were analyzed using appropriate statistical tests. ***Results:*** Among GDM patients, 49.02% had normal GWG, 31.37% excessive, and 19.61% inadequate. Cesarean section was significantly higher in the excessive GWG group (93.7%) compared to normal (40.0%) and inadequate (60.0%) GWG groups (p=0.006). Maternal complications were more frequent in PGDM than GDM across all GWG categories but without statistical significance. Fetal complications were significantly higher in PGDM mothers with normal GWG (57.9% vs. 28.0%, p=0.046), while other GWG groups showed no significant differences. Type-specific fetal complications in inadequate GWG were not statistically different between GDM and PGDM. ***Conclusion:*** Both excessive and inadequate GWG in diabetic pregnancies are associated with increased maternal and fetal complications, with PGDM mothers at higher risk. Appropriate monitoring and management of GWG is crucial to optimize perinatal outcomes.

Keywords: Gestational weight gain, gestational diabetes mellitus, pregestational diabetes, maternal complications, fetal complications.

INTRODUCTION

Gestational weight gain (GWG) is a critical determinant of maternal and neonatal outcomes. The Institute of Medicine (IOM) provides guidelines for optimal GWG according to maternal pre-pregnancy body mass index (BMI), aiming to balance the risks of inadequate and excessive weight gain [1]. Deviations from these recommendations are associated with adverse pregnancy outcomes, such as hypertensive disorders, cesarean delivery and abnormal birth weight [2].

Diabetes in pregnancy, including both pregestational diabetes mellitus and gestational diabetes mellitus (GDM), presents an additional challenge in maternal and fetal health [3]. Women with diabetes are

at increased risk of complications such as preeclampsia, premature rupture of membranes (PROM), postpartum hemorrhage (PPH) and operative delivery [4]. For the fetus, maternal diabetes is linked to risks of intrauterine growth restriction, macrosomia, congenital anomalies, neonatal hypoglycemia, respiratory distress and the need for neonatal intensive care unit (NICU) admission. Achieving optimal GWG in this high-risk group is therefore of particular clinical importance [5].

Excessive GWG in diabetic mothers has been reported to increase the likelihood of cesarean section, macrosomia and neonatal complications. Conversely, inadequate GWG may predispose to small-for-gestational-age (SGA) infants and other adverse perinatal outcomes [6]. While these associations have been well-documented in the general obstetric population, data specific to women with diabetes, particularly in South Asian countries, remain limited [7]. The interplay between diabetes type, maternal weight gain and pregnancy outcomes in resource-limited settings requires further evaluation [8, 9].

Bangladesh bears a growing burden of diabetes and obesity, with increasing numbers of women of reproductive age affected. BIRDEM General Hospital, a tertiary referral center specializing in diabetes and metabolic disorders, manages a large cohort of pregnant women with both pregestational diabetes and GDM. Studying this population provides an opportunity to assess the influence of GWG on maternal and fetal outcomes in a high-risk setting where adherence to antenatal guidelines and nutritional counseling may be variable.

This study aimed to assess the association of excessive, adequate and inadequate gestational weight gain with maternal and fetal complications among women with pregestational diabetes and GDM delivering at BIRDEM General Hospital, Dhaka.

METHODOLOGY & MATERIALS

This cross-sectional analytical study was conducted in the Department of Obstetrics and Gynecology, BIRDEM General Hospital, Dhaka, under the Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM) from August 2022 to June 2024. The study population consisted of pregnant women with either pregestational diabetes or gestational diabetes mellitus (GDM) admitted for delivery after 37 completed weeks of gestation. A total of 102 patients were recruited, including 51 with pregestational diabetes and 51 with GDM. Inclusion criteria were singleton pregnancy with pregestational diabetes or GDM, delivery after 37 weeks and availability of a registered diabetic book and antenatal card with documentation from the first antenatal visit before 12 weeks of gestation. Exclusion criteria included pregnancies complicated by significant co-morbidities such as renal failure, sepsis, hypertension, or hypothyroidism.

The dependent variables were maternal outcomes including preeclampsia, gestational hypertension, postpartum hemorrhage (PPH) and premature rupture of membranes (PROM) and fetal outcomes including birth weight, congenital anomalies, neonatal hypoglycemia, respiratory distress, intrauterine fetal death and NICU admission. The independent variables were gestational weight gain (GWG) and diabetes type, while demographic variables included age, socioeconomic status and educational status. GWG was defined as the amount of weight gained between conception and delivery and was categorized according to the Institute of Medicine (IOM, 2009) guidelines based on pre-pregnancy BMI. BMI was calculated as weight in kilograms divided by height in meters squared and classified according to WHO criteria. Operational definitions were followed for macrosomia, PROM, PPH, neonatal hypoglycemia and socioeconomic status.

Eligible participants were consecutively enrolled after approval from the Institutional Review Board. Participants were categorized into three GWG groups: excessive, adequate and inadequate. Data sources included patient interviews, observation, clinical examination, antenatal cards and hospital records. A semi-structured questionnaire was used to collect demographic, clinical, obstetric and neonatal data and each participant had an individual data sheet. Data were analyzed using SPSS version 26.0. Descriptive statistics were applied and associations between GWG and maternal and fetal outcomes were assessed using Chi-square or Fisher's exact test, with $p<0.05$ considered statistically significant. Written informed consent was obtained from all participants and confidentiality was strictly maintained.

RESULTS

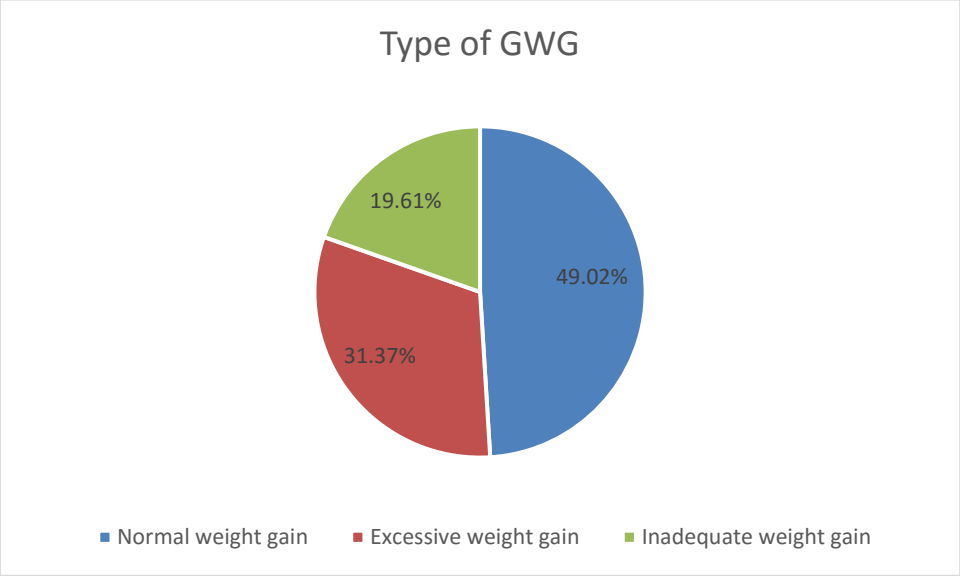

Figure 1: Pie chart of Type of gestational weight gain among GDM patients

Figure 1 shows the distribution of gestational weight gain (GWG) types among participants with gestational diabetes mellitus (GDM). It indicates that 49.02% of the participants had normal weight gain (red segment, 25 participants), 31.37% had excessive weight gain (blue segment, 16 participants) and 19.61% had inadequate weight gain (green segment, 10 participants). Normal weight gain was the most common, while inadequate weight gain was the least common.

Table I: Categorize GDM patient according to sociodemographic characteristic by groups

Sociodemographic parameter	Excessive weight gain (n=16) N (%)	Normal weight gain (n=25) N (%)	Inadequate weight gain (n=10) N (%)	P value
Age in years (Mean ± SD)	27.7 ± 3.4	27.5 ± 3.6	28.4 ± 5.1	0.840[a]
Education				
Primary	0 (0.0)	3 (12.0)	0 (0.0)	
SSC	3 (18.8)	3 (12.0)	1 (10.0)	0.644[b]
HSC and above	13 (81.2)	19 (76.0)	9 (90.0)	
Occupation				
Housewife	8 (50.0)	18 (72.0)	8 (80.0)	
Service holder	8 (50.0)	6 (24.0)	1 (10.0)	0.126[b]
Student	0 (0.0)	1 (4.0)	1 (10.0)	
Socioeconomic status				
Poor	1 (6.2)	2 (8.0)	0 (0.0)	
Middle class	11 (68.8)	15 (60.0)	7 (70.0)	0.981[b]
Rich	4 (25.0)	8 (32.0)	3 (30.0)	

[b]Fisher's exact test, [a]ANOVA test
Group I= Excessive weight gain
Group II= Normal weight gain
Group III= Inadequate weight gain

Among patients with GDM, the mean age was similar across the groups with excessive, normal and inadequate weight gain. In the excessive weight gain group, 81.2% had passed HSC and 18.8% had completed SSC. In the normal weight gain group, 76.0% had passed HSC, 12.0% had completed SSC and 12.0% had primary education. In the inadequate weight gain group, 90.0% had passed HSC and 10.0% had completed SSC (Table I).

Table II: Categorize GDM patient according to mode of delivery by groups

Mode of delivery	Excessive weight gain (n=16) N (%)	Normal weight gain (n=25) N (%)	Inadequate weight gain (n=10) N (%)	P value
NVD	1 (6.3)	15 (60.0)	4 (40.0)	0.006[b]
CS	15 (93.7)	10 (40.0)	6 (60.0)	

[b] Fisher's exact test

Table II shows the mode of delivery for each weight gain group. In the excessive weight gain group, 6.3% had a normal vaginal delivery (NVD) and 93.7% had a cesarean section (CS). In the normal weight gain group, 60.0% had NVD and 40.0% had CS. In the inadequate weight gain group, 40.0% had NVD and 60.0% had CS. All these values were statistically significant (p=0.006).

Table III: Categorize Pregestational DM patient according to fetal complications by groups

Fetal complication	Excessive weight gain (n=13) N (%)	Normal weight gain (n=19) N (%)	Inadequate weight gain (n=19) N (%)	P value
Present	12 (92.3)	17 (89.5)	14 (73.7)	0.104[b]
Absent	1 (7.7)	2 (10.5)	5 (26.3)	

[b]Fisher's exact test

Table III reveals that fetal complications were present in 92.3% of cases with excessive weight gain, 89.9% with normal weight gain and 73.7% with inadequate weight gain, with a statistically not significant difference between the groups (P = 0.104). Complications were absent in 7.7% of the excessive weight gain group, 10.5% of the normal weight gain group and 26.3% of the inadequate weight gain group.

Table IV: Categorize excessive weight gain patient according to presence of maternal complications by groups (GDM=16 and PGDM=13)

Maternal complication	GDM N (%)	PGDM N (%)	P value
Present	7 (43.8)	8 (61.5)	0.340[c]
Absent	9 (56.2)	5 (38.5)	

[c]Chi square test

Table IV shows that 43.8% of mothers with gestational diabetes mellitus (GDM) and 61.5% of mothers with pregestational diabetes mellitus (PGDM) experienced complications, with no significant difference between the two groups (P value = 0.340).

Table V: Categorize excessive weight gain patient according to presence of fetal complications by groups (GDM=16 and PGDM=13)

Fetal complication	GDM (n=16) N (%)	PGDM (n=13) N (%)	P value
Present	10 (62.5)	12 (92.3)	0.06[b]
Absent	6 (37.5)	1 (7.7)	

[b]Fisher's exact test

Table V shows that fetal complications were significantly more common in pregnancies with gestational diabetes mellitus (GDM) (62.5%) compared to pregestational diabetes mellitus (PGDM) (7.7%), with a P value of 0.06.

Table VI: Categorize normal weight gain patient according to presence of maternal complications by groups (GDM=25 and PGDM=19)

Maternal complication	GDM N (%)	PGDM N (%)	P value
Present	4 (16.0)	5 (26.3)	0.287[b]
Absent	21 (84.0)	14 (73.7)	

[b]Fisher's exact test

Table VI shows that 16.0% of mothers with gestational diabetes mellitus (GDM) and 26.3% of mothers with pregestational diabetes mellitus (PGDM) experienced complications, with no significant difference between the two groups (P value = 0.287).

Table VII: Categorize normal weight gain patient according to presence of fetal complications by groups (GDM=25 and PGDM=19)

Fetal complication	GDM (n=25) N (%)	PGDM (n=19) N (%)	P value
Present	7 (28.0)	11 (57.9)	0.046[c]
Absent	18 (72.0)	8 (42.1)	

[c]Chi square test

Table VII shows that fetal complications were significantly more common in pregnancies with pregestational diabetes mellitus (PGDM) (57.9%) compared to gestational diabetes mellitus (GDM) (28.0%), with a P value of 0.046.

Table VIII: Categorize inadequate weight gain patient according to presence of fetal complications by groups (GDM=10 and PGDM=19)

Fetal complication	GDM (n=10) N (%)	PGDM (n=19) N (%)	P value
Present	6 (60.0)	14 (73.7)	0.45[b]
Absent	4 (40.0)	5 (26.3)	

[c]Chi square test

Patients with inadequate weight gain were categorized according to the presence of fetal complications into two groups: GDM and PGDM. In the GDM group, 6 patients (60.0%) had fetal complications, while in the PGDM group, 14 patients (73.7%) had fetal complications, with a P value of 0.45. There were no fetal complications in 4 patients (40.0%) in the GDM group and in 5 patients (26.3%) in the PGDM group (Table VIII).

Table IX: Categorize inadequate weight gain patient according to type of fetal complications by groups (GDM=10 and PGDM=19)

Type of fetal complication	GDM (n=10) N (%)	PGDM (n=19) N (%)	P value
Birthweight of newborn			
SGA	2 (20.0)	7 (36.8)	0.431[b]
Hypoglycemia	1 (10.0)	0 (0.0)	0.345[b]
RD	2 (20.0)	1 (5.3)	1.000[b]
Jaundice	0 (0.0)	2 (10.5)	0.532[b]
NICU admission	1 (10.0)	4 (21.1)	0.633[b]
APGAR Score in first 5 min			
<7	1 (10.0)	4 (21.1)	0.633[b]
≥7	9 (90.0)	15 (78.9)	

[b]Fisher's exact test,

Patients with inadequate weight gain were categorized according to the type of fetal complications into two groups: GDM (n=10) and PGDM (n=19). In the GDM group, 8 patients (80.0%) had newborns with normal birth weight, compared to 12 patients (63.2%) in the PGDM group, with a P value of 0.704. SGA was observed in 2 patients (20.0%) in the GDM group and 7 patients (36.8%) in the PGDM group, with a P value of 0.431. No cases of macrosomia were reported in either group. Hypoglycemia occurred in 1 patient (10.0%) in the GDM group, while no cases were found in the PGDM group, with a P value of 0.345. RD was observed in 1 patient (5.3%) in the PGDM group and 2 patient (20.0%) in the GDM group, with a P value of 1.00. Jaundice was present in 2 patients (10.5%) in the PGDM group, with no cases in the GDM group, with a P value of 0.532. NICU admission was required for 1 patient (10.0%) in the GDM group and 4 patients (21.1%) in the PGDM group, with a P value of 0.633. An APGAR score of less than 7 in the first 5 minutes was recorded in 1 patient (10.0%) in the GDM group and 4 patients (21.1%) in the PGDM group, with a P value of 0.633. An APGAR score of 7 or higher was observed in 9 patients (90.0%) in the GDM group and 15 patients (78.9%) in the PGDM group (Table IX).

DISCUSSION

Gestational weight gain (GWG) plays a critical role in determining maternal and fetal outcomes, especially in pregnancies complicated by diabetes. In our study, normal GWG was the most prevalent among women with gestational diabetes mellitus (GDM) (49.02%), followed by excessive (31.37%) and inadequate GWG (19.61%). This distribution aligns with previous reports highlighting that both excessive and inadequate GWG are common in diabetic pregnancies and are associated with adverse outcomes [10, 11].

Excessive GWG was strongly associated with cesarean section (CS), as 93.7% of women with excessive GWG underwent CS compared to 40.0% in the normal GWG group. This finding is consistent with the work of Santos Monteiro et al., who reported higher rates of operative delivery in women with excessive GWG [12]. Increased maternal adiposity, fetal macrosomia and obstetric complications likely contribute to the higher CS rates observed in excessive GWG [13, 14].

Fetal complications in pregestational diabetes mellitus (PGDM) were most frequent in the excessive GWG group (92.3%), though the difference among GWG categories was not statistically significant (p=0.104). This trend corroborates findings by Ke et al. and Durnwald, indicating that excessive maternal weight gain in diabetic pregnancies predisposes neonates to complications such as macrosomia, hypoglycemia and respiratory distress [15, 16]. Similarly, in the excessive GWG group, fetal complications were more common in PGDM than in GDM (92.3% vs. 62.5%; p=0.06), highlighting the additive risk of pre-existing diabetes on adverse neonatal outcomes [17].

Maternal complications were also higher in the excessive GWG group, affecting 61.5% of PGDM and 43.8% of GDM mothers, although this difference was not significant (p=0.340). This aligns with evidence by Sun et al. and Miao et al., who reported increased rates of preeclampsia, gestational hypertension and postpartum hemorrhage in women with excessive GWG and diabetes [18, 19]. Excessive GWG can exacerbate insulin resistance, endothelial dysfunction and inflammatory pathways, contributing to maternal complications.

Interestingly, fetal complications were significantly more common in PGDM than GDM mothers with normal GWG (57.9% vs. 28.0%; p=0.046), suggesting that even appropriate weight gain cannot fully mitigate the risks associated with pregestational diabetes [20, 21]. This emphasizes the importance of optimal glycemic control alongside monitoring GWG to improve fetal outcomes.

Inadequate GWG was less common but still notable (19.61% in GDM), with 60.0% of GDM and 73.7% of PGDM mothers experiencing fetal complications. Although not statistically significant, this finding highlights that insufficient GWG can also negatively impact fetal growth, as previously demonstrated by Ikenoue et al [22]. Small-for-gestational-age (SGA) infants, low APGAR scores and NICU admissions were more frequent in inadequate GWG groups, suggesting that undernutrition or suboptimal maternal weight gain can compromise fetal development [23].

Overall, our findings underscore the dual risk of both excessive and inadequate GWG in diabetic pregnancies. Excessive GWG is associated with higher rates of CS, maternal complications and fetal complications, while inadequate GWG primarily affects fetal growth and neonatal outcomes. These results reinforce the need for individualized counseling on optimal weight gain, careful monitoring of maternal glucose and timely obstetric interventions in women with GDM and PGDM [24, 25].

Limitations of the study

Weight gain during pregnancy is complex, affecting pregnancy outcomes and overall health and influenced by physiological, psychological, environmental, behavioral, familial and cultural factors. Result of the study may not represent the exact picture of the whole population.

Recommendations

To address the numerous variables impacting prenatal weight gain, a multidisciplinary approach involving obstetricians, endocrinologists, nutritionists and mental health practitioners should be implemented. More extensive, controlled research is necessary to determine the best therapies and to acquire a better understanding of the association between gestational weight increase and pregnancy outcomes in moms with diabetes.

CONCLUSION

In conclusion, achieving appropriate GWG in diabetic pregnancies is crucial for minimizing maternal and fetal complications. Both extremes of weight gain, excessive or inadequate, pose significant risks, highlighting the importance of nutritional guidance, glycemic control and regular monitoring throughout gestation.

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