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ORIGINAL ARTICLE

A Randomized Controlled Trial on the Effectiveness of Short Message Service (SMS) Reminders in Improving Postpartum Follow-up among Gestational Diabetes Mellitus Patients

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Abstract

Objective. This study assessed whether short message service (SMS) reminders would improve follow-up rate among gestational diabetes mellitus (GDM) patients by 12 weeks postpartum.

Methodology. In this single-center, single-blind randomized controlled trial, we assigned 308 patients with GDM to either of 2 arms, usual care alone versus usual care with SMS reminders. In the usual care group, 154 patients received a 10-minute short lecture on GDM and a 75 g oral glucose tolerance test (OGTT) request prior to discharge. In the SMS group, 154 patients received twice a week SMS reminders at 4 weeks, 8 weeks, and 10 weeks after delivery in addition to usual care. The primary outcome was clinic visit within 6 to 12 weeks postpartum with a 75 g OGTT result.

Results. In our population, the overall follow-up rate was 19.8% (61/308). Follow up rates were 20.1% (31/154) for the usual care group and 19.5% (30/154) for the SMS. The addition of SMS reminders was not associated with an increase in follow-up rate at 12 weeks postpartum (adjusted RR 0.98, 95% CI 0.63-1.52; *p*=0.932). The use of insulin or metformin for GDM control was associated with increased follow-up (adjusted RR 1.92, 95% CI 1.20-3.07; *p*=0.006).

Conclusion. SMS reminders did not improve postpartum follow-up rate among GDM patients at 12 weeks postpartum.

Key words: gestational diabetes, short message service, reminder system

INTRODUCTION

The prevalence of gestational diabetes mellitus is reported to be as high as 14% among Filipinos, based on the ASEAN Federation of Endocrine Societies (AFES) Study Group on Diabetes in Pregnancy.[1] Following GDM, 35 to 60% of women develop type 2 diabetes within 10 years.[2] The incidence of postpartum glucose intolerance among Filipino GDM patients was reported to be as high as 42% (overt diabetes in 7.3% and prediabetes in 34.7%).[3] Subclinical glucose intolerance during pregnancy is also associated with a dose-related increase in cardiovascular disease later in life.[4] Taking into account these long-term implications, early identification of postpartum type 2 diabetes mellitus risk and glucose intolerance is imperative. This can be done by postpartum glucose screening as this presents an opportunity for education and primary diabetes prevention.[5]

The Philippine Clinical Practice Guidelines on the Diagnosis and Management of Diabetes Mellitus recommend that women with GDM be screened for persistent glucose abnormality at 6 to 12 weeks postpartum.[2] However, in our institution, follow-up rates are generally poor, as most are lost to follow-up after discharge from the hospital. Studies from the United States and Australia also report low postpartum screening, with rates ranging from 19 to 73%.[5,6] There are efforts to increase awareness focusing mainly on education, as it has been demonstrated that women who are better educated on the importance of postpartum testing are more likely to follow-up.[7-9] The need to identify simple and innovative strategies to augment current care protocols may serve to improve postpartum glucose testing and follow-up. Among GDM patients, postpartum postal reminders, telephone calls and emails were shown to increase screening rates as reported by other studies.[10,11] A meta-analysis of postpartum screening practices among Asian women with a known history of GDM showed that postpartum testing rate ranged from 13 to 82% during routine care, as compared to 67 to 95% of women who received SMS or call interventions in the studies.[12] The intention behind putting a reminder system in place orovides not only an avenue for continuity of care, but also a continual of awareness of the risk for development of diabetes.[11]

In 2015, our National Telehealth Center reported that there were 114.6 million mobile connections in the country.[13] Given the widespread use of texting and mobile phones and the evidence to support their use, numerous text messaging programs for health promotion have

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been developed.[14] Studies on the use of short message service in health care, particularly among human immunodeficiency virus patients and persons with type 2 diabetes mellitus, showed improved adherence to treatment and increased appointment attendance.[15] Locally, SMS as an adjunct to standard diabetes care has been shown to improve adherence to diet and exercise, supporting disease self-management.[16] An SMS reminder system among postpartum GDM patients in Australia was demonstrated to increase overall postpartum screening rate.[17] In a local study on GDM patients which implemented persistent SMS reminders or calls for scheduled postpartum 75 g oral glucose tolerance test (OGTT), the reported follow-up rate was 71.6%.[3]

Given the prevalent use of mobile phones among Filipinos and the low cost of text messaging (PhP 1.00 equivalent to ~USD 0.020 per standard 160-character SMS), a reminder system through text messaging may prove to be an inexpensive, effective, feasible and culture-appropriate strategy to improve rates of postpartum glucose testing and follow-up.

This study aimed to compare the effectiveness of SMS reminders in addition to usual care in improving follow-up and postpartum glucose testing among GDM patients. We also determined the association of follow-up and socio-demographic and perinatal characteristics, including clinical and neonatal outcomes, and among postpartum GDM patients. We also described self-reported barriers and facilitators for postpartum testing.

METHODOLOGY

Study design and participants

This study was a single-blind randomized controlled trial that was conducted at the Philippine General Hospital, a tertiary teaching hospital in Manila. A concurrent qualitative method approach through survey questions was used to identify self-reported barriers and facilitators for postpartum follow-up. Ethics approval was obtained from the University of the Philippines Manila Research Ethics Board.

Participants were eligible for inclusion if they were diagnosed with GDM during their most recent pregnancy by their physician, or based on criteria from the International Association of Diabetes and Pregnancy Study Group (IADPSG) or the Philippine Obstetric and Gynecology Society (POGS). They should have access to a personal mobile phone (not a shared phone), be able to read and write in Filipino, have normal capillary blood glucose (CBG) upon discharge [fasting blood glucose (FBG) <108 mg/dL and 2-hour postprandial blood glucose (PPBG) <144 mg/dL] and with written informed consent. The diagnosis of GDM based on the IADPSG and POGS criteria is summarized in Table 1.

The following were excluded from the study: pre-gestational/overt diabetes (type 1 or type 2 diabetes mellitus), history of intake of drugs that can affect glucose metabolism (e.g., steroids, beta agonists), history of long term medical or surgical condition that can affect glucose metabolism (e.g., post-pancreatectomy, acromegaly, Cushing's syndrome), multiple gestation and perinatal death in the most recent pregnancy (Table 1).

Table 1. Criteria for diagnosing gestational diabetes mellitus and overt diabetes in pregnancy

	IADPSG[a]	POGS[b]
Gestational diabetes[c]		
75 g OGTT[d]:		
Fasting plasma glucose, mg/dL	≥92	≥92
1-hour post-load plasma glucose, mg/dL	≥180	
2-hour post-load plasma glucose, mg/dL	≥153	≥140
Overt diabetes[c]		
Fasting plasma glucose, mg/dL	≥126	≥126
HbA1c, %	≥6.5	≥6.5
Random plasma glucose, mg/dL	≥200[e]	≥200[e]

[a] International Association of Diabetes and Pregnancy Study Groups
[b] Philippine Obstetrical and Gynecological Society
[c] Criteria for diagnosis entails at least one abnormal value
[d] Oral glucose tolerance test
[e] Plus confirmation with fasting glucose or HbA1c

Sample size calculation for 2 independent proportions assumed an estimated baseline follow-up rate of 20%. Stata version 13.0 sample size calculator was used to estimate the sample size. To detect a 15% absolute improvement in follow-up from 20% to 35%, with 80% power, at 95% confidence interval, 5% error, and accounting for 10% data loss inherent in SMS, the sample size needed was computed at 308.

Description of study procedure

All participants admitted for delivery who were referred to the Section of Endocrinology, Diabetes and Metabolism for co-management of GDM, were assessed for eligibility. The primary investigator obtained informed consent if they met the inclusion criteria.

Eligible participants were randomized to either usual care or SMS (in addition to usual care) groups. Randomization was carried out in a 1:1 ratio using a computer-generated random allocation sequence. Allocation of treatment was done by third party personnel, using sequential sealed opaque envelopes. The outcome assessor and primary physician were blinded to treatment allocations. Blinding of the participants was not possible due to the nature of the intervention. Baseline socio-demographic characteristics, GDM status and maternal and fetal outcomes were abstracted from inpatient records and written in data collection forms. Additional information not indicated in the inpatient records was obtained by interview by the primary investigator.

Study intervention

Prior to discharge, the usual care group received a 10-minute lecture on postpartum GDM care and a 75 g OGTT request form. Explicit instructions were given pertaining to the laboratory location and timing of testing at 6 to 12 weeks postpartum. Follow-up visit with test results was also advised.

In addition to the above usual care, the SMS group received twice a week SMS reminders. The SMS were sent at 4, 8 and 10 weeks after delivery: one SMS on a weekday (Wednesday) and one on a weekend (Saturday). The messages in Filipino language contained a short reminder on different aspects of GDM postpartum care

and reiteration of written instructions for follow-up (Appendix A). The participants were not required to reply to these reminders. The content of the SMS was derived from a discussion with an endocrinologist who is also a medical informatics specialist. The SMS were sent manually by the study investigators. The overall cost of sending the text messages for the 154 participants in the SMS group was PhP 924.00, equivalent to USD 17.74 to 19.67 based on the current exchange rate during the course of the study. No monetary incentive was given to the participants to avoid any effect on follow-up.

An independent outcome assessor evaluated the participants on clinic follow-up. The date and results of the OGTT were recorded. If the OGTT results were abnormal, the participant was referred to her respective endocrinologist for subsequent follow-up and intervention. At the end of the clinic consult, each participant was asked a survey question on why they came for follow-up (Appendix B). If the participant belonged to the SMS group, she was asked the number of SMS reminders received.

All the participants who did not follow-up at 12 weeks postpartum were contacted through voice call to answer the survey questions (Appendix B). Responses were recorded verbatim. If a participant could not be reached on the first call, SMS were sent and she was again contacted on a different day. At least 3 attempts at varied times and on different days were made to reach the participant. The patient was then listed as not contactable if any of the following were encountered: phone number cannot be completed as dialed, subscriber cannot be reached, phone number is unattended or out of coverage area, call ended or dropped, wrong number, or ringing but with no answer on all attempts.

Outcome assessment

The primary outcome was follow-up defined as a clinic visit within 12 weeks postpartum with 75 g OGTT results. The follow-up rate for each group was calculated as the number of participants who followed-up divided by total number of participants in the group multiplied by 100. Participants who did not come for follow-up or came for clinic visit after the 3-month time period were labeled as non-follow-up. Participants who did not bring an OGTT result on clinic visit were considered as follow up, given another OGTT request and advised to come back within the time period.

Responses to survey questions were examined and grouped for emerging themes, and then classified as self-reported barriers and facilitators to postpartum follow-up.

Data analysis

Descriptive analyses were performed and bivariate analyses were run by follow-up status. The percentages across independent variables by follow-up status were calculated. The significance of the main effects of the different independent variables on the follow-up status was determined by bivariate analysis using Mann-Whitney U test for continuous data, while chi-square and Fisher's exact tests were used to compare categorical data. Bivariate analysis was initially performed to have an idea of the nature of the strength of association of each independent variable and the outcome variable. A bivariate test resulting to a p value ≤0.25 was considered a candidate for the multivariable model. Multivariate logistic regression with backward selection strategy was then performed to determine the factors associated with follow-up, while taking into account all other associated factors. The significance level for removal of a variable in the model was 0.05. Risk ratios (RR), 95% confidence interval (CI), and p values were derived. All statistical analyses were performed using Stata 14 for Windows® (StataCorp LP, College Station, TX, USA). Outcome comparisons were made according to treatment allocation, on an intention-to-treat analysis.

RESULTS

Recruitment and participant flow

Recruitment was performed from April 2017 until March 2018 when the pre-specified sample size was reached. Follow-up of study outcomes was completed by June 2018. Out of the 336 participants assessed for eligibility, 28 were excluded. Twenty-four met different exclusion criteria: 12 had overt diabetes, 2 did not meet postpartum glucose cut-offs and were sent home on diabetes medication, 4 did not have a personal mobile phone, 4 had twin gestation in the index pregnancy, one had required long-term steroid treatment during the postpartum period for idiopathic thrombocytopenia, and one had neonatal death. There were 3 patients who did not give consent to participate, while another was excluded because of poor comprehension of instructions from a speech impediment (Figure 1).

Participants were randomized to either usual care (n=154) or SMS (n=154) groups. It was presumed that 151 participants received their text reminders. Three participants reported that no text reminders were received due to change of phone number, subscriber identity module (SIM) card malfunction and inability of mobile unit to receive SMS. A total of 81 (26.3%) participants could not be contacted at the end of the follow-up period [34 (22%) from the usual care group and 46 (30%) from the SMS group]. At the end of the study, these participants were considered as non follow-up, in accordance with an intention-to-treat analysis. During the follow up period, one participant died due to eclampsia in the immediate postpartum period.

Socio-demographic characteristics of included women

There were no significant differences in socio-demographic characteristics between the 2 groups. The mean age for both groups was 31 years. Approximately 60% of participants have college level education. The distribution of other demographic (monthly household income, employment status and parental status) and anthropometric characteristics [pre-pregnant weight and body mass index (BMI)] were similar in both groups (Table 2).

Perinatal factors

There were no significant differences in maternal factors between the groups . Antenatal 75 g OGTT results were available for 295 participants. The 13 patients without

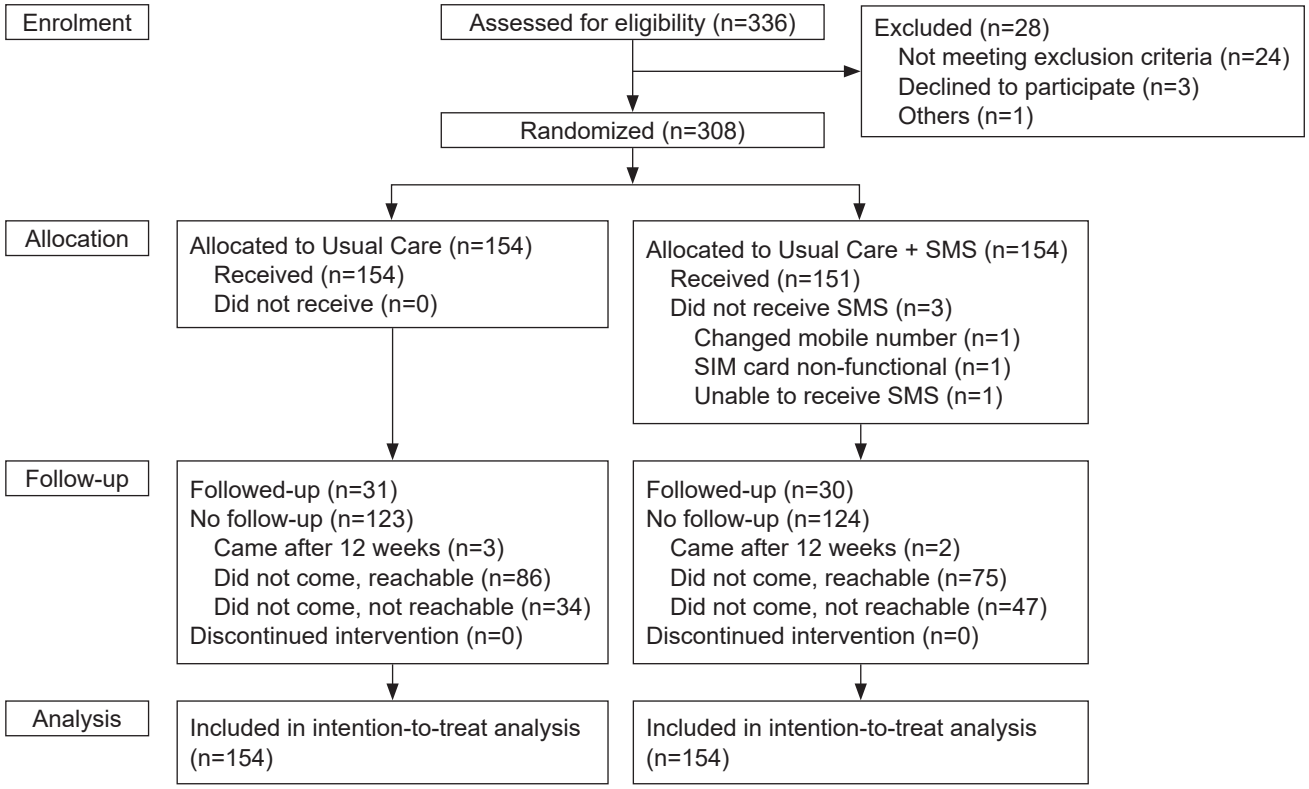

Figure 1. Participant flow diagram.

Table 2. Socio-demographic and anthropometric characteristics at trial entry

Characteristic	Total (n=308)	Usual care (n=154)	Usual care + SMS[a] (n=154)
Age in years (%)			
≤19	5 (1.6)	3 (1.9)	2 (1.3)
20-29	111 (36.4)	56 (36.4)	55 (35.7)
30-39	157 (51.0)	75 (48.7)	82 (53.2)
≥40	35 (11.4)	20 (13.0)	15 (9.7)
Mean age, year (SD[a])	31.6 (6.3)	31.5 (6.4)	31.7 (6.2)
Highest level of education (%)			
Secondary and below	122 (39.6)	58 (37.7)	64 (41.6)
College level and above	186 (60.4)	96 (62.3)	90 (58.4)
Employment status (%)			
Unemployed	189 (61.4)	98 (63.6)	91 (59.1)
Employed	119 (38.6)	56 (36.4)	63 (40.9)
Parental status (%)			
Single parent	15 (4.9)	7 (4.6)	8 (5.2)
With partner	293 (95.1)	147 (95.5)	146 (94.8)
Monthly household income[c] (%)			
Below minimum wage	112 (36.4)	59 (38.3)	53 (34.4)
Minimum wage and above	196 (63.6)	95 (61.7)	101 (65.6)
Mean pregestational weight, kg (SD)	56.1 (10.2)	56.6 (10.5)	55.7 (9.9)
Pregestational BMI BMI[d], kg/m^2 (%)			
Underweight	15 (4.9)	9 (5.8)	6 (3.9)
Normal	179 (58.1)	89 (57.8)	90 (58.4)
Overweight	90 (29.2)	44 (28.6)	46 (29.9)
Obese	24 (7.8)	12 (7.8)	12 (7.8)
Mean pregestational BMI[d], kg/m^2 (SD)	23.9 (4.1)	24.1 (4.1)	23.8 (4.2)

[a] SMS, short message service
[b] SD, standard deviation
[c] Based on the 2012 Family Income and Expenditure Survey, Philippine Statistics Authority
[d] BMI, body mass index

actual OGTT results on admission were physician-diagnosed and on active outpatient follow-up with an endocrinologist during their current pregnancy (Table 3).

More participants in the SMS group had a history of preterm delivery (3.9% in the usual care, 9.1% in the SMS groups). On the other hand, more participants in the usual care group delivered pre-term in the index pregnancy (19.5% in the usual care, 7.1% in the SMS groups). Consequently, a higher rate of neonatal hypoglycemia was recorded in the usual care compared to the SMS group (22.1% versus 13.6%, p=0.053) but this difference did not reach statistical significance. Birth weights and neonatal ICU admissions were similar in both groups (Table 3).

Table 3. Maternal factors at trial entry

Factor	Total (n=308)	Usual care (n=154)	Usual care + SMS[a] (n=154)
GDM [b] control (%)			
Diet	256 (83.1)	125 (81.2)	131 (85.1)
Insulin/metformin	52 (16.9)	29 (18.8)	23 (14.9)
Gravidity (%)			
Primigravid	86 (27.9)	48 (31.2)	38 (24.7)
Multigravid	222 (72.1)	106 (68.8)	116 (75.3)
Past obstetric history (%)			
GDM [b]	13 (4.2)	9 (5.8)	4 (2.6)
Preterm delivery	20 (6.5)	6 (3.9)	14 (9.1)
Abortion/stillbirth	68 (22.1)	31 (20.1)	37 (24.0)
Macrosomia[c]	15 (4.9)	7 (4.6)	8 (5.2)
Neonatal death	13 (4.2)	6 (3.9)	7 (4.6)
Gestational hypertension	21 (6.8)	8 (5.2)	13 (8.4)
Other past medical history (%)	91 (29.6)	45 (29.2)	46 (29.9)
Smoking (%)	14 (4.6)	8 (5.2)	6 (3.9)
Family history of diabetes[d] (%)	110 (35.7)	58 (37.7)	52 (33.8)
Breastfeeding (%)	307 (99.7)	153 (99.4)	154 (100.0)
Mode of delivery[e] (%)			
Spontaneous or assisted vaginal delivery	142 (46.1)	75 (48.7)	67 (43.5)
Caesarean section	166 (53.9)	79 (51.3)	87 (56.5)
Neonatal Outcomes[f] (%)			
Gestational age at birth			
Preterm	41 (13.3)	30 (19.5)	11 (7.1)
Full term	267 (86.7)	124 (80.5)	143 (92.9)
Birthweight			
Small for gestational age	9 (2.9)	5 (3.2)	4 (2.6)
Appropriate for gestational age	286 (92.9)	142 (92.2)	144 (93.5)
Large for gestational age	13 (4.2)	7 (4.6)	6 (3.9)
Neonatal hypoglycemia	55 (17.9)	34 (22.1)	21 (13.6)
Neonatal intensive care unit admission	80 (26.0)	44 (28.6)	36 (23.4)

[a] SMS, short message service
[b] GDM, gestational diabetes mellitus
[c] Neonatal death in previous pregnancies (excluding current/index pregnancy)
[d] Limited to first-degree relatives
[e] Pertains to index pregnancy
[f] Definitions are based on guidelines used by Department of Pediatrics, Section of Neonatology, Philippine General Hospital

Table 4. Postpartum follow-up rates and glucose status

Outcome	Total	Usual care	Usual care + SMS[a]
Follow-up status (%)	(n=308)	(n=154)	(n=154)
Follow-up	61 (19.8)	31 (20.1)[b]	30 (19.5)[b]
No follow-up	247 (80.2)	123 (79.9)	124 (80.5)
Postpartum glucose status (%)	(n=66)	(n=34)	(n=32)
Normal	42 (63.6)	24 (70.6)	18 (56.2)
IFG[c]	11 (16.7)	3 (8.8)	8 (25.0)
IGT[d]	6 (9.1)	2 (5.9)	4 (12.5)
IFG[c] + IGT[d]	2 (3.0)	1 (2.9)	1 (3.1)
Type 2 DM[e]	3 (4.6)	2 (5.9)	1 (3.1)
Unknown	2 (3.0)	2 (5.9)	0 (0)

[a] SMS, short message service
[b] p=0.886
[c] IFG, impaired fasting glucose
[d] IGT, impaired glucose tolerance
[e] DM, diabetes mellitus

Postpartum follow-up and glucose status

A total of 66 participants came for postpartum visit, resulting to an overall follow-up rate of 19.8%. Five participants (3 from the usual care and 2 from the SMS groups) came after the prescribed 6 to 12 week postpartum period and were then considered as non-follow-up. The difference in follow-up rates between groups was not statistically significant (Table 4).

Among those who were able to return for follow-up, 42 (63.6%) had normal glucose status. Nineteen (28.8%) had pre-diabetes, with impaired fasting glucose (IFG) as the most common condition (11 participants, 16.7%). Type 2 DM was newly diagnosed in 3 (4.6%) participants. Two (3%) had unknown glycemic status because the postpartum OGTT was not done at that time of clinic visit (Table 4).

The study was only powered to detect a difference in the follow-up rates between the usual care and SMS groups. The factors associated with follow-up were explored nonetheless to better characterize our population of GDM patients. A bivariate analysis was done to determine the association of demographic and maternal characteristics, including clinical and neonatal outcomes and follow-up (Appendix C). Participants were more likely to come for postpartum follow up if they were older, had a monthly household income at or above minimum wage, and used insulin or metformin for glycemic control during pregnancy. After adjusting for these factors, the addition of SMS to usual care did not increase follow up after 12 weeks postpartum (adjusted RR 0.98, 95% CI 0.63-1.52; p=0.932). Patients who used insulin or metformin during pregnancy were twice more likely to follow-up after delivery (adjusted RR 1.92, 95% CI 1.20-3.07; p=0.006) (Table 5).

Table 5. Logistic regression analysis of factors associated with follow-up

	Unadjusted RR[a] (95% CI[b])	*p* value	Adjusted RR[a] (95% CI[b])	*p* value
Study group				
Usual care	1.00 (reference)		1.00 (reference)	
Usual care + SMS[c]	0.97 (0.62-1.52)	0.886	0.98 (0.63-1.52)	0.932
Monthly household income				
Below minimum wage	1.00 (reference)		1.00 (reference)	
Minimum wage and above	1.48 (0.89-1.06)	0.132	1.37 (0.82-2.27)	0.218
Age	1.02 (0.99-1.06)	0.213	1.01 (0.97-1.05)	0.446
GDM[d] control				
Diet	1.00 (reference)		1.00 (reference)	
Insulin/metformin	2.06 (1.30-3.27)	0.002	1.92 (1.20-3.07)	0.006

[a] RR, relative risk
[b] CI, confidence interval
[c] SMS, short message service
[d] GDM, gestational diabetes mellitus

Because of the significant number of participants who did not follow-up, a post hoc per protocol analysis was performed, excluding 34 patients from the usual care group and 47 from the SMS group who were unreachable at the end of 12 weeks (Appendix D). The results were similar in both intention-to-treat and per-protocol analyses.

Self-reported barriers and facilitators for postpartum follow-up

The participants who came for postpartum reassessment were asked about their reasons for follow-up. The most common reason cited by the responders (n=66) was the need to to know their glucose status after pregnancy. Among those who did not follow-up, most reported child care difficulties as the reason for not returning for clinic visit. Table 6 cites the themes identified as facilitators and barriers for follow-up based on open-ended responses.

Table 6. Identified barriers and facilitators to follow-up

Themes	n
Facilitators	
Desire to know the outcome of blood sugar test results after pregnancy/desire to get better	47
Prevent diabetes	14
Obtain more information on diabetes	13
Monitor health condition/control diabetes	6
Doctor/advice from the doctor	4
Personal safety	3
One's self and/or family	3
Having prior gestational diabetes	2
Fear of outcome of diabetes	2
Text reminder	1
Given laboratory request	1
Keeping one's word/promise to return for follow-up	1
Barriers	
Child care difficulties	
No one to care for baby	
Unable to bring baby with her for follow-up	
Cannot leave home because of other children	50
Sick baby	
Baby too young to be brought out of the house	
Breastfeeding	
Transfer of residence, temporarily or permanently leaving Metro Manila	
Work	
Returned to work	37
Busy with work	27
No leave allowed	
Clinic schedule in conflict with work schedule	
Limited finances	
No budget for OGTT[a]	
Resources allotted for baby	24
No funds for follow-up (including fare and food during clinic visit)	
Patient got sick	
Postpartum depression	6
Caesarean section surgical site infection	
Other postpartum and puerperal complications	
Long distance from clinic location/long commute	
Followed-up with another physician/in another center or clinic nearer to home or work place	6 5
Bad weather	4
Patient forgot	4
Need to care for sick relative	2
Lost laboratory request/no OGTT[a] done yet	2
Unable to fast	2
Fear of fasting while breastfeeding	
Inadequate fasting	
Patient died	1
Wrong number	1

[a] OGTT, oral glucose tolerance test

DISCUSSION

The results indicate that SMS reminders in addition to usual care did not improve follow-up among GDM patients at 12 weeks postpartum in our center. In addition, the postpartum testing rates were suboptimal (<50%) for both groups. We found that the use of insulin or metformin for GDM control was significantly associated with higher follow-up rate, among the various factors examined. Identification of self-reported facilitators and barriers to follow-up gave us an overall context of the suboptimal outcome of postpartum follow-up in our setting.

Our findings are similar to the results of the DIAMIND study. The investigators reported that SMS reminders did not increase postpartum OGTT, fasting plasma glucose or HbA1c completion, despite a higher overall screening rate of 82%. This was attributed to the concurrent receipt of postal reminders under the national reminder scheme and an OGTT recommendation in the follow-up treatment plan.[17] The findings of a study done in an Asian population reported a better follow-up rate in contrast to our study, at 66.6 to 94.9%, after being recalled by SMS reminder, phone call or invitation to join in studies.[12] A high follow-up rate was reported by Malong in a similar Filipino cohort, possibly attributable not only to persistent SMS or call reminders, but also because the cost of OGTT was free for the patients.[3] While employing a reminder system similar to the aforementioned studies, we investigated the effect of SMS reminders alone, without any concurrent reminder system or monetary incentives that may have affected the rate of follow-up. Another difference is that all of the studies had considerably longer follow-up duration of up to a mean of 22.8 months.[3,12,17] Our trial specified follow-up within the recommended 6 to 12 weeks postpartum. This may possibly coincide with the period of adjustment

to new parenting roles, which took precedence over postpartum follow-up, regardless of an SMS reminder. This was also observed in a study on a South Asian population in Australia. Although majority of the women were aware of the importance of OGTT screening, they struggled with the lack of support in the immediate postpartum period, and many were unable to attend for routine OGTT screening at 6 weeks postpartum leading to postponement of testing.[18] While SMS may seem like a simple platform to employ behavioral intervention, it may not be the case for this particular subset of patients.

The open-ended responses to the survey questions provided insight into the reasons for lack of follow-up. Logistics such as child care difficulties, work and transfer of residence were identified by the participants as the most common reasons for non-follow-up. From those who were unable to return for follow-up, 5 patients had attended postpartum consult in a center within closer proximity to their home or workplace. Financial limitation was cited as the fourth most common reason for non-follow-up based on the survey. Postpartum follow-up is not covered by PhilHealth, our national social insurance program, making it an out-of-pocket expense. Follow-up visits possibly take a low priority in resource allocation for some individuals. These concerns come into play in any behavioral outcome and may have played a major role in the low overall follow-up rates. These barriers to follow-up cannot be addressed by any reminder system alone.

Another technology-based consideration is that about 26.3% of our participants were deemed not reachable by the end of the study period. Our pre-specified data loss at 10% may have underestimated real life attrition among those receiving SMS intervention in our setting.

The use of insulin or metformin for GDM control was significantly associated with higher follow-up in our trial. Apart from the additional intervention of medication use, these women are compelled to come for more regular antepartum follow-up particularly for medication adjustment and monitoring. This may have allowed for more physician-patient interaction and more opportunities to make the patients aware of their condition and the implications on their health, as opposed to their diet-only counterparts. This factor, along with older age, nulliparity and higher income or education, were identified to be predictors of higher follow-up rates in a review by Tovar.[6] With the exception of nulliparity, we also found the same factors to be associated with higher follow-up based on bivariate analysis.

Identification and description of self-reported facilitators and barriers to postpartum follow-up gave us an overall context of the low rate of follow up in our setting. We observed that follow-up was not mechanistic, in that the addition of reminders does not necessarily result to better rates of postpartum follow-up.

We also noted that the results of early postpartum glucose profiles in our study are similar to the rate of early postpartum glucose status in Asian countries. These studies observed incidences of 3.9 to 41.8% for prediabetes, and 2.8 to 20.6% for overt diabetes within 12 weeks postpartum.[3,11] Postpartum glucose abnormalities in our trial may have been under-reported, given a follow-up rate of only 19.8%.

Limitations and Recommendations

As a public tertiary referral center, the patients seen in our institution belong mostly to lower income brackets. Majority of our referrals came from service consults in the Department of Obstetrics and Gynecology. Fewer than 10% of patients came from the private wards, making higher income brackets less represented in our cohort. Future studies may look into better income bracket representation, especially because follow-up is an out-of-pocket expense for our patients.

Improved SMS intervention design aimed at making messages more engaging and persuasive should be a consideration for similar projects in the future. Personalized messages and a two-way versus a one-way SMS design may be more effective, as this allows for more interaction and versatility.[19,20] Quantification of the actual effect of the SMS intervention is difficult to ascertain and remains a limitation of technology-based intervention.

We were not able to contact 26.3% of the participants by the end of the study period. Although no difference in results were seen statistically when this group was excluded from analysis, this remains a significant percentage of the study population. Because we had no control over data loss, a higher attrition rate may be considered in future study designs involving SMS interventions. In addition, other social media platforms which may be more engaging and persuasive, such as a closed Facebook group for GDM patients, can be explored in future studies. Apart from looking for adjunctive methods to increase follow-up, we recommend expanding the sample size to better delineate socio-cultural-economic factors that affect follow-up in our setting, as these were some of the self-reported barriers and facilitators to follow-up. This is the first study in our setting which aimed to identify possible predictors of postpartum follow-up.

The postpartum stage is indeed a challenging period, as can be surmised from the survey responses of the participants. Strategies to make postpartum follow-up universal, more accessible, more affordable and closer to local hospitals and health centers may serve to improve overall follow-up rates. Simplifying postpartum follow-up by incorporating pediatric, obstetric and medical follow up in a single clinic within the same schedule may be a viable option for future healthcare systems planning.

CONCLUSION

SMS reminders did not improve postpartum follow-up rate among GDM patients at 12 weeks postpartum in our setting. Among the factors examined, the use of insulin or metformin was independently associated with increased follow-up rate. Strategies addressing accessibility and affordability of postpartum care may serve to improve overall follow-up rates.

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Statement of Authorship
All authors certified fulfillment of ICMJE authorship criteria.

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APPENDICES

Appendix A. Teaching material and short message service content

Teaching material	Short message service
Ito ang ABCDEF *ng* GDM *pagkapanganak.* (This is the ABCDEF of GDM after delivery.)	
Assessment: *Ang mga nagka*-GDM *ay pwedeng magka*-diabetes. *Anim sa 10 na may* GDM *ay pwedeng magkadiabetes sa loob ng 10 taon. Samakatuwid, mainam na magpakonsulta pagkapanganak.* *Magpasuri ng* 75 g OGTT *at mag* follow-up *6 hanggang 12 linggo pagkapanganak.* (**Assessment**: Persons who have had GDM may have diabetes. Six out of 10 persons who had GDM may have diabetes in the next 10 years. Therefore, it is good to seek consult after delivery. Have a 75 g OGTT done and follow-up 6 to 12 weeks after delivery.)	Sender: PGH OPD DIABETES CLINIC *Ang mga nagka*-GDM *ay pwedeng magka*-diabetes. *Mag-* follow-up *6-12 na linggo pagkapanganak. Dalhin ang resulta ng 75* g OGTT *sa* Medicine Academic Complex Monday 8am. (Persons who have had GDM may have diabetes. Follow-up 6 to 12 weeks after delivery. Bring your 75 g OGTT results to the Medicine Academic Complex Monday 8am.)
Breastfeeding: *Pwedeng makaiwas sa* diabetes *ang pagpapasuso.* *Bukod sa benepisyo ng* breastmilk *sa sanggol, ang breastfeeding ay nagbubunga ng mas mababang peligro ng pagkakaroon ng patuloy na abnormal na blood sugar sa ina.* *(***Breastfeeding**: Breastfeeding may help prevent diabetes. Aside from the benefits of breastmilk to the newborn, breastfeeding may confer a lower risk of persistently elevated blood sugar to the nursing mother.)	Sender: PGH OPD DIABETES CLINIC *Pwedeng makaiwas sa* diabetes *ang pagpapasuso. Mag-*follow-up *6-12 na linggo pagkapanganak. Dalhin ang* 75 g OGTT result *sa* Medicine Academic Complex Monday 8am. (Breastfeeding may help prevent diabetes. Follow-up 6 to 12 weeks after delivery. Bring your 75 g OGTT results to the Medicine Academic Complex Monday 8am.)
Contraception: *Mag-agwat ng pagbubuntis para di magka*-diabetes*. Magplano ng pamilya. Ang magkasunod na pagbubuntis ay nagbubunga ng 3x mas mataas na peligro ng* diabetes *sa ina.* *(***Contraception**: Provide sufficient time in between pregnancies to avoid diabetes. Practice family planning. Consecutive pregnancies confer a threefold increase in the risk of diabetes in the mother.)	Sender: PGH OPD DIABETES CLINIC *Mag-agwat ng pagbubuntis para di magka*-diabetes*. Mag-*follow-up *6-12 na linggo pagkapanganak. Dalhin ang* 75 g OGTT result *sa* Medicine Academic Complex Monday 8am. (Provide sufficient time in between pregnancies to avoid diabetes. Follow-up 6 to 12 weeks after delivery. Bring your 75 g OGTT results to the Medicine Academic Complex Monday 8am.)
Diet: *Sundin ang tamang* diet *para makaiwas sa* diabetes. *Ang tamang* diet *ay kaugnay ng mas mababang panganib ng pagkakaroon ng* diabetes *sa hinaharap.* (**Diet**: Eat a proper diet to avoid diabetes. A proper diet is linked to a lower risk of developing diabetes.)	Sender: PGH OPD DIABETES CLINIC *Sundin ang tamang* diet *para makaiwas sa* diabetes. *Mag-*follow-up *6-12 na linggo pagkapanganak. Dalhin ang* 75 g OGTT result *sa* Medicine Academic Complex Monday 8am. (Eat a proper diet to avoid diabetes. Follow-up 6 to 12 weeks after delivery. Bring your 75 g OGTT results to the Medicine Academic Complex Monday 8am.)
Ehersisyo*:* *Mag-ehersisyo para pumayat at makaiwas sa* diabetes. *Ang* regular *na ehersisyo ay makatutulong sa panunumbalik sa tamang timbang at panatilihing malusog ang pangangatawan.* (**Ehersisyo**: Exercise to lose weight and prevent diabetes. Regular exercise helps revert to proper weight and maintain health.)	Sender: PGH OPD DIABETES CLINIC *Mag-ehersisyo para pumayat at makaiwas sa* diabetes*. Mag-follow-up 6-12 na linggo pagkapanganak. Dalhin ang* 75 g OGTT result *sa* Medicine Academic Complex Monday 8am. (Exercise to lose weight and prevent diabetes. Follow-up 6 to 12 weeks after delivery. Bring your 75 g OGTT results to the Medicine Academic Complex Monday 8am.)
Family: *Kailangan ang suporta ng pamilya para iwas* diabetes. *Upang maayos na maisagawa ang* **ABCDEF *ng* GDM,** *hikayating ang suporta ng pamilya.* **Family**: Family support is needed to prevent diabetes. To help follow the **ABCDEF of GDM,** enlist the support of your family.	Sender: PGH OPD DIABETES CLINIC *Kailangan ang suporta ng pamilya para iwas* diabetes. Follow-up *6-12 na linggo pagkapanganak. Dalhin ang* 75 g OGTT result *sa* Medicine Academic Complex Monday 8am. (Family support is needed to prevent diabetes. Follow-up 6 to 12 weeks after delivery. Bring your 75 g OGTT results to the Medicine Academic Complex Monday 8am.)

Appendix B. Survey Questions

	Usual Care	Usual Care + SMS
Follow-up	*Ano po ang nag-udyok na inyo na mag*-follow-up*?* (What motivated you to return for follow-up?)	*Ano po ang nag-udyok na inyo na mag*-follow-up*?* *Natanggap niyo po ba ang mga paalala sa* text messages*?* *Ilang paalala po ang inyong natanggap?* (What motivated you to return for follow-up? Did you receive the SMS reminders? How many reminders did you receive?)
No follow-up	*Ano po ang mga dahilan kung bakit hindi kayo nakabalik para sa* follow-up*?* (What are your reasons for not being able to return for follow-up?)	*Ano po ang mga dahilan kung bakit hindi kayo nakabalik para sa* follow-up*?* *Natanggap niyo po ba ang mga paalala sa* text messages*?* *Ilang paalala po ang inyong natanggap?* (What are your reasons for not being able to return for follow-up? Did you receive the SMS reminders? How many reminders did you receive?)

Appendix C. Bivariate analysis of factors associated with follow-up

Characteristic	Total (n=308)		With follow-up (n=61)		No follow-up (n=247)		*p* value
	n or mean	%	n or mean	% within category	n or mean	% within category	
Study group							
Usual care	154	50.0	31	20.1	123	123	
Usual care + SMS[a]	154	50.0	30	19.5	124	124	0.886[b]
Age in years							
≤19	5	1.6	1	20.0	4	80.0	
20-29	111	36.0	16	14.4	95	85.6	
30-39	157	51.0	36	22.9	121	77.1	
≥40	35	11.4	8	22.9	27	77.1	
Mean age, year (SD[c])	31.6 (6.3)		31.4 (6.3)		32.5 (6.0)		
Meadian age, year	32.0		31.0		33.0		0.150[d]
Highest level of education (%)							
Secondary and below	122	39.6	21	17.2	101	82.8	
College level and above	186	60.4	40	21.5	146	78.5	0.384[e]
Employment status (%)							
Unemployed	189	61.4	37	19.6	152	80.4	
Employed	119	38.6	24	20.2	95	79.8	0.899[b]
Parental status (%)							
Single parent	15	4.9	3	20.0	12	80.0	
With partner	293	95.1	58	19.8	235	80.2	0.985[b]
Monthly household income[d] (%)							
Below minimum wage	112	36.4	17	15.2	95	84.8	
Minimum wage and above	196	63.6	44	22.4	152	77.6	0.124[b,k]
Mean pregestational BMI[f], kg/m^2 (SD[c])	23.9 (4.1)		23.9 (3.6)		23.9 (4.2)		
Median pregestational BMI[f], kg/m^2	23.4		23.4		23.3		0.832[d]
Pregestational BMI[f], kg/m^2							
Underweight	15	4.9	2	13.3	13	86.7	
Normal	179	58.1	32	17.9	147	82.1	
Overweight	90	29.2	24	26.7	66	73.3	
Obese	24	7.8	3	12.5	21	87.5	0.282[e]
Basis of diagnosis							
IADPSG[h]	242	78.6	46	19.0	196	81.0	
POGS[i]	53	17.2	11	20.8	42	79.2	0.771
GDM[j] control							
Diet	256	83.1	43	16.8	213	83.2	
Insulin/Metformin	52	16.9	18	34.6	34	65.4	0.003[k]
Gravidity							
Primigravid	86	27.9	17	19.8	69	80.2	
Multigravid	222	72.1	44	19.8	178	80.2	0.992
Presence of any obstetric history							
Yes	108	35.1	21	19.4	87	80.6	
No	200	64.9	40	20.0	160	80.0	0.907[b]
Other past medical history							
Yes	91	29.6	19	20.9	72	79.1	
No	217	70.4	42	19.4	175	80.6	0.759[b]
Smoking							
Yes	14	4.6	1	7.1	13	92.9	
No	294	95.4	60	20.4	234	79.6	0.317[e]
Family history of diabetes							
Yes	110	35.7	24	21.8	86	78.2	
No	198	64.3	37	18.7	161	81.3	0.509[b]
Mode of delivery							
Spontaneous/assisted vaginal delivery	142	46.1	32	22.5	110	77.5	
Caesarean section	166	53.9	29	17.5	137	82.5	0.266[b]
Gestational age at birth							
Preterm	41	13.3	9	22.0	32	78.0	
Full term	267	86.7	52	19.5	215	80.5	0.711
Birthweight							
Small for gestational age	9	2.9	1	11.1	8	88.9	
Appropriate for gestational age	286	92.9	58	20.3	228	79.7	
Large for gestational age	13	4.2	2	15.4	11	84.6	0.916[e]
Neonatal hypoglycemia							
Yes	55	17.9	11	20.0	44	80.0	
No	253	82.1	50	19.8	203	80.2	0.968[b]
Neonatal intensive care unit admission							
Yes	80	26.0	15	18.8	65	81.2	
No	228	74.0	46	20.2	182	79.8	0.783[b]

[a] SMS, short message service
[b] Chi-square test
[c] SD, standard deviation
[d] Mann-Whitney test
[e] Fisher's exact test
[f] BMI, body mass index
[g] Fisher's exact test
[h] IADPSG, International Association of Diabetes and Pregnancy Study Groups
[i] POGS, Philippine Obstetrical and Gynecological Society
[j] GDM, gestational diabetes mellitus
[k] Included in multiple logistic regression analysisDM, gestational diabetes mellitus

Appendix D. Logistic regression analysis of factors associated with follow-up, per protocol analysis, n=227

Variable	Unadjusted association		Adjusted association	
	RR[a] (95% CI[a])	*p* value	RR[a] (95% CI[a])	*p* value
Study group				
Usual care	1.00 (reference)		1.00 (reference)	
Usual care + SMS[b]	1.08 (0.70-1.66)	0.708	1.09 (0.71-1.67)	0.689
Education				
Secondary and below	1.00 (reference)		1.00 (reference)	
College level and above	1.34 (0.85-2.12)	0.203	1.19 (0.75-1.90)	0.452
Monthly household income				
Below minimum wage	1.00 (reference)		1.00 (reference)	
Minimum wage and above	1.38 (0.84-2.25)	0.195	1.23 (0.75-2.04)	0.402
Age, year	1.02 (0.99-1.06)	0.154	1.02 (0.98-1.06)	0.204
GDM[c] control				
Diet	1.00 (reference)		1.00 (reference)	
Insulin/metformin	1.79 (1.15-2.77)	0.009	1.61 (1.04-2.51)	0.032
Mode of delivery				
Spontaneous/assisted vaginal delivery	1.00 (reference)		1.00 (reference)	
Caesarean section	0.75 (0.49-1.15)	0.195	0.70 (0.46-1.07)	0.108

[a] CI, confidence interval
[b] SMS, short message service
[c] GDM, gestational diabetes mellitus
[d] Mann-Whitney test
[e] Fisher's exact test
[f] BMI, body mass index