

Original article

Hybrid digital lifestyle medicine program and glycemic trends in type 2 diabetes: a pilot study in a Thai primary care setting

Weerin Susiriwatananont^{a,*}, Arpasiri Normsars^a, Itchaya Pluembamroe^a, Woranan Choochan^b, Wiracha Nithisateinchai^a, Natthanit Sapsitthikul^a, Sangduane Puttaragsa^a, Natcha Nantapatavee^a

^aDepartment of Social Medicine, BangPlee Hospital, Samut Prakan, Thailand

^bDivision of Community Health Nurse, Bangplee Hospital, Samut Prakan, Thailand

Abstract

Background: To align with Thailand's 2025 "non-communicable diseases Remission" policy, the researchers developed the Hybrid Digital Lifestyle Medicine Program.

Objective: To evaluate the effectiveness of this program on glycemic and metabolic outcomes in patients with type 2 diabetes mellitus (T2DM) within a primary care setting.

Methods: This quasi-experimental pilot study enrolled patients with T2DM at primary care unit of Bangplee Hospital. Participants self-selected into the intervention (LM) or control groups. Both received standard care, motivational interviewing, and Lifestyle Medicine counselling. The LM group received an additional hybrid digital lifestyle medicine program. A follow-up was conducted over six months, with the primary endpoint being 3-month HbA1c change. Data were analyzed using modified Intention-to-Treat method and analysis of covariance.

Results: Forty-six participants were enrolled (LM = 22, control = 24). At 3 months, the primary endpoint did not demonstrate between-group superiority ($P = 0.17$). However, the LM group demonstrated a significant within-group HbA1c reduction of 0.65% ($P = 0.012$). By month 6, the LM group achieved a sustained within-group HbA1c decrease of 0.8% ($P = 0.031$) and a significant reduction in antihypertensive pill burden ($P = 0.026$). Inter-group analysis showed superior improvements in LM group for body mass index ($P = 0.001$), systolic blood pressure ($P = 0.038$) and triglycerides ($P = 0.049$). Behavioral analysis revealed 65.0% of LM group were progressors in their stages-of-change ($P = 0.007$) with zero regression.

Conclusion: The hybrid digital LM program is feasible and effective for enhancing metabolic profiles and behavioral change in Thai primary care. It facilitates NCD remission without escalating pharmacotherapy, offering high scalability for resource-constrained clinical settings.

Keywords: Health behavior, lifestyle medicine, primary health care, telemedicine, type 2 diabetes.

*Correspondence to: Weerin Susiriwatananont, Bangkeaw, Bangphli, Samutprakarn 10540.

E-mail: emcinpry.mafu@gmail.com

Received: March 10, 2026

Revised: June 8, 2026

Accepted: July 20, 2026

Global disease burden forecasts predict a continued transition from communicable diseases toward non-communicable diseases (NCDs). By 2050, non-communicable diseases are projected to dominate the global health landscape, accounting for nearly 78.0% of all disability-adjusted life years.⁽¹⁾ This trajectory signals a substantial escalation in the burden of premature mortality and long-term disability. The trend is mirrored in Thailand. According to the Thai National Health Survey (NHES) 2024–2025, metabolic syndrome and diabetes are primary drivers of the national NCD burden, with a prevalence of 28.4% and 10.6%, respectively. Despite wide diabetes treatment coverage (> 90.0%), fewer than one-third of patients (28.6%) achieve optimal glycemic control.⁽²⁾ This disparity represents a critical challenge, as poor control leads to significant microvascular and macrovascular complications.⁽³⁾

Suboptimal diabetes control is particularly prevalent in the working-age population and is largely attributed to unhealthy lifestyle behaviors. Since lifestyle modification is the cornerstone of metabolic management⁽⁴⁾, there is an urgent need to expand healthcare channels beyond traditional clinic visits. The expansion of telehealth in Thailand carries the potential to improve the quality of diabetes care by facilitating remote continuous care. By reducing geographical and time-based barriers, telemedicine enables high-frequency support for behavioral change, while simultaneously alleviating hospital congestion and increasing patient convenience.⁽⁵⁾

In alignment with the 2025 Thai national health policy focusing on “NCD Remission”, this research recognizes that while the benefits of lifestyle modification are well-established, their integration into standard clinical practice remains hindered by a lack of dedicated delivery channels. Achieving sustainable remission requires a transition from traditional, episodic pharmacological management toward continuous, active lifestyle interventions. We therefore aim to evaluate a scalable hybrid program that bridges this implementation gap by delivering Lifestyle Medicine through motivational interviewing techniques, integrated within a digital telemedicine framework. The primary objective of this study was to evaluate the efficacy of a 3-month hybrid digital Lifestyle Medicine program on HbA1c reduction in patients with T2DM compared to a control group. Secondary objectives include assessing longitudinal changes in metabolic parameters—comprising body mass index (BMI), waist circumference (WC), blood pressure (BP), and lipid profiles—in conjunction with evaluations of pill burden and behavioral progression

according to the stages-of-change (SOC) model at six months.

Materials and methods

Study design and participants

This was a quasi-experimental study conducted at two primary care units of Bangplee Hospital, Samut Prakan, Thailand. The study involved a 3-month intervention phase with a total longitudinal follow-up of six months. Patients with T2DM were enrolled and assigned to either the hybrid digital Lifestyle Medicine program group (LM) or a control group. Allocation was determined by voluntary enrollment, based on willingness and technical readiness of participants to engage with the digital health platform.

This study received ethical approval from the Institutional Review Board (IRB no. 4/2568) on 7 February 2025. All participants were informed about the study’s objectives and procedures, and written informed consent was obtained from all individual participants included in the study before enrollment.

Eligibility criteria

Inclusion criteria were: 1) age ≥ 18 years; 2) confirmed T2DM with HbA1c levels 7.0% to 10.0% within the preceding six months; 3) insulin-naïve status or documented refusal of insulin therapy; and 4) literacy and proficiency in mobile instant messaging. Patients with 1) > 3 chronic comorbidities; 2) functional impairment, defined as the loss of > 2 Basic (bADL) or Instrumental Activities of Daily Living (iADL) 3) cognitive impairment; 4) unstable cardiac status or recent myocardial infarction; 5) chronic kidney disease (CKD) stage > 3; and 6) atypical diabetes profiles (type 1 diabetes, latent autoimmune diabetes, gestational diabetes, or early-onset T2DM) were excluded.

Intervention protocol

Participants in both groups received standard medical care, motivational interviewing, and lifestyle medicine counseling based on the six pillars of lifestyle medicine, and access to the hospital’s educational media. In addition, the LM group received a 3-month hybrid digital intervention consisting of weekly interactive digital health education and monthly remote coaching. The digital content consisted of weekly evidence-based modules focusing on the six pillars of lifestyle medicine (including tailored nutrition for NCDs, physical activity, sleep, stress management, social support, and substance cessation) delivered via a mobile instant messaging application (LINE; LY Corporation, Tokyo, Japan) for 12 weeks, featuring

two-way interactive support for participant inquiries. Remote coaching consisted of monthly one-on-one telephone sessions designed to reinforce behavioral modifications and provide personalized guidance. A schematic representation of the 3-month hybrid digital lifestyle medicine intervention workflow compared to standard care is presented in **Figure 1**. A summary of the weekly digital educational content is provided in **Supplementary material 1**.

Data collection and outcome

Metabolic markers (HbA1c, FBS), anthropometric measurements (BP, BMI, WC) and medication pill burden were collected at baseline, three months, and six months. Lipid profiles were assessed at baseline and 6 months. Behavioral progression was assessed

via in-depth interviews using the SOC model. Adherence was monitored through the frequency of successful coaching calls and consistency of interactions via the digital messaging platforms.

Statistical analysis

Sample size estimation was based on a standard two-independent-means formula. A cohort of 46 participants (23 per arm) provided 80.0% power (β) at a two-sided alpha of 0.05 to detect a minimum clinically important difference (d) of a 1.0% HbA1c reduction. The calculation assumed a population variance (σ^2) of 1.2, derived from baseline primary care unit data at Bangplee Hospital, and incorporated an anticipated 20.0% dropout rate. Normally distributed data are reported as mean and standard

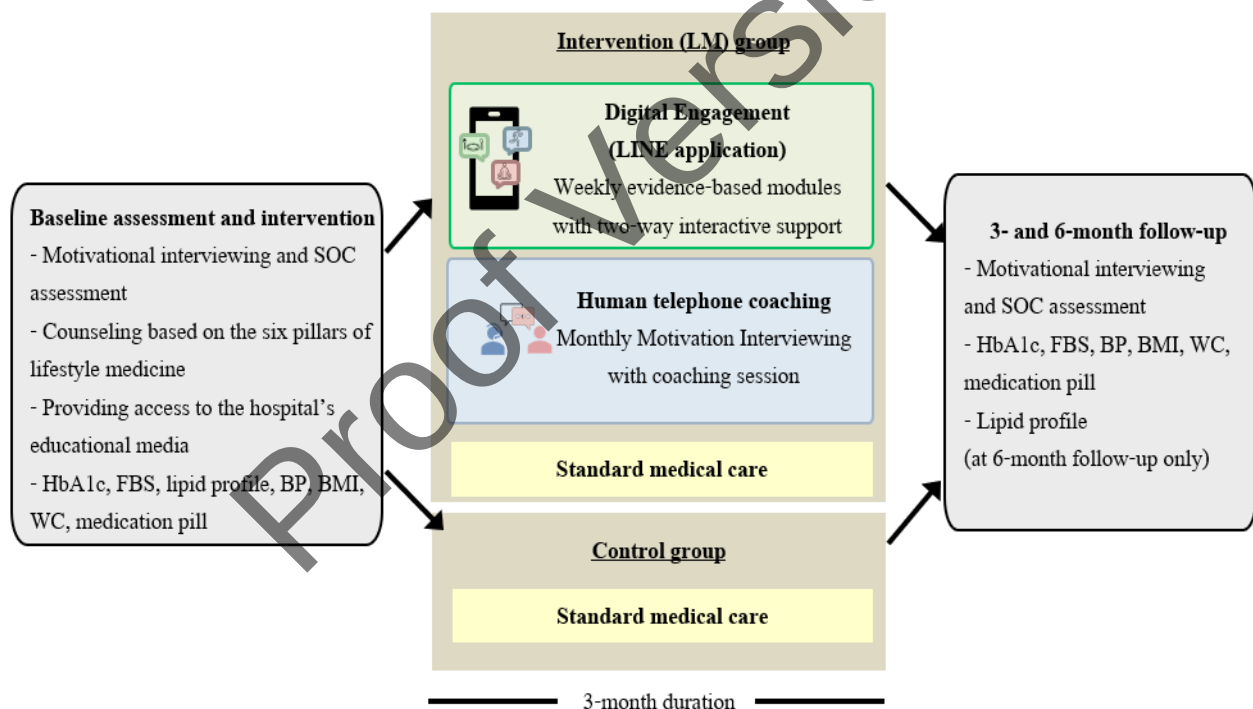


Figure 1. Schematic representation of the 3-month hybrid digital lifestyle medicine intervention workflow compared to standard care. Group allocation was determined via voluntary enrollment based on the willingness and technological readiness of participants to engage with the digital health platform. The lifestyle medicine (LM) arm combined standard medical care with weekly digital modules via the LINE application and monthly telephone coaching, whereas the control arm received standard medical care alone. Abbreviations: BMI, body mass index; WC, waist circumference; BP, blood pressure; FBS, fasting blood sugar; SOC, stage of change.

deviation (SD), while non-normal data are presented as median and interquartile range (IQR). Baseline intergroup comparisons utilized the unpaired Student's *t*-test, Wilcoxon rank-sum test, or Fisher's exact test, as appropriate. Within-group longitudinal changes were assessed via paired *t*-tests or Wilcoxon signed-rank tests. Efficacy was analyzed using a modified intention-to-treat (mITT) approach, defined as participants who attended at least one intervention session. Between-group comparisons of follow-up endpoints were performed using Analysis of Covariance (ANCOVA), adjusting for baseline values as covariates. Behavioral shifts according to the stage-of-change (SOC) model were categorized as progressors, stable, or regressors and analyzed using Fisher's exact test. Statistical significance was defined

as a two-tailed $P < 0.05$. All analyses were performed using Stata version 18.0 (StataCorp, College Station, TX, USA).

Results

Patient disposition and baseline characteristics

Between Mid-February and June 2025, a total of 738 patients across two primary care units (PCUs) at Bangplee Hospital were screened at the NCD diabetes clinics. Of these, 46 patients met the eligibility criteria and were enrolled. All 46 participants (LM group, $n = 22$; Control group, $n = 24$) completed the 3-month primary endpoint follow-up. At 6 months, four patients (8.7%) were lost to follow-up (two from each group), resulting in 42 patients for the final longitudinal analysis (**Figure 2**).

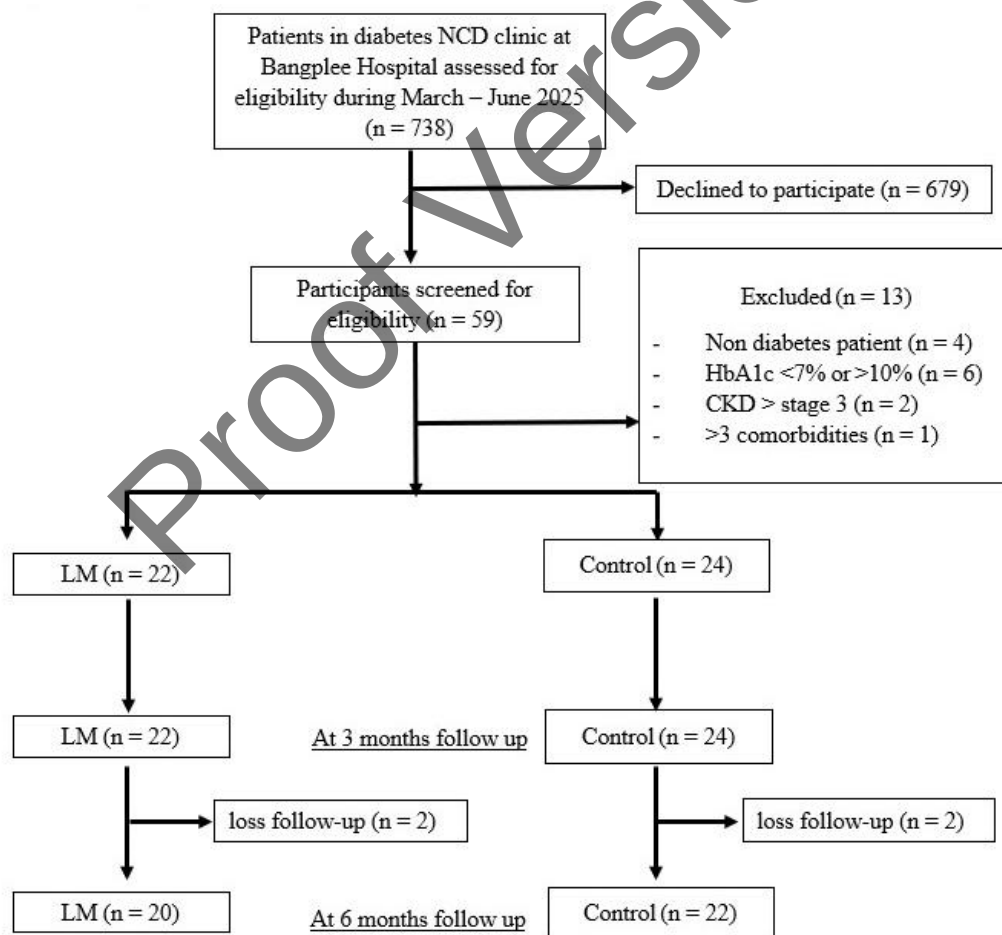


Figure 2. Patient disposition. The diagram illustrates the screening, enrollment, and follow-up process of the study participants over the 6-month period. A total of 42 patients completed the final longitudinal analysis. LM, intervention group; NCD, non-communicable diseases; CKD, chronic kidney disease.

Table 1. Baseline characteristics.

	LM (n = 22)	Control (n = 24)	P-value*
Age (years), median (range)	59 (40 - 73)	62 (46 - 78)	0.19
Female (n, %)	17 (77.3%)	17 (70.8%)	0.74
BMI (kg/m ²), mean ± SD	28.7 ± 6.3	27.3 ± 3.9	0.38
Waist circumference (cm), mean ± SD	97.0 ± 12.8	95.0 ± 11.1	0.57
Obesity (BMI ≥ 25 kg/m ²)	15 (68.2%)	14 (58.3%)	0.48
DM duration (years)	8.3 ± 5.4	7.3 ± 4.8	0.52
Hypertension (n, %)	18 (81.8%)	21 (87.5%)	0.69
Dyslipidemia (n, %)	16 (72.7%)	21 (87.5%)	0.27
SBP (mmHg), median (IQR)	131 (128 - 140)	135 (129 - 147)	0.24
DBP (mmHg), median (IQR)	78 (73 - 82)	81 (72 - 85)	0.62
HbA1C (%), median (IQR)	7.8 (7.4 - 8.7)	7.5 (7.3 - 7.8)	0.058
FBS (mg/dL), median (IQR)	148 (132 - 176)	136 (127 - 150)	0.091
Total cholesterol (mg/dL), mean ± SD	206 ± 40	178 ± 34	0.012*
Triglyceride (mg/dL), median (IQR)	160 (133 - 172)	111 (73 - 165)	0.005*
LDL-C (mg/dL), mean ± SD	115 ± 36	95 ± 31	0.05
HDL-C (mg/dL), mean ± SD	54 ± 15	59 ± 13	0.17
State of change			0.089
Contemplation	8 (36.4%)	3 (12.5%)	
Preparation	12 (54.5%)	20 (83.3%)	
Action	2 (9.1%)	2 (4.2%)	
DM medication			
Number of classes, median (range)	2 (1 - 3)	2 (1 - 3)	0.41
Number of pills, median (range)	4.5 (1 - 10.5)	4 (1 - 9.5)	0.75
Metformin (n, %)	22 (100.0%)	23 (95.8%)	1.00
Glipizide (n, %)	14 (63.6%)	20 (83.3%)	0.18
Pioglitazone (n, %)	6 (27.3%)	8 (33.3%)	0.75
Number of HT pills, median (range)	2 (0 - 5)	2 (0 - 4)	0.93
Number of DLP pills, median (range)	1 (0 - 1.5)	1 (0 - 2)	0.092

Statistically significant values ($P < 0.05$) are Asterisks (*). LM: Intervention Group; BMI: Body Mass Index; DM: Diabetes mellitus; SBP: Systolic Blood Pressure; FBS: Fasting Blood Sugar; LDL-C: Low-Density Lipoprotein Cholesterol; HDL-C: High-Density Lipoprotein Cholesterol; HT: Hypertension; DLP: Dyslipidemia

Baseline characteristics were generally comparable between the two groups as shown in **Table 1**. No significant differences were observed regarding age, sex, BMI, WC, or BP. The prevalence of co-morbidities, T2DM duration, and initial medication pill burden were similar across both cohorts. However, the LM group presented with a significantly worse metabolic profile at baseline compared to the control group, including higher total cholesterol, triglycerides (TG), and LDL-C. Trends toward higher baseline HbA1c ($P = 0.058$) and FBS ($P = 0.091$) were also observed in the intervention group. Regarding behavioral readiness, a higher proportion of participants in the LM group were in the “Preparation” stage compared to the intervention group (83.3% vs. 54.5%; $P = 0.089$).

Intervention adherence and engagement

Participants in the LM group demonstrated high levels of program engagement. Universal passive digital engagement (100.0% read-receipt rate) and at least one successful telephone follow-up were achieved by all participants. Active two-way interaction via the mobile application was observed in 45.5% of the cohort, while 63.6% completed the full 3-month telephone coaching regimen. Overall, behavioral adherence was high, with 81.8% of participants meeting at least 25.0% of their self-defined lifestyle goals, and the majority (59.1%) exceeding 75.0% of the goal threshold as shown in **Table 2**.

Table 2. Engagement and adherence in the LM group.

Adherence metric	n (%)
Digital engagement (LINE application)	
Passive engagement (read all messages)	22 (100.0%)
Active engagement (two-way interaction)	10 (45.5%)
Telephone follow-up (once monthly for 3 months)	
At least one successful contact	22 (100.0%)
Completed all 3 sessions	14 (63.6%)
Completed 2 sessions	4 (18.2%)
Complete 1 session	4 (18.2%)
Adherence to behavioral change	
High adherence (> 75.0% of goals met)	13 (59.1%)
Partial adherence (25.0% - 75.0% of goal met)	5 (22.7%)
Low adherence (< 25.0% of goal met)	4 (18.2%)

Table 3. Glycemic control trends and intervention effect over 6 months.

HbA1c outcome	LM (n = 22)	Control (n = 24)	P-value*
Baseline HbA1c (%), median (IQR)	7.8 (7.4 - 8.7)	7.5 (7.3 - 7.8)	0.058
3-month HbA1c (%), median (IQR)	7.2 (6.8 - 8.4)	7.5 (7.1 - 7.8)	0.17
6-month HbA1c (%), median (IQR)	7.4 (6.7 - 8.5)	7.6 (7.0 - 8.2)	0.13
Within-group change			
Median change (baseline – 3 months)	-0.65 (-1.2, 0.2)	-0.1 (-0.5, 0.4)	-
Within-group P - value	0.012*	0.66	
Median change (baseline – 6 months)	-0.8 (-1.4, -0.1)	+0.1 (-0.4, 0.6)	-
Within-group P - value	0.031*	0.30	

P-value for between-group comparison (ANCOVA adjusted for baseline). Asterisks () indicate statistical significance at $P < 0.05$. LM, intervention group.

Primary outcome: HbA1c control trends

The primary outcome of HbA1c change is summarized in **Table 3**. Despite the higher baseline HbA1c, the LM group demonstrated a statistically significant within-group reduction in HbA1c at both 3-month and 6-month intervals. The median HbA1c in the LM group decreased from 7.8% (IQR 7.4 - 8.7) to 7.2% (IQR 6.8 - 8.4) at 3 months (median change -0.65; $P = 0.012$). The improvement was sustained at 6 months with a median HbA1c of 7.4% (IQR 6.7 - 8.5), representing a median reduction of 0.8% from baseline ($P = 0.031$). In contrast, the control group maintained stable HbA1c levels throughout the 6-month study period ($P > 0.05$ for all within-group comparisons shown in **Table 3** and **Figure 3**).

Comparing the two groups using ANCOVA to adjust for baseline imbalances, the difference in HbA1c levels between the LM and control groups did not reach statistical significance at 3 months ($P = 0.17$) or 6 months ($P = 0.13$). However, three participants in the LM group achieved the criteria for NCD remission (HbA1c < 6.5% without glucose-lowering medication for at least 3 months), whereas no participants in the control group reached this endpoint.

Secondary outcomes

At the 6-month follow-up, between-group analysis revealed significant improvements of BMI, SBP, and TG in the LM group. Regarding pill burden, diabetes medication counts remained stable in the LM group (median change 0.0; $P = 0.09$), while a significant within-group reduction in hypertension pill burden was observed ($P = 0.026$) as shown in **Table 4**. No significant changes in medication counts or metabolic markers were observed in the control group.

Behavioral outcomes: stages of change migration

The progression of behavioral readiness from baseline to 6 months differed significantly between the two groups ($P = 0.007$). Participants in the LM group demonstrated a positive shift in their readiness for change; 65.0% ($n = 13$) were categorized as progressors (improved SOC), compared to only 33.3% ($n = 7$) in the control group. Notably, none of the intervention group regressed during the study period, whereas 28.6% ($n = 6$) of the control group were regressors (declined SOC). The proportion of participants remaining stable was comparable between the LM (35.0%) and control (38.1%) groups. These behavioral transitions, illustrating the stabilization and advancement of lifestyle readiness through digital support, are visualized in **Figure 4**.

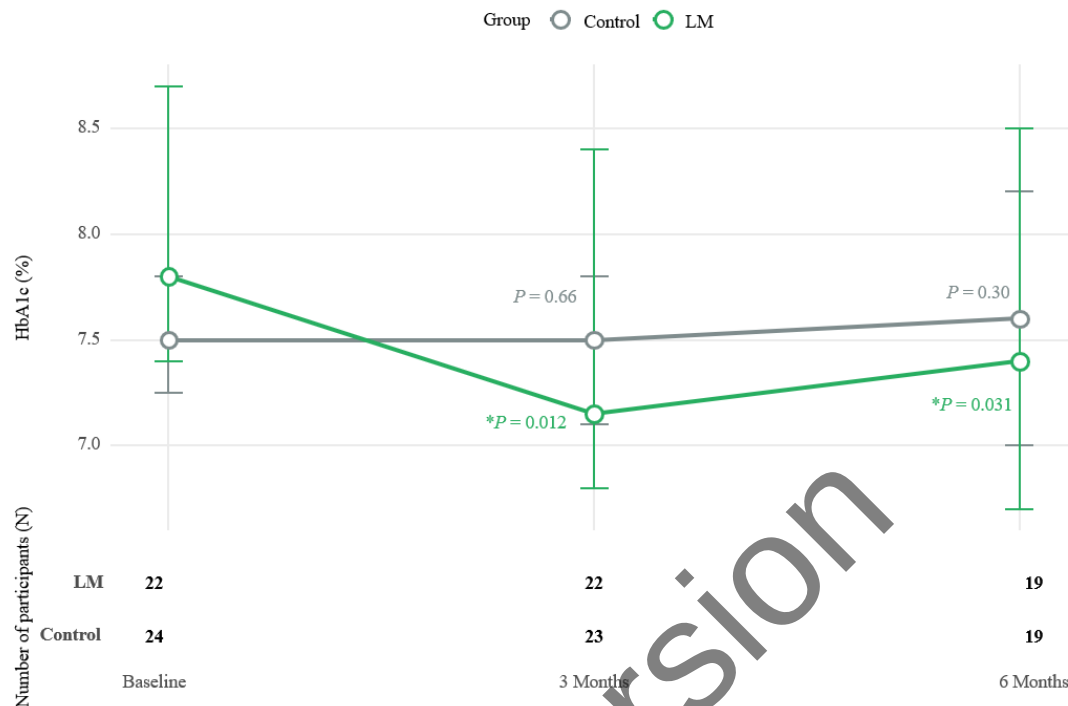


Figure 3. Longitudinal changes in HbA1c levels from baseline to 6 months. Data are presented as medians with IQRs represented by error bars. The intervention group demonstrated a significant reduction in HbA1c at 3-month (median change: -0.65; $P = 0.012$) and 6-month (median change: -0.8; $P = 0.031$) timepoints relative to baseline. The control group showed no significant change in HbA1c levels over the study period. P values denote within-group changes from baseline analyzed via the Wilcoxon signed-rank test. Asterisks (*) indicate statistical significance at $P < 0.05$. LM: intervention group.

Table 4. Secondary outcomes and intervention effect at 6 months.

Outcome measure	LM (n = 20)	Control (n = 22)	P-value*
BMI (kg/m ²), mean ± SD	27.1 ± 6.4	27.0 ± 3.8	0.001*
Within-group change, P- value	-1.6 ± 1.4, <0.001*	-0.1 ± 0.8, 0.69	-
WC (cm), mean ± SD	91.9 ± 13.2	93.5 ± 11.0	0.053
Within-group change, P- value	-5.2 ± 7.4, 0.006*	1.1 ± 4.9, 0.32	-
SBP (mmHg), median (IQR)	129 (125 - 137)	136 (130 - 143)	0.038*
Within-group change, P - value	-5.0 (-17.5, +8), 0.19	+0.5 (-6.0, +10.0), 0.90	-
FBS (mg/dL), median (IQR)	138 (119 - 180)	141 (130 - 148)	0.75
Within-group change, P - value	-20 (-51, +21), 0.22	-3 (-13, +14), 0.78	-
TC (mg/dL), mean ± SD	182 ± 30	185 ± 35	0.46
Within-group change, P - value	-29 ± 52, 0.027*	+7 ± 33, 0.32	-
LDL-C (mg/dL), mean ± SD	104 ± 29	99 ± 29	0.85
Within-group change, P - value	-18 ± 47, 0.12	+3 ± 25, 0.58	-
TG (mg/dL), mean ± SD	115 (80 - 200)	78 (67 - 201)	0.049*
Within-group change, P - value	-42 (-72, +31), 0.087	+5 (-17, 35), 0.47	-
DM pill burden, median (IQR)	3.0 (0.5 - 8.0)	4.75 (2.75 - 6.5)	0.38
Within-group change, P - value	-0.25 (-1.5, 0.0), 0.09	0.0 (0.0, 0.25), 0.65	-
DLP pill burden, median (IQR)	1.0 (1.0 - 1.0)	1.0 (1.0 - 1.0)	0.96
Within-group change, P - value	0.0 (0.0, 0.0), 0.95	0.0 (0.0, 0.0), 0.54	-
HT pill burden, median (IQR)	1.0 (0.0 - 3.0)	2.0 (0.5 - 2.75)	0.11
Within-group change, P - value	0.0 (-0.5, 0.0), 0.026*	0.0 (0.0, 0.0), 0.63	-

* P-value for between-group comparison (ANCOVA adjusted for baseline). Asterisks (*) indicate statistical significance at $P < 0.05$. LM, Intervention Group; BMI, Body Mass Index; WC, Waist circumference; SBP, Systolic Blood Pressure; FBS: Fasting Blood Sugar; TC, Total Cholesterol; LDL-C: Low-Density Lipoprotein Cholesterol; TG, Triglycerides; DM, Diabetes mellitus; DLP, Dyslipidemia; HT, Hypertension.

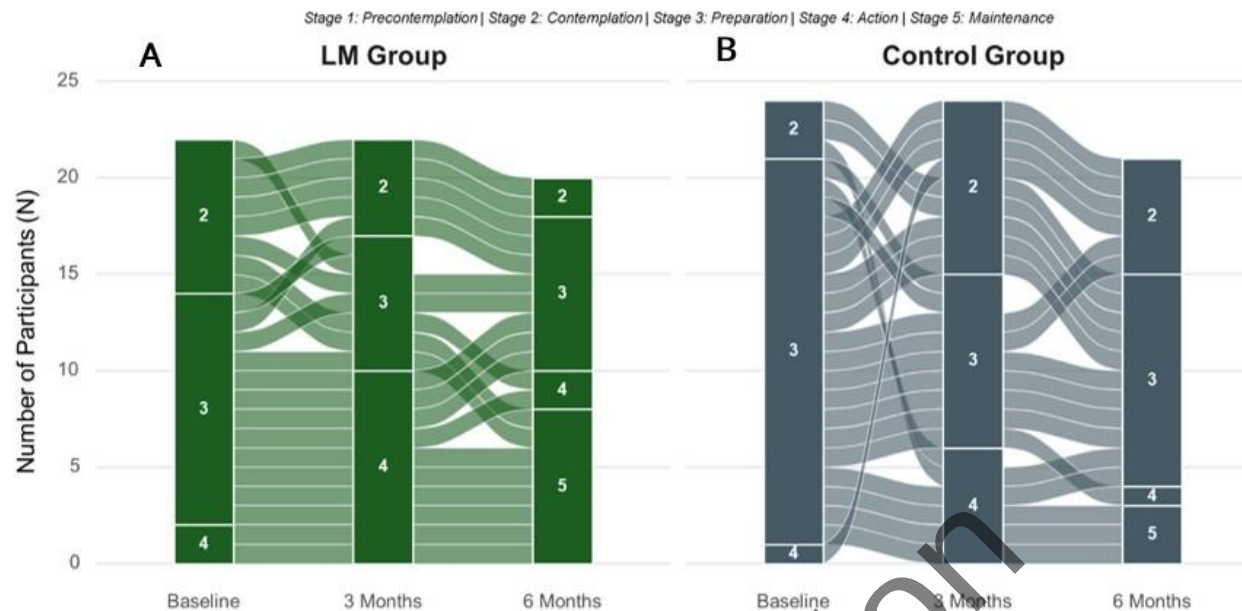


Figure 4. Diagram illustrating the migration in state-of-change for each participant over a 6-month period. The diagram shows the migration of individual participants through different behavioral stages over time. The LM group (A) shows a higher flow toward Stages 4 (Action) and 5 (Maintenance) by the 6-month mark compared to the Control group; (B) Each ribbon represents the path of participants as they progressed, maintained, or regressed in their readiness to change. LM, intervention group.

Discussion

This pilot study demonstrates that a 3-month hybrid lifestyle medicine program—integrating digital engagement via mobile messaging with structured telephone coaching—is a feasible and clinically effective strategy for managing cardiovascular risk factors in T2DM patients. Due to the small sample size and baseline imbalances, such as a less favorable baseline HbA1c in the intervention group, the between-group analysis for the primary HbA1c endpoint did not reach statistical significance. However, the clinically meaningful within-group HbA1c reduction of 0.8% in the intervention group suggests that the protocol provides a potent stimulus for glycemic improvement over time.

The broader systemic impact of the intervention is validated by the significant between-group differences achieved in key secondary cardiovascular and anthropometric outcomes at the 6-month endpoint, including BMI, SBP, and TG. This demonstrates that even when initial baseline disparities obscure between-group differences, a structured lifestyle intervention

can still drive improvements across key cardiovascular and anthropometric parameters by the 6-month timepoint.

Although this pilot study was underpowered to establish correlations between adherence metrics and specific clinical endpoints, we observe an alignment of behavioral mechanisms. The high passive digital engagement (100.0% message read rate) and active participation (63.6% completion of all three telephone coaching sessions) mirror the superior behavioral outcomes observed at 6 months. Within the LM group, 65.0% of participants were categorized as behavioral progressors according to the SOC model, and notably, 0.0% regressed. This sustained psychological readiness serves as the plausible driver behind the physical improvements recorded at the 6-month endpoint. The 59.1% of participants who had high adherence (> 75.0% of lifestyle goals met) closely parallel the cohort that achieved significant within-group reductions in BMI, WC, and TC. This alignment highlights that consistent digital and telephone engagement functions as a framework, translating participant compliance into measurable metabolic improvements.

The clinical implications of these findings are highly relevant for resource-limited primary care environments. Standard NCD care in Thailand is frequently episodic, characterized by long wait times and brief clinical encounters that leave little room for the intensive counseling required to alter sustained behavioral changes.⁽⁶⁾ This hybrid digital model successfully transforms traditional episodic care into a continuous health-coaching experience. By extending support beyond traditional clinic walls, these digital tools serve as a dynamic psychological platform that effectively sustains long-term patient motivation and active self-management.^(7, 8)

From a clinical management perspective, a major success of this protocol is that these comprehensive metabolic gains were achieved without escalating pharmacological doses. For patients with hypertension, the lifestyle modifications facilitated a statistically significant reduction in within-group pill burden. In an era where high-cost modern pharmacotherapies like SGLT2 inhibitors or GLP-1 receptor agonists dominate diabetes management, this model offers a safe, scalable, and low-cost alternative.⁽⁹⁻¹⁰⁾ This deprescribing potential is critical as the economic burden of NCDs in Thailand continues to rise.⁽¹¹⁻¹²⁾

A primary strength of this study is its pragmatic implementation within a real-world primary care clinic, demonstrating that digital interventions are feasible in non-specialized environments. However, several limitations must be noted. The single-center, quasi-experimental design and small sample size resulted in baseline variations that limited the statistical power to detect between-group HbA1c differences. Additionally, voluntary allocation introduces a potential digital enthusiast bias; however, patient willingness is an inherent component of any telehealth model and accurately reflects real-world clinical adoption. Furthermore, approximately 40.0% of the intervention group demonstrated low or partial adherence, completing only 1–2 coaching sessions. This suggests that a one-size-fits-all digital framework may be insufficient for a subset of patients, highlighting the need for highly personalized, adaptive compliance strategies in future larger-scale protocols. Finally, because lipid profiles were only recorded at baseline and 6 months, we cannot determine the exact temporal trajectory of these improvements, only their final 6-month utility.

Given the ongoing shortage and maldistribution of healthcare workers in Thailand,⁽¹³⁾ utilizing digital

lifestyle medicine principles represents a critical path forward. Future application of this model could incorporate artificial intelligence and large language models to automate routine educational touchpoints. This would significantly reduce the human labor burden on medical staff while maintaining personalized, high-quality, continuous behavioral support for patients with chronic diseases.

Conclusion

A hybrid approach of chat-based messaging and telephone coaching is a feasible model for NCD clinics in the Thai primary care setting. This framework effectively drives behavioral progression and improves multi-system metabolic markers. Future refinements should leverage artificial intelligence to minimize the labor burden on medical officers while expanding coverage across the country.

Conflict of interest

The authors declare that they have no conflicts of interest. This work has not been previously published in whole or in part, and it is not under consideration for publication elsewhere.

During the preparation of this manuscript, the authors used Gemini (Google LLC, Mountain View, CA, USA) to improve the English grammar and readability of the text. After using this tool, the authors critically reviewed, edited, and verified all content, and take full responsibility for the scientific integrity and final version of the manuscript.

Author contributions

Weerin Susirawatanaont and Woranan Choochan contributed substantially to the concept and design of this study. Weerin Susirawatanaont contributed substantially to acquiring the data, reviewing the literature, and its analysis and interpretation.

Arpasiri Normsars, Itchaya Pluembamroe, Wiracha Nithisateinchai, Natthanit Sapsitthikul, Sangduane Puttaragsa and Natcha Nantapatavee contributed substances to acquiring the data.

All authors contributed to drafting the manuscript and edited the manuscript critically for important intellectual content.

All authors approved the final version submitted for publication and take responsibility for statements made in the published article.

Acknowledgements

The authors would like to express their gratitude to all participants who were involved in this study.

Conflict of interest statement

All authors have completed and submitted the International Committee of Medical Journal Editors Uniform Disclosure Form for Potential Conflicts of Interest. All authors declare that they have no conflicts of interest.

Data sharing statement

Data sharing statement. All data generated or analyzed during the present study are included in this published article. Further details are available for noncommercial purposes from the corresponding author on reasonable request.

References

1. Murray CJL. Findings from the global burden of disease study 2021. *Lancet* 2024;403:2259-62.
2. Patanavanich R, Aekplakorn W. The seventh thai national health examination survey (NHES VII) 2024-2025. Nonthaburi, Thailand: Health Systems Research Institute (HSRI); 2024.
3. Beckman JA, Creager MA. Vascular complications of diabetes. *Circ Res* 2016;118:1771-85.
4. American Diabetes Association Professional Practice Committee for Diabetes. 5. Facilitating Positive health behaviors and well-being to improve health outcomes: standards of care in diabetes-2026. *Diabetes Care* 2026;49:S89-S131.
5. Pluetrattanabha N, Direksunthorn T. Mobile health clinics and telehealth outreach in Thailand: a focus on elderly care and NCDs. *J Multidiscip Healthc* 2025;18:8321-31.
6. Wattanapisit A, Saengow U. Patients' perspectives regarding hospital visits in the universal health coverage system of Thailand: A qualitative study. *Asia Pac Fam Med* 2018;17:9.
7. Kitsiou S, Pare G, Jaana M, Gerber B. Effectiveness of mHealth interventions for patients with diabetes: An overview of systematic reviews. *PLoS One* 2017;12: e0173160.
8. Parchman ML, Arambula-Solomon TG, Noel PH, Larme AC, Pugh JA. Stage of change advancement for diabetes self-management behaviors and glucose control. *Diabetes Educ* 2003;29:128-34.
9. Vallis M. Behaviour Change to Promote Diabetes Outcomes: Getting more from what we have through dissemination and scalability. *Can J Diabetes* 2023; 47:85-9.
10. Barber MJ, Gotham D, Bygrave H, Cepuch C. Estimated Sustainable cost-based prices for diabetes medicines. *JAMA Netw Open* 2024;7:e243474.
11. Aekplakorn W, Chariyalertsak S, Bumrerraj S, Assanangkornchai S, Taneepanichskul S, Neelapaichit N, et al. Diabetes trends and determinants among Thai adults from 2004 to 2020. *Sci Rep* 2025;15:31620.
12. United Nations Thailand. Prevention and control of noncommunicable diseases in thailand: the case for investment. Bangkok: United Nations Thailand, 2021.
13. Siripanumas C, Suphanchaimat R, Nittayasoot N, Sawaengdee K. Distribution of physicians to public health facilities and factors contributing to new medical graduates serving in public facilities, 2016-2020, Thailand. *Risk Manag Healthc Policy* 2022;15:1975-85.