Impact of Behaviour Change Communication on Immediate Complications of Gestational Diabetes Mellitus: A Prospective Quasi-Experimental Study

Pooja G. Dhutraj[1], Sujata Shirish Pol[2], Dhanashree V. Khade[3]

[1]Assistant Professor, MGM Medical College, Nerul, Navi Mumbai
[2]Professor, (Addl)-LTMMC & GH, Mumbai
[3]Assistant Professor- RJMC, Thane

Correspondence: Dr. Pooja G. Dhutraj, Email: pooja.dhutraj@gmail.com

Abstract:

Introduction: Gestational Diabetes Mellitus (GDM) is an emerging public health concern in India and is associated with adverse maternal and neonatal outcomes. Behaviour Change Communication (BCC) is a cost-effective strategy that can promote healthy behaviours and improve pregnancy outcomes among women with GDM. This study aims to assess the impact of BCC on immediate maternal and neonatal complications of GDM among antenatal women. **Material and Methods:** A single-centre, prospective quasi-experimental study was conducted at a tertiary care teaching institute in a metropolitan city. Systematic enrolment of 220 antenatal women diagnosed with GDM between 24–28 weeks of gestation was carried out from a sampling frame of 285 GDM-positive clinic attendees. Participants were allocated to an intervention group (Group A, n=110) and a control group (Group B, n=110) using a structured alternate-day systematic pseudo-randomisation method. Group A received structured health education through BCC, while Group B received routine antenatal care. Participants were followed up during late pregnancy and up to six weeks postpartum. **Results:** The proportion of women who did not experience immediate maternal complications was significantly higher in Group-A (61.79%) than in Group-B (20.68%) ($p<0.05$). A significantly greater reduction in post-prandial blood glucose levels was observed in the intervention group ($p<0.05$). Neonatal complications were numerically lower in Group A, though the overall difference was not statistically significant. **Conclusions:** BCC significantly reduced immediate maternal complications and improved glycaemic control among women with GDM. Incorporating BCC into routine antenatal services may help reduce GDM-related morbidity.

Keywords: Gestational diabetes mellitus, Behaviour Change Communication, Maternal complications, Neonatal complications, Blood Sugar Level, Antenatal Care.

Introduction:

According to the International Federation of Gynaecology and Obstetrics (FIGO) Initiative, Gestational Diabetes Mellitus (GDM) is any degree of glucose intolerance with onset or first recognition during pregnancy. The definition of GDM is evolving. When hyperglycaemia detected during routine testing in pregnancy (generally between 24 and 28 weeks), it is called GDM[1].

National guideline for diagnosis and management of Gestational Diabetes gives a single step test for diagnosis of GDM by using a 75-gm glucose, through

Quick Response Code	Access this article online	How to cite this article :
	Website : www.healthlinejournal.org	Dhutraj P, Pol S, Khade D. Impact of Behaviour Change Communication on Immediate Complications of Gestational Diabetes Mellitus: A Prospective Quasi-Experimental Study Healthline. 2026;17(2): 125-131
	DOI : 10.51957/Healthline_834_2026	

Received : 23-03-2026 **Accepted** : 11-06-2026 **Published :** 23-07-2026

Oral Glucose Tolerance Test and threshold value of 2-hour blood sugar >140 mg/dL irrespective of the last meal.[2] GDM not only influences maternal complications (polyhydramnios, pre-eclampsia, prolonged labour, obstructed labour, caesarean section, uterine atony, postpartum haemorrhage and infection which are the leading global causes of maternal morbidity and mortality) but also neonatal complications (spontaneous abortion, intra-uterine death, stillbirth, congenital malformation, shoulder dystocia, birth injuries, neonatal hypoglycaemia and infant respiratory distress syndrome). Women with GDM and their offspring are at increased risk of developing type-2 diabetes later in life[2]. The Indian women have 11-fold increased risk of developing glucose intolerance during pregnancy compared to Caucasian women.[3] The incidence of GDM is expected to increase to 20% i.e. one in every 5 pregnant women is likely to have GDM.[3] According to the IDF Diabetes Atlas (2023), the global prevalence of hyperglycaemia in pregnancy is estimated at 13.9%, affecting approximately 21 million live births annually.[4]

Behaviour Change Communication is an interactive process with communities to develop tailored messages and approaches using a variety of communication channels to develop positive behaviours; promote and sustain individual, community and societal behaviour change; and maintain appropriate behaviours.[5] BCC has valid applications in both clinical settings and public health in the prevention of communicable and noncommunicable diseases.[5] Behavioural and educational interventions that address psychological elements - including perceived susceptibility, severity, benefits, and barriers - shape dietary habits, enhance self-efficacy, identify personal challenges to healthy behaviour, and cultivate intrinsic motivation for change, resulting in improved health-related quality of life among women at risk of or diagnosed with GDM.[6]

Despite the rising burden of GDM, awareness and implementation of preventive strategies remain inadequate, even among healthcare providers. Most existing studies focus on clinical management, with limited emphasis on behavioural interventions in routine antenatal settings. Behaviour Change Communication (BCC) is a structured approach that motivates individuals to adopt and sustain healthy behaviours. However, evidence regarding its effectiveness in reducing immediate maternal and neonatal complications of GDM in real-world settings is limited. Therefore, the present study was undertaken to assess the impact of BCC on immediate complications of GDM among antenatal women.

Material and Methods:

Study Design and Setting:

A single-centre, prospective quasi-experimental study was conducted at the ANC clinic of a tertiary care teaching hospital in a metropolitan city from January 2018 to September 2019, following Institutional Ethics Committee approval. The study is designated quasi-experimental because, while group allocation employed a structured, pre-defined, investigator-independent criterion (calendar day of clinic attendance), formal allocation concealment was not employed.

Ethics and Confidentiality:

Written informed consent was obtained from all participants. Participant data were anonymised using coded identifiers; no personally identifiable information was included in the analysis dataset. The study was conducted in accordance with the Declaration of Helsinki.

Selection Criteria

Inclusion Criteria:

(I) Antenatal women at 24–28 weeks of gestation with confirmed GDM (75-g OGTT, 2-hour postprandial blood glucose $\geq$140 mg/dL).

(ii) Antenatal women previously diagnosed with GDM in the current pregnancy, confirmed by medical records.

(iii) Those willing to participate and providing written informed consent.

Exclusion Criteria:

(I) Antenatal women with pre-existing (pre-gestational) Type 1 or Type 2 diabetes mellitus.

(ii) Antenatal women suffering from chronic renal disease, pancreatic disease, or other severe systemic illness.

(iii) Antenatal women receiving steroids, nicotinic acid, or other medications known to cause dysglycaemia.

(iv) Those not willing to participate in the study.

Participant Enrolment:

During the study period, 412 antenatal women were screened using the 75-g OGTT; 285 were diagnosed with GDM and constituted the sampling frame. Of these 285, all were assessed against the selection criteria; 240 fulfilled all inclusion and exclusion criteria. Of the 240 eligible women, 220 provided written informed consent and were enrolled; 20 declined participations.

Systematic random sampling was applied as the enrolment method: investigators attended the ANC clinic daily (Monday to Saturday) and systematically approached every eligible GDM-positive woman attending each clinic day in chronological order of attendance. This sequential, non-selective, clinic-population-based approach constitutes systematic random sampling as applied in community medicine research. Enrolment continued until the pre-determined target of 220 was achieved.

Group Allocation:

Enrolled participants were allocated to two equal groups of 110 using a structured alternate-day systematic pseudo-randomisation method: women attending on odd calendar days were assigned to Group A (BCC intervention group; n=110), and those attending on even calendar days to Group B (control/usual care group; n=110). This calendar-day-based allocation constitutes systematic pseudo-randomisation — an external, pre-defined, non-subjective criterion that eliminates investigator and participant selection bias. A single-blinding technique was applied: Group B participants were not informed of the BCC intervention delivered to Group A.

BCC Intervention (Group A):

Group A received structured health education through a validated BCC booklet developed using standard obstetrics and gynaecology references and national GDM management guidelines, with pictorial aids in the participant's preferred language. Three individual educational sessions were delivered: (i) at enrolment (24–28 weeks); (ii) at first follow-up (34–38 weeks); and (iii) at second follow-up (within 6 weeks postpartum). Sessions covered: understanding GDM and its risks; dietary modification and glycaemic self-monitoring; safe physical activity during pregnancy; medication adherence; danger sign recognition; and breastfeeding and postpartum care. Group B received routine antenatal care only.

Operational Definitions of Outcomes:

Immediate Complications of GDM:

Those complications occurring due to GDM during pregnancy or within the first six weeks of the postpartum period.

Immediate Maternal Complications:

Pre-eclampsia/pregnancy-induced hypertension (PIH), polyhydramnios, prolonged labour (>18 hours in primigravidae; >12 hours in multigravida), obstructed labour, postpartum haemorrhage (>500 mL for vaginal delivery; >1000 mL for caesarean), puerperal sepsis/infection, abnormal gestational weight gain, miscarriage, uterine atony, and preterm delivery. Assessed clinically by the treating obstetrician at each follow-up visit and at delivery.

Immediate Neonatal Complications:

Neonatal hypoglycaemia (blood glucose <47 mg/dL), respiratory distress syndrome (Silverman-Anderson score $\geq$3 or SpO <92%), macrosomia (birth weight >4 kg), neonatal jaundice requiring phototherapy (serum bilirubin >12 mg/dL in term neonates), polycythaemia, hypocalcaemia, intrauterine fetal death (IUFD), congenital malformation, and birth injuries. Identified through clinical examination by the paediatrician and neonatal case records within the first 28 days of life.

Data Collection:

A predesigned, pretested, and validated structured interview questionnaire was used at baseline and follow-up visits. Instruments included a sphygmomanometer (blood pressure), weighing scale and measuring tape (anthropometry), and ANC records (blood investigations). Follow-up visits were conducted at 34–38 weeks of gestation (first follow-up) and within six

weeks postpartum (second follow-up), either at the hospital or telephonically for women who delivered elsewhere. Telephonic follow-up used the same structured questionnaire; potential recall bias from this method is acknowledged as a study limitation.

Statistical Analysis:

Data were entered in Microsoft Excel 2016 and analysed using SPSS version 25.0. Descriptive statistics (mean, SD, proportions/percentages) and inferential statistics (chi-square test, Fisher's exact test for cells with expected count <5, and unpaired t-test) were applied as appropriate. Data normality was assessed using the Shapiro-Wilk test prior to parametric testing.

Result:

A total of 220 antenatal women with GDM were enrolled and allocated to Group A (BCC intervention) and Group B (Control group). During follow-up, 20 participants were lost (12 from Group A and 8 from Group B). Table no. 1 shows the socio-demographic distribution of participants in Group A & Group B.

Table no. 2 shows the comparison of immediate maternal and neonatal complications in both groups [Note: 'Immediate maternal complications' are defined as complications occurring from 34 weeks gestation through 6 weeks postpartum. 'Immediate neonatal complications' include those occurring within the first 28 days of life, diagnosed clinically or per standard laboratory thresholds].

In Group A, 61.79% of women had no immediate maternal complications compared to 20.68% in Group B, a statistically significant difference (χ^2=30.63, p<0.05).

Absence of immediate neonatal complications was observed in 53.60% of Group A neonates and 40.59% of Group B neonates; however, this difference was not statistically significant (χ^2=3.36, p>0.05). In both groups, jaundice was the most common complication (14.3% vs 26.5%), followed by hypoglycaemia (5.1% vs 18.6%) and respiratory distress (4.1% vs 14.7%), with macrosomia, congenital malformations, and intrauterine death occurring more frequently in Group B.

Table No. 1: Sociodemographic profile of group A (n1: 110) & group B (n2: 110)

Variable	Group A (Intervention group)	Group B (Control Group)	
Age of the participants (years)			
17–21	1 (0.9%)	21 (19.1%)	
22–26	49 (44.5%)	23 (20.9%)	
27–31	38 (34.5%)	35 (31.8%)	
32–36	16 (14.5%)	29 (26.4%)	<0.001
≥37	6 (5.5%)	2 (1.8%)	
Mean ± SD	27.82 ± 4.16	27.66 ± 5.00	
Education level			
Illiterate	18 (16.4%)	14 (12.7%)	
Primary school	0 (0%)	11 (10.0%)	
Middle school	61 (55.5%)	56 (50.9%)	<0.001
High school	21 (19.1%)	4 (3.6%)	
Graduate	10 (9.1%)	25 (22.7%)	
Religion			
1. Hindu	57	56	
2. Muslim	53	46	
3. Christian	00	08	

Chi-square test for categorical variables; unpaired t-test for age.

Table No.2: Immediate Maternal complications Group A (n1: 98) & group B (n2: 102)

Immediate Maternal Complications	Group A (n1=98)	Group B (n1=102)	p-value
Polyhydramnios	8 (8.1%)	13 (12.7%)	0.31
Obstructed labour	7 (7.1%)	14 (13.7%)	0.12
Prolonged labour	2 (2%)	11 (10.7%)	0.01
Infection	8 (8.1%)	25 (24.5%)	<0.01
PIH 12(12.2%)	19 (18.6%)	0.21	
Women with ≥ 1 complication	37 (37.7%)	82 (80%)	< 0.001
No Maternal complication	61 (62%)	20 (19.46%)	< 0.001

Abbreviations:
BCC- Behavioural Change Communication
GDM- Gestational Diabetes Mellitus
Ethical Clearance Certificate: Attached

The mean reduction in post-prandial blood sugar was significantly greater in Group A (-37 ± 22.67 mg/dl) than in Group B (-23.41 ± 30.25 mg/dl) ($t = 3.75$, $p < 0.05$). Normality of the blood glucose reduction data was assessed using the Shapiro-Wilk test. A confirmatory Mann-Whitney U test also demonstrated a significant intergroup difference ($p < 0.05$), consistent with the t-test result. Normotension was observed in 90.38% of Group A participants compared to 77.35% in Group B, with a higher proportion of hypertensive subjects in Group B (22.64%) than Group A (9.61%).

Early initiation of breastfeeding occurred in 41.09% of Group A and 31.25% of Group B mothers, with no statistically significant difference ($\chi^2=1.42$, $p>0.05$). Exclusive breastfeeding was practiced by 80% of Group A and 84.37% of Group B mothers, and colostrum feeding by 94.73% and 90.62%, respectively; these differences were not statistically significant ($p > 0.05$).

Among 33 participants advised pharmacological treatment, compliance was higher in Group A (87.5%) than Group B (76.4%), though the difference was not statistically significant ($p > 0.05$).

Discussion:

The mean ages of participants were similar between the two groups (Group A: 27.82 ± 4.16 years; Group B: 27.66 ± 5.00 years) with no statistically significant difference on unpaired t-test ($p=0.77$), confirming comparability of the groups in terms of average age. These findings are comparable to those reported by Arjmandi Far et al.[7], who noted a mean age of 27.81 ± 4.11 years among GDM-positive antenatal women. However, while the mean ages were statistically comparable, the distribution of participants across age sub-groups differed significantly between the two groups (chi-square, $p<0.001$). Specifically, the 17–21 years age sub-group comprised 21 women (19.1%) in Group B versus only 1 woman (0.9%) in Group A. These two observations — comparable means and different sub-group distribution — are not contradictory; they reflect different levels of statistical analysis of the same age variable. The larger standard deviation in Group B (5.00 vs 4.16) reflects greater age dispersion driven by the concentration of very young participants. Very young maternal age (<21 years) is an established independent risk factor for adverse pregnancy outcomes, including PIH and obstructed labour, and constitutes a potential confounding factor that may partially explain the magnitude of the between-group difference in maternal complication rates. This distributional imbalance is an inherent limitation of the quasi-experimental design and is presented as a caveat when interpreting the results.

He et al.[8] demonstrated that structured health education combined with personalised care significantly reduced maternal complications and improved glycaemic control in women with GDM compared to routine care alone — findings that align with our results showing improved glycaemic control and significantly fewer immediate maternal complications in the BCC group.

The intervention group showed lower incidences of premature delivery, polyhydramnios, postpartum haemorrhage, fetal distress, and urinary tract infections, with no significant difference observed in placenta previa. These findings are consistent with the present study, where Behaviour Change Communication (BCC) resulted in improved glycemic control, a higher proportion of normotensive women, and significantly fewer immediate maternal complications in the intervention group. Together, these studies underscore the critical role of focused health education and behavior-based interventions in improving maternal outcomes in GDM, even when neonatal outcomes may not demonstrate statistically significant differences.

In the present study, infections were observed in 8% of women in Group A and 18% in Group B. Hafija Akter et al. [9] reported vaginal candidiasis in 12–24% of GDM patients, while Vijaya Nandhini Rengarajan et al.[10] documented a significantly higher incidence of urinary tract infections among GDM mothers compared to non-GDM mothers.

Pregnancy-induced hypertension (PIH) was noted in 12% of women in Group A and 18% in Group B. In comparison, Hafija Akter et al.[9] reported gestational hypertension in 28% of GDM cases, and Sahu L et al.[11] observed gestational hypertension in 35 women, indicating a higher prevalence than that observed in the present study. These discrepancies may reflect differences in diagnostic criteria (WHO vs ADA), the predominantly younger study population in our cohort, and the potential protective effect of the BCC intervention on blood pressure control through dietary and lifestyle modification.

Neonatal jaundice was the most common neonatal complication in the present study and was more frequent in Group A compared to Group B. Vijaya Nandhini Rengarajan et al.[10]similarly found high rates of neonatal hyperbilirubinemia among GDM mothers (85.7%), which is higher than observed in either group in our study — possibly reflecting more stringent diagnostic thresholds or a higher-risk population in that setting. These findings are consistent with reports by Kumari et al.[11] and Kwik et al.[12], all of which highlight an increased risk of neonatal jaundice in GDM pregnancies.

Respiratory distress was observed in 4 neonates in Group A and 15 neonates in Group B. Vijaya Nandhini Rengarajan et al.[10] reported two cases of respiratory distress syndrome among neonates of GDM mothers, with none in the non-GDM group. The HAPO Study [13] further identified GDM as a significant risk factor for delayed fetal lung maturation and increased neonatal respiratory complications.

Neonatal hypoglycemia was noted in 5 neonates in Group A and 19 neonates in Group B. The HAPO Study[14] reported a higher prevalence of neonatal hypoglycemia among infants born to GDM mothers compared to non-GDM mothers (75% vs. 25%, $p = 0.07$). These findings are supported by Kumari R et al.[11], Abu-Heija AT et al.[14], and Patel et al.[15], who attributed this increased risk to fetal hyperinsulinemia—a compensatory response to maternal hyperglycemia during pregnancy.

This study highlights the significant role of behavioural interventions in improving maternal outcomes in GDM. Unlike purely clinical approaches, BCC addresses lifestyle modification, treatment adherence, and self-care practices, which are critical in glycaemic control. The lack of statistically significant difference in neonatal outcomes may be attributed to the shorter follow-up period and multifactorial determinants of neonatal health. Further multicentric studies with larger sample sizes and longer follow-up are recommended to establish the long-term impact of BCC interventions.

Conclusion:

The present study demonstrates that Behaviour Change Communication (BCC) is an effective intervention in reducing immediate maternal complications among antenatal women with Gestational Diabetes Mellitus. Women who received BCC had better glycemic control and fewer maternal complications than those who did not receive the intervention. Although neonatal outcomes did not show statistically significant differences, fewer neonatal complications were observed among participants who received BCC. BCC proved to be a resource-efficient and scalable in improving key maternal health parameters among women with GDM. Strengthening such interventions

within routine antenatal care may help reduce GDM-related complications, especially in resource-limited settings.

Declarations:

Acknowledgment (if any)- No

Financial support & Sponsorship: No funding support and /or sponsorship received from national or international funding agencies.

Conflicts of Interest- Nil

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