



Effect of a Nurse-Led Multimodal Intervention on Glycaemic Control among Primary Care Patients with Type 2 Diabetes: A Quasi-Experimental Study

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Abstract: Aims: This study sought to determine the impact of a nurse-led multimodal intervention on glycaemic control in patients with type 2 diabetes receiving care in a primary care setting. Methods: A quasi-experimental study was conducted involving 36 patients with type 2 diabetes attending primary care services, with 19 participants assigned to the intervention group and 17 to the control group. Patients in the intervention group received care from nurses using a structured multimodal intervention programme, while those in the control group continued with usual care. Glycaemic control was assessed using glycated haemoglobin (HbA1c) levels and glycaemic risk stratification before and after the intervention. Results: At four weeks, the intervention group demonstrated a mean reduction in HbA1c of 0.37%, whereas the control group showed a mean increase of 0.11%. In addition, 63% of participants in the intervention group showed improvement in glycaemic risk category, compared with 78% of control group participants who remained in the highest risk category. The greatest improvement was observed among patients with baseline HbA1c levels $\geq 8.0\%$. However, statistical significance values (e.g., p-values and effect sizes) were not reported in this study. Conclusions: In primary care settings, a nurse-led multimodal intervention was associated with improved glycaemic control among patients with type 2 diabetes. These findings suggest that structured nursing interventions may contribute to better diabetes management and risk stratification, particularly in patients with poor baseline glycaemic control.

Keywords: Glycaemic control; Health promotion; Nurse-led intervention; Primary care; Type 2 diabetes

Introduction

Type 2 diabetes mellitus (T2DM) remains a major contributor to morbidity and premature mortality worldwide and is increasingly prevalent in low- and middle-income countries, where primary healthcare systems often face substantial resource constraints (Ali et al., 2012; Ansari et al., 2016; Beaglehole et al., 2008; Chatterjee et al., 2017). A considerable proportion of patients fail to achieve adequate glycaemic control with current pharmacological therapies, thereby maintaining a high risk of both microvascular and macrovascular complications (Bannuru et al., 2024; Bodner et al., 2025;

Chen et al., 2025). Importantly, suboptimal treatment outcomes in primary care settings are frequently not solely attributable to a lack of medication (Christ et al., 2022; Fadli et al., 2025).

Primary care is the cornerstone of long-term management for most individuals with T2DM, particularly those with stable disease courses (Jacobs et al., 2024; Kivity et al., 2025; Kunutsor et al., 2024). However, in many healthcare settings, physician-centred care models are challenged by high patient volumes and limited consultation time, which restrict opportunities for structured education and behavioural support (Laffi et al., 2025; Li et al., 2025). Consequently,

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strengthening interprofessional collaboration and team-based care in primary care has been widely recognised as a feasible strategy to improve diabetes outcomes while maintaining system efficiency (Makhfudli et al., 2025; Naja et al., 2019; Nurchis et al., 2022; Okorobe et al., 2026).

In this context, nurse-delivered interventions have emerged as a promising approach to address gaps in routine diabetes care through the integration of education and behavioural support into everyday clinical practice (Powell et al., 2021; Powers et al., 2020; Pullyblank et al., 2025; Sadeghian et al., 2025; Sørensen et al., 2020; Sun et al., 2025; Zhou et al., 2018). Evidence from systematic reviews and meta-analyses suggests that nurse-led interventions can produce modest but statistically significant reductions in glycated haemoglobin (HbA1c), particularly when delivered in an individualised and multimodal format (Terathongkum et al., 2025; Tien et al., 2019). These interventions are aligned with the principles of Diabetes Self-Management Education and Support (DSMES) and the Chronic Care Model, which emphasise patient empowerment, self-efficacy, and proactive chronic disease management (Grant, 2016; Xue-juan et al., 2018; Zamanillo-Campos et al., 2025).

It is important to note that the effects of nurse-led interventions are not uniform across studies. Greater improvements are typically observed among patients with poorer baseline glycaemic control, whereas reliance on mean HbA1c changes alone may obscure clinically meaningful improvements in high-risk subgroups. Therefore, the inclusion of glycaemic risk stratification alongside mean HbA1c change has been recommended to provide a more comprehensive evaluation of intervention effectiveness (Okorobe et al., 2026).

Despite the growing evidence supporting nurse-led diabetes management, most existing studies have focused on longer-duration interventions or have primarily reported mean HbA1c changes without integrating short-term risk-based outcome evaluation in routine primary care settings. Moreover, relatively few studies have specifically examined brief, structured multimodal nursing interventions that combine education, behavioural support, and digital reinforcement within a real-world primary care context while simultaneously assessing both glycaemic outcomes and risk category shifts. This represents a critical gap in the literature, particularly in low-resource primary care settings where scalable and time-efficient interventions are needed.

The novelty of this study lies in its focus on a short-term (four-week) nurse-led multimodal intervention evaluated not only through changes in HbA1c, but also through glycaemic risk stratification, thereby providing a dual-perspective assessment of clinical effectiveness in

a real-world primary care setting. In this regard, the aim of this study was to evaluate the impact of a nurse-led multimodal intervention on glycaemic control and glycaemic risk distribution among patients with type 2 diabetes receiving primary care services.

Method

Study Design and Setting

This study employed a quasi-experimental pilot design with intervention and control groups. The study was conducted in a primary care clinic providing routine diabetes management services. This design was chosen to allow evaluation of the effectiveness of a pragmatic multimodal nursing intervention under real-world conditions without full randomization.

Participants

Eligible participants were adults aged ≥ 18 years with a confirmed diagnosis of type 2 diabetes mellitus and a baseline HbA1c of $\geq 7.0\%$. Exclusion criteria included pregnancy, severe cognitive impairment, medical instability, or current participation in another structured diabetes management programme.

A total of 36 participants were recruited. The intervention group consisted of 19 participants, and the control group consisted of 17 participants. Participants were allocated into groups using a non-randomized consecutive sampling approach based on clinic attendance and eligibility criteria. Written informed consent was obtained from all participants prior to enrolment.

Intervention

Participants in the intervention group received a four-week nurse-led multimodal programme delivered by trained nurse intervention specialists. The programme consisted of one weekly session (60–90 minutes per session) including diabetes education, individualized nutritional counselling, medication adherence support, and goal-setting strategies aligned with DSMES principles.

In addition, participants received brief digital follow-up messages between sessions to reinforce behavioural goals. The control group received usual care, consisting of routine physician consultations and medication management without structured educational or behavioural interventions.

Outcomes and Measures

The primary outcome was the change in glycated haemoglobin (HbA1c) from baseline to four weeks. Secondary outcomes included changes in glycaemic risk categories based on HbA1c thresholds ($<7.0\%$, $7.0\text{--}7.9\%$, and $\geq 8.0\%$).

It is acknowledged that HbA1c reflects average glycaemic control over approximately 2–3 months; therefore, the four-week follow-up primarily captures early trends in glycaemic change rather than full biological equilibrium response. Baseline demographic and clinical data were obtained from medical records and participant interviews.

Statistical Analysis

Given the small sample size and non-normal distribution of HbA1c values, non-parametric statistical tests were applied. Within-group comparisons were conducted using the Wilcoxon Signed-Rank Test, while between-group differences were analysed using the Mann-Whitney U Test. Changes in glycaemic risk categories were analysed using descriptive statistics and the chi-square goodness-of-fit test.

All analyses followed an intention-to-treat principle, including all enrolled participants in the final analysis. Statistical significance was set at $p < 0.05$, and analyses were performed using standard statistical software.

Ethical Considerations

The study protocol was reviewed and approved by the Ethics Committee of the Health Polytechnic of the Ministry of Health Palembang (Approval No: [insert ethical approval number here]). All procedures were

conducted in accordance with the Declaration of Helsinki. Confidentiality and anonymity of participant data were strictly maintained throughout the study.

Methodological Considerations

As a quasi-experimental pilot study, this research is subject to potential limitations related to internal validity, including selection bias and baseline differences between groups. The non-randomized allocation may also introduce confounding factors.

Furthermore, the short intervention duration (four weeks) is a significant limitation, as HbA1c reflects glycaemic control over a 2–3 month period. Therefore, observed changes should be interpreted as early response trends rather than definitive long-term glycaemic outcomes. Longer follow-up studies are required to assess sustained effects of the intervention.

Result and Discussion

In this case, the effect of the intervention on the control of blood glucose levels in the subjects of the study would be determined by comparing the clinical and demographic differences in the outcome of blood Hb1c levels in the intervention and control groups. The starting point in this analysis would entail an examination of the similarities in the baseline measurements between the groups.

Table 1. Demographic and Clinical Characteristics of Participants

Variable	Intervention Group (n = 19)	Control Group (n = 17)
Age (years), mean $\pm$ SD	57.3 $\pm$ 6.8*	59.1 $\pm$ 8.2*
Sex, n (%)		
Female	12 (63.2)	10 (58.8)
Male	7 (36.8)	7 (41.2)
Education level, n (%)		
Low	8 (42.1)	7 (41.2)
Middle	7 (36.8)	6 (35.3)
High	4 (21.1)	4 (23.5)
Dietary pattern, n (%)		
Good (regular 3 meals/day)	11 (57.9)	7 (41.2)
Poor/irregular diet	8 (42.1)	10 (58.8)
Medication adherence, n (%)		
Regular	13 (68.4)	6 (35.3)
Irregular	6 (31.6)	11 (64.7)
Genetic risk factor, n (%)		
Present	15 (78.9)	14 (82.4)
Absent	4 (21.1)	3 (17.6)
Duration of diabetes (years)	1–27	1–11

Note: Values are presented descriptively due to limited sample size.

Baseline comparability between the intervention and control groups was assessed prior to outcome analysis. Table 1 presents the demographic and clinical characteristics of participants. Overall, both groups were broadly comparable in terms of age distribution, sex

composition, educational level, dietary patterns, and genetic risk factors. However, a notable difference was observed in medication adherence, with the intervention group showing relatively higher adherence compared with the control group. The duration of diabetes ranged

from 1–27 years in the intervention group and 1–11 years in the control group, indicating some variability in disease chronicity between groups.

Table 2 presents the changes in HbA1c levels and glycaemic control outcomes. At baseline, the mean HbA1c was 8.92% (SD 1.87) in the intervention group

and 10.27% (SD 2.78) in the control group. At four-week follow-up, HbA1c decreased to 8.55% (SD 1.83) in the intervention group, whereas a slight increase was observed in the control group (10.38% $\pm$ 2.84). The mean change in HbA1c was -0.37% in the intervention group compared with $+0.11\%$ in the control group.

Table 2. Detailed Analysis of HbA1c Levels and Glycemic Control

Variable	Intervention Group (n = 19)	Control Group (n = 17)
HbA1c at Baseline (%)		
Mean $\pm$ SD	8.92 $\pm$ 1.87	10.27 $\pm$ 2.78
Median (Min–Max)	9.0 (5.9–11.7)	9.6 (6.0–15.2)
HbA1c at Follow-up (%)		
Mean $\pm$ SD	8.55 $\pm$ 1.83	10.38 $\pm$ 2.84
Median (Min–Max)	8.4 (5.4–11.5)	9.6 (6.2–15.3)
Change in HbA1c (Δ HbA1c)		
Mean Change (Post–Pre)	-0.37	$+0.11$
Direction of Change	Decrease	Stable / Increase
HbA1c Tier at Baseline, n (%)		
Tier 1 (<7.0%)	Few	Few
Tier 2 (7.0–8.0%)	Some	Few
Tier 3 (>8.0%)	Majority	Majority
HbA1c Tier at Follow-up, n (%)		
Tier 1 (<7.0%)	Increased	No change
Tier 2 (7.0–8.0%)	Increased	Minimal
Tier 3 (>8.0%)	Reduced	Dominant

In terms of glycaemic risk stratification, a shift toward lower-risk categories was observed in the intervention group, particularly among participants initially classified in the highest HbA1c tier (>8.0%). In contrast, most participants in the control group remained in the highest risk category at follow-up. However, statistical significance values (p-values), confidence intervals, and effect sizes were not available for reporting, which limits inferential interpretation of these findings.

Discussion

The findings of this study suggest that a nurse-led multimodal intervention may contribute to early improvements in glycaemic control among patients with type 2 diabetes in primary care settings. Although the reduction in HbA1c observed in the intervention group over a four-week period was modest, the direction of change contrasted with the slight deterioration in the control group. This divergence indicates a potential early beneficial effect of the intervention, particularly when delivered in a structured and behaviorally oriented format.

Importantly, the improvement observed in glycaemic risk stratification suggests that intervention effects may be more appropriately captured when outcomes are assessed beyond mean HbA1c changes alone. Risk-based categorisation provides a more clinically meaningful interpretation of patient status,

particularly in heterogeneous populations where baseline glycaemic control varies substantially. This finding is consistent with previous evidence indicating that individuals with poorer baseline glycaemic control tend to experience greater absolute benefits from structured diabetes interventions (Bodner et al., 2025). It further supports the argument that reliance solely on average HbA1c changes may underestimate clinically relevant improvements in high-risk subgroups.

The present findings are also consistent with the broader literature demonstrating that nurse-led interventions and diabetes self-management education and support (DSMES) programmes can improve glycaemic outcomes, particularly when interventions incorporate structured education, behavioural reinforcement, and ongoing follow-up (Grant, 2016; Sørensen et al., 2020; Terathongkum et al., 2025). In this study, the integration of brief digital messaging between sessions may have strengthened continuity of care and reinforced patient engagement. This is in line with emerging evidence suggesting that technology-supported nursing interventions can enhance adherence, self-monitoring behaviours, and patient motivation, thereby contributing to improved metabolic outcomes (Pullyblank et al., 2025; Sadeghian et al., 2025; Tien et al., 2019).

From a theoretical perspective, these results are aligned with the Chronic Care Model and DSMES frameworks, both of which emphasise patient

empowerment, self-efficacy, and sustained behavioural support as core mechanisms for improving chronic disease outcomes (Grant, 2016; Xue-juan et al., 2018). Nurse-led interventions are particularly well positioned to operationalise these principles in routine primary care practice, as nurses often have more frequent patient contact and greater opportunity for ongoing education compared with physician-centred models, especially in time-constrained settings.

The observed improvements may also be partially explained by a reduction in therapeutic inertia, a well-documented barrier in the management of type 2 diabetes (Christ et al., 2022). Therapeutic inertia often arises from delays in treatment intensification and insufficient reinforcement of lifestyle modification. In this study, the structured and proactive nature of nurse-led follow-up, including goal-setting and behavioural counselling, may have contributed to improved adherence and earlier behavioural adjustment. This is consistent with evidence suggesting that increased patient contact and structured education can improve treatment responsiveness, particularly among individuals with suboptimal baseline glycaemic control (Jacobs et al., 2024; Li et al., 2025; Okorobe et al., 2026).

From a health systems perspective, the integration of nurse-led multimodal interventions into primary care may represent a scalable and cost-conscious strategy for improving diabetes management. Such models may reduce dependence on physician-led consultations while maintaining or improving care quality, thereby improving system efficiency in high-burden settings (Kivity et al., 2025; Makhfudli et al., 2025; Nurchis et al., 2022). This is particularly relevant for low- and middle-income countries, where the rising prevalence of non-communicable diseases places increasing strain on already limited healthcare resources (Ali et al., 2012; Laffi et al., 2025). In this context, task-sharing approaches that leverage nursing capacity may offer a practical pathway toward strengthening chronic disease management at the primary care level.

However, several limitations should be acknowledged. First, the small sample size and quasi-experimental design limit the generalisability of findings and preclude strong causal inference. Second, baseline differences in medication adherence and duration of diabetes between groups may have acted as potential confounders influencing outcomes. Third, the short follow-up duration of four weeks represents a major methodological limitation, as HbA1c reflects average glycaemia over approximately 2–3 months; therefore, observed changes should be interpreted cautiously as early response trends rather than stable metabolic outcomes. Finally, the absence of p-values, confidence intervals, and effect size measures limits the statistical robustness and inferential strength of the results.

Future research should employ randomized controlled trial designs with larger and more diverse samples, longer follow-up periods aligned with HbA1c physiological dynamics, and comprehensive statistical reporting, including effect sizes and confidence intervals. Such studies are necessary to confirm the clinical effectiveness, sustainability, and scalability of nurse-led multimodal interventions in primary care diabetes management.

Conclusion

In conclusion, this study provides preliminary evidence that a brief nurse-led multimodal intervention may support early improvements in glycaemic control and glycaemic risk stratification among patients with type 2 diabetes in primary care settings. These findings suggest the potential value of integrating structured nursing interventions within routine primary care as a practical approach to supporting diabetes management. However, given the quasi-experimental design, small sample size, and short intervention duration, the results should be interpreted with caution and cannot be generalized to broader populations. The observed effects are better understood as early trends rather than definitive evidence of long-term effectiveness. Further research is recommended using randomized controlled trial designs with larger sample sizes and longer follow-up periods to confirm the effectiveness, sustainability, and scalability of nurse-led multimodal interventions in improving diabetes outcomes in primary care settings.

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Author Contributions

AZ: Conceptualization, Writing- Original Draft, Review & Editing. IA: Conceptualization, Methodology, Manuscript review. IE: Formal analysis, Writing -Original draft, Manuscript review.

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Conflicts of Interest

The author declares no conflict of interest.

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