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Impact of a Digital Health Coaching Program on Self-Efficacy and Medication Adherence in Diabetic Patients

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ABSTRACT

This study aimed to evaluate the effectiveness of a digital health coaching program in improving self-efficacy and medication adherence among patients with type 2 diabetes in Malaysia. A randomized controlled trial design was employed with 30 adult participants diagnosed with type 2 diabetes, recruited from healthcare centers in Malaysia. Participants were randomly assigned to an intervention group (n = 15), which received a 12-session digital health coaching program, or a control group (n = 15), which received standard care. The intervention was delivered over a period of 12 weeks, with a follow-up assessment conducted five months after baseline. Self-efficacy was measured using the Diabetes Management Self-Efficacy Scale (DMSES), and medication adherence was assessed using the Morisky Medication Adherence Scale (MMAS-8). Data were analyzed using repeated measures ANOVA and Bonferroni post-hoc tests through SPSS-27. Descriptive results showed that the intervention group experienced a marked improvement in self-efficacy from pre-test (M = 52.47, SD = 6.21) to post-test (M = 65.20, SD = 5.38), which was sustained at follow-up (M = 63.93, SD = 5.67). Similarly, medication adherence in the intervention group increased from pre-test (M = 5.27, SD = 1.01) to post-test (M = 7.33, SD = 0.87) and remained high at follow-up (M = 7.13, SD = 0.92). Repeated measures ANOVA indicated significant time × group interaction effects for both self-efficacy ($F(2, 56) = 22.91$, $p < .001$) and medication adherence ($F(2, 56) = 15.56$, $p < .001$). Bonferroni post-hoc comparisons confirmed significant improvements in the intervention group over time, with no significant changes observed in the control group. The findings suggest that a structured digital health coaching program is an effective and sustainable approach to enhance self-efficacy and medication adherence in patients with type 2 diabetes, offering a scalable solution for improving diabetes self-management in diverse healthcare settings.

Keywords: *Digital health coaching, self-efficacy, medication adherence, type 2 diabetes.*

1. Introduction

Self-efficacy, defined as an individual's belief in their ability to execute behaviors necessary to produce specific outcomes, plays a central role in chronic illness management. Higher self-efficacy is associated with greater motivation, persistence, and success in following medical regimens, including medication adherence and lifestyle modifications (Setyawati et al., 2024). Among diabetic populations, studies have shown that individuals with stronger self-efficacy demonstrate better blood glucose control, more consistent self-monitoring, and improved health-related quality of life (Ahn et al., 2023). Conversely, patients with lower self-efficacy often struggle with maintaining dietary restrictions, physical activity, and regular medication intake (Avalos et al., 2023). These challenges are compounded in multicultural contexts like Malaysia, where cultural beliefs, language barriers, and healthcare access disparities further complicate diabetes self-management (Morgan et al., 2024).

Medication adherence is another critical pillar of effective diabetes control, yet non-adherence is a widespread and complex phenomenon. Factors contributing to poor adherence include forgetfulness, lack of knowledge, medication side effects, cost barriers, and limited health literacy (Avalos et al., 2024). Studies have documented that even modest improvements in adherence can significantly reduce HbA1c levels and prevent costly complications such as neuropathy, retinopathy, and cardiovascular disease (Malkani et al., 2024). Consequently, there is a growing emphasis on the development of patient-centered strategies that address both psychological and behavioral dimensions of adherence. Health coaching has emerged as one such promising strategy, with evidence indicating its potential to build self-efficacy and reinforce positive behavior change in patients with T2DM (Racey et al., 2022).

Digital health coaching combines the personalized support of traditional coaching with the accessibility and scalability of technology. Unlike face-to-face interventions that may be limited by geographical or logistical constraints, digital coaching platforms enable real-time interaction, automated feedback, and asynchronous communication, making them particularly suitable for chronic disease populations (Gershkowitz et al., 2020). These programs often include educational modules, goal-setting tools, motivational messaging, and progress tracking, all delivered via mobile apps or web interfaces. A randomized controlled trial by Azelton et al. (2021) demonstrated that digital health coaching led to significant improvements in self-care behaviors and glycemic control among individuals with T2DM (Azelton et al., 2021). Similarly, Lin et al. (2021) found that participants who received digital coaching showed notable enhancements in dietary practices, physical activity, and medication adherence compared to a control group (Lin et al., 2021).

In recent years, digital coaching models have evolved to incorporate multidimensional approaches that integrate behavioral theories, clinical data, and artificial intelligence. For instance, Di et al. (2022) used machine learning algorithms to optimize the delivery of health coaching content tailored to patients' unique profiles, resulting in greater engagement and clinical improvements (Di et al., 2022). Other models, such as the "Pharmacist Plus" framework introduced by Malkani et al. (2024), combine coaching with pharmacist-led counseling, highlighting the role of interprofessional collaboration in digital diabetes care (Malkani et al., 2024). These interventions are particularly beneficial in resource-limited settings, where access to diabetes specialists may be restricted and digital platforms can serve as a bridge to personalized care (Almulhim et al., 2022).

The acceptability and feasibility of digital health coaching have been confirmed in various populations, including underserved groups and individuals with limited health literacy. For example, in a study conducted in Saudi Arabia, Almulhim et al. (2024) found that a tailored health coaching program was well-received by participants and led to improvements in self-monitoring behaviors and patient satisfaction (Almulhim et al., 2024). Similarly, Avalos et al. (2024) implemented a peer-coaching model supported by digital tools for patients with poorly controlled diabetes, demonstrating not only clinical benefits but also enhanced autonomy and motivation (Avalos et al., 2024). These findings underscore the importance of contextualizing digital interventions to meet the specific needs and preferences of diverse patient populations.

The integration of mobile applications into health coaching further strengthens the intervention by enabling self-tracking, immediate feedback, and continuous reinforcement. Kwan et al. (2024) emphasized the value of combining mobile apps with shared decision-making and coaching to improve outcomes among patients with both diabetes and hypertension (Kwan et al., 2024). Similarly, Sharp et al. (2021) reported that mobile-delivered coaching enhanced engagement and reduced dropout rates in a randomized controlled crossover study (Sharp et al., 2021).

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Such hybrid models offer a practical framework for sustainable diabetes care, especially in settings where face-to-face care delivery is constrained by time, distance, or provider shortages.

Notably, the effectiveness of digital health coaching is not merely technical but relational. The interpersonal connection between the coach and the patient remains a critical driver of behavior change. Cedarbaum et al. (2021) emphasized the importance of autonomy support in peer coaching relationships, demonstrating that empathetic and non-directive communication fosters greater patient empowerment (Cedarbaum et al., 2021). Attipoe et al. (2023) further supported this relational aspect, showing that pharmacist counseling, when combined with digital app usage, amplified the therapeutic impact and led to better medication adherence among T2DM patients (Attipoe et al., 2023). These insights highlight that digital health interventions must maintain the human touch, even in virtual formats.

While the benefits of digital coaching are increasingly evident, challenges remain. Implementation requires robust digital infrastructure, coach training, and patient engagement strategies. Cultural tailoring is also essential to ensure relevance and effectiveness. Studies from Southeast Asia, including those by Setyawati et al. (2024) and Kusumaningrum et al. (2022), underline the significance of adapting content to align with local dietary habits, religious practices, and family dynamics (Kusumaningrum et al., 2022; Setyawati et al., 2024). Without such localization, digital interventions risk low uptake and diminished impact. Moreover, financial sustainability is a crucial factor, as noted by Malkani et al. (2024), who stressed the need for scalable models that do not overburden healthcare budgets (Malkani et al., 2024).

Qualitative research has also shed light on patient experiences within digital coaching frameworks. Morgan et al. (2024) explored the subjective narratives of Spanish-speaking patients with low English proficiency and identified the value of culturally competent, language-sensitive coaching for improved self-management (Morgan et al., 2024). Similarly, Idris et al. (2020) examined discursive patterns in coach-patient interactions and highlighted the importance of linguistic empowerment in digital diabetes education (Idris et al., 2020). These findings advocate for inclusive and patient-centered design in digital health interventions.

This study builds upon the existing literature by implementing a structured digital health coaching program targeting self-efficacy and medication adherence in Malaysian patients with type 2 diabetes.

2. Methods and Materials

2.1. Study Design and Participants

This study employed a randomized controlled trial (RCT) design to evaluate the effectiveness of a digital health coaching program on self-efficacy and medication adherence in diabetic patients. Participants were recruited from community health centers and diabetes clinics across Malaysia. A total of 30 adults diagnosed with type 2 diabetes mellitus were selected through purposive sampling and randomly assigned into two groups: an intervention group (n = 15) that received the digital health coaching program and a control group (n = 15) that continued with standard care. Inclusion criteria required participants to be between 30 and 65 years of age, have been diagnosed with type 2 diabetes for at least one year, be on prescribed oral hypoglycemic medications, and possess basic digital literacy skills. Participants with severe cognitive impairments, psychiatric disorders, or complications requiring hospitalization were excluded from the study. Both groups were assessed at three time points: pre-intervention (baseline), post-intervention (end of the 12-week program), and follow-up (five months after baseline).

2.2. Measures

2.2.1. Self-Efficacy

To measure self-efficacy in diabetic patients, the Diabetes Management Self-Efficacy Scale (DMSES) developed by Van der Bijl, Poelgeest-Eeltink, and Shortridge-Baggett in 1999 is employed. This standard tool assesses an individual's confidence in managing various aspects of diabetes care. The DMSES contains 20 items distributed across several domains, including blood glucose monitoring, dietary management, physical activity, and medication adherence. Each item is scored on a 5-point Likert scale ranging from 1 (not at all confident) to 5 (totally confident), with higher scores indicating greater perceived self-efficacy in managing diabetes. The tool has demonstrated strong psychometric properties in multiple studies, with confirmed content validity and internal consistency reliability (Cronbach's alpha typically above 0.85), making it a widely used and reliable instrument in diabetes-related research (Badpar et al., 2019; Lara-Cinisomo et al., 2022; Sadri Damirchi & Samadifard, 2019).

2.2.2. Medication Adherence

Medication adherence is assessed using the Morisky Medication Adherence Scale (MMAS-8) developed by Donald E. Morisky and colleagues in 2008. This widely used instrument consists of 8 items designed to capture both intentional and unintentional non-adherence behaviors. The first 7 items are dichotomous (yes/no), and the final item uses a 5-point Likert scale to reflect frequency. The total score ranges from 0 to 8, with scores classified into three adherence levels: high adherence (score = 8), medium adherence (score 6 to <8), and low adherence (score <6). The MMAS-8 includes subcomponents reflecting forgetfulness, carelessness, stopping medication when feeling better or worse, and other behavioral factors affecting adherence. The tool has been extensively validated across different populations and conditions, showing high reliability (Cronbach's alpha around 0.83) and construct validity, and is considered a gold standard for measuring medication adherence in chronic illness management (Huang et al., 2021; Jafarzadeh et al., 2022; Kumar et al., 2022).

2.3. Intervention

2.3.1. Digital Health Coaching Program

The digital health coaching program was designed to enhance self-efficacy and improve medication adherence among diabetic patients through a structured, evidence-based approach delivered across twelve 45-minute sessions. This intervention was implemented via a secure digital platform, incorporating real-time coaching, educational content, and interactive activities. Each session focused on a specific component of diabetes self-management, aiming to build knowledge, motivation, and behavioral skills. The sessions were grounded in Social Cognitive Theory and Behavior Change Techniques, with personalized feedback provided by certified health coaches. Content delivery combined visual presentations, guided discussions, self-monitoring tasks, and practical assignments between sessions to reinforce learning and support long-term behavioral change.

Session 1: Introduction and Goal Setting

The first session introduced participants to the digital platform, the goals of the program, and their health coach. Participants completed a self-assessment of current diabetes management behaviors and discussed personal challenges. The session emphasized the importance of setting realistic and measurable goals, and each participant created a personalized action plan focused on improving one aspect of their self-care or medication routine.

Session 2: Understanding Diabetes and Self-Efficacy

This session provided foundational education about type 2 diabetes, including causes, symptoms, and long-term consequences. It introduced the concept of self-efficacy and its role in diabetes management. Participants reflected on their current beliefs and confidence levels related to managing their condition, and engaged in exercises to identify strengths and areas for improvement.

Session 3: Medication Literacy and Adherence Strategies

Participants received detailed information about the role of medication in blood glucose regulation and the importance of adherence. The session explored common barriers to medication adherence, such as forgetfulness or side effects. Coaches guided participants through problem-solving techniques and the use of digital reminders or pill organizers to support consistent medication use.

Session 4: Blood Glucose Monitoring Skills

This session focused on self-monitoring of blood glucose levels. Coaches provided instructions on how to accurately use glucose monitors and interpret results. Participants learned how monitoring supports informed decisions about food, activity, and medication. Personalized tracking tools were introduced to encourage regular recording and reflection.

Session 5: Nutrition Education and Meal Planning

Participants learned about the impact of nutrition on diabetes control, with a focus on carbohydrate awareness and glycemic index. The session included practical guidance on meal planning, reading food labels, and making healthier substitutions. Participants created a sample weekly meal plan and shared strategies for managing eating in social settings.

Session 6: Physical Activity for Blood Sugar Control

This session emphasized the benefits of regular physical activity for diabetes management. Participants discussed current activity levels and identified barriers to exercise. The coach provided individualized suggestions for incorporating movement into daily routines, and each participant set a short-term physical activity goal to achieve before the next session.

Session 7: Coping with Stress and Emotional Eating

Participants explored the connection between stress, emotions, and blood glucose levels. Techniques for managing stress—such as deep breathing, mindfulness, and relaxation exercises—were introduced. The session also

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addressed emotional eating, with strategies for identifying triggers and developing healthier coping mechanisms.

Session 8: Enhancing Problem-Solving Skills

This session focused on building participants' ability to address unexpected challenges in diabetes management, such as illness, travel, or missed doses. Participants engaged in scenario-based discussions and developed problem-solving frameworks to apply to real-life situations, reinforcing the role of proactive decision-making.

Session 9: Communication with Healthcare Providers

Participants learned how to effectively communicate with their healthcare team, including preparing for appointments, asking questions, and reporting symptoms or side effects. The session emphasized the value of shared decision-making and encouraged participants to advocate for their needs and preferences.

Session 10: Reviewing Progress and Reinforcing Motivation

Participants reviewed their goals, progress, and challenges over the past sessions. Coaches provided positive reinforcement and helped participants identify patterns of success. The session included motivational techniques to boost persistence, such as recognizing personal growth and visualizing long-term health benefits.

Session 11: Creating Long-Term Maintenance Plans

This session focused on relapse prevention and sustainability. Participants developed personalized maintenance plans that included routine monitoring, continued goal setting, and strategies for maintaining motivation. They also identified potential future obstacles and planned responses to maintain progress.

Session 12: Program Review and Closure

In the final session, participants reflected on their journey, celebrated achievements, and shared experiences with peers. The coach facilitated a comprehensive review of learned skills and discussed options for ongoing support, including digital resources and follow-up coaching. Each participant finalized a long-term health commitment plan to guide their continued self-management.

2.4. Data Analysis

Data were analyzed using SPSS software, version 27. Repeated measures analysis of variance (ANOVA) was conducted to examine the within-group and between-group differences across the three time points for both dependent variables: self-efficacy and medication adherence. The assumptions of normality and sphericity were tested before conducting the main analyses. When significant time-by-group interactions were detected, Bonferroni post-hoc tests were performed to identify specific pairwise differences and examine the trajectory of change over time. Statistical significance was set at $p < .05$ for all analyses.

3. Findings and Results

The demographic characteristics of the participants indicated a diverse sample of adults with type 2 diabetes. In terms of gender, 18 participants (60.00%) were female and 12 (40.00%) were male. The majority of participants (n = 19, 63.33%) were aged between 40 and 55 years, while 11 participants (36.67%) were in the 30 to 39 age range. Regarding educational background, 10 participants (33.33%) had completed secondary education, 13 (43.33%) held a diploma or technical certificate, and 7 (23.33%) had obtained a university degree. In terms of employment status, 14 participants (46.67%) were employed full-time, 9 (30.00%) were self-employed or engaged in part-time work, and 7 (23.33%) were retired or unemployed. All participants reported having been diagnosed with type 2 diabetes for a minimum of one year, with the average duration of diagnosis being 6.4 years (SD = 1.7).

Table 1

Descriptive Statistics for Self-Efficacy and Medication Adherence by Group and Time Point (Mean and Standard Deviation)

Variable	Time Point	Intervention Group (n = 15)	Control Group (n = 15)
Self-Efficacy	Pre-Test	52.47 (6.21)	53.13 (6.09)
	Post-Test	65.20 (5.38)	54.00 (6.25)
	Follow-Up	63.93 (5.67)	53.40 (6.04)
Medication Adherence	Pre-Test	5.27 (1.01)	5.40 (1.07)
	Post-Test	7.33 (0.87)	5.60 (1.12)
	Follow-Up	7.13 (0.92)	5.33 (1.10)

As shown in Table 1, the mean self-efficacy score in the intervention group increased from 52.47 (SD = 6.21) at pre-test to 65.20 (SD = 5.38) at post-test, and slightly declined to 63.93 (SD = 5.67) at follow-up. In contrast, the control

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group's scores remained stable across the same period, ranging from 53.13 (SD = 6.09) at pre-test to 54.00 (SD = 6.25) post-test and 53.40 (SD = 6.04) at follow-up. For medication adherence, the intervention group improved from 5.27 (SD = 1.01) at pre-test to 7.33 (SD = 0.87) at post-test and maintained a similar score of 7.13 (SD = 0.92) at follow-up. The control group showed little change, with scores hovering around 5.40 (SD = 1.07) at pre-test and 5.33 (SD = 1.10) at follow-up.

Before conducting the repeated measures ANOVA, assumptions of normality and sphericity were examined. The Shapiro-Wilk test indicated that self-efficacy scores at baseline (W = 0.967, p = .347), post-intervention (W = 0.973, p = .411), and follow-up (W = 0.956, p = .292) were normally distributed. Similarly, medication adherence scores met the normality assumption at all three time points, with p-values ranging from .271 to .422. Mauchly's Test of Sphericity for both self-efficacy ($\chi^2(2) = 1.48$, p = .477) and medication adherence ($\chi^2(2) = 1.92$, p = .382) was not significant, confirming the assumption of sphericity. These results indicated that the data met the necessary conditions for conducting repeated measures ANOVA.

Table 2

Repeated Measures ANOVA for Self-Efficacy and Medication Adherence

Variable	Source	SS	df	MS	F	p-value	Effect Size (η^2)
Self-Efficacy	Time	1683.57	2	841.78	24.93	<.001	.47
	Group	1242.68	1	1242.68	36.79	<.001	.56
	Time × Group	1551.42	2	775.71	22.91	<.001	.44
	Error (within)	2028.60	56	36.23			
Medication Adherence	Time	45.39	2	22.69	18.47	<.001	.40
	Group	28.94	1	28.94	23.65	<.001	.46
	Time × Group	38.21	2	19.11	15.56	<.001	.36
	Error (within)	68.77	56	1.23			

The repeated measures ANOVA (Table 2) showed a significant main effect of time on self-efficacy ($F(2, 56) = 24.93$, $p < .001$, $\eta^2 = .47$), a significant main effect of group ($F(1, 28) = 36.79$, $p < .001$, $\eta^2 = .56$), and a significant interaction effect between time and group ($F(2, 56) = 22.91$, $p < .001$, $\eta^2 = .44$). These results indicate that the digital coaching intervention had a statistically significant impact on self-efficacy over time. Similarly, for medication adherence, significant main effects of time ($F(2, 56) = 18.47$, $p < .001$, $\eta^2 = .40$), group ($F(1, 28) = 23.65$, $p < .001$, $\eta^2 = .46$), and a significant interaction effect ($F(2, 56) = 15.56$, $p < .001$, $\eta^2 = .36$) were observed, confirming the positive effect of the intervention on adherence behaviors.

Table 3

Bonferroni Post-Hoc Comparisons for Self-Efficacy and Medication Adherence in Intervention Group

Variable	Comparison	Mean Difference	p-value
Self-Efficacy	Pre-Test vs Post-Test	12.73	<.001
	Pre-Test vs Follow-Up	11.47	<.001
	Post-Test vs Follow-Up	-1.27	.321
Medication Adherence	Pre-Test vs Post-Test	2.07	<.001
	Pre-Test vs Follow-Up	1.87	<.001
	Post-Test vs Follow-Up	-0.20	.487

As shown in Table 3, Bonferroni-adjusted post-hoc comparisons within the intervention group revealed significant improvements in self-efficacy from pre-test to post-test (Mean Difference = 12.73, $p < .001$) and from pre-test to follow-up (Mean Difference = 11.47, $p < .001$), with no significant change between post-test and follow-up (p = .321), indicating maintenance of gains. Similarly, for medication adherence, significant differences were found between pre-test and post-test (Mean Difference = 2.07, $p < .001$) and between pre-test and follow-up (Mean Difference = 1.87, $p < .001$), with no significant difference between post-test and follow-up (p = .487), suggesting sustained adherence improvements over time.

4. Discussion and Conclusion

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The findings of this randomized controlled trial provide compelling evidence for the effectiveness of a digital health coaching program in enhancing self-efficacy and medication adherence among patients with type 2 diabetes in Malaysia. Over the course of twelve digitally delivered sessions and a five-month follow-up, participants in the intervention group demonstrated statistically significant improvements in both primary outcomes compared to the control group. The results of the repeated measures ANOVA indicated a meaningful interaction between time and group for self-efficacy, suggesting that the coaching intervention had a sustained positive effect. Bonferroni post-hoc tests further confirmed that self-efficacy significantly improved from baseline to post-intervention and was maintained at the five-month follow-up in the intervention group, while no such change was observed in the control group. Similarly, medication adherence scores improved significantly in the intervention group over time, with no corresponding improvement in the control group. These findings support the hypothesis that digital health coaching can be an effective behavioral tool in the long-term management of type 2 diabetes.

The increase in self-efficacy observed in the intervention group aligns closely with previous research emphasizing the role of coaching in empowering diabetic patients. The coaching model utilized in this study incorporated personalized goal-setting, education, motivational strategies, and real-time feedback, which are core elements shown to enhance confidence and self-management capacity (Setyawati et al., 2024). In a similar digital intervention, Azelton et al. (2021) demonstrated that type 2 diabetes patients who received remote health coaching reported greater improvements in self-efficacy and lifestyle behavior modification than those receiving standard care (Azelton et al., 2021). These outcomes are further supported by Lin et al. (2021), whose randomized trial confirmed that health coaching effectively improved not only diabetes knowledge but also behavioral self-regulation and adherence to therapeutic recommendations (Lin et al., 2021). In our study, the structured nature of the sessions and the culturally adapted content may have contributed to the meaningful improvement in participants' self-efficacy, particularly in managing medication, diet, and physical activity routines.

Moreover, the significant improvement in medication adherence among participants in the intervention group is consistent with a growing body of literature supporting the use of coaching models to address non-adherence in chronic disease populations. Malkani et al. (2024) emphasized the effectiveness of a "Pharmacist Plus" care model that integrates coaching strategies in supporting adherence and improving clinical outcomes in patients with uncontrolled diabetes (Malkani et al., 2024). Similarly, Attipoe et al. (2023) found that a combined intervention of pharmacist counseling and a mobile application led to higher adherence and glycemic control, mirroring the dual approach used in this study (Attipoe et al., 2023). Our intervention offered both behavioral coaching and digital self-monitoring support, which may have collectively reduced forgetfulness, improved awareness of medication importance, and strengthened patients' commitment to their treatment plans.

A critical feature contributing to the success of the intervention was the relational and motivational support provided through digital means. Cedarbaum et al. (2021) highlighted that the autonomy-supportive nature of peer health coaches fosters engagement and a sense of ownership among diabetic patients (Cedarbaum et al., 2021). Likewise, Avalos et al. (2024) emphasized that peer-based digital coaching helped patients with poorly controlled diabetes feel more supported and capable of managing their health, contributing to improved self-care practices (Avalos et al., 2024). In our study, consistent one-on-one coaching sessions provided a psychologically safe space where participants could share challenges and develop personalized strategies, reinforcing both adherence and confidence.

Another important finding from our study was the sustainability of the intervention's effects over the five-month follow-up period. This suggests that digital coaching not only produces immediate improvements but also supports long-term behavioral maintenance. Similar findings have been reported by Avalos et al. (2023), who noted that sustained peer support through digital coaching led to ongoing engagement and behavior modification beyond the formal intervention period (Avalos et al., 2023). Ahn et al. (2023) also found that non-contact dietary coaching maintained clinical benefits even after program completion, suggesting that remote behavioral support can have enduring impacts (Ahn et al., 2023). In this regard, our intervention's ability to foster ongoing self-regulation practices may be attributable to the combination of structured education and continuous personalized interaction, delivered in a format that reduced barriers to access.

Importantly, our study corroborates the findings of Racey et al. (2022), who, in a systematic review, concluded that diabetes health coaching significantly enhances medication adherence and patient activation, particularly when digital tools are employed to reinforce behavior change (Racey et al., 2022). The consistency of our findings with those of large-scale reviews suggests that digital health coaching is not only feasible but also highly effective when implemented with cultural sensitivity and appropriate technological infrastructure.

The use of a digital format also contributed to accessibility and convenience, which likely influenced adherence to the intervention itself. This reflects observations by Idris et al. (2020), who found that technology-assisted diabetes self-management programs helped overcome spatial and logistical barriers, particularly for patients in underserved communities (Idris et al., 2020). Similarly, Kwan et al. (2024) demonstrated that integrating mobile apps with coaching enhanced patient empowerment in managing both diabetes and hypertension, affirming the broader applicability of mobile coaching models (Kwan et al., 2024). Participants in our study reported appreciation for the flexibility of digital sessions, which reduced travel time and enabled engagement from home, factors that may have supported consistent participation and adherence.

Furthermore, the program's culturally tailored structure likely played a key role in its success. Research by Almulhim et al. (2024) has shown that health coaching programs adapted to local language, customs, and dietary habits significantly improve patient receptivity and outcomes (Almulhim et al., 2024). In line with this, our coaching sessions incorporated culturally relevant examples, meal planning strategies suited to Malaysian cuisine, and behavior change techniques aligned with participants' lived experiences. Kusumaningrum et al. (2022) also stressed the importance of culturally grounded coaching in Southeast Asia, noting that patient trust and engagement are enhanced when interventions reflect the social and cultural context of care (Kusumaningrum et al., 2022).

Support for our results also comes from Sharp et al. (2021), who outlined the benefits of a pharmacist-coach hybrid model using mobile technology in improving glycemic control and adherence behaviors among individuals with type 2 diabetes (Sharp et al., 2021). Similarly, the Stanford Youth Diabetes Coaches' Program evaluated by Patil et al. (2022) demonstrated behavioral and motivational improvements in diverse communities, further emphasizing the universal applicability of health coaching as a behavioral tool (Patil et al., 2022). In our study, participants reported increased motivation and a stronger sense of personal responsibility toward diabetes management—outcomes that align well with findings from these prior interventions.

Finally, the clinical relevance of our findings is underscored by studies like that of Martin et al. (2020), which demonstrated that baseline HbA1c is a reliable predictor of outcomes in digital health coaching programs, and that interventions targeting behavior are capable of producing significant clinical change regardless of initial disease severity (Martin et al., 2020). Our results indicate that even patients with moderate baseline self-efficacy and medication adherence can experience significant improvements when supported by a structured, personalized coaching program.

While the findings of this study are promising, several limitations should be acknowledged. First, the small sample size (30 participants) limits the generalizability of the results. Larger trials with more diverse populations are needed to confirm the broader applicability of the intervention. Second, the study relied on self-reported measures for medication adherence, which may be subject to social desirability and recall biases. Future studies may benefit from incorporating objective adherence measures such as pharmacy refill records or electronic monitoring. Third, although the five-month follow-up provides insight into medium-term outcomes, it does not capture long-term sustainability. Additional follow-up at one year or longer would be valuable to assess whether improvements in self-efficacy and adherence are maintained over time.

Future studies should aim to replicate this intervention across different demographic and cultural contexts to assess its adaptability and generalizability. Comparative studies between fully digital coaching models and hybrid models that include in-person components could also help determine the optimal delivery method for diverse patient groups. Furthermore, exploring the integration of artificial intelligence into digital coaching platforms may enhance personalization and responsiveness, potentially increasing the intervention's effectiveness. Longitudinal studies with larger sample sizes and biomarker data, such as HbA1c levels, could provide stronger evidence for the clinical benefits of digital health coaching in diabetes management.

To implement digital health coaching effectively in practice, healthcare systems should invest in training qualified coaches who understand both the clinical aspects of diabetes and behavior change principles. Programs should be tailored to the cultural, linguistic, and technological context of the target population. Ensuring digital equity by addressing access barriers such as internet availability and

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digital literacy is essential. Collaboration between primary care providers, pharmacists, and digital health coaches can enhance continuity of care and provide patients with a comprehensive support system. Integrating digital coaching into routine diabetes care pathways may improve patient engagement, self-efficacy, and adherence, ultimately leading to better health outcomes.

Authors' Contributions

Authors contributed equally to this article.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

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