



Effectiveness of a safe model–based health education intervention for self-management of gestational diabetes mellitus

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ABSTRACT

Objective: To evaluate the effectiveness of a SAFE model–based health education intervention for self-management of gestational diabetes mellitus (GDM) among pregnant women at Da Nang Family General Hospital. **Subjects and methods:** A cross-sectional descriptive study was conducted on 119 patients with gestational diabetes treated at Da Nang Family General Hospital using a structured questionnaire from March to August 2025. The SAFE model at the hospital included face-to-face health education counseling, leaflet distribution, and telephone counseling. Treatment adherence was assessed before the intervention and at 1 and 2 months after the intervention. **Results:** Before intervention, the average treatment adherence score was 14.6 ± 2.1 out of 25, with a treatment adherence rate of 87.4%. At one month after intervention, the mean score increased to 15.8 ± 1.9 , with a treatment adherence rate of 91.6% ($p < 0.05$). At two months after intervention, the average mean score increased to 17.6 ± 1.7 ($p > 0.05$), with a treatment adherence rate of 100%. **Conclusion:** The SAFE model was associated with improved treatment adherence among patients with GDM. The programme should be maintained, its content strengthened, and multiple health education and counselling approaches combined.

Keywords: Gestational diabetes mellitus, treatment adherence, health education intervention.

INTRODUCTION

Gestational diabetes mellitus (GDM) is a condition characterised by glucose intolerance with onset or first recognition during pregnancy. Distinct from overt diabetes, GDM remains a well-established predictor of adverse obstetric outcomes¹. Globally, the American Diabetes Association estimates the prevalence of GDM to range between 1% and 14% among pregnant women². In Vietnam, this rate varies considerably from 3.6% to 39.0%,³

with epidemiological trends indicating a significant surge from 3.9% in 2004 to 20.9% in 2017⁴. The clinical implications of GDM are profound; it elevates the risk of perinatal complications such as miscarriage, stillbirth, preterm birth, gestational hypertension, polyhydramnios, urinary tract infections, and caesarean section. Furthermore, women with a history of GDM face a substantially higher long-term risk of developing type 2 diabetes and subsequent cardiovascular morbidities⁵.

The cornerstone of GDM management lies in lifestyle modifications, primarily through dietary optimization and physical activity, which can often maintain euglycaemia without pharmacotherapy. However, initiating and sustaining these behavioural changes remains a formidable challenge. Inadequate adherence to lifestyle regimens is a primary catalyst for suboptimal glycaemic control, whereas effective mitigation of risk factors significantly reduces disease burden, hospitalisation rates, and healthcare costs ^{6, 7}. The SAFE model have been developed to structure these behaviours by focusing on antenatal monitoring, diet, and physical activity. Unfortunately, limited health literacy and inadequate provider-patient communication frequently impede effective self-management ⁷. Given the robust evidence supporting the efficacy of nutritional and exercise interventions for blood glucose regulation ^{8, 9}, targeted nursing interventions are crucial. Structured health education led by nurses is essential to enhance patients' understanding of GDM, reinforce the necessity of treatment adherence, and mitigate the consequences of non-adherence ¹⁰.

To optimize maternal and fetal outcomes, Da Nang Family General Hospital has adopted the SAFE model for GDM management. Despite its implementation, there is a paucity of empirical evidence evaluating self-management outcomes and the model's true clinical efficacy within this specific population. Addressing this knowledge gap is necessary to determine the extent of patient adherence to GDM treatment protocols and to ascertain whether targeted health education can significantly improve these behavioural metrics. Therefore, this study aimed to evaluate the

effectiveness of a SAFE model-based health education intervention in enhancing self-management behaviours among pregnant women diagnosed with GDM at Da Nang Family General Hospital.

METHODS

Study design and setting

A one-group pretest-posttest quasi-experimental design was employed. The study was conducted from February to June 2025 at the Endocrinology and Diabetes Center of Da Nang Family General Hospital, Vietnam.

Participants and sampling: The target population comprised pregnant women newly diagnosed with gestational diabetes mellitus (GDM).

Inclusion criteria were: (1) aged 18 years or older; (2) first-time diagnosis of GDM at the initial prenatal examination, based on the 2018 Vietnamese Ministry of Health criteria; (3) physical and mental capacity to participate; and (4) willingness to provide written informed consent.

Patients were excluded if they presented with pre-gestational diabetes, fetal or placental abnormalities, malignancies, severe medical or surgical comorbidities, psychiatric illnesses, severe communication barriers, contraindications to physical exercise, or clinical indications for insulin therapy at baseline.

Sample and sampling: The sample size was calculated to detect a difference in the proportion of patients practising self-management from an estimated baseline of 5% (p_0) to 20% post-intervention (p_1). Utilizing a two-sided test with a type I error rate of 5% ($Z_{1-\alpha/2} = 1.96$) and a statistical power of 90% ($Z_{1-\beta/2} = 1.28$), the

minimum required sample size was 96. Using consecutive sampling, eligible patients attending the clinic were recruited until a final sample of 119 participants was achieved.

Intervention protocol: The intervention utilized the SAFE (Self-monitoring, Activity, Food, and Education) model. Educational materials were developed in accordance with the national guidelines on GDM screening and management. The intervention consisted of two phases:

Initial Face-to-Face Education: Following baseline assessment, participants received a 45-minute individualized counselling session while awaiting laboratory results. Patients were provided with illustrated A4 educational leaflets to review for 5–10 minutes. A healthcare professional then conducted a focused interview to identify specific gaps in treatment adherence. Based on these insights, the provider delivered targeted guidance on disease management, healthy lifestyle modifications, and practical strategies to overcome barriers to home care.

Tele-counselling Follow-up: To reinforce adherence, weekly telephone or video calls via the Zalo application were scheduled during the first and second months post-intervention. Healthcare professionals conducted one call per week (up to 30 minutes each), totaling four sessions in the first month and eight sessions by the end of the second month. These sessions focused on the patients' progress, practical application of the recommendations, and resolving ongoing challenges. If a patient was unreachable, up to three additional attempts were made at varying times, supplemented by text messages to reschedule.

Instruments: Data were collected using a structured questionnaire comprising two sections: socio-demographic characteristics and GDM treatment adherence. The adherence scale assessed five behavioural domains: (1) dietary compliance, (2) physical activity, (3) lifestyle modifications, (4) home blood glucose monitoring, and (5) follow-up appointment attendance. The tool contained 20 items with a maximum achievable score of 25. Overall adherence was defined as achieving $\geq 50\%$ of the maximum score (≥ 13 points); scores below this threshold indicated non-adherence ¹¹.

Content validity was established by a panel of three GDM experts. The item-level content validity index (I-CVI) and the scale-level content validity index based on universal agreement (S-CVI/UA) were both 1.0, exceeding the rigorous thresholds of 0.78 and 0.80, respectively.

Data collection: Following institutional approval, eligible patients were screened and enrolled. Data collection occurred at three distinct time points. At baseline (T_0), prior to the intervention, the questionnaire was administered to assess initial lifestyle behaviours and outcome indicators (maternal blood glucose, fetal status, and patient weight). This 10-15-minute assessment was integrated into the patient's waiting period. Subsequent assessments utilizing the same instrument were conducted at one month (T_1) and two months (T_2) post-intervention. For patients who missed scheduled clinical appointments or transferred their antenatal care to other facilities, follow-up data were collected via telephone or Zalo, conditional upon their continued consent. Patients who remained unreachable after repeated attempts were classified as lost to follow-up and handled according to the study protocol.

Data analysis : Data were entered using EpiData version 3.1 and analyzed using SPSS version 20.0. Descriptive statistics, including frequencies, percentages, and means, were used to summarize participant characteristics and adherence levels. Changes in treatment adherence and clinical outcomes across the time points were evaluated using McNemar's test for categorical variables and the paired-samples t-test for continuous variables. Statistical significance was established at $p < 0.05$.

Ethical considerations: The study was approved by the Biomedical Research Ethics Committees of Nam Dinh University of Nursing and Da Nang Family General Hospital (Decision No. 361/QD-DDN, dated February 25, 2025). Participation was strictly voluntary, and written informed consent was obtained prior to enrollment. Participants retained the right to withdraw at any time without prejudice to their standard medical care. All data were anonymized to ensure strict confidentiality.

RESULTS

Table 1. Baseline demographic and clinical characteristics of participants (n = 119)

Characteristics		Frequency (n)	Percentage (%)
Age (years)	18 - 25	40	33.6
	26 – 30	20	16.8
	31 - 35	17	14.3
	≥ 36	42	35.3
	Mean $\pm$ SD (Min-Max)	30 $\pm$ 7.5 (Min: 18; Max: 45)	
Gestational age at enrollment (weeks)	≤ 12	27	22.7
	13-24	88	73.9
	≥ 25	4	3.4
Family history of diabetes	Yes	4	3.4
	No	115	96.6

As presented in Table 1, approximately one-third of the 119 pregnant women with GDM were aged 18–25 years (33.6%), with a mean age of 30.0 ± 7.5 years. At baseline, the majority of participants (73.9%) were in their second trimester (13–24 weeks of gestation), and nearly all (96.6%) reported no family history of diabetes.

Table 2. Mean treatment adherence scores across assessment time points

Assessment time	Score achieved			p-value (Paired-samples t-test)
	Minimum	Maximum	Mean $\pm$ SD	
Before intervention (T0)	9	19	14.6 $\pm$ 2.1	$p_{1-0} = 0.000$
One month after intervention (T1)	10	19	15.8 $\pm$ 1.9	
Two months after intervention (T2)	14	22	17.6 $\pm$ 1.7	$p_{2-0} = 0.229$

The mean treatment adherence score prior to the intervention was 14.6 ± 2.1 (out of a maximum of 25). At one month post-intervention, the mean score significantly increased to 15.8 ± 1.9 compared to baseline ($p < 0.001$). By the two-month follow-up, the mean score further increased to 17.6 ± 1.7 ; however, based on the statistical analysis provided, the difference between the two-month and baseline scores did not reach statistical significance ($p = 0.229$).

Table 3. Overall treatment adherence rates before and after the intervention

Adherence Status	Assessment time						p-value (McNemar test)
	Before intervention (T ₀)		One month after intervention (T ₁)		Two months after intervention (T ₂)		
	n	%	n	%	n	%	
Adherent (≥ 13 points)	104	87.4	109	91.6	119	100	p ₁₋₀ = 0.022
Non-adherent (< 13 points)	15	12.6	10	8.4	0	0	

Before the intervention, 87.4% of the participants met the criteria for overall treatment adherence. This proportion significantly improved to 91.6% at one-month post-intervention ($p = 0.022$). By the two-month follow-up, 100% of the study cohort demonstrated treatment adherence.

Table 4. Adherence to specific GDM management behaviours

		Before intervention (T ₀)		One month after intervention (T ₁)		Two months after intervention (T ₂)		p-value (McNemar test)
		n	%	n	%	n	%	
Dietary adherence	Adherent	109	91.6	117	98.3	115	96.6	$p_{1-0} = 1,000$
	Non-adherent	10	8.4	2	1.7	4	3.4	$P_{2-0} = 0.002$
Physical activity adherence	Adherent	97	81.5	100	84	105	88.2	$p_{1-0} = 0.000$
	Non-adherent	22	18.5	19	16	14	11.8	$P_{2-0} = 0.000$
Lifestyle modifications	Adherent	119	100	119	100	119	100	But
	Non-adherent	0	0	0	0	0	0	
Home blood glucose monitoring	Adherent	71	59.7	88	73.9	93	78.2	$p_{1-0} = 0.000$
	Non-adherent	48	40.3	31	26.1	26	21.8	$P_{2-0} = 0.000$
Follow-up appointments	Adherent	58	48.7	91	76.5	112	94.1	$p_{1-0} = 0.000$
	Non-adherent	61	51.3	28	23.5	7	5.9	$P_{2-0} = 0.013$

Before intervention, adherence was exceptionally high for lifestyle modifications (100%) and diet (91.6%), but notably lower for home blood glucose monitoring (59.7%) and regular follow-up appointment attendance (48.7%). At one month post-intervention, adherence rates improved across most domains; however, the increase in dietary adherence from baseline was not statistically significant ($p = 1.000$). By two months post-intervention, adherence rates for physical activity, home monitoring, and follow-up attendance demonstrated statistically significant improvements compared to baseline ($p < 0.05$).

Table 5. Relationship between treatment adherence and fasting blood glucose

Clinical Target	Before intervention (T ₀)		One month after intervention (T ₁)		Two months after intervention (T ₂)	
	Adherent	Non-adherent	Adherent	Non-adherent	Adherent	Non-adherent
Elevated FBG ($\geq$ 92 mg/dL)	104 (87.4)	15 (12.6)	68 (94.4)	4 (5.6)	24 (100)	0
Target FBG Achieved (< 92 mg/dL)	0	0	41 (87.2)	6 (12.8)	95 (100)	0

Before intervention, all 119 participants exhibited elevated fasting blood glucose levels (≥ 92 mg/dL). One month following the intervention, 47 participants successfully achieved the target FBG level (< 92 mg/dL), 41 of whom were in the adherent group. By the two-month follow-up, 95 participants achieved the target FBG range, all of whom demonstrated compliance with the GDM treatment regimen.

DISCUSSION

In this study, the mean maternal age was 30.0 years, with over one-third of the cohort (35.3%) aged 36 years or older. This demographic profile aligns with findings by Chau My Chi (2021)¹², who reported a comparable age distribution among patients with GDM. Advanced maternal age in the context of GDM warrants heightened clinical vigilance, as it exacerbates maternal and fetal vulnerabilities, increasing the risk of poor glycaemic control, caesarean delivery, neonatal respiratory distress, and perinatal mortality⁵.

The majority of participants (73.9%) were diagnosed during the second trimester (13–24 weeks of gestation). Notably,

96.6% of the cohort reported no family history of diabetes, representing a stark contrast to previous domestic studies where familial predisposition was more prevalent (e.g., 27.27% in Chau's cohort)¹². This finding underscores the imperative to comprehensively evaluate a broader spectrum of modifiable lifestyle and clinical risk factors when designing individualized educational interventions, rather than relying solely on genetic or familial predictors.

Baseline assessments revealed a mean treatment adherence score of 14.6 ± 2.1 , with 87.4% of the cohort classified as adherent. This proportion is substantially higher than the rates reported by Pigato et al. (2023)¹³, who observed full adherence in only 46.9%

of their 260-patient cohort. This discrepancy is likely attributable to methodological variations in adherence classification; while the present study utilized a dichotomous categorization (adherent vs. non-adherent), Pigato et al. employed a tripartite system. Future research should prioritize the standardization of adherence metrics to facilitate cross-study comparability.

Following the SAFE model-based health education intervention, adherence rates demonstrated progressive improvement. At one month post-intervention, the mean adherence score significantly increased to 15.8 ± 1.9 ($p < 0.05$), with 91.6% of participants achieving adherence. By the two-month follow-up, the adherence rate reached 100%, and the mean score peaked at 17.6 ± 1.7 . Although our statistical analysis indicated that the difference in mean scores between baseline and the two-month mark was not statistically significant, the universal achievement of the adherence threshold (100%) highlights the substantial clinical utility of the intervention. These findings advocate for the integration of continuous, multidimensional educational reinforcement to sustain long-term behavioural modifications.

At baseline, all 119 participants had GDM. One month after the intervention, 47 participants had achieved the target fasting blood glucose level, including 41 who met the adherence criterion and 6 who did not. At 2 months, 95 participants had achieved the target, and all 95 met the adherence criterion. These findings are consistent with Le Duc Cuong et al.¹⁴ (2023), who reported that 82.6% of pregnant women with GDM achieved glycaemic control after 2 weeks of lifestyle intervention at three hospitals in Thai Binh Province. Pham Thi Bao Yen¹⁵

(2018) also reported improved glucose stability with dietary restriction combined with physical activity among patients with GDM. Taken together, these studies support the role of lifestyle modification in glycaemic control during pregnancy.

CONCLUSION

This study demonstrates that a structured health education intervention based on the SAFE model is a highly effective strategy for improving self-management behaviours and clinical outcomes among pregnant women with GDM. The intervention yielded progressive improvements in overall treatment adherence, culminating in a 100% adherence rate and substantial gains in target fasting blood glucose attainment at two months post-intervention. These findings highlight the critical value of structured, nurse-led educational frameworks in mitigating the clinical burden of GDM.

IMPLICATIONS FOR CLINICAL PRACTICE

Based on these findings, it is recommended that healthcare facilities systematically assess treatment adherence and integrate structured, continuous health education into routine outpatient antenatal care for patients with GDM. Future educational initiatives should prioritize the most challenging behavioural domains identified in this population, specifically strict adherence to physical activity regimens and consistent home blood glucose monitoring, to ensure comprehensive and sustained disease management.

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