

The effectiveness of promoting health literacy through infographics combined with health behavior counseling for type 2 diabetes patients in Nakhon Nayok Province, Thailand

Thanakorn Panyasaisophon¹, Ammara Visuttranukul²,  Prombuncha Prommala³,  Rapeepat Rakguson⁴,  Phitsaran Thamrongworakun^{5*}

¹Public Health Program, Faculty of Science, Phranakhon Rajabhat University, Bangkok, Thailand; thanakorn.p@pnru.ac.th (T.P.).

²Independent Researchers Thailand; ammara@g.swu.ac.th (A.V.).

³Computer Animation and Multimedia Program, Faculty of Science and Technology, Phranakhon Rajabhat University, Thailand; bird001new@gmail.com (P.P.).

⁴Faculty of Nursing, Rattana Bundit University, Thailand; rapeepat.rakg@dome.tu.ac.th (R.R.).

⁵Department of Psychology, Faculty of Education, Ramkhamhaeng University, Thailand; phitsaran.t@rumail.ru.ac.th (P.T.).

Abstract: This study aimed to examine the effects of a health literacy promotion program using infographics combined with health behavior counseling among patients with type 2 diabetes in Nakhon Nayok Province, Thailand. A quasi-experimental, one-group pretest–posttest design was used with 30 purposively selected patients. The intervention consisted of a health literacy program integrating infographics and health behavior counseling. Data were collected using health literacy and health behavior questionnaires and glycated hemoglobin (HbA1c) measurements. Descriptive statistics and paired-sample t tests were used for data analysis. After the intervention, participants showed significant improvements in health literacy, including knowledge, access to healthcare services, communication skills, self-management, media literacy, and decision-making ($p < 0.01$). Health behaviors related to diet, physical activity, stress management, smoking and alcohol control, and medication adherence also improved significantly ($p < 0.01$). HbA1c levels significantly decreased after the intervention ($p < 0.01$). The use of infographics combined with health behavior counseling effectively enhanced health literacy, promoted healthy behaviors, and improved glycemic control. This program can be integrated into healthcare settings to strengthen diabetes self-management, improve health outcomes, and reduce the risk of diabetes-related complications.

Keywords: Health behavior, Health literacy, Type 2 diabetes patients.

1. Introduction

Diabetes is a chronic noncommunicable disease that poses a significant global health problem, with its prevalence steadily increasing worldwide [1]. Diabetes-related complications can affect multiple organ systems and include stroke, chronic kidney disease, cardiovascular disease, and diabetic retinopathy [2]. At the 7th Global Conference on Health Promotion in Nairobi, Kenya, the World Health Organization emphasized that Member States should prioritize the development of health literacy among their population. Health literacy encompasses cognitive and social skills that motivate individuals to access, understand, and use information to maintain and improve their health [3].

In this context, health literacy encompasses the ability to find, assess, and integrate diverse types of health information from various contexts. It also requires knowledge of health terminology and an understanding of the culture of the healthcare system [4]. The development of adequate health literacy and the adoption of appropriate health behaviors can help patients with diabetes better control their blood

glucose levels and reduce or delay the onset of complications. This can be achieved by developing the ability to seek, understand, and apply health information; manage barriers; communicate effectively; and make informed decisions to maintain appropriate health behaviors. For patients with diabetes, adequate health literacy contributes to an accurate understanding of the disease and appropriate self-care. When faced with health-related problems and barriers, patients are better able to make informed decisions. These abilities enable them to improve glycemic control, reduce disease severity, and delay the onset of complications, even if diabetes is a chronic condition with no definitive cure [5].

Thailand aims to become a leading medical and health hub in alignment with the goals of the 13th National Health Development Plan (2023–2027), which focuses on transforming the Thai health system toward sustainability based on the principles of the Sufficiency Economy Philosophy, the Bio-Circular-Green (BCG) Economy Model, and resilience. The plan emphasizes enhancing health literacy among the population, ensuring equitable access to high-quality healthcare services, developing a high-value health economy, and establishing sustainable support mechanisms [6]. The 20-Year National Strategy, which envisions Smart Thailand and Smart Thai citizens, emphasizes that people of all age groups should possess adequate health literacy and the ability to manage their own health. The National Reform Council has proposed making the promotion of public health literacy a national priority, incorporating health literacy development into the 20-Year National Strategy, and supporting research and population-based surveys on health literacy and health behaviors every 3–5 years [7].

A review of research on the effectiveness of multidisciplinary team-based care in achieving diabetes remission revealed statistically significant differences in mean body weight, waist circumference, body mass index, and HbA1c levels after a 24-week intervention. Furthermore, 90% of patients were able to reduce their diabetes medication use, 50% discontinued their medications, and 26% maintained medication discontinuation for more than 3 months [8].

Research on the development of a health literacy system focusing on health behaviors and HbA1c levels among patients with type 2 diabetes revealed that participants demonstrated improvements in health literacy, health behaviors, and glycemic control, as reflected by reduced HbA1c levels following the intervention [9]. Another study examined health literacy among patients with type 2 diabetes who had received continuous treatment for at least three months at a subdistrict health-promoting hospital in Ongkharak District, Nakhon Nayok Province. Using a survey research design, a sample of 200 patients was selected through purposive sampling [10, 11]. The results revealed that patients with type 2 diabetes had moderate levels of health literacy ($\bar{x} = 2.40\text{--}2.80$) in terms of knowledge and understanding and good levels ($\bar{x} = 3.20$) in terms of access to healthcare services, communication skills, media and information literacy, and decision-making. Their health behaviors, including physical activity, emotional management, smoking, alcohol consumption, and medication adherence, were moderate ($\bar{x} = 1.20\text{--}1.80$), while their dietary behaviors were good ($\bar{x} = 2.20$). The study also revealed that patients lacked a clearly defined framework for health literacy development.

The Community Health Center in Ongkharak District, Nakhon Nayok Province, Thailand, is a primary care facility that serves the local population. However, a clearly defined model for providing health literacy interventions to patients with type 2 diabetes is lacking. A review of previous studies also revealed no clearly established model addressing this issue. This gap highlights the need for such a model and is consistent with the Ministry of Public Health's policy to promote health literacy across all age groups, particularly among individuals with chronic diseases such as diabetes, hypertension, and stroke. Interviews with public health personnel revealed that a major challenge was the inability of patients with diabetes to maintain their blood glucose levels within the recommended target range. This problem was associated with various unhealthy behaviors, including poor dietary habits, inadequate emotional management, insufficient physical activity, alcohol consumption, smoking, and poor medication adherence. This situation is consistent with the national research agenda of the Ministry of Public Health, which emphasizes the development of community-based models, the expansion of research and development in specific areas, and the creation of integrated community development models.

Therefore, the research team sought to examine the effectiveness of a health literacy promotion program using infographics combined with health behavior counseling among patients with type 2 diabetes in Nakhon Nayok Province, Thailand. To promote sustainable behavior change through enhanced health literacy, researchers have recognized the importance of incorporating principles of acceptance and commitment therapy (ACT) as an innovative approach to strengthening self-efficacy and intrinsic motivation. This approach focuses on creating a supportive and psychologically safe environment in which individual challenges can be explored in depth, and patients can receive psychological support to overcome barriers to self-care. By presenting complex health information in a clear, concise, and easily understandable format, infographics serve as effective communication tools. Integrating in-depth counseling with appropriate health communication media may significantly increase health literacy and lead to measurable improvements in health behaviors and clinical outcomes. Accordingly, this study aimed to evaluate the effects of this integrated intervention and generate evidence to support the development and implementation of health literacy programs in local healthcare settings.

1.1. Research Objectives

The objective of this study was to compare health literacy, health behaviors, and HbA1c levels among patients with type 2 diabetes in Nakhon Nayok Province, Thailand, before and after the intervention.

1.2. Research Framework

The research team developed a program based on the health literacy concept [4] to promote health literacy through infographics combined with health behavior counseling [12].

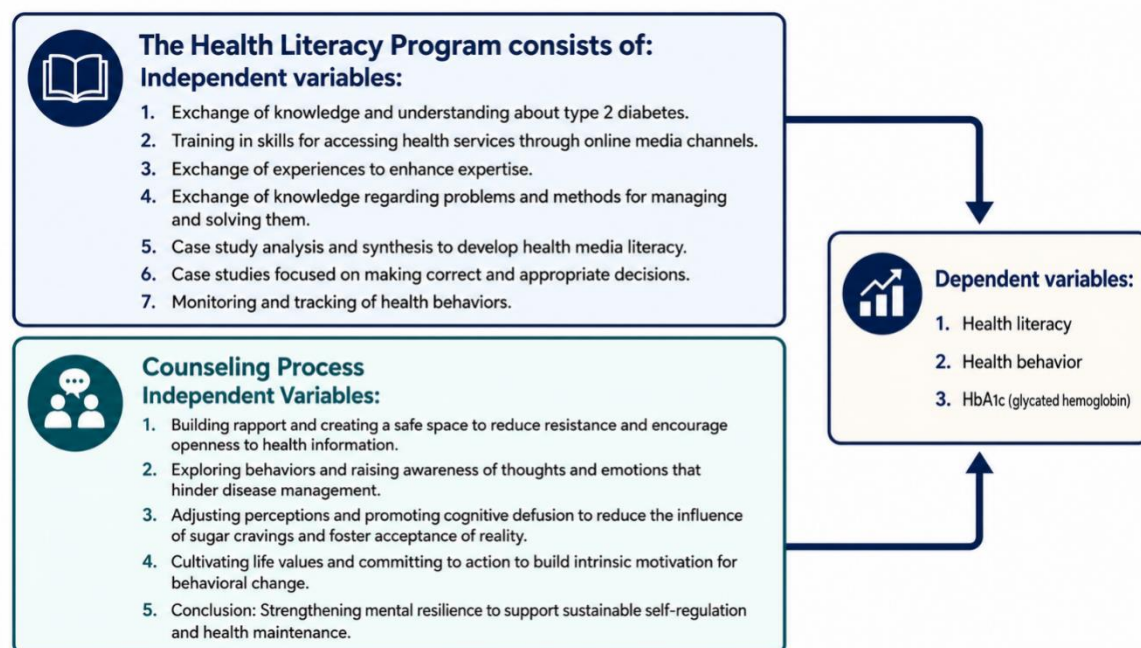


Figure 1.
Research conceptual framework.

2. Research Methodology

This study employed a quasi-experimental one-group pretest–posttest design. Participants received the health literacy promotion program, and outcomes were measured before and after the intervention.

The study population consisted of patients with type 2 diabetes who had received continuous care for at least 6 months at a subdistrict health-promoting hospital in Ongkharak District, Nakhon Nayok Province, Thailand, and who had moderate or below-average scores in each domain of the health literacy assessment. The sample size was calculated using Cohen [10], assuming a large effect size ($d = 0.80$), a 95% confidence level, and appropriate statistical power for an experimental study. To account for potential attrition during the study, the final sample size was set at 30 participants. Participants were selected through purposive sampling on the basis of predefined eligibility criteria [11].

The inclusion criteria were as follows: (1) male and female patients aged 20 years or older with a diagnosis of type 2 diabetes; (2) diagnosed by a physician; (3) receiving continuous care at a community health center for at least 6 months; (4) having moderate or below-average health literacy in all assessed domains; and (5) providing written informed consent to participate in the study.

The exclusion criteria were as follows: (1) participation in fewer than four of the six intervention sessions or (2) withdrawal from the study at any time for any reason.

2.1. Research Tools

The research team developed the following instruments:

1. Intervention Tools: These tools included a health literacy promotion program for patients with type 2 diabetes that integrated counseling based on the principles of acceptance and commitment therapy (ACT) with infographics. The program was developed by researchers on the basis of a health literacy framework and through participatory discussions and brainstorming sessions with key stakeholders, taking into account the specific problems and needs of the local context. The stakeholders included district public health officers, directors of subdistrict health-promoting hospitals, registered nurses, public health professionals, patient care support staff, patients with type 2 diabetes, and village health volunteers (VHVs). A total of 12 stakeholders participated in the program development process [13] and were recruited using snowball sampling [14].

The data were then analyzed and synthesized [13], resulting in a draft health literacy model that was presented to stakeholders for feedback and further refinement. The research team subsequently submitted the draft model to three experts in relevant fields for content validity assessment. The index of item-objective congruence (IOC) values ranged from 0.66 to 1.00, and the model was revised on the basis of the experts' recommendations. The model included activities designed to enhance knowledge and understanding of type 2 diabetes; develop skills in accessing online health information and services; promote experience sharing to strengthen health literacy skills; facilitate discussions of health-related problems and potential solutions; analyze and critically evaluate health information and media through case studies; develop appropriate and informed decision-making skills through case-based learning; and monitor health behaviors, including diet, physical activity, emotional management, smoking, alcohol consumption, and medication adherence.

Combined with counseling based on the principles of acceptance and commitment therapy (ACT), the program focuses on building therapeutic relationships and creating psychologically safe spaces, exploring behaviors and enhancing self-awareness, adjusting perceptions and promoting cognitive defusion, cultivating personal values and strengthening commitment to value-based actions, and concluding with activities aimed at strengthening psychological resilience.

The media used in the program included infographics, internet-based resources, and mobile devices. Content validity was assessed by three experts based on the appropriateness of the content, activity implementation, duration, media and materials, and methodology. The index of item-objective congruence (IOC) values ranged from 0.67 to 1.00.

2. Health literacy questionnaire [9]: The health literacy questionnaire consisted of the following sections:

- 1) General Information Questionnaire: This section included items on sex, age, marital status, educational level, monthly income, religion, and duration of illness. The items were presented in a checklist and open-response format.

2) Knowledge Test: This section assessed knowledge related to diet, physical activity, emotional management, smoking, alcohol consumption, and medication adherence and consisted of 14 items. Each correct answer was assigned a score of 1, whereas each incorrect answer was assigned a score of 0. Total scores were converted into percentages and interpreted according to the following criteria: good (80.00–100.00%), moderate (50.00–79.99%), and needs improvement (0.00–49.99%) [11]. The reliability of the test, which was assessed using the Kuder–Richardson Formula 20 (KR-20), was 0.78.

3) Health Literacy Questionnaire: This section assessed five domains of health literacy: access to healthcare services (5 items), communication skills (6 items), management of health conditions (7 items), media literacy (5 items), and decision-making (4 items). The questionnaire employed a 5-point Likert scale ranging from 1 (never) to 5 (always). The mean scores were interpreted according to four levels: needs improvement (1.00–2.00), average (2.01–3.00), good (3.01–4.00), and excellent (4.01–5.00). The reliability coefficients for the five domains were 0.75, 0.89, 0.90, 0.91, and 0.88, respectively [11].

4) Health-Promoting Behavior Questionnaire: This section consists of 20 items and uses a 5-point rating scale ranging from 0 to 4, with the following response categories: 4 = regularly practiced (7 days/week), 3 = frequently practiced (5–6 days/week), 2 = occasionally practiced (3–4 days/week), 1 = rarely practiced (1–2 days/week), and 0 = not practiced. Mean scores were interpreted according to four levels: needs improvement (0.00–1.00), average (1.01–2.00), good (2.01–3.00), and excellent (3.01–4.00). The questionnaire's reliability coefficient was 0.99 [11].

5) Glycated hemoglobin (HbA1c): The participants' HbA1c levels were obtained from the medical records of the community health center.

Data Collection: This study received ethical approval from the Human Research Ethics Committee of Phranakorn Rajabhat University (Document No. 01.020/68) on July 25, 2025. The research team also completed training in human research ethics in accordance with the principles of the Declaration of Helsinki. Ethical considerations included obtaining written informed consent, maintaining the confidentiality of participants' data, reporting findings in aggregate form, ensuring voluntary participation and the right to withdraw from the study at any time without penalty, and clearly explaining the study's objectives, procedures, potential benefits, and possible risks before participants decided whether to participate.

1. The research team reviewed the relevant literature on the healthcare setting, health literacy, health behaviors, and related studies.

2. The research team developed a draft health literacy model through participatory discussions, analysis, and synthesis in collaboration with stakeholders, and prepared an implementation plan.

3. The draft health literacy model was submitted to relevant experts for content-validity assessment, revised based on their recommendations, and subsequently presented to stakeholders for further feedback and refinement.

4. The research team implemented the health literacy model over 12 weeks as follows:

1) The research team explained the study procedures to the participants, administered the health literacy and health behavior assessment instruments, obtained preintervention HbA1c levels from the participants' medical records, and scheduled appointments for the intervention activities.

2) The research team implemented the developed health literacy promotion program over 12 weeks.

3) After the intervention, the research team administered the health literacy and health behavior assessment instruments again and obtained postintervention HbA1c levels from the participants' medical records.

Data were analyzed using descriptive statistics, including percentages, means, and standard deviations. A paired-sample t-test was used to compare health literacy, health behaviors, and HbA1c levels before and after the intervention.

3. Research Results

The majority of patients with type 2 diabetes at the subdistrict health-promoting hospital in Ongkharak District, Nakhon Nayok Province, Thailand, were female (90.00%). The mean age was 47.87 years (SD = 7.04; range = 30–59 years). A total of 56.70% of the participants were married, and 66.70% had completed primary education. The mean monthly income was 8,620.00 Thai baht (SD = 3,577.36; range = 4,000–20,000 Thai baht), and the mean duration of diabetes was 9.97 years (SD = 3.70; range = 5–17 years).

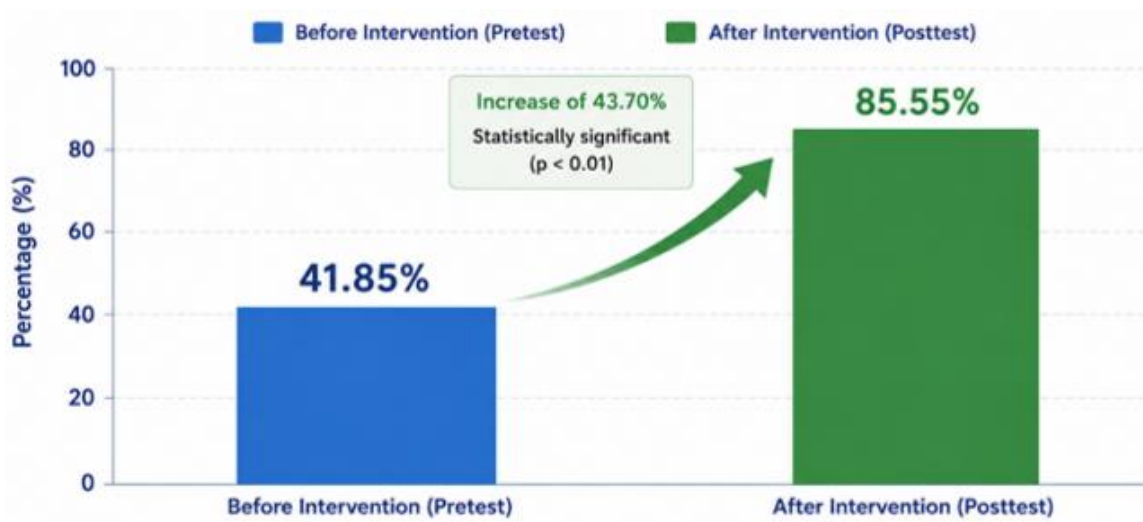


Figure 2.
Knowledge scores on health promotion and prevention of diabetes complications.

As shown in Figure 2, among patients with type 2 diabetes who received the health literacy promotion program at a community health center in Nakhon Nayok Province, Thailand, the mean knowledge and understanding score regarding health promotion and the prevention of diabetes-related complications increased from 41.85% before the intervention to 85.55% after the intervention.

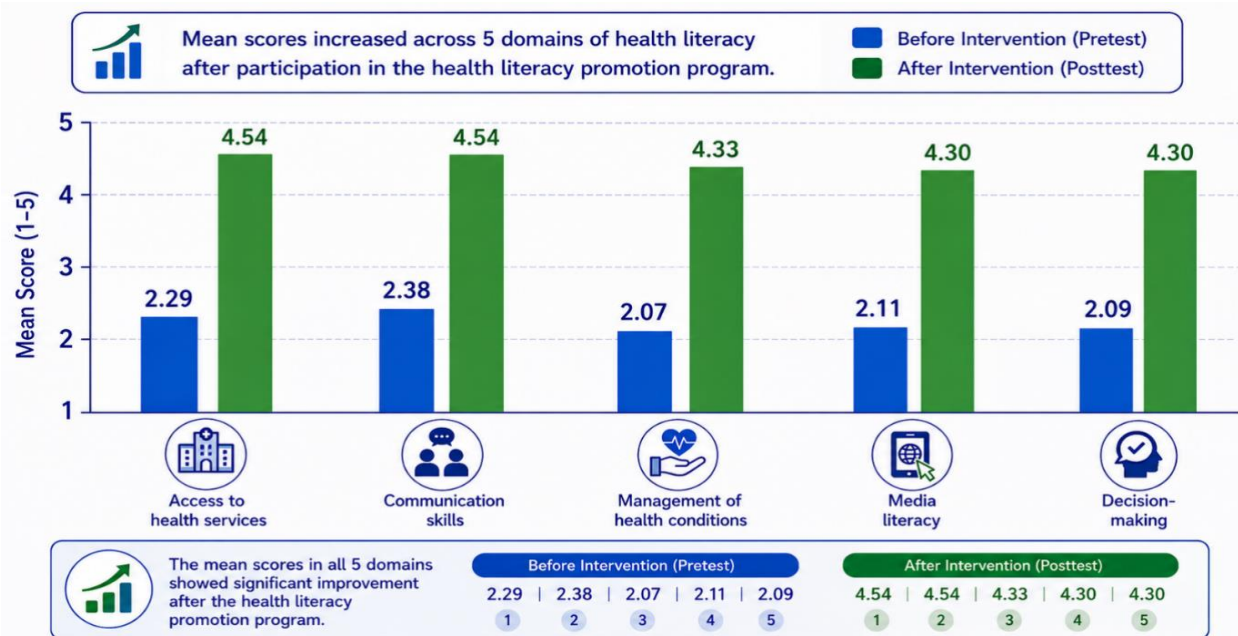


Figure 3.
Health literacy scores before and after the intervention among patients with type 2 diabetes.

The data in Figure 3 show that patients with type 2 diabetes at a community health center in Nakhon Nayok Province, Thailand, who received the health literacy promotion program demonstrated improvements in access to healthcare services, communication skills, health condition management, media literacy, and decision-making. The mean scores for these five domains increased from 2.29, 2.38, 2.07, 2.11, and 2.09 before the intervention to 4.54, 4.54, 4.33, 4.30, and 4.30 after the intervention, respectively.

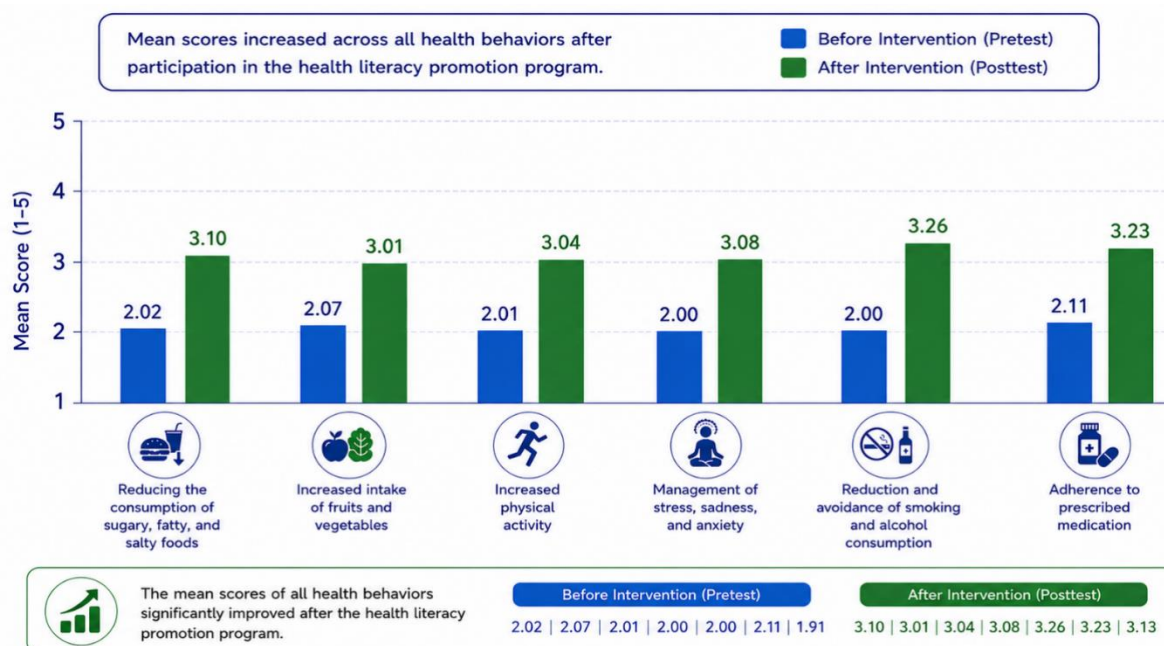


Figure 4.
Health behavior scores before and after the intervention among patients with type 2 diabetes.

The data in Figure 4 show that patients with type 2 diabetes at a community health center in Nakhon Nayok Province, Thailand, who received the health literacy promotion program demonstrated improvements in seven health behaviors: reducing the consumption of sugary, fatty, and salty foods; increasing fruit and vegetable intake; engaging in physical activity; managing stress, sadness, and anxiety; reducing or avoiding smoking; reducing or avoiding alcohol consumption; and adhering to prescribed medications. The mean scores for these seven health behaviors increased from 2.02, 2.07, 2.01, 2.00, 2.00, 2.11, and 1.91 before the intervention to 3.10, 3.01, 3.04, 3.08, 3.26, 3.23, and 3.13 after the intervention, respectively.

Table 1.

Comparison of health literacy and health-promoting behaviors before and after the intervention.

Variables	Assessment	Mean	SD	<i>t</i>	<i>p</i>
1. Health literacy					
1.1 Health knowledge and understanding	Pre-intervention	41.85%	14.49	17.131	<0.01
	Post-intervention	85.55%	12.76		
1.2 Access to health information and services	Pre-intervention	2.29	0.28	37.660	<0.01
	Post-intervention	4.54	0.27		
1.3 Communication to enhance health literacy	Pre-intervention	2.38	0.22	36.307	<0.01
	Post-intervention	4.54	0.20		
1.4 Self-management for health promotion	Pre-intervention	2.07	0.18	36.525	<0.01
	Post-intervention	4.33	0.22		
1.5 Media and health information literacy	Pre-intervention	2.11	0.25	37.359	<0.01
	Post-intervention	4.30	0.24		
1.6 Appropriate health decision-making	Pre-intervention	2.09	0.24	30.254	<0.01
	Post-intervention	4.30	0.31		
2. Overall health behaviors	Pre-intervention	2.02	0.25	18.465	<0.01
	Post-intervention	3.10	0.32		
2.1 Reducing the consumption of foods high in sugar, fat, and sodium	Pre-intervention	2.07	0.23	13.878	<0.01
	Post-intervention	3.01	0.32		
2.2 Increasing physical activity and exercise	Pre-intervention	2.01	0.41	9.298	<0.01
	Post-intervention	3.04	0.32		
2.3 Managing stress, depression, and anxiety	Pre-intervention	2.00	0.38	11.540	<0.01
	Post-intervention	3.08	0.31		
2.4 Reducing or abstaining from alcohol consumption	Pre-intervention	2.00	0.64	9.690	<0.01
	Post-intervention	3.26	0.44		
2.5 Reducing or quitting smoking	Pre-intervention	2.11	0.38	7.441	<0.01
	Post-intervention	3.23	0.58		
2.6 Adherence to prescribed medication	Pre-intervention	1.91	0.40	10.899	<0.01
	Post-intervention	3.13	0.41		

The data in Table 1 show that patients with type 2 diabetes who were treated at a community health center in Nakhon Nayok Province, Thailand, had significantly higher mean health literacy scores after the intervention than before the intervention. Significant improvements were observed across all domains, including knowledge and understanding, access to healthcare services, communication skills, management of health conditions, media literacy, and decision-making. Health-promoting behaviors also improved significantly after the intervention, including reducing the consumption of sugary, fatty, and salty foods; increasing fruit and vegetable intake; engaging in physical activity; managing stress, sadness, and anxiety; reducing or avoiding smoking; reducing or avoiding alcohol consumption; and adhering to

prescribed medications. Overall, compared with baseline values, all health literacy domains and health-promoting behaviors significantly improved after the intervention ($p < 0.01$).

Table 2.

Comparison of HbA1c levels before and after the intervention within the group.

Variable	Assessment	<i>n</i>	Mean	SD	<i>t</i>	<i>p</i>
3. Glycated hemoglobin (HbA1c), %	Pre-intervention	30	10.50	2.77	4.485	<0.01
	Post-intervention	30	8.35	1.54		

Table 2 shows that patients with type 2 diabetes who were treated at a community health center in Nakhon Nayok Province, Thailand, had significantly lower HbA1c levels after the intervention than at baseline. These findings indicate that the intervention was effective in improving glycemic control among the participants. The difference in HbA1c levels before and after the intervention was statistically significant ($p < 0.01$).

4. Discussion and Conclusion

The results revealed that the health literacy promotion program involving the use of infographics combined with health behavior counseling significantly improved health literacy among patients with type 2 diabetes in Nakhon Nayok Province, Thailand. Significant improvements were observed across all domains of health literacy, including knowledge and understanding, access to healthcare services, communication skills, management of health conditions, media literacy, and decision-making. Health-promoting behaviors also improved significantly after the intervention, including reducing the consumption of sugary, fatty, and salty foods; increasing fruit and vegetable intake; engaging in physical activity; managing stress, sadness, and anxiety; reducing or avoiding smoking; reducing or avoiding alcohol consumption; and adhering to prescribed medications. Furthermore, the HbA1c level decreased significantly after the intervention, indicating improved glycemic control.

This may be explained by the initial assessment of the health literacy problems and needs of patients by the research team, followed by focus group discussions with stakeholders to develop a health literacy program tailored to the specific local context. In particular, the program integrated a counseling process based on the principles of acceptance and commitment therapy (ACT), which served as a key mechanism for facilitating changes in patients' internal psychological processes. This approach involved creating a psychologically safe and supportive environment that helped patients reduce resistance and accept the reality of living with their illness without judgment. The process also promoted awareness of thoughts and emotions that could hinder self-care, such as cravings for sugary foods or feelings of hopelessness, and helped patients practice cognitive defusion by learning to observe their thoughts without automatically reacting to or being controlled by them.

To mitigate the influence of triggers that contribute to unhealthy behaviors, a key mechanism for change is the clarification and cultivation of personal values.

This process shifts motivation from externally imposed medical goals toward intrinsic motivation grounded in personally meaningful values, thereby promoting resilient and sustainable engagement in health-promoting behaviors, even in the face of temporary obstacles or setbacks.

This approach included knowledge sharing; skills training in accessing online health information and healthcare services; experience sharing to strengthen health literacy skills; discussions of health-related problems and problem-solving strategies; case-based activities involving the analysis and critical evaluation of health information and media; exercises designed to promote appropriate and informed decision-making; and the monitoring and evaluation of health-promoting behaviors, all of which were integrated with counseling processes.

The process consisted of four steps:

- 1) Exploring individual behaviors to identify the problems and barriers contributing to unhealthy behaviors.

- 2) Setting goals for health behavior change.
- 3) Collaboratively developing health behavior-change strategies between the counselor and the patient.
- 4) Evaluating counseling outcomes to determine the need for further support and readiness for counseling termination.

This process was implemented through infographic-based communication in an online group, including discussions, question-and-answer sessions, and activity summaries facilitated by experts in cognitive development, health education and behavioral science, psychology, and sports science over 12 weeks. These findings are consistent with those of previous research examining health literacy levels among patients with type 2 diabetes who were treated at the diabetes clinic at the Endocrinology Center of King Fahad Medical City [15].

The majority of participants (68.7%) had adequate health literacy. These findings are consistent with the results of the present study and with previous research indicating that patients who received training based on the principles of acceptance and commitment therapy (ACT) tended to monitor their blood glucose levels more frequently and had significantly lower HbA1c levels than those who received general health education. Furthermore, acceptance was identified as a key factor in helping patients overcome resistance to treatment.

These findings are consistent with those of a previous study that examined the effectiveness of acceptance and commitment therapy (ACT) in reducing psychological distress and improving self-management among patients with type 2 diabetes. The study revealed that ACT had significant positive effects on self-management ability and disease-related anxiety. A key mechanism underlying these effects was enhanced psychological resilience, which enabled patients to accept their condition and adhere to their treatment plans more consistently than those who received education alone did [16].

These findings are consistent with those of a previous study that examined health literacy levels among patients with type 2 diabetes receiving care at Golestan Hospital in Ahvaz, Iran. Most participants reported inadequate health literacy (46.7%), followed by marginal health literacy (39.5%) and adequate health literacy (13.8%). These findings are also aligned with the Shanghai Declaration on Promoting Health in the 2030 Agenda for Sustainable Development, adopted at the 9th Global Conference on Health Promotion, held in Shanghai, China, from November 21 to 24, 2016. The Declaration emphasizes three key pillars for advancing health promotion, with health literacy identified as one of its core pillars [17]:

1. Good governance refers to the establishment of strong policies and governance mechanisms that promote accessible and affordable health choices for the public, as well as the development of sustainable systems through collaboration across all sectors of society.

2. Healthy cities and communities refer to creating clean, safe, and healthy environments where people can live, work, and participate harmoniously in community activities while maintaining good health and well-being.

3. Health literacy and social mobilization enhance the knowledge and social skills necessary to enable individuals to make informed decisions about their own health and that of their families. This is consistent with Nutbeam's definition of health literacy, which describes it as the cognitive and social skills that determine individuals' motivation and ability to access, understand, and use health information in ways that promote and maintain good health [4].

This includes developing an understanding of the health context and fostering changes in attitudes and motivation that promote appropriate and independent health behaviors. These findings are consistent with those of a previous mixed-methods study that examined the effects of a health literacy intervention on health behaviors and glycated hemoglobin (HbA1c) levels among patients with type 2 diabetes mellitus (T2DM). The quantitative component employed a quasi-experimental repeated-measures design to assess health literacy, health behaviors, and glycemic control and to evaluate the effectiveness of the intervention. The quantitative sample consisted of 30 participants who received the health literacy program through purposive sampling. Qualitative data were collected through interviews with 10 participants selected by simple random sampling and seven participants recruited through snowball

sampling until data saturation was achieved. The research instruments included a health literacy program, a health literacy assessment questionnaire, and HbA1c test results obtained from hospital records. Quantitative data were analyzed using percentages, means, standard deviations, and one-way repeated-measures analysis of variance (ANOVA) [18].

Results: The quantitative research findings revealed the following:

1) Patients with T2DM showed significant improvements in health knowledge, health behaviors, and glycemic control across repeated measurements, with all differences reaching statistical significance ($p < 0.01$).

2) The developed health literacy program included activities designed to enhance health knowledge, demonstrate and practice skills in accessing health information, facilitate the exchange of learning experiences, develop problem-solving skills, promote the critical analysis of health-related advertisements, and use case studies to strengthen informed decision-making. These activities enhanced participants' learning experiences and ability to make informed decisions regarding appropriate health behaviors. These improvements contributed to reduced glycated hemoglobin (HbA1c) levels and supported health behavior changes that were appropriate for the patients' lifestyles and local context.

Similarly, the results of the present study demonstrated that the health literacy promotion program improved patients' understanding of health information, self-management behaviors, and glycemic control. These findings suggest that structured education and counseling may enhance patients' ability to manage diabetes effectively, make appropriate dietary decisions, and reduce the risk of diabetes-related complications.

This finding is consistent with the findings of a previous mixed-methods study titled "Effects of Educational Health Literacy Development Program on Health Literacy, Health Behaviors, and Clinical Outcomes in Type 2 Diabetes Mellitus Patients in Thailand," which reported that postintervention health literacy levels were significantly higher in the experimental group than in the control group ($p < 0.01$) [19].

In addition, fasting blood glucose levels decreased significantly, whereas HbA1c levels remained stable. The qualitative findings revealed that participants in the experimental group developed a better understanding of basic technical terms related to diabetes and laboratory test results. Moreover, they demonstrated an improved ability to make informed decisions regarding appropriate health behaviors. On the basis of these findings, the Educational Health Literacy Development Program (EHLDP) was considered effective at reducing fasting blood glucose levels and supporting glycemic control. Therefore, the program may have potential for wider implementation among patients with type 2 diabetes in community settings.

These findings are consistent with those of Graham, et al. [20] who conducted a literature review of acceptance and commitment therapy (ACT) interventions for patients with chronic illnesses published between 2016 and 2021. Their review indicated that value clarification is a core component of ACT. When patients connect health behaviors with personally meaningful values, such as being present to see their children succeed, they may develop more sustained motivation for behavior change, even if they have previously struggled with traditional behavior change approaches [20].

5. Limitations

This study was conducted on diabetes clinic days, which limited the ability of the research team to fully implement the intervention; however, the schedule was adjusted to align with the routine service activities of the subdistrict health-promoting hospital. In addition, some components of the study were conducted online, requiring assistance from public health personnel to coordinate activities and monitor participants. Further limitations arose from variations in the specialized knowledge and skills of the public health personnel involved in supporting the intervention.

6. Suggestions

1. This study revealed that patients with type 2 diabetes demonstrated improved health literacy after the intervention compared with baseline. Therefore, health literacy promotion programs may be considered for implementation in healthcare settings with similar contexts.

2. HbA1c levels among patients with type 2 diabetes decreased after the intervention compared with baseline. Therefore, further research using qualitative or mixed-methods approaches is recommended to explore the factors and experiences underlying these improvements.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

Acknowledgments:

The successful completion of this study was made possible through research funding provided by Phranakhon Rajabhat University and the valuable support and contributions of district public health personnel, staff at subdistrict health-promoting hospitals, community stakeholders, village health volunteers, and patients with diabetes who participated in and supported this research.

Copyright:

© 2026 by the authors. This article is an open-access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

References

- [1] World Health Organization, "Diabetes," 2020. <https://www.who.int/news-room/fact-sheets/detail/diabetes>. [Accessed Aug. 26, 2025]
- [2] Y. Mori, A. Futamura, H. Murakami, K. Kohashi, T. Hirano, and M. Kawamura, "Increased detection of mild cognitive impairment with type 2 diabetes mellitus using the Japanese version of the Montreal Cognitive Assessment: A pilot study," *Neurology and Clinical Neuroscience*, vol. 3, no. 3, pp. 89–93, 2015. <https://doi.org/10.1111/ncn3.153>
- [3] World Health Organization, *Health promotion glossary*. Geneva, Switzerland: World Health Organization, 1998.
- [4] D. Nutbeam, "The evolving concept of health literacy," *Social Science & Medicine*, vol. 67, no. 12, pp. 2072–2078, 2008. <https://doi.org/10.1016/j.socscimed.2008.09.050>
- [5] R. Rajatanavin and T. Ningsanon, *Self care when sick, in Full Knowledge of Diabetes*, T. Himathongkam. Bangkok, Thailand: Vitayapat Printing, 2011.
- [6] Office of the National Economic and Social Development Council, *National economic and social development plan No. 13: Transforming Thailand into a progressive society and sustainable value creation economy*. Bangkok, Thailand: Office of the National Economic and Social Development Council, 2021.
- [7] K. Attaphon, *Driving health literacy and health communication*. Thailand: Department of Health, Ministry of Public Health, 2021.
- [8] K. Khotphakdee, "The development of a care model to promote diabetes remission in Tha Bo District, Nong Khai Province," *Journal of Nursing and Therapeutic Care*, vol. 43, no. 2, pp. 1–15, 2025.
- [9] J. Suwannarat and T. Panyasaisophon, "Development model for a health literacy system for health behaviors and hemoglobin A1c level control in patients with type 2 diabetes mellitus," *Journal of Nursing and Health Care*, vol. 40, no. 2, pp. 95–104, 2022.
- [10] J. Cohen, *Statistical power analysis for the behavioral sciences*. New York, USA: Academic Press, 1969.
- [11] P. Thanakorn, *Health services research in public health*. Bangkok, Thailand: Danex Inter corporation Co., Ltd, 2025.
- [12] S. C. Hayes, K. D. Strosahl, and K. G. Wilson, *Acceptance and commitment therapy: The process and practice of mindful change*, 2nd ed. New York, USA: Guilford Press, 2011.
- [13] M. Hennink and B. N. Kaiser, "Sample sizes for saturation in qualitative research: A systematic review of empirical tests," *Social Science & Medicine*, vol. 292, p. 114523, 2022. <https://doi.org/10.1016/j.socscimed.2021.114523>
- [14] C. Noy, "Sampling knowledge: The hermeneutics of snowball sampling in qualitative research," *International Journal of Social Research Methodology*, vol. 11, no. 4, pp. 327–344, 2008. <https://doi.org/10.1080/13645570701401305>
- [15] A. H. Mashi *et al.*, "The association of health literacy with glycemic control in Saudi patients with type 2 diabetes," *Saudi Medical Journal*, vol. 40, no. 7, pp. 675–680, 2019. <https://doi.org/10.15537/smj.2019.7.24277>

- [16] A. J. Han and S. L. Tan, "Effectiveness of Acceptance and Commitment Therapy (ACT) on psychological distress and self-management in patients with type 2 diabetes: A systematic review and meta-analysis," *Journal of Contextual Behavioral Science*, vol. 24, pp. 86–95, 2022.
- [17] M. Noroozi, Y. Madmoli, M. Derikvand, M. Saki, and M. Moradi Kalboland, "Investigating health literacy level and its relation with some factors in patients with type 2 diabetes in Ahvaz-2018," *Journal of Health Literacy*, vol. 4, no. 1, pp. 43–52, 2019. <https://doi.org/10.22038/jhl.2019.39813.1049>
- [18] A. Visuttranukul, P. Thamrongworakun, K. Visuttipukdee, N. Thanaphonganan, and T. Panyasaisophon, "Effects of re-measurements of health literacy, health behavior, and hemoglobin A1c with qualitative confirmation in patients with type 2 diabetes mellitus," *Journal of Natural Science, Biology and Medicine*, vol. 15, no. 1, pp. 148–158, 2024.
- [19] T. Panyasaisophon, A. Visuttranukul, P. Thamrongworakun, T. Buapian, K. Tudpor, and N. Thanaphonganan, "Effects of educational health literacy development program on health literacy, health behaviors, and clinical outcomes in type 2 diabetes mellitus patients in Thailand: A mixed-method study," *Journal of Population Therapeutics and Clinical Pharmacology*, vol. 30, no. 5, pp. 598–606, 2023. <https://doi.org/10.47750/jptcp.2023.30.05.059>
- [20] C. D. Graham, J. Gouick, C. Krahé, and D. Gillanders, "A systematic review of the use of Acceptance and Commitment Therapy (ACT) in chronic disease and long-term conditions," *Clinical Psychology Review*, vol. 46, pp. 46–58, 2016. <https://doi.org/10.1016/j.cpr.2016.04.009>