Effects of Diabetes Self-Care Calendar on Self-Care Behavior, Knowledge, and HbA1c among Type 2 Diabetes Mellitus Patients: A Randomized Controlled Trial

Sugiharto[1,*], Yu-Yun Hsu [2]

[1]Department of Medical Surgical Nursing, School of Nursing, Universitas Muhammadiyah Surakarta, Surakarta 57169, Central Java, Indonesia.
[2]Department of Nursing, College of Medicine, National Cheng Kung University, Taiwan
**corresponding author: Sugiharto@ums.ac.id*

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Abstract

Aims: To examine the effects of a diabetes self-care calendar on self-care activities, diabetes knowledge, and glycemic control in individuals with type 2 Diabetes Mellitus.

Methods: This study used a randomized controlled trial design. This study employed a proportionate random cluster selection. The participants were blindly divided into intervention and control groups. The study was conducted at three community health centers in the region. The intervention group was provided with a Diabetes Self-Care Calendar (DSCC). The control group received conventional care. The summary of diabetes self-care activities and the diabetes knowledge questionnaire (Indonesian version) were used to assess the participants' self-care performance and knowledge. The Infopia Clover A1c Analyser™ was used to measure HbA1c levels. These variables were measured twice, at two months and four months after the intervention. A repeated-measures ANOVA and t-test were used to analyze the hypotheses.

Results: A total of 126 patients with type 2 diabetes mellitus were enrolled in this study, which were equally divided into an intervention group and a control group. The results showed that the DSCC significantly ($p<0.001$) increased the diet, physical activity, self-monitoring of blood glucose, foot care, and medication adherence. The diabetes knowledge and HbA1c levels in the intervention group were significantly greater than those in the control group ($p<0.001$ and $p=0.001$), respectively.

Conclusion: The diabetes self-care calendar enhances self-care activity adherence, knowledge, and HbA1c. As a reminder, the calendar obeys the pillars of diabetes self-care; it is an age-friendly and family empowered reminder and is usable.

Keywords: diabetes knowledge, diabetes self-care calendar, hba1c, self-care activities, type 2 diabetes mellitus

Introduction

The number of individuals suffering from diabetes mellitus (DM) increases every year worldwide. Indonesia is one of the top ten countries with a large DM population. According to the International Diabetes Federation (2025), 20.4 million Indonesians suffer from DM in 2024, which is projected to increase to 28.6 million by 2050. Type 2 Diabetes Mellitus (T2DM) is the predominant form of diabetes, accounting for 90%-95% of all diabetes cases (Aikaeli et al., 2022; Ye et al., 2023; Zheng et al., 2018). T2DM increases morbidity due to microvascular or macrovascular complications (Khan et al., 2020). The incidence of microvascular problems in T2DM ranges from 24% to 74% (Balogun et al., 2024; Merid et al., 2024; Solela et al., 2024). The prevalence of macrovascular complications is 20–30% (Mohammed et al., 2025; Solela et al., 2024). Such complications lead to premature mortality and affect the quality of life (Ye et al., 2023). In line with this, the mortality rate for Indonesian patients with T2DM due to DM complications is 57.42% and is the third leading cause of death (Vos et al., 2020). To address this issue, studies have recommended diabetes self-care (Jancev et al., 2024; Kunutsor et al., 2024).

Self-care is characterized by the capacity to attend to one's own needs through awareness, self-discipline, and independence to attain, sustain, or enhance optimal health and well-being (Martínez et al., 2021). According to Kolb (2020) and Sugiharto (2021), the diabetes self-care framework proposed by the American Association of Diabetes Educators (AADE) includes healthy coping, healthy eating, being active, taking medications, monitoring, reducing risks, and problem-solving. Evidence has demonstrated that commitment to diabetic self-care can enhance HbA1c levels (Fabrizi et al., 2020; Mogre et al., 2019; Sapkota et al., 2015). However, the adherence rates of self-care remain low and vary across all subscales (Barasa Masaba & Mmusi-Phetoe, 2020; Mogre et al., 2019) owing to the intricacy of the self-care practices (Lu et al., 2016). Adherence to self-care among adults with T2DM is significantly inadequate in various contexts. While medication adherence is frequently superior to other behaviors, areas such as nutrition, physical exercise, blood glucose monitoring, and foot care exhibit considerably lower levels of engagement (Mogre et al., 2019; Sukarno et al., 2024). Paudel et al. (2022) reported that the adherence rates for self-care in South Asia were approximately 64% for medication, 53% for physical activity, 48% for nutrition, and 42% for foot care. This phenomenon also occurs in Indonesia, where adherence to self-care among individuals with T2DM is limited, with an adherence rate of approximately 40% (Sukarno et al., 2024). A significant factor affecting low adherence is frequent forgetfulness, particularly regarding medication adherence (Kurnia et al., 2017; Pamungkas et al., 2019; Wibowo et al., 2021). A reminder tool is required to improve patients' commitment to self-care. A reminder tool is an instrument intended to prompt diabetes self-management activities, including dietary adherence, physical exercise, medication administration, and blood glucose assessment.

Several reminders have been established, most of which are in the form of mobile applications and the internet, which require digital literacy (Kim & Hu, 2024; Syabariyah et al., 2024; Yao et al., 2024; Yoon et al., 2024). Although these applications contain medication schedules, diets, and blood sugar monitoring, they have not yet fully aligned with the AADE's recommendations (Kolb, 2020; Belete et al., 2023; Sugiharto & Hsu, 2020). The effectiveness of mobile health in improving self-care practices, including nutrition, exercise, and self-monitoring, has been confirmed (Belete et al., 2023; Makhfudli et al., 2025). Regrettably, the adoption and consistent utilization of reminders

remain constrained, despite the availability of numerous locally built applications (Belete et al., 2023). These issues stem from inadequate digital literacy, insufficient access to dependable internet infrastructure, particularly in rural and isolated regions, and a deficiency in steady electricity or device availability (Aisyah et al., 2025; Hati et al., 2024). Furthermore, in rural Javanese communities, it was emphasized that numerous low-income patients possessed only basic phones instead of smartphones, connectivity was inconsistent, and the linguistic and literacy requirements of applications posed significant challenges (Dyah, 2018). Consequently, although digital tools are promising, the structural limitations of connectivity, literacy, cost, and infrastructure in numerous Indonesian contexts render them suboptimal. Furthermore, in proposing the development of an efficient reminder tool, numerous variables must be considered, including cost-effectiveness, adaptation to local literacy levels, connectivity, and workflow integration. Furthermore, tailored, sustainable, and replicable interventions that meet the needs of people with DM living in developing countries or rural regions are needed (Sohal et al., 2015; Belete et al., 2023). However, research has yet to determine a sustainable and culturally tailored diabetes self-care reminder that can optimize glycemic control among patients with DM in Indonesia. To address these challenges, the authors created a diabetes self-care calendar that functions as a reminder of diabetes self-care activities (Sugiharto & Hsu, 2020). The manual calendar comprises weekly activities, including medication administration, dietary management, physical exercise, blood glucose monitoring, and foot care. The calendar facilitates the seven pillars of diabetes self-care by incorporating monthly goal-setting, providing information on diabetes management, and featuring motivational phrases for emotional encouragement. This study aimed to examine the effects of a calendar reminder on diabetes self-care activities, diabetes knowledge, and metabolic control in patients with T2DM.

Methods

Setting and Sampling

The participants were recruited from three Community Health Centers (CHC) with the highest prevalence of T2DM in the Pekalongan Regency, Indonesia. The study used G-power 3.1.5 software to calculate the sample size, which included an alpha of 5%, a power of 80%, an effect size of 0.56 based on a similar study conducted by Roter et al. (1998), and a group allocation ratio of one. This led to an estimated total of 104 subjects. With a 20% attrition rate, the overall sample size was 126, comprising 63 subjects in each group. In the preliminary stage, two CHCs were randomly assigned to the intervention and control groups using a lottery method.

Owing to the insufficient sample size obtained from the initial two CHCs, a third CHC was incorporated. The third CHC was randomly allocated based on geographical location (northern or southern region) employing an identical randomization method. Each CHC comprises many villages; hence, proportionate sampling was implemented within each CHC to guarantee that the number of participants selected from each village corresponded to its population size, preserving the representativeness across research groups. There are 26 villages, that is, 10 villages from the first CHC and eight villages from the second and third CHC. An independent researcher uninvolved in participant recruitment or data collection generated and maintained the random allocation sequence. Allocation concealment was preserved using sequentially numbered, opaque, and sealed envelopes. The envelopes were opened only once a CHC was recruited for the study, guaranteeing that group assignment remained undisclosed to the field researchers until allocation took place. Participants were not informed of their group

allocation (intervention or control) to mitigate performance bias. The intervention was administered consistently and on schedule across locations, rendering participants oblivious to which group received the particular intervention under examination. Data collectors and analysts were masked to group assignments during data entry and analysis to mitigate the potential for measurement and analytical bias.

The inclusion criteria were patients with T2DM aged ≥18 years with an HbA1c level >7%. The exclusion criteria included severe problems (e.g., renal failure, acute myocardial infarction, or stroke), foot ulcers, physician-diagnosed severe psychological conditions, and inability to exercise due to physical dependence. All 63 participants in the intervention group successfully completed the study and were included in the final analyses. In the control group, two of the 63 participants (3.2%) were lost to follow-up due to death during the research period, remaining to 61 participants included in the analysis. No further missing values were detected for any outcome variables. Data were evaluated using a per-protocol methodology, wherein only individuals who completed the study and complied with the designated procedure were included. No data imputation methods were implemented, and an intention-to-treat analysis was not performed. The baseline characteristics (age, sex, and relevant clinical parameters) of the participants who completed the trial were compared with those of those who did not. No statistically significant differences were detected, suggesting that the attrition of the two participants was unlikely to have introduced bias or undermined the validity of the study's findings.

Instruments

The socio-demographic questionnaire

The socio-demographic questionnaire was developed by the primary investigator (PI) and included age, gender, education level, marital status, occupation, duration of DM, treatment regimen, health insurance, income, diabetes education-perceived, and diet consultation.

The Summary of Diabetes Self-Care Activities Indonesian Version (SDSCA-I)

The Indonesian version of the SDSCA was used to assess adherence to self-care activities. The SDSCA-I is a 25-item self-administered questionnaire translated from the English version of the SDSCA developed by Toobert et al. (2000). The SDSCA-I evaluates self-care activities, including five regimens of diet (item number1–5), exercise (items 6 and 7), blood glucose testing (items 8 and 9), medication (items 15 – 17), and foot care (items 10 – 14) (Sugiharto et al., 2019). Each item is rated on a weekly frequency, and the mean days in each regimen are calculated independently, with the highest number of days of self-care indicating a higher level of self-care adherence. The scoring system was only applied to 17 items, and others, such as healthcare provider recommendations and smoking habits, were excluded from the scoring system. The score ranged from 0 to 7. The Cronbach's alpha of the internal reliability of the SDSCA-I was 0.72, and the validity was 0.98 (Sugiharto et al., 2019).

Diabetes Knowledge Questionnaire Indonesian Version (DKQ-I)

The Indonesian version of the DKQ was adopted from the English version developed by Eigenmann, Skinner, and Colagiuri (2011). The DKQ-I, which consists of 14 multiple-choice items, was used to assess diabetes knowledge. This questionnaire asked about the range of normal blood glucose levels, the benefits of physical activity, diabetes complications, the risk of foot problems, the management of acute diabetes

complications, and the National Diabetes Services Scheme. The correct answer is scored with a 1, while for items 5, 7, 8, 10, and 12, the "as many as apply" answer is entered for each option. The score ranges from 0 to 28. The DKQ-I was validated with a Cronbach's alpha of 0.81. Diabetes knowledge levels were reflected based on the number of correct answers.

HbA1c

HbA1c was measured to assess metabolic control using the Infopia Clover A1c Analyser™. The Infopia device was used in this study because we collected HbA1c blood samples door-to-door; therefore, a portable device was needed. Additionally, the Infopia Clover A1c AnalyserTM complies with the specifications of an IVD device for point-of-care testing and quantifies the percentage of hemoglobin A1c (HbA1c) using the known method of boronate affinity. It can be examined in both capillary whole blood and venous blood samples. The Infopia Clover A1c Analyser™ requires a minimal blood sample (4 µl) and has a brief testing duration (5 minutes). HbA1c measurement results are expressed as percentages (%) according to the Diabetes Control and Complications Trial (DCCT) system.

Intervention

A single-blind design was employed, wherein the participants were unaware of their group assignments. The participants in the intervention group received a Diabetes Self-Care Calendar (DSCC) and were accompanied by their families. The control group participants received standard care without reminder tools.

The DSCC is designed as a weekly calendar and serves as a self-care reminder, consisting of a medication schedule, diet, physical activity, blood glucose self-monitoring, and foot care developed by Sugiharto & Hsu (2020). The DSCC also provides information related to diabetes and its care, self-care activity guidelines, goal setting, games, quizzes, and motivational quotes. The feasibility of the DSCC has been tested among patients with T2DM in Indonesia, and it has been recognized as an acceptable and applicable reminder tool for patients with DM. The pilot study approved that the DSCC meets the criteria of a quality intervention, that is, being accessible, acceptable, effective, efficient, and appropriate (Sugiharto & Hsu, 2020).

Study Procedure

Initially, we randomly designated two CHCs as the intervention and control groups. Subsequently, we identified prospective patients from each CHC according to the established inclusion and exclusion criteria. Eligible subjects who fulfilled the requirements and consented to participate were requested to sign the consent form. A meeting was held at the village meeting hall of the chosen CHC within the intervention group to elucidate the study objectives and procedures to prospective participants. The principal investigator (PI) instructed the participants and their families in the intervention group on utilizing the calendar and requested that they perform the self-care activities outlined on it over four months. Using the calendar, the participants set their goals on a monthly basis. They then evaluated their goal achievement at the end of each month. Moreover, the research assistants (RAs) collected the participants' baseline data, including sociodemographic data, self-care activities, diabetes knowledge, and HbA1c levels.

The control group received conventional care from a physician, including a general assessment and medication. Patients or their families visit the public health center monthly to take their medication or consult if they have any complaints. The control group did not use any diabetes self-care-reminder tools. The RAs collected the participants' baseline data, including sociodemographics, self-care activities, diabetes knowledge, and HbA1c levels.

After two months of the intervention, the RAs collected data on self-care activities from both groups using a questionnaire. The RAs asked the participants in the intervention group to complete quizzes posted on the calendar during the evaluation. If the answers were correct, they received a gift. After four months of the intervention, the RAs contacted the participants of the two groups to collect the second follow-up data, which included self-care activities, diabetes knowledge, and HbA1c once taking the calendar (Figure 1).

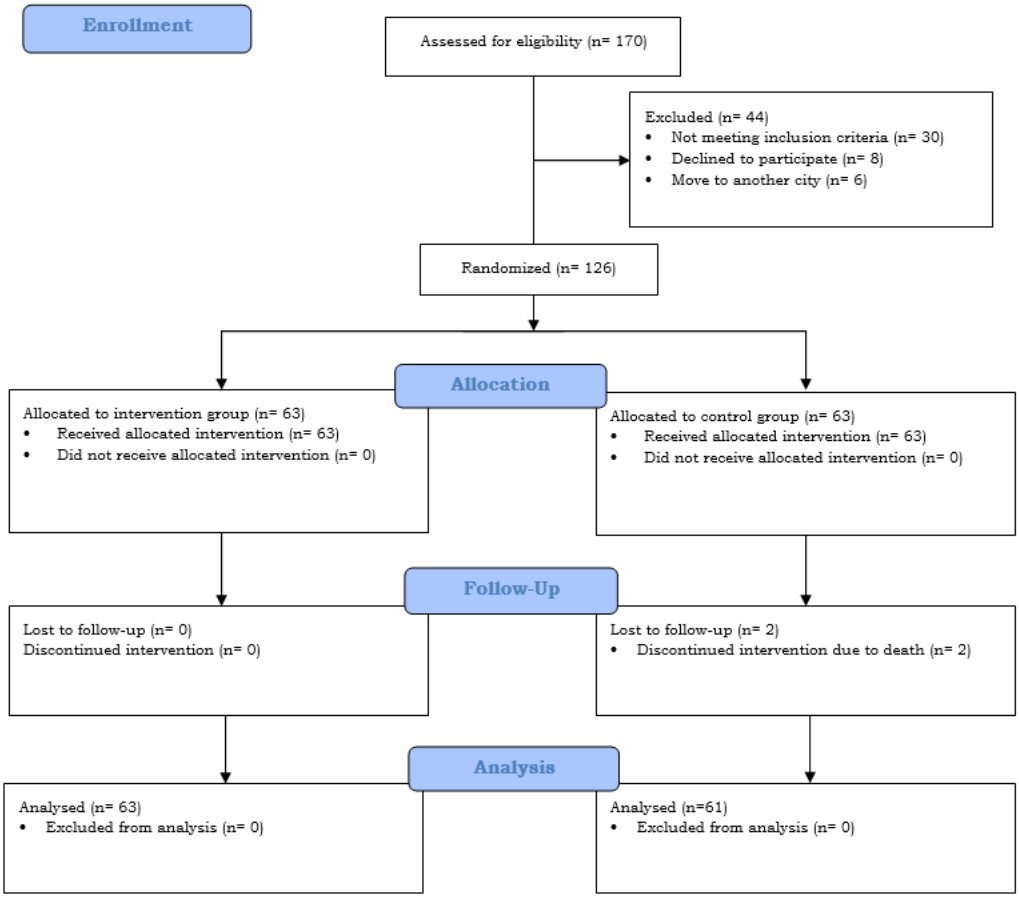

Figure 1. The Study Procedure

Ethical Considerations
Approval from the Institutional Review Board was obtained with the registered number 005/EP-FKIK-UMY/IX/2015. The Department of Health of Pekalongan Regency and the Bureau of Research Center approved this study. The consent form was signed by the participants to affirm their agreement to participate in the study.

Data Analysis
Three variables were measured: self-care activities, diabetes knowledge, and HbA1c. All these variables are on a ratio scale. The independent variables were measured before the intervention. As dependent variables, they were measured in the fourth month of the intervention. The data were analyzed using SPSS version 18.0. Self-care activities, diabetes knowledge levels, and HbA1c levels were normally distributed in both groups ($p>0.50$). Consequently, paired t-tests and independent t-tests were conducted to assess intra- and inter-group variations following the intervention.

Results

Characteristics of the Participants
A total of 126 T2DM patients participated in this study, with 63 in each group. On the second follow-up, two participants dropped out due to death (Figure 1). Overall, the average age was 54.9±7.30, ranging from 32 to 78 years. The mean duration (years) of diagnosed diabetes was 4.9±5.2. Of the participants, 67.7% were women, and 61.3% had a low level of education. Most participants were married (85.5%). More than half (58.9%) of the participants were unemployed. Most participants (82.3%) were treated with Oral Hypoglycemic Agents (OHAs). National health insurance covered the majority (72.6%) of participants. Eighty (64.5%) participants were at low income levels. Half of the participants had never received diabetes education (50.8%) or diet consultation (69.4%) (**Table 1**).

Table 1. Participants' Characteristics

Characteristic	**All (N=124) M±SD**	**IG (n=63) M±SD**	**CG (n=61) M±SD**	**t**	**p value**
Age (years)	55±7.30	55.80±6.70	54.20±7.90	1.28	0.20
Duration of DM	4.90±5.20	5.50±6.4	4.20± 3.3	1.37	0.17
Characteristic	**n (%)**	**n (%)**	**n (%)**	**X^2**	**p value**
Gender					
Male	40 (32.30)	18 (28.60)	22 (36.10)	0.80	0.37
Female	84 (67.70)	45 (71.40)	39 (63.90)		
Education levels					
No formal education	39 (31.50)	19 (30.20)	20 (32.80)	6.34	0.10
Primary School	37 (29.80)	20 (31.70)	17 (27.90)		
High School	32 (25.80)	12 (19.00)	20 (32.80)		
College or above	16 (12.90)	12 (19.00)	4 (6.60)		
Marital Status					
Married	106 (85.50)	51 (81)	55 (90.20)	2.12	0.15
Widow	18 (14.50)	12 (19)	6 (09.80)		
Employment					
No	73 (58.90)	37 (58.80)	36 (59)	0.001*	0.97
Yes	51 (41.10)	26 (41.20)	25 (41)		
Treatment regimen					
No treatment	17 (13.7)	7 (11.1)	10 (16.4)	0.85	0.65
OHA	102 (82.3)	53 (84.1)	49 (80.3)		
Insulin, or + OHA	5 (04.0)	3 (4.8)	2 (3.3)		

DM Complications					
No	91 (73.40)	46 (73)	45 (73.80)	0.01	0.92
Yes	33 (266)	17 (27)	16 (26.02)		
National Health Insurance					
No	34 (27.4)	20 (31.7)	14 (23)	1.21	0.27
Yes	90 (72.6)	43 (68.3)	47 (77)		
Income (million Rp)					
<2	80 (64.5)	37 (58.7)	43 (70.5)	1.88	0.39
2–4	32 (25.8)	19 (30.2)	13 (21.3)		
≥4	12 (9.7)	7 (11.1)	5 (8.2)		
Diabetes education					
No	63 (50.8)	32 (50.8)	31 (50.8)	0.001	1.00
Yes	61 (49.2)	31 (49.2)	30 (49.2)		
Diet consultation with a nutritionist					
No	86 (69.4)	40 (63.5)	46 (75.4)	2.07	0.15
Yes	38 (30.6)	23 (36.5)	15 (24.6)		

Diabetes self-care calendar and self-care activities

Paired t-test results showed that the self-care activities in the intervention group increased significantly from baseline (M=2.00, SD=1.00) to follow-up (M=3.00, SD=1.00), t(62)=7.92, p<0.001. In turn, the self-care activities in the control group did not increase from baseline to follow-up (M=2.00, SD=1.00; t(60)=0.00, p=1.000). The self-care activities in the intervention group were significantly higher than those in the control group (t (122)=5.10, p<0.001, d=1.00) (Table 2).

Diabetes self-care calendar and diabetes knowledge

Paired t-test results showed that the diabetes knowledge levels in the intervention group increased significantly from baseline (M=10.20, SD=4.60) to follow-up (M=19.00, SD=4.30), with t (62)=25.56, p<0.001. Conversely, the diabetes knowledge levels in the control group did not increase from baseline (M=10.90, SD=4.60) to follow-up (M=10.10, SD=3.60); t (60)=1.89, p=0.074. The diabetes knowledge levels in the intervention group were significantly greater than those in the control group (t(122)=16.80, p<0.001, d=2.20) (Table 2).

Diabetes self-care calendar and HbA1c

The paired t-test results showed that the HbA1c levels in the intervention group decreased significantly from baseline (M=10.50, SD=2.20) to follow-up (M=9.60, SD=2.20) with t (62)=5.45, p<0.001. However, the HbA1c levels in the control group did not decline from baseline (M=10.9, SD=2.30) to follow-up (M=10.80, SD=2.20) with t (60)=0.41, p=0.68. The HbA1c levels in the intervention group were significantly lower than those in the control group (t(122)=3.58, p=0.001), with an effect size of d=0.64. The HbA1c level decreased by 1% on average among participants in the intervention group (Table 2).

Table 2. The paired t-test and independent t-test within and between groups of the self-care activities, diabetes knowledge, and HbA1c

Variables	Baseline M ± SD	Follow-up M ± SD	t^a	t^b	Cohen's d
Diabetes Self-Care Activities					
IG (n=63)	2.00±1.00	3.00±1.00	7.94***	5.100***	1.00
CG (n=61)	2.00±1.00	2.00±1.00	0.00^{ns}		
Diabetes Knowledge					
IG (n=63)	10.20±4.60	19.00±4.30	25.55***	16.80***	2.20
CG (n=61)	10.90±04.6	10.10±3.60	1.82^{ns}		
HbA1c					
IG (n=63)	10.50± 2.20	9.60±2.20	5.45***	3.58***	0.64
CG (n=61)	10.90±2.30	10.80±2.20	0.41^{ns}		

Note. IG: Intervention Group; CG: Control Group; [a]: within-groups; [b]: between-groups; [ns]: not significant
***p<0.001

Discussion

These results indicate that the diabetes self-care calendar is an effective reminder tool for adherence to self-care activities for patients with diabetes. The results demonstrated a significant improvement in knowledge and self-care adherence among participants in the intervention group. Subsequently, HbA1c levels decreased.

The results indicated that adherence to self-care activities among the intervention group increased dramatically. The improvement in self-care adherence was related to the utility of the DSCC, which is considered a self-care guideline and reminder tool. The DSCC provided guidance on managing daily self-care activities for participants in the intervention group. The participants easily monitored their self-care activities by ticking a calendar timetable. The DSCC encourages participants to follow the guidelines, which means involving them in their care. This finding was in line with Mogueo et al. (2021) and Li et al. (2020), who found that involving patients in their care has a positive impact on lifestyle changes, especially in individuals with poorly controlled T2DM (Cheng et al., 2017). Another valuable function of the DSCC is a diary, which provides space for users to write down their own self-care goals by monthly goal achievement and adherence. The positive effect of the DSCC on self-care adherence is consistent with web-based intervention studies conducted by Ramadas et al. (2018) and Saslow et al. (2020). During the follow-up study, the participants in the intervention group were provided with feedback. Offering feedback on performance, problem-solving, and action planning are effective behavioral modification strategies, particularly for persons exhibiting inadequate glycemic control (Cheng et al., 2017).

One of the self-care subscales, self-monitoring blood glucose, did not change throughout the study in either group. The potential reasons may stem from socioeconomic variables, including the financial burden of purchasing a blood glucose monitor, proficiency in using the equipment, and emotional readiness required. The financial burden is the

most influential factor in self-monitoring blood glucose adherence in low- and middle-income countries (Faizi et al., 2025; Mohamad et al., 2025; Tellez et al., 2024). In this study, most participants did not own a blood glucose meter due to financial limitations. Of the participants, 64.5% had incomes lower than USD 155 per month. In addition, most participants tested their blood glucose levels in hospitals or clinics only when they felt that their symptoms were worsening.

Self-care activities among the intervention group slightly declined in the second follow-up. Similarly, a decrease in self-care activity engagement was also found in studies conducted by Esferjani et al. (2022) and Amoozadeh et al. (2023). These studies observed a weakening of intervention participation over three months. Participants expressed several obstacles, including weather was one of them. The participants complained that physical activity declined during the rainy season. In addition, a short follow-up period for behavioral and psychosocial interventions tends to be more efficacious than a long period (Butayeva et al., 2023; Castillo-Merino et al., 2023; Chowdhury et al., 2024). Furthermore, to sustain self-care practice, patients require motivational and psychological reinforcement (Sohal et al., 2015).

In the initial measurement, all participants in both groups had a low level of knowledge about diabetes and its treatment. This finding is consistent with several studies in low- and middle-income countries, such as Ethiopia (Kassahun et al., 2016), Indonesia (Faizi et al., 2025), and Malaysia (Mohamad et al., 2025). Among these studies, low levels of diabetes knowledge were found in 44.9% to 85% of patients with T2DM. Surprisingly, after four months of the intervention, our study showed a significant improvement in diabetes knowledge levels among participants in the intervention group. The DSCC gradually improved the knowledge level of patients in the intervention group. The DSCC can teach participants about diabetes and how to treat it. As mentioned earlier, the DSCC provides information related to diabetes and self-care activities based on evidence. Consequently, the participants would repeatedly review this information while fulfilling the timetable of self-care activities. The information provided in the calendar was designed based on the guidelines and combined with Indonesian culture (Sugiharto et al., 2017). It was approved that providing information about diabetes and its care and support could enhance diabetic patients' self-care practices (Camargo-Plazas et al., 2023; Jarvandi et al., 2023). The intervention was given over four months. The short-period of the intervention was more effective in improving knowledge.

Diabetes knowledge is a cornerstone of self-care behavior among T2DM patients because knowledge drives patients' self-care behaviors. On the calendar, the DSCC provides scientific knowledge about diabetes and its treatment. These findings provide evidence that diabetes education can play a significant role in self-care among people with T2DM. This supports the proposition that enhancing patient knowledge are key mechanisms influencing behavioural outcomes. A structured educational intervention that targets knowledge and behaviour change are likely to yield improvements in self-care. As diabetes knowledge increased among participants, their self-care activities for diabetes improved.

After a four-month intervention, the HbA1c level significantly decreased in the intervention groups. The HbA1c levels among the intervention group declined by about 1% on average. This is an excellent finding, since every 1% decrease in HbA1c could reduce the risk of complications by 14% (Hasebe et al., 2023; Kunutsor et al., 2024;

Tabesh et al., 2024) and mortality by 8% to 21% (Diallo et al., 2025; Liu et al., 2023; Yu et al., 202; Lee et al., 2024). The DSCC is a valuable and comprehensive intervention that provides more information about diabetes and its care, reflects motivation (as reflected in the quote), and triggers family member engagement. Family members play a crucial role as partners for patients with T2DM to perform good self-care behaviors and ensure that their blood glucose is under control (Butayeva et al., 2023; Castillo-Merino et al., 2023).

Limitations

This study has some limitations, such as the fact that the participants focused on T2DM; therefore, the benefits of using the DSCC cannot be applied to other types of DM. Another limitation is the sample size; only 124 T2DM patients participated in this study. Further studies with larger sample sizes are recommended. Finally, we conducted the study over a short period of four months. Hence, the long-term effectiveness of the DSCC is recommended.

Contribution to Global Nursing Practice

The study findings contribute significantly to global nursing practice in several ways as follows. The DSCC can be used as a reminder tool for diabetes self-care activities as well as a monitoring tool for self-care adherence among patients with T2DM. Moreover, the DSCC also provides information on diabetes-related care. It could be a medium of health education for patients, families, or caregivers. The DSCC was developed based on evidence and culturally tailored to Indonesian conditions; it is acceptable and affordable for Indonesian society. The DSCC functions as a manual reminder system, eliminating the requirement for technological literacy. The underlying causal pathway can be described as an educational intervention that enhances diabetes awareness, which subsequently improves self-care behaviors and ultimately leads to better glycemic control (HbA1c). The study results reflect this trend and indicate that knowledge and behavior act as mediating factors for glycemic enhancement. From an implementation standpoint, the robust response in knowledge and self-care indicates that our intervention may be especially efficacious in the mid-to-short term for behavioral modification.

Conclusion

The DSCC, a calendar reminder tool, is precious because it provides information about diabetes and its care that can drive users in their self-care, quotes as a motivator, a goal-setting form that can be used to set the user's plans for their self-care for a whole month, and games and quizzes that entertain and can be used as feedback for their knowledge. The DSCC is an appropriate tool, especially for those who are illiterate with cloud system applications and live in areas with limited internet connections. The DSCC can enhance adherence to self-care activities, knowledge, and glycemic control. The Diabetes Self-Care Calendar, in particular, can assist in improving HbA1c levels in T2DM patients.

Author Contribution
All authors contributed significantly to the study conception and design, data collection, data analysis and interpretation, drafting of the manuscript, critical revision of the manuscript, and final approval of the manuscript.

Conflict of Interest
The authors declare that this study has no conflicts of interest.

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