

Effects of Enhance Health Literacy through Transformative Learning Program on Self-Management and Hemoglobin A1C Level Among Adults with Uncontrolled Type 2 Diabetes: A Randomized Controlled Trial

Mathaka Sriklo, Decha Tamdee,* Sivaporn Aungwattana, Thane Kaewthummanukul

Abstract: Health literacy is fundamental to people's ability to manage their health and make appropriate health decisions. Health literacy enhancement can maximize self-management and health outcomes, especially among uncontrolled type 2 diabetes persons with chronic symptoms that can cause microvascular and macrovascular complications. This randomized controlled trial examined the effects of the Enhance Health Literacy through Transformative Learning Program on self-management and HbA1C levels among adults with uncontrolled type 2 diabetes. The sample included 64 adults with uncontrolled type 2 diabetes visiting two health-promoting hospitals in a province in central Thailand. They were randomly allocated to either the experimental group (n = 32) receiving the 4-week transformative learning program in addition to usual care or the control group (n = 32) receiving only usual care. A demographic data questionnaire, the Self-Management Behaviors Scale, and the HbA1C record form were instruments for obtaining data. Data were analyzed using descriptive statistics, two-way repeated measures ANOVA, and independent t-tests.

Results showed that after receiving the program, the experimental group had significantly higher self-management scores than the control group and was more elevated. In addition, the experimental group had significantly lower HbA1C levels than the control group after the intervention at 12 weeks than before receiving the program. In conclusion, the Enhance Health Literacy through Transformative Learning Program can increase self-management behaviors and lower HbA1C levels. However, nurses need to further test the effectiveness of the literacy program before implementing widely in practice.

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Introduction

Currently, type 2 diabetes mellitus (T2DM) is a significant threat to global public health. It accounts for more than 95% of all cases of diabetes,¹ with a worldwide incidence and prevalence of diabetes of 22.9 million and 476.0 million, respectively.² In Thailand, the number of new diabetes cases in 2020 stood at 286,776,³ and without proper management,

Mathaka Sriklo, RN, PhD (Candidate) Faculty of Nursing, Chiang Mai University, Mueang, Chiang Mai, Thailand 50200,
E-mail: mathaka_s@cmu.ac.th

Correspondence to: Decha Tamdee,* RN, PhD, Associate Professor Faculty of Nursing, Chiang Mai University, Mueang, Chiang Mai, Thailand 50200
E-mail: decha.t@cmu.ac.th

Sivaporn Aungwattana, RN, PhD, Associate Professor Faculty of Nursing, Chiang Mai University, Mueang, Chiang Mai, Thailand 50200
E-mail: sivaporn.a@cmu.ac.th

Thane Kaewthummanukul, RN, PhD, Assistant Professor Faculty of Nursing, Chiang Mai University, Mueang, Chiang Mai, Thailand 50200
E-mail: thanee.kaewthummanu@cmu.ac.th

adults with T2DM who have an HbA1c of >7% are considered uncontrolled.⁴ Only 35.6% of Thai

adults with diabetes could control HbA1c⁵ under the recommendation from American Diabetes Association.⁴ Uncontrolled T2DM leads to severe complications and impacts, with 127.22 deaths per 100,000 Thai people aged over 15 years.⁶

The key to diabetes care is to prevent complications by controlling HbA1C, which can be achieved through self-management. Consistent engagement in diabetes self-management has been associated with improved blood glucose control, a normal HbA1C level, and minimized complications.⁷ However, Thai adults with T2DM have been found to have only a moderate level of management of eating behaviors (55.3%) and a low level of exercise behaviors (78.3%).⁸ For example, they often have inappropriate self-management in food and alcohol consumption (such as eating sticky rice and salty or sweet food); medication non-adherence; stress from chronic illness and fear of worsening symptoms; and loss of follow-up because of forgetfulness.⁹ These behaviors suggest an urgent need to promote self-management in this group.

Health literacy is fundamental to acquiring proper self-management of their health and making appropriate health decisions. Health literacy involves cognitive and social skills that determine motivation and ability to gain access to, understand, and use the information to promote and maintain good health.¹⁰ Health literacy comprises three levels: 1) functional health literacy to access, 2) understand and apply health information; communicative health literacy to extract health information and derive meaning from various forms of communication, and 3) critical health literacy to critically analyze and make a decision to take action over health determinants.¹⁰ Health literacy has been proven to determine successful self-management among persons with uncontrolled T2DM,¹¹ with critical health literacy, notably, being the strongest predictor of self-management among persons with uncontrolled T2DM.¹² Unfortunately, 55.9% of Thai adults with uncontrolled T2DM had a low level of functional and communicative health literacy and a deficient level of

critical health literacy,¹³ indicating a need for health literacy improvement in this population.

Since health literacy is linked with cognitive abilities, improving health literacy also depends on a person's perspective or attitude toward health as it drives decision-making in the healthcare context. People's assumptions and expectations frame their thinking, feelings, and actions, which are congruent with critical health literacy that involves an interest and motivation to learn more about health issues.¹⁴ However, evidence shows that adults with uncontrolled T2DM have a low attitude about diabetes (48.8%).⁸ Therefore, they need a transformation of perspectives to develop health literacy and achieve more sustainable behavior change for self-management and a reduction in HbA1C. The application of transformative learning has promise for people with T2DM to increase their cognitive abilities and motivation to access, understand and use the information to achieve glycemic control through perception adjustments that result in new behaviors.

Conceptual Framework and Review of Literature

The conceptual framework for this study was based on transformative learning,¹⁵ health literacy,¹⁰ and self-management.¹⁶ Transformative learning comprises four elements (disorienting dilemma or experience, critical reflection, discourse, and action) that can be performed in ten steps, including step 1: disorientating dilemma; step 2: self-examination; step 3: critical assessment; step 4: a recognition that one's discontent and process of transformation are shared; step 5: the exploration of options for new roles, relationships, and actions; step 6: planning a course of action; step 7: acquisition of knowledge and skills for implementing one's plans; step 8: provisional trying of new roles; step 9: the building of competence and self-confidence in new roles and relationships;

and step 10: reintegration into one's life based on conditions dictated by one's new perspectives.¹⁵ These steps are essential in guiding adults with uncontrolled T2DM to open to new perspectives for better health behaviors by developing health literacy.

Health literacy encompasses a person's six skills.^{10,17} First, access skill involves choosing sources of health information, accessing, and seeking accurate and updated health information. Second, cognitive skill is knowing and memorizing the main points of behavior to maintain good health, understanding, and explaining how to apply such knowledge in practice. Third, communication skill represents speaking, reading, or writing health information to make others understand. Fourth, self-management skill includes setting a goal, planning for behavior, and following a plan to achieve goals for good health. Fifth, media literacy skill means checking for the accuracy and reliability of health information. Lastly, decision-making skill reflects using reasoning to analyze the advantages and disadvantages of health behaviors.^{10,17} Thus, with adequate health literacy, adults with uncontrolled T2DM can have cognitive abilities and skills to perform self-management, which leads to lower HbA1C.

Self-management refers to people's responsibility for day-to-day care during chronic illness through three self-management tasks: medical, role, and emotional management.¹⁶ There are three self-management tasks, including medical management through adherence to medication; role management through changing and maintaining new health behaviors in proper diet and exercise; and emotional management through reduction of stress and negative emotions.¹⁶ Diabetes self-management is vital because healthy behaviors produce optimum glycemic control, which helps lower HbA1C⁷ and prevent subsequent acute and long-term complications.¹⁸

Evidence from the literature demonstrates that transformative learning programs could lead to improvements in self-management in diabetes^{19,20} and reductions in HbA1C.^{19,21} To our knowledge,

there is a lack of programs to employ transformative learning steps to guide the development of health literacy skills to achieve the three levels of health literacy mentioned above, especially among adults with uncontrolled T2DM.

Study Aim and Hypotheses

This study aimed to examine the effect of the Enhance Health Literacy through Transformative Learning Program (EHL-TLP) on self-management and HbA1C levels among adults with uncontrolled T2DM. It was hypothesized that the experimental group would have higher self-management at 8 and 12 weeks and lower HbA1C after the program than before receiving it and at a lower level than the control group.

Methods

Design: This study was a parallel, two-group randomized controlled trial (RCT) with a pretest-posttest design. This research report was guided by the Consolidated Standards of Reporting Trials (CONSORT).

Sampling and settings: The sample size was calculated using a power table for ANOVA for mean test²² with a significance of .05 and power of .80. Due to no similar studies in Thailand, this study used the effect size of 0.4, which is the acceptable range of effect size for nursing research.²² This resulted in 29 participants per group. In addition, we added 10% of the estimated sample size for possible participant dropout, finally yielding 32 participants per group with a total of 64 participants.

The sample was selected using multi-stage random sampling. First, one province was randomly selected from 22 provinces in central Thailand. Next, one district was randomly selected from the six districts of the province, and next, two hospitals were randomly selected from the ten health-promoting hospitals in that district (**Figure 1**). Participants were purposively selected based on the inclusion criteria of 1) age 35–59 years, male or female, 2) HbA1c >7 % assessed every

three months twice during 2020–2021 despite treatment by oral medication, 3) able to perform activities of daily living by oneself with a score of at least 12 points in the Barthel Activities of Daily Living (ADL); 4) cognitively intact with a minimum score of 18 points in the Mini-Mental State Examination (MMSE-Thai 2002); 5) own a smartphone; and 6) able to communicate in Thai. Participants were excluded if they had severe T2DM (had a recent cardiovascular event within three months before the study). Discontinuation criteria were: 1) wishing to withdraw from the study and 2) not completing participation 100% in intervention sessions.

Participants in Hospital A were assigned to an experimental group, and those in Hospital B were assigned to a control group using random cluster sampling.

In Hospital A, 71 people with uncontrolled diabetes were initially approached. Ten did not meet the criteria, and 29 were unable to participate. In Hospital B, 73 people with uncontrolled diabetes were approached, 11 did not meet the requirements, and 30 were unable to participate. During the study period, all those in both groups were able to participate in the study. The final number of participants used for data analyses was 32 in each hospital (**Figure 1**).

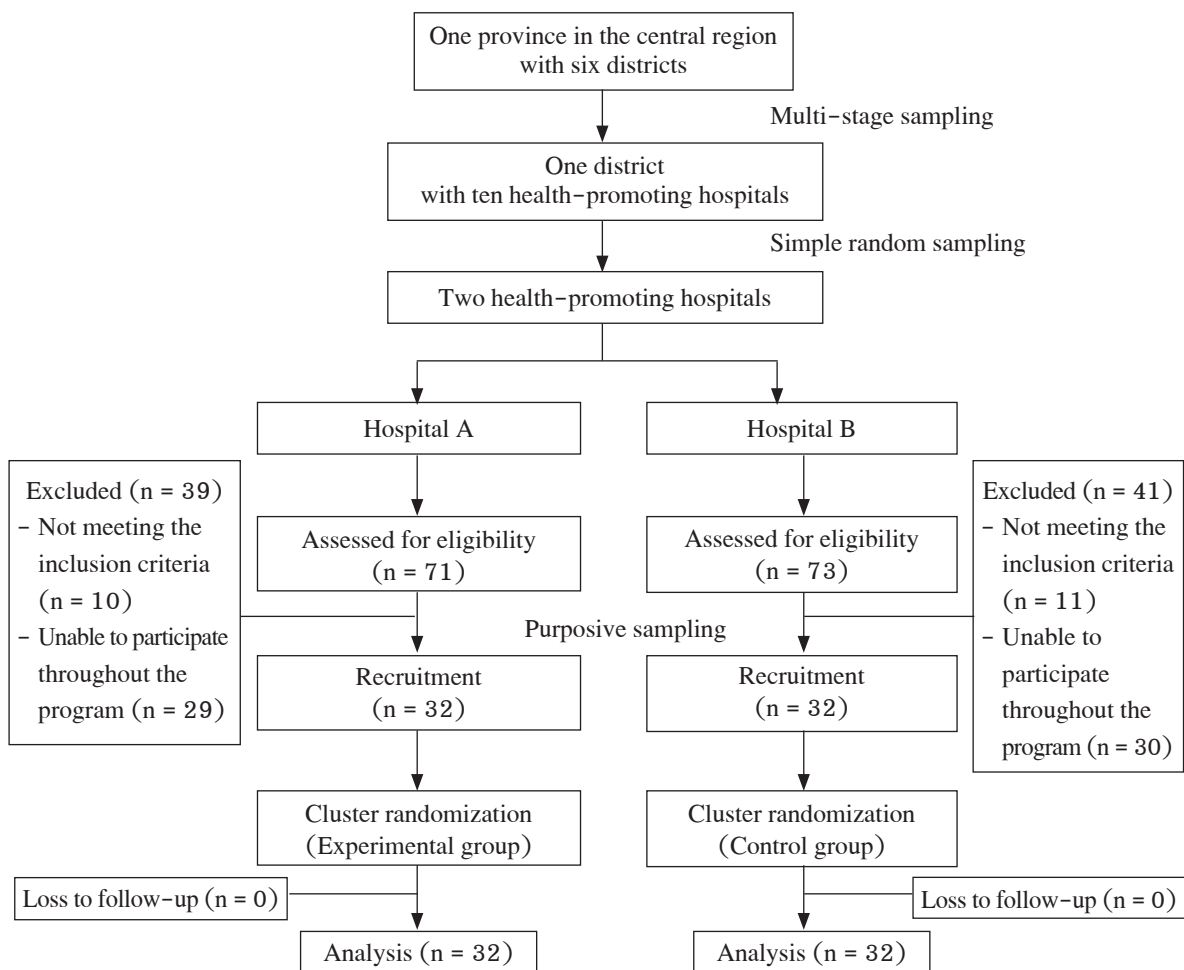


Figure 1. Flow diagram of participants in randomized controlled trial

Ethical Considerations: This research was approved by the Institutional Review Board of the Faculty of Nursing, Chiang Mai University (No. 2021-EXP038), and the participating hospitals. The participants were informed of details about the research, including research objectives, protection of human rights, potential risks, and benefits. Participants were also told that participation in this study was entirely voluntary, and they could withdraw from the research project anytime without any consequence on their health care services. After agreeing to participate and being assured about the protection of their identities and confidentiality, they signed a consent form. This study was conducted during the COVID-19 pandemic, so prevention measures were strictly maintained throughout the program.

Research Instruments:

A *demographic questionnaire* was developed by the primary investigator (PI) to collect participant information about gender, age, marital status, education level, monthly income, income sufficiency, duration since T2DM diagnosis, body mass index, history of smoking and alcohol consumption, comorbidity, and HbA1c in the past 1–3 months.

The *Functional, Communicative and Critical Health Literacy Scale* was used to monitor health literacy. It was translated into Thai by Noppakraw et al.²³ from the original scale,²⁴ and consists of 14 items. There are five negative items for functional health literacy, five positive items for interactive health literacy, and four positive items for critical health literacy. An example of an item is: “You seek health information from various sources.” Each item is rated on a 4-point Likert scale from 1 (never) to 4 (always). Negative items are reverse-scored. Possible total scores range from 14 to 56 (14–28 = low health literacy, 28.01–42 = moderate health literacy, 42.01–56 = high health literacy).²³ The score of each subscale (functional, interactive, and critical health literacy) is calculated by summing the score of items in each subscale and dividing by the number of items to give a subscale

score. Higher scores indicate higher health literacy. For internal consistency reliability, Cronbach’s alphas were .87 in the pretest with ten adults and .90 in the actual study with 64 participants.

The *Self-Management Behaviors Scale* was used to measure self-management after permission was obtained. It was developed in the Thai language by Angboonta et al.²⁵ based on self-management¹⁶ covering three self-management tasks (medical, role, and emotional management). It consists of 17 positive items: exercise (5 items), diet (3 items), perception and management of symptoms and stress (3 items), diabetes medication (3 items), and communication with physicians (3 items). An example item is “You take your medicine on time; take pre-meal medicine half an hour before meals and take after-meals medicine half an hour after meals.” Each item is rated on a 4-point Likert scale from 1 (never) to 4 (always). The total possible score ranges from 17 to 68. Higher scores indicate higher self-management behavior, with a score of 17–34 indicating low self-management, 34.01–51 indicating moderate self-management, and 51.01–68, indicating high self-management. The scale-level content validity index (S-CVI) was 0.83.²⁵ For internal consistency reliability, Cronbach’s alphas were .92 in the pretest with ten adults with uncontrolled diabetes and .93 in the actual study with 64 participants.

HbA1C assays were performed using SYSMEX BX-3010 with inhibition of enzyme metric method. The unit of measurement was reported in percentage (%). The test was conducted by taking 3 ml. of the blood sample from the vein in the arm and stored in purple-cap blood collection tubes containing ethylenediaminetetraacetic acid or EDTA. Blood tests were done in a hospital laboratory within 2 hours of collecting blood samples. The SYSMEX BX-3010 was certified to meet the International Federation of Clinical Chemistry (IFCC) standards.²⁶

The EHL-TLP

The EHL-TLP included a set of activities developed by the PI based on transformative learning.

It was designed to enhance health literacy for self-management through 10 steps of transformative learning.¹⁵ The program consisted of four weekly sessions led by the PI (60 minutes/session/week). In each session, the participants were divided into a group of 10–12 members. Session 1 included activities to enhance access and cognitive skills of health literacy by integrating steps 1–3 of transformative learning. Session 2 included exercises to improve communication and self-management skills of health literacy through steps 4–6 of transformative learning. Session 3 included

activities to enhance media literacy skills and decision-making skills of health literacy based on steps 7–8 of transformative learning. Session 4 comprised activities to enhance media literacy and decision-making skills based on steps 9–10 of transformative learning. (see **Table 1**) Six experts reviewed the content validity of the program; three nursing faculties specialists in health literacy, two nurses specialists in diabetes self-management, and one physician in diabetes); it was revised based on expert suggestions before implementation.

Table 1. Contents of the transformative learning to enhance health literacy program

Week/Session/ Time	Topic/Teaching method and strategy	Objectives	Teaching-learning activities
Week 1 / Session 1 / (1 hour)	Steps 1–3 of transformative learning 1. Disorientating dilemma 2. Self-examination 3. Critical assessment	To enhance access and cognitive skills of health literacy	1. Self-introduction to make a good mutual relationship 2. Program introduction, including objectives and procedures of the study 3. Share lived experiences and feelings about their dilemma caused by diabetes that affects life (<i>Disorientating dilemma</i>) 4. Examine and share beliefs or perspectives about their experience in diabetes care that caused guilt or shame (<i>Self-examination</i>) through group discussion with open-ended questions: 1) <i>What is your present blood sugar? Why is it important for you to know?</i> 2) <i>Did you know about the recommended level of blood sugar?</i> 3) <i>What do you think about your current health status?</i> 4) <i>Have you ever had symptoms of high blood sugar? What are your symptoms?</i> 5. Reflect on beliefs about blood sugar control (<i>Critical reflection and rational discourse</i>) through group discussion with open-ended questions; make critical self-reflection and perform self-questioning about attitude related to diabetes in exercise and diet, barriers, and solutions.

Table 1. Contents of the transformative learning to enhance health literacy program (Cont.)

Week/Session/ Time	Topic/Teaching method and strategy	Objectives	Teaching-learning activities
Week 2/Session 2/(1 hour)	Steps 4–6 of transformative learning 4. Recognition that one is discontent and the processes of transformation are shared 5. Exploration of options for new roles, relationships, and actions 6. Planning a course of action	To enhance com- munication and self-management skills in health literacy	1. Discuss previous knowledge of diabetes using open-ended questions and receive information about exercise, diet, and emotional management for diabetes using a PPT. Discuss with questions: 1) <i>What do you think about the importance of blood sugar control at the recommended level? Why?</i> 2) <i>How do you perform blood sugar control?</i> 3) <i>What are your problems with blood sugar control?</i> 4) <i>If you want to change your behaviors for blood sugar control, what should you do?</i> 2. Set the optimal goal and commitment to responsibilities to control blood sugar to the recommended level 3. Receive a demonstration of the consequences of uncontrolled diabetes using a PPT – Step 4: Share attitudes and perspectives about exercise, diet, and emotional management for diabetes with other participants – Step 5: Discuss new behaviors and roles in self-management regarding diet, exercise, emotional management, medication taking, prevention of complications and impacts, and HbA1C control as the key to diabetes care – Step 6: Plan your diet correctly for T2DM; Share opinions and discuss the planned diet; Receive suggestions and praise for a proper diet plan and encouragement for proper diet at home
Week 3/ Session 3/ (1 hour)	Steps 7–8 of transformative learning 7. Acquisition of knowledge and skills for implementing one's plans 8. Provisional trying of new roles	To enhance media literacy and decision-making skills of health literacy	1. Share lived experiences about previous eating behaviors – Teaching about an appropriate diet for adults with uncontrolled T2DM, as well as diabetes medication, properties, administration, side effects, and storage using PPT – Practicing dietary planning using food models through group activities

Table 1. Contents of the transformative learning to enhance health literacy program (Cont.)

Week/Session/ Time	Topic/Teaching method and strategy	Objectives	Teaching-learning activities
			2. Share lived experiences about emotional problems through group discussion - Teaching about stress management using PowerPoint presentation - Receive a demonstration on how to search for information on the internet using “emotional management” as the search term from a smartphone - Receive a demonstration and practice on relaxation techniques: breathing exercises, muscle relaxation, and massage - Receive education about diabetes medication, its properties, administration, side effects, and storage - Describe possible issues related to medication; Share and receive feedback and recommendations for answers - Receive a booklet to review general knowledge of diabetes, medication to lower blood sugar, diet for diabetes, simple exercise, stress management at home, and self-management in diet, medication, training, and stress management - Step 7: Receive education on diabetes treatment and transformative learning to promote six health literacy skills; Share how to solve the issues; Receive feedback and recommendation - Step 8: Share and receive feedback on self-management in exercise and diet for diabetes, emotional management, and medication taking
Week 4/ Session 4/ (1 hour)	Steps 9-10 of transformative learning 9. Building competence and self-confidence in new roles and relationships	To enhance media literacy and decision-making skills of health literacy	1. Share experiences about daily exercises through group discussion - Teaching about the benefits of regular exercise and effective exercise for adults using PowerPoint presentation - Demonstrating and practicing exercise

Table 1. Contents of the transformative learning to enhance health literacy program (Cont.)

Week/Session/ Time	Topic/Teaching method and strategy	Objectives	Teaching-learning activities
	10. Reintegration into one's life based on conditions dictated by one's new perspectives		2. Share experiences about medication management and role management through group discussion - Teaching about medication management and role management using PowerPoint presentation - Practicing medication management using medication instruction sheets through group activities - Step 9: Receive verbal reinforcement to increase confidence in self-management - Step 10: Discuss how to integrate the obtained health information into diabetes self-management in your own context

Data Collection: The PI approached the participants who met the inclusion criteria, informed the study's purposes, and received written informed consent. A pretest of self-management and HbA1C was conducted in a meeting room of the selected health-promoting hospitals. Then, the participants in the experimental and control groups engaged in activities. The experimental group received the program in addition to usual care. The control group received only usual care, including routine nursing care activities provided at the diabetes clinic of the hospitals. To monitor health literacy four weeks after the program, the participants completed the Functional, Communicative and Critical Health Literacy Scale. For the post-test, after the program, participants completed the Self-Management Behaviors Scale twice at 8 and 12 weeks and had an HbA1C test once at 12 weeks. The PI trained research assistants for data collection. A single-blind technique prevented data collectors from knowing the groups' status.

Data Analysis: Demographic data were analyzed using frequency, percentage, mean, and standard deviation and compared using the Chi-square test or

Fisher's exact test and t-test. Self-management scores were compared using two-way repeated measures ANOVA. HbA1C levels and health literacy were compared using an independent t-test. Before analysis, all statistical assumptions were tested, indicating no violations of the assumptions.

Results

There were 32 participants in each group. In both groups, most were female, married, and had elementary school education with a monthly income of 5,000–10,000 baht (149–298 USD). They had been diagnosed with T2DM for 11–15 years, with a normal range of body mass index and a history of smoking and alcohol consumption. They had no comorbidity alongside diabetes, lived with one to three family members, and had a moderate level of self-management behavior and moderate control of HbA1C. There were no significant differences between participants in the experimental and control groups regarding demographic and clinical characteristics (Table 2).

Table 2. Demographic characteristics of the experimental group and control groups

Characteristics	Experimental (N = 32)		Control (N = 32)		p-value
	N	%	N	%	
Gender					.602 ^a
Male	12	37.50	12	37.50	
Female	20	62.50	20	62.50	
Age (years)					.249 ^t
36–45	2	6.26	2	6.25	
46–55	15	46.87	22	68.75	
56–60	15	46.87	8	25.00	
Mean (SD)	53.81(5.18)		52.66 (4.05)		
Marital status					.402 ^b
Married	30	93.75	27	84.38	
Divorced/separated	2	6.25	4	12.50	
Widow/widower	–	–	1	3.13	
Education level					.635 ^a
Lower Elementary	15	46.88	12	37.50	
Upper Elementary	10	31.25	13	40.62	
Lower Secondary	7	21.87	7	21.88	
Monthly income in Baht (US\$)					.363 ^b
< 5,000 (149.43)	11	34.38	8	25.00	
5,000–10,000 (149–299)	18	56.25	21	75.00	
10,001–15,000 (299–448)	1	3.13	1	3.13	
15,001–20,000 (448–598)	1	3.13	1	3.13	
> 20,001 (597.76)	1	3.13	1	3.13	
Income sufficiency					.500 ^b
Sufficient	32	100.00	31	96.88	
Insufficient	–	–	1	3.13	
Duration since T2DM diagnosis (years)					.657 ^b
6–10	1	3.13	2	6.25	
11–15	19	59.38	17	53.13	
16–20	11	34.38	13	40.63	
21–25	1	3.13	–	–	
Body mass index (kg/m ²)					.394 ^t
18.50–22.99	11	34.38	9	28.13	
≥ 23.00	21	65.63	23	71.88	
Mean (SD)	23.95 (2.70)		24.41 (2.97)		
History of smoking					.119 ^b
Yes	32	100.00	29	90.63	
No	–	–	3	9.38	

Table 2. Demographic characteristics of the experimental group and control group (Cont.)

Characteristics	Experimental (N = 32)		Control (N = 32)		p-value
	N	%	N	%	
History of alcohol consumption					.119 ^b
Yes	32	100.00	29	90.63	
No	-	-	3	9.38	
Comorbidity besides T2DM					.613 ^a
No	24	75.00	24	75.00	
Yes: hypertension	8	25.00	8	25.00	
No. of family members					.401 ^a
1-3	19	59.38	17	53.13	
4-6	13	40.63	15	46.88	
Self-management behavior					.644 ^t
Moderate (34.01-51.00)	15	46.87	16	50.00	
High (51.01-68)	17	53.13	16	50.00	
Mean (SD)	50.69 (1.82)		50.91 (1.94)		
Range	47-55		46-55		
HbA1C (%)					.867 ^t
Moderate control (7-8.50)	26	81.25	26	81.25	
Poor control (> 8.50)	6	18.75	6	18.75	
Mean (SD)	7.76 (0.80)		7.73 (0.80)		
Range	7.00-10.90		6.52-10.90		

Note. ^t = t-test, ^a = Chi-square test, ^b = Fisher's Exact test

Health literacy was compared between the groups at baseline and four weeks after the program using an independent t-test. There was no significant difference between groups at baseline for overall functional, communicative, and critical health literacy. However, the experimental group had significantly higher health literacy than the control group four weeks after the program (Table 3).

The mean scores for self-management behaviors between the experimental and control groups before

the program, at weeks 8 and 12, were compared using two-way repeated measures ANOVA. There was no significant difference between both groups. However, the experimental group's mean score of self-management behaviors was significantly higher than that of the control group 8 and 12 weeks after the program ended (Table 3). Moreover, there was an interaction effect between the experimental and time ($p < .001$) (Table 4).

Table 3. Mean scores for health literacy, self-management behavior, and HbA1C between the experimental and control groups

	Experimental (N = 32)		Control (N = 32)		p-value
	mean	SD	mean	SD	
Health literacy					
Overall					
Before program	39.84	1.51	39.84	1.35	1.000
Four weeks after	48.59	1.48	41.03	2.04	< .001

Table 3. Mean scores for health literacy, self-management behavior, and HbA1C between the experimental and control groups (Cont.)

	Experimental (N = 32)		Control (N = 32)		p-value
	mean	SD	mean	SD	
Functional					
Before program	10.50	0.88	10.50	0.76	1.000
Four weeks after	14.47	0.88	11.66	1.38	< .001
Communicative					
Before the program	17.19	1.03	17.19	0.74	1.000
Four weeks after	18.69	0.62	17.19	0.86	< .001
Critical					
Before program	12.16	1.02	12.16	0.99	1.000
Four weeks after	15.25	0.76	12.41	1.01	< .001
Self-management behavior					
Before program	50.69	1.82	50.91	1.94	.644
Eight weeks after	57.25	2.31	51.61	1.43	< .001
12 weeks after	59.56	1.92	51.66	1.97	< .001
HbA1C (%)					
Before program	7.76	0.80	7.73	0.80	.867
12 weeks after	6.75	0.24	7.58	0.84	< .001

Table 4. Variance analysis of the mean score on self-management behavior between the experimental methods and the experimental period

Source of variation	SS	df	MS	F	p	h^2
Between subjects	1375.48	63	1005.26			
Group (G)	999.19	1	999.19	164.64	< .001	.726
Error	376.29	62	6.06			
Within subjects	1652	86.55	1013.15			
Interval	787.88	1.35 ^a	582.57	1.36	< .001	.733
I x G	577.72	1.35 ^a	427.17	125.05	< .001	.669
Error (Interval)	286.39	83.85 ^a	3.41			
Total	3027.48	149.55	2018.41			

Note: a = Greenhouse-Geisser Epsilon

In addition, there were statistically significant differences in the mean scores of self-management behaviors before and after the program ended at weeks 8 and 12 ($p < .001$). The mean score of self-management behaviors at 12 weeks after receiving the program was higher than at eight weeks after receiving the program and receiving the program, respectively (**Table 5**).

For the HbA1C, there were no significant differences in the mean HbA1C levels between the experimental group and control group at baseline ($p > .05$). However, after the program ended, there were significant differences in the mean HbA1C levels between the experimental group and control group ($p < .001$) (**Table 3**). Furthermore, diabetic control, indicated by HbA1C < 7%, was achieved by all 32

participants in the experimental group compared to only 19 participants in the control group. Additionally, the results showed significant differences in the mean HbA1C levels of the experimental group before and

after the program at 12 weeks ($p < .01$). The mean HbA1C levels of the experimental group at 12 weeks after the program were lower than before the program (Table 5).

Table 5. Comparison of mean scores of self-management behavior and HbA1C of experimental group between before and after the program

Variable	Baseline (1)	Eight weeks after program (2)	12 weeks after program (3)	p-value		
	Mean (SD)	Mean (SD)	Mean (SD)	(1) vs. (2)	(1) vs. (3)	(2) vs. (3)
Self-management	50.69 (1.82)	57.25 (2.31)	59.56 (1.92)	< .001	< .001	< .001
HbA1C (%)	7.76 (0.80)	-	6.75 (0.24)	-	.007	-

Discussion

The finding showed that the EHL-TLP effectively enhances self-management behaviors and decreases HbA1C. These findings confirmed that the ten steps of transformative learning¹⁵ could improve the self-management of adults with uncontrolled T2DM by enabling them to reassess the structure of assumptions and expectations that frame their thinking, feeling, and action, followed by the development of health literacy, which is an influential factor in diabetes self-management.^{11,12}

In this study, each step of transformative learning helped guide the development of six health literacy skills. First, participants took part in small groups of 10–12 to facilitate group-based discussion, where they were encouraged to share, discuss, and give feedback about their experiences and self-management challenges with others. Steps 1–3 of transformative learning aimed at enhancing access and cognitive skills of health literacy through sharing experiences of negative consequences caused by diabetes, self-examining beliefs or perspectives about diabetes care that caused guilt, and critically assessing own attitudes related to diabetes. These processes stimulated the participants to question their deeply held personal values and perspectives about diabetes while raising their awareness of the negative consequences of uncontrolled diabetes and complications that could endanger their lives, which served as

motivators for personal change. Similarly, previous research indicated that perspectives and motivation derived from reflecting on the negative consequences of diabetes were the enablers of self-management behaviors to prevent diabetes complications.²⁷ Then, participants' communication and self-management skills of health literacy were enhanced with steps 4–7 of transformative learning by sharing perspectives about diabetes self-management and relevant plans to perform the three tasks to control HbA1c. These tasks included 1) medical management through proper diet, exercise, reducing stress factors, and medication adherence to the recommended level; 2) role management by maintaining, changing, and creating new health behaviors; and 3) emotional management by dealing with emotions associated with diabetes. The activities were also reinforced by education about diabetes treatments and training in problem-solving skills. After that, steps 8–10 of transformative learning served to enhance media literacy and decision-making skills of health literacy by teaching how to search for reliable information about diabetes self-management on the internet and make a decision to perform better health behaviors through integrating diabetes self-management in their context based on the new perspectives. Participation in these activities helped participants recognize that their transformation process was shared with others with the same chronic conditions. Participants explored options for new roles

together and built competence and self-confidence in new roles and relationships to effectively self-manage their chronic conditions.

As evidenced by the significant increases in health literacy in the experimental group, transformative learning steps promoted health literacy by moving from accessing health information in functional health literacy to extracting health information from different forms of communication in communicative health literacy. Finally, the experimental group gained the ability to critically analyze information and apply it to achieve greater control over health in critical health literacy. Consistent with previous findings, transformative learning led to significant improvements in attitude toward self-care and health literacy, with the highest increase observed in critical health literacy.²⁸ The effectiveness of transformative learning on improving self-management from our findings is in line with other studies.^{19,20}

Regarding the program's effects on HbA1C, our findings showed that the program could lower HbA1C in adults with uncontrolled T2DM diabetes. After joining the program, the participants developed the capability to take an active role in performing a range of health practices, especially effective self-management in the medical, role, and emotional management to help control T2DM leading to a decrease in HbA1C. Consistent with previous research, self-management behaviors led to successful glycemic control and decreased HbA1C.⁷ Lastly, our findings aligned with earlier studies regarding the effectiveness of transformative learning programs on lower HbA1C.^{19,21}

Limitations

This study had some limitations. First, the self-management post-test was conducted 8 and 12 weeks after the program ended, which is a short interval that might not be sufficient to show the sustainability of behavior change. Moreover, our study was conducted on people with uncontrolled diabetes

visiting health-promoting hospitals in a province in central Thailand. Therefore, generalizability to other groups and settings may be limited.

Conclusions and Implications for Nursing Practice

This study is the first to utilize transformative learning steps to guide the development of health literacy skills for adults with uncontrolled T2DM to help them develop from functional to communicative and critical health literacy to achieve better self-management and lower HbA1C. Our findings confirmed that changing the perspective of people with health problems is essential to activating self-management behavior. Nurses can incorporate this program into routine diabetes nursing care to increase self-management and control HbA1C by helping adults with uncontrolled T2DM reflect on the consequences of their condition, reassess their beliefs, and recognize the need for personal change. However, further testing of the program in other settings with different samples and the application of innovative technology is needed.

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ผลของโปรแกรมส่งเสริมความรอบรู้ด้านสุขภาพผ่านการเรียนรู้เพื่อการเปลี่ยนแปลงต่อการจัดการตนเองและระดับฮีโมโกลบินเอวันซีในผู้ป่วยโรคเบาหวานชนิดที่ 2 ที่ควบคุมไม่ได้ : การทดลองแบบสุ่มและมีกลุ่มควบคุม

มัตถก ศรีคล้อย เดชา ทำดี* ศิวพร อึ้งวัฒนา ธาณี แก้วธรรมานุกูล

บทคัดย่อ: ความรอบรู้ด้านสุขภาพเป็นพื้นฐานของความสามารถของบุคคลในการจัดการสุขภาพและตัดสินใจด้านสุขภาพที่เหมาะสม การส่งเสริมความรอบรู้ด้านสุขภาพสามารถทำให้มีการจัดการตนเองและผลลัพธ์ด้านสุขภาพดีขึ้น โดยเฉพาะอย่างยิ่งในผู้ป่วยโรคเบาหวานชนิดที่ 2 ที่ควบคุมไม่ได้ ซึ่งมีอาการเรื้อรังที่อาจก่อให้เกิดภาวะแทรกซ้อนในหลอดเลือดขนาดเล็กและหลอดเลือดขนาดใหญ่ การวิจัยเชิงทดลองแบบสุ่มและมีกลุ่มควบคุมนี้มีวัตถุประสงค์เพื่อศึกษาผลของโปรแกรมส่งเสริมความรอบรู้ด้านสุขภาพผ่านการเรียนรู้เพื่อการเปลี่ยนแปลงต่อการจัดการตนเองและระดับฮีโมโกลบินเอวันซีในผู้ป่วยโรคเบาหวานชนิดที่ 2 ที่ควบคุมไม่ได้ กลุ่มตัวอย่างประกอบด้วยผู้ป่วยโรคเบาหวานชนิดที่ 2 ที่ควบคุมไม่ได้จำนวน 64 คน ที่เข้ารับบริการที่โรงพยาบาลส่งเสริมสุขภาพ 2 แห่งในจังหวัดภาคกลางของประเทศไทย สุ่มเข้ากลุ่มทดลอง ($n = 32$) ที่ได้รับการดูแลตามปกติและโปรแกรมการเรียนรู้เพื่อการเปลี่ยนแปลงเป็นระยะเวลา 4 สัปดาห์หรือกลุ่มควบคุม ($n = 32$) ที่ได้รับการดูแลตามปกติเท่านั้น รวบรวมข้อมูลโดยใช้แบบสอบถามข้อมูลส่วนบุคคล แบบวัดการจัดการตนเองและการทดสอบฮีโมโกลบินเอวันซี วิเคราะห์ข้อมูลโดยใช้สถิติเชิงพรรณนา การทดสอบความแปรปรวนแบบเกี่ยวข้องกันสองทางและสถิติทีอิสระ

ผลการศึกษาพบว่า กลุ่มทดลองมีคะแนนการจัดการตนเองหลังได้รับโปรแกรมสูงกว่ากลุ่มควบคุมและสูงกว่าก่อนได้รับโปรแกรมอย่างมีนัยสำคัญทางสถิติ กลุ่มทดลองมีระดับฮีโมโกลบินเอวันซีต่ำกว่ากลุ่มควบคุมและหลังจากการได้รับโปรแกรมที่ 12 สัปดาห์ต่ำกว่าก่อนได้รับโปรแกรมอย่างมีนัยสำคัญทางสถิติ สรุปได้ว่าโปรแกรมการส่งเสริมความรอบรู้ด้านสุขภาพผ่านการเรียนรู้เพื่อการเปลี่ยนแปลงสามารถเพิ่มการจัดการตนเองหลังและลดระดับฮีโมโกลบินเอวันซี อย่างไรก็ตาม พยาบาลจำเป็นต้องทดสอบประสิทธิภาพของโปรแกรมความรอบรู้ด้านสุขภาพเพิ่มเติมก่อนที่จะนำไปปฏิบัติอย่างแพร่หลายต่อไป

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คำสำคัญ: ฮีโมโกลบินเอวันซี ความรอบรู้ด้านสุขภาพ การทดลองแบบสุ่มและมีกลุ่มควบคุม การจัดการตนเอง การเรียนรู้เพื่อการเปลี่ยนแปลง โรคเบาหวานชนิดที่ 2 ที่ควบคุมไม่ได้

มัตถก ศรีคล้อย พยาบาลวิชาชีพ นักศึกษาปริญญาเอก คณะพยาบาลศาสตร์ มหาวิทยาลัยเชียงใหม่ อำเภอเมือง เชียงใหม่ ประเทศไทย 50200

E-mail: mathaka_s@cmu.ac.th

ติดต่อ: เดชา ทำดี* พยาบาลวิชาชีพ พด. รองศาสตราจารย์ คณะพยาบาลศาสตร์ มหาวิทยาลัยเชียงใหม่ อำเภอเมือง เชียงใหม่ ประเทศไทย 50200

E-mail: decha.t@cmu.ac.th

ศิวพร อึ้งวัฒนา พยาบาลวิชาชีพ ศด. รองศาสตราจารย์ คณะพยาบาลศาสตร์ มหาวิทยาลัยเชียงใหม่ อำเภอเมือง เชียงใหม่ ประเทศไทย 50200

E-mail: sivaporn.a@cmu.ac.th

ธาณี แก้วธรรมานุกูล พยาบาลวิชาชีพ ปร.ด. ผู้ช่วยศาสตราจารย์ คณะพยาบาลศาสตร์ มหาวิทยาลัยเชียงใหม่ อำเภอเมือง เชียงใหม่ ประเทศไทย 50200

E-mail: thanee.kaewthummanu@cmu.ac.th