

# Prevention of Diabetic Retinopathy through a Multidisciplinary Team Education Program in Adults with Type 2 Diabetes: A Quasi-Experimental Study

Panisara Songwatthanayuth, Petchrung Dechpoonyachit,\* Nantaya Buongam

**Abstract:** Diabetic retinopathy is preventable with glycemic control through appropriate health behaviors that are influenced by health beliefs. A multidisciplinary team education led by nurses can address health beliefs, but the impact of preventing diabetic retinopathy remains unexplored. This two-group quasi-experimental, pretest-posttest study investigated the effects of a Multidisciplinary Team Education Program on diabetic retinopathy prevention behavior and hemoglobin A1c. The participants comprised 62 adults with type 2 diabetes who had a hemoglobin A1c level over 7%, selected from a general hospital in Thailand's western province using simple random sampling. They were assigned to the experimental group (n = 31), which engaged in the 12-week Multidisciplinary Team Education Program along with usual care, and the control group (n = 31), which received only usual care. Data were collected between May 2023 and February 2024 using the Diabetic Retinopathy Prevention Behavior Questionnaire and the hemoglobin A1c test. Data were analyzed using descriptive statistics, paired t-test, and independent t-test.

Following the program, the experimental group had significantly higher mean scores on diabetic retinopathy prevention behavior, as well as lower hemoglobin A1c levels, compared to the control group and before the program. Nurses should be trained to implement this program to raise awareness of diabetic retinopathy and motivate behavior change for glycemic control. However, a further multisite randomized controlled study is needed before it can be implemented in practice.

**Keywords:** Diabetic retinopathy, Glycemic control, Multidisciplinary team education, Type 2 diabetes

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## Introduction

Diabetes mellitus (DM) is a metabolic disorder associated with elevated levels of blood glucose.<sup>1</sup> A persistently elevated blood glucose level leads to systemic vascular damage, causing a number of macro and microvascular complications. Diabetic retinopathy (DR) is a serious eye issue that typically develops after type 2 DM (T2DM).<sup>2</sup> The global incidence of DR in 2020 was estimated at 103 million, and is anticipated

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to affect 130 million people by 2030 and 161 million by 2045.<sup>3</sup> Compared to high-income countries, DR is more prevalent in low- and middle-income nations.

In Southeast Asia, the age-adjusted prevalence of DR is anticipated to rise to 12.2% in 2030.<sup>1</sup> Thailand has a large number of adults with T2DM and a rising projected burden, with DR prevalence of 134 per 1,000 Thai people.<sup>4</sup> DR is caused by prolonged high blood glucose levels, which bring about abnormalities of the tiny blood vessels that give the retina its blood supply.<sup>2</sup> Severe DR can cause neovascularization, resulting in vision impairment and blindness,<sup>5</sup> which causes dependence, isolation, and distress,<sup>6</sup> and reduces the quality of life.<sup>7</sup> Although the detrimental consequences are avoidable by screening, early diagnosis and treatments, these initiatives can be insufficiently organized, particularly in resource-limited areas, leaving some individuals visually impaired and blind.<sup>8</sup>

Glycemic control with a decrease in hemoglobin A1c (HbA1c) to a recommended level is necessary for reducing the chance of developing DR.<sup>9</sup> However, DR prevention practice is hindered by a number of health beliefs and the lack of awareness on the severity and risks of DR<sup>10</sup> because it is a silent, subtle problem that frequently goes undiagnosed until its effects on vision become obvious.<sup>9</sup> Many adults with T2DM still have low risk perception of DR due to a lack of knowledge about how diabetes affected the eyes, resulting in the lack of motivation to prevent DR.<sup>11</sup> Moreover, even if the need for DR prevention is recognized, it is difficult to achieve since it entails several meticulous tasks, as current glycemic control guidelines for DR prevention recommend maintaining a healthy diet, exercise, adherence to medications, and eye care.<sup>9,12</sup> Unfortunately, 73.50% of adults with T2DM had inadequate health behaviors to prevent DR.<sup>13</sup> These complex practices are best addressed by a multidisciplinary team<sup>8,9</sup> who can evaluate health conditions from several angles and develop treatment strategies tailored to the individuals' needs, encompassing comprehensive management from controlling blood glucose to preventing vision impairment.<sup>14</sup> Multidisciplinary team interventions for T2DM allowed for comprehensive care, which not only dispelled false beliefs but also

increased knowledge of diabetes and self-care behavior,<sup>15</sup> resulting in lower HbA1c.<sup>15-17</sup> However, the primary focus of those interventions was on diabetes-related outcomes in general. For DR prevention, previous interventions have included eye examinations and guidance from ophthalmologists and retina specialists,<sup>18</sup> as well as involvement from diabetes center staff, optometrists, and family members,<sup>19</sup> resulting in increased DR knowledge and self-efficacy,<sup>18</sup> and better eye care practices.<sup>19</sup> Nevertheless, these interventions have not been based explicitly on the multidisciplinary team education approach and did not focus on addressing health beliefs for DR prevention that are the foundation of motivation for behavior change and maintenance of healthy behaviors in diabetes.<sup>20</sup>

The Multidisciplinary Team Education Program (MTEP), grounded in the Health Belief Model (HBM), constitutes a substantive enhancement to usual care, which generally offers only broad health guidance. By integrating the specialized expertise of nurses, nutritionists, physicians, and pharmacists, the program systematically strengthens diabetic retinopathy (DR)-related knowledge and more effectively equips individuals with the requisite competencies to engage in a range of evidence-based DR prevention behaviors.

## **Literature Review and Conceptual Framework**

DR prevention requires blood glucose control, defined as HbA1c of 7% or lower.<sup>21</sup> A 1% drop in HbA1c is associated with a 35% lower chance of developing DR, a 15-25% lower chance of DR progression, a 25% reduction in visual acuity loss, and a 15% lower chance of developing blindness.<sup>22</sup> To control blood glucose, adults with T2DM need complex self-care, including maintaining a healthy diet, exercise, adherence to medications, and eye care.<sup>9,12</sup> Diet, which is low in carbohydrates but high in whole grains, vegetables, fruits, fibers, and good fats, has benefits in reducing cardiovascular problems and enhancing insulin

sensitivity.<sup>23</sup> Changes in diet have an impact on a number of metabolic pathways, such as increased fiber consumption, which can lower insulin demand and stabilize postprandial blood glucose levels by slowing the absorption of glucose.<sup>22-24</sup> Regarding exercise, moderate to vigorous aerobic exercise promotes anti-inflammatory functions in the retina that can prevent the progression of DR<sup>25</sup> and improve glucose control through insulin sensitivity and oxidative enzymes.<sup>22</sup> Adherence to medications is another important aspect of self-care for preventing DR because glycemic-lowering drugs work effectively when the individuals' antidiabetic medication-taking behaviors correspond with clinicians' recommendations.<sup>26</sup> The practice of these complex behaviors, however, needs to be motivated by the person's health beliefs that the practice will have a positive effect on themselves, encouraging them to take up healthier behaviors.<sup>20</sup>

The HBM is a thorough framework for comprehending actions related to disease prevention, considering multiple health beliefs.<sup>27</sup> The HBM asserts that individuals take steps to avoid a health condition when they believe that (a) they are at risk of it (perceived susceptibility), (b) it might have detrimental effects (perceived severity), (c) certain health actions can lessen the conditions' severity or their own susceptibility (perceived benefits), (d) they perceive minimal unfavorable aspects of the health actions (perceived barriers), (e) they believe in their ability to perform the health-promoting action (self-efficacy), and (f) they are triggered to initiate their action (cues to action).<sup>27</sup> These health beliefs towards T2DM affect the adoption and upkeep of self-care behaviors. HBM has been used to guide a previous intervention, leading to better T2DM knowledge and self-care behavior.<sup>28</sup> In DR prevention context, HBM-based health education intervention contributed to better eye care, and lower HbA1c among adults with T2DM.<sup>19</sup>

However, since the adoption of diabetes self-care is influenced by a combination of several factors, the integration of expertise from a multidisciplinary team is paramount.<sup>9</sup> The multidisciplinary team approach

involves various health specialists working together in diagnosing, treating, and providing overall care.<sup>16</sup> In diabetes care for DR, the multidisciplinary team usually includes several professionals who are essential for early detection of diabetic ocular problems and support in achieving glycemic control.<sup>12,17</sup> Doctors give eye exams that can detect subtle alterations in the retina before they become apparent vision issues.<sup>9</sup> Nurses promote general wellness, teach self-care techniques, provide skill-based instruction, such as how to apply eye drops, and recommend a nearby eye clinic for eye care monitoring.<sup>29</sup> Nutritionists provide information on diabetes-specific dietary patterns and individualized meal plans on what and how much to eat daily by demonstrating choices of carbohydrates, how to count carbohydrates, and the plate method.<sup>12</sup> Pharmacists also give education on T2DM medications, correct doses, and proper administration, and how to store insulin devices.<sup>30</sup> The diversity of the multidisciplinary team is essential in embracing the complexity and uniqueness of individuals with T2DM and related comorbidities.<sup>29</sup> Previous interventions using a multidisciplinary team included drug evaluation or modification, health education, health condition assessment, self-monitoring, diet modification, and treatment modification, leading to better compliance with T2DM treatments, lower HbA1c, and minimized risks of complications in non-DR populations,<sup>16,17</sup> but the multidisciplinary team interventions in DR prevention are limited.

## **Study Aim and Hypotheses**

The aims of our study were to examine the effects of the MTEP on DR prevention behavior, and HbA1c in adults with T2DM between before and after receiving the MTEP, and between those who received the MTEP and those who received only usual care.

We hypothesized that 1) after receiving the MTEP, the participants would have higher scores on DR prevention behavior, and lower HbA1c than before receiving it, and 2) the participants receiving the MTEP would have higher scores on DR prevention behavior, and lower HbA1c than those receiving usual care.

## Methods

**Design:** We conducted a quasi-experimental, pretest-posttest study with two groups following the Transparent Reporting of Evaluations with Nonrandomized Designs (TREND). A matched-pair method was performed with age and HbA1c.

**Participants and Setting:** This study took place at a 500-bed general hospital in a province in the western region of Thailand that provides specialized treatment for non-communicable chronic diseases and ophthalmology. Participants were adults with T2DM selected using simple random sampling, considering the following inclusion criteria: aged 20–59 years; HbA1c >7% on the latest blood test; without DR based on a dilated eye exam performed by ophthalmologists; able to communicate

in Thai; and willing to participate throughout the study process. Participants were excluded if they had DR based on a dilated eye exam. Discontinuation criteria included experiencing complications during study participation, such as hypoglycemia.

Sample size was obtained utilizing G\*Power 3.1.9.4 with an effect size of 0.85 based on a similar study,<sup>19</sup> significance of 0.05, and a power of 0.95. This gave a sample size of 62. Participants were assigned randomly to groups, with 31 participants for the experimental group and 31 participants for the control group. The experimental group received MTEP plus usual care, and the control group received usual care only. All 62 participants remained until the end of the study (31 participants in each group for data analysis) (Figure 1).

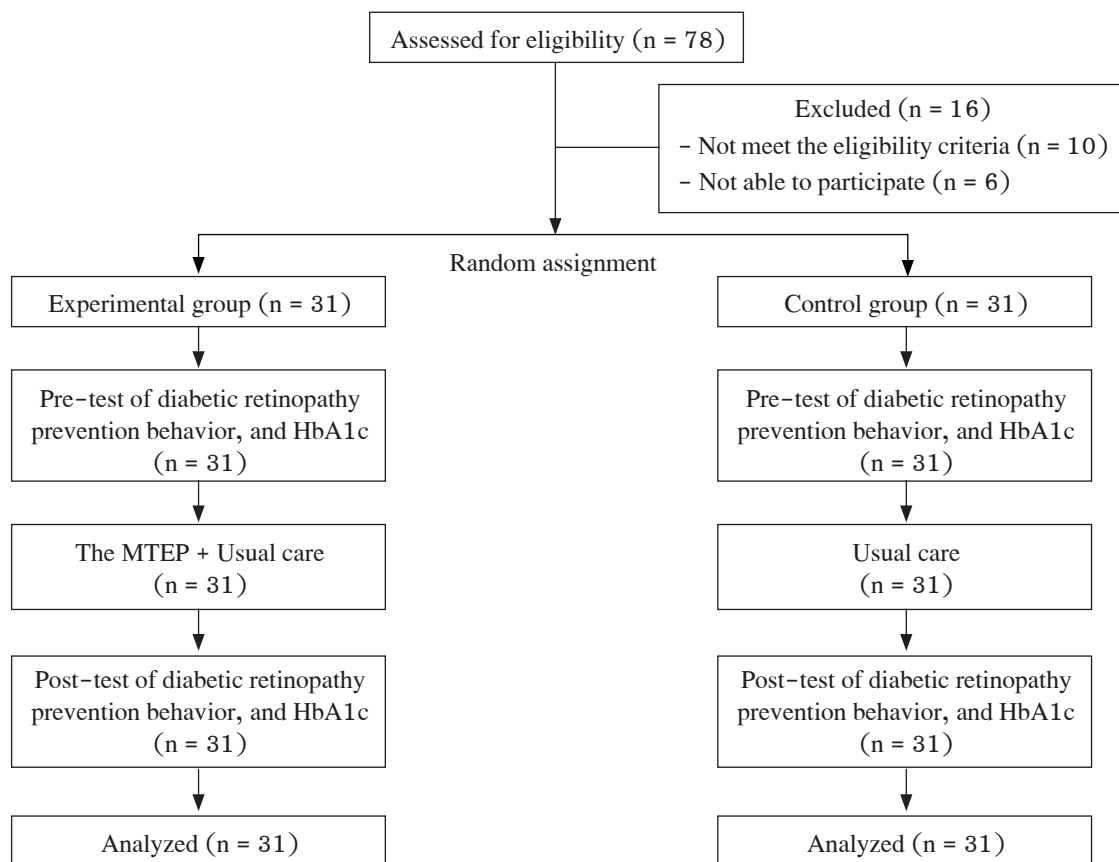


Figure 1. Flow diagram in this study

**Ethical Considerations:** Our study was approved by the Institutional Review Board of Phrachomkiao Hospital (Study number: 8/2566, on 26 April 2023) and followed the Declaration of Helsinki. The participants were fully informed of the study details and had the freedom to withdraw participation at any time without consequences on their treatments. Confidentiality and anonymity were strictly maintained by using codes instead of the participants' names. All participants signed an informed consent.

#### **Research Instruments**

*A Demographic and Health Data Questionnaire* was developed by the research team and contains 10 items on age, gender, marital status, education, occupation, monthly family income, time since diabetes diagnosis, visual acuity, HbA1c, and body mass index (BMI).

*The Diabetic Retinopathy Prevention Behavior Questionnaire* was used to assess DR prevention behavior. It was developed by the research team following a literature review and consists of 20 items categorized into eating (6 items), exercise (3 items), medication taking (4 items), emotion (3 items), and eye care and general health behavior (4 items). Items are rated on a 4-point scale ranging from 1 (never practiced) to 4 (always practiced). Example item is "You take care of your eyes and vision, such as blurred vision, abnormal vision, distorted vision, black spots or black lines that look like spider webs." The total score ranges from 20 to 80, indicating high (scores of 61–80), moderate (scores of 41–60), and low (scores of 0–40) levels of DR prevention behavior. Content validity was assessed by three experts in DR, yielding a CVI of 0.90. Cronbach's alpha was 0.81 in a pilot test (n = 30) and 0.88 in the actual study.

*HbA1C testing* was performed using the Sysmex BX-3010 with the enzymatic method. Three milliliters of blood were drawn from the arm vein for the test, and the sample was placed in blood collection tubes that contained ethylenediaminetetraacetic acid. Within two hours of drawing blood samples, blood tests were performed in a hospital laboratory. Percentage (%) was used to represent the unit of measurement. The Sysmex BX-3010 was approved to satisfy the requirements

of the Thailand National External Quality Assessment Scheme (NEQAS).<sup>31</sup>

#### **The Intervention**

The MTEP was developed based on the HBM.<sup>27</sup> The activities were delivered by the multidisciplinary team composed of nurses, doctors, nutritionists, and pharmacists, with nurses as the primary coordinators to promote DR perceived severity, perceived susceptibility, perceived self-efficacy, and perceived benefits of DR prevention while reducing perceived barriers to DR prevention and providing cues to action. The MTEP included five sessions over 12 weeks (**Appendix, Table A1**).

**Usual Care:** Usual care included outpatient services from doctors, nurses, and pharmacists. The doctors gave a health examination and health advice. The services provided by nurses included taking a history of diabetes and any associated complications, drawing blood samples for the HbA1c test every three months, measuring weight, waist circumference, and blood pressure, giving advice on controlling blood glucose, and scheduling medical appointments as needed. The pharmacists filled the prescription and advised on medications.

**Data Collection:** This was performed by the principal investigator (PI) between May 2023 and February 2024. We used a single-blind method to prevent participants from knowing their group status. The PI collected baseline data (demographic and health data, DR prevention behavior, and HbA1c) and post-test data (DR prevention behavior, and HbA1c) immediately after the program ended. After data collection, the control group was offered the MTEP on a voluntary basis. The control participants with high HbA1c were referred to the healthcare team for medical attention.

**Data Analysis:** SPSS Software, version 26.0, was employed for data analysis. Prior to analysis, statistical assumptions were tested, including independence and normality, utilizing a histogram, Q-Q plot, and Shapiro-Wilk test with  $p > 0.05$ . The results showed normal data distribution. Demographic and health data were described using descriptive statistics (percentage, frequency, mean, and standard deviation),

and then compared using the Chi-square test, Fisher's exact test, and an independent t-test. Assumptions for homogeneity of variance were met. DR prevention behavior, and HbA1c levels were compared between groups using an independent t-test, and between baseline and post-test using a paired t-test.

### Results

All 62 participants remained in the study, with 31 participants in each of the two groups. Their mean age was  $46.80 \pm 8.08$  years for the experimental group and  $44.80 \pm 9.41$  years for the control group. A large

proportion of the participants in both groups were female, married, had a primary school education, and worked as farmers. Their average monthly family income ranged between 21,741.93 Thai baht (656.06 USD) and 19,477.42 Thai baht (587.73 USD), respectively. The experimental group had been living with T2DM for an average of 8.23 years, while the control group had T2DM for an average of 6.55 years. They had mild visual impairment, with a mean HbA1c of almost 8% and an average BMI of about 25–26 kg/m<sup>2</sup>. Participants' characteristics at baseline did not differ significantly ( $p > 0.05$ ) (Table 1).

**Table 1.** Homogeneity test of characteristics between two groups

Characteristics	Experimental group (n = 31)	Control group (n = 31)	$\chi^2$ , t or Fisher's exact test	p-value
	n (%) or Mean $\pm$ SD	n (%) or Mean $\pm$ SD		
Age (years)	$46.80 \pm 8.08$	$44.80 \pm 9.41$	0.898 <sup>a</sup>	0.373
20–29	2 (6.4)	2 (6.4)		
30–39	4 (12.9)	4 (12.9)		
40–49	13 (41.9)	13 (41.9)		
50–59	12 (38.7)	12 (38.7)		
Gender			0.235 <sup>b</sup>	0.118
Female	26 (83.9)	21 (67.7)		
Male	5 (16.1)	10 (32.3)		
Marital status			7.067 <sup>c</sup>	0.132
Single	8 (25.8)	7 (22.6)		
Married	20 (64.5)	20 (64.5)		
Widowed/ widower	1 (3.2)	0 (0.0)		
Divorced/ separated	2 (6.5)	4 (12.9)		
Education			3.456 <sup>c</sup>	0.750
Primary	10 (32.3)	12 (38.7)		
Secondary/Vocational	7 (22.6)	5 (16.1)		
High school	6 (19.3)	5 (16.1)		
Diploma	2 (6.4)	1 (3.2)		
Bachelor's degree	6 (19.3)	8 (25.8)		
Occupation			3.185 <sup>c</sup>	0.203
Merchant	10 (32.3)	9 (29.0)		
Farmer	13 (41.9)	15 (48.4)		
Government employee	6 (19.3)	5 (16.1)		
Unemployed	2 (6.4)	2 (6.4)		

**Table 1.** Homogeneity test of characteristics between two groups (Cont.)

Characteristics	Experimental group (n = 31)	Control group (n = 31)	$\chi^2$ , t or Fisher's exact test	p-value
	n (%) or Mean $\pm$ SD	n (%) or Mean $\pm$ SD		
Monthly family income in Thai baht (USD)	21,741.93 $\pm$ 2.37 (656.06 USD)	19,477.42 $\pm$ 3.18 (587.73 USD)	0.393 <sup>a</sup>	0.360
< 15,000 (452.63)	11 (35.5)	10 (32.3)		
15,001 (452.66)–30,000 (905.25)	13 (41.9)	13 (41.9)		
30,001 (905.28)–45,000 (1,357.86)	4 (12.9)	5 (16.1)		
45,001 (1,357.91)–60,000 (1,810.50)	3 (9.7)	3 (9.7)		
Time since T2DM diagnosis (years)	8.23 $\pm$ 6.27	6.55 $\pm$ 4.22	1.234 <sup>a</sup>	0.222
1–10	20 (64.5)	18 (58.1)		
11–20	6 (19.4)	7 (22.5)		
21–30	5 (16.1)	6 (19.4)		
Visual acuity (VA)			0.622 <sup>b</sup>	0.430
Mild visual impairment	18 (58.1)	21 (67.7)		
Moderate visual impairment	13 (41.9)	10 (32.2)		
HbA1c (%)	7.89 $\pm$ 1.16	7.80 $\pm$ 0.91	0.310 <sup>a</sup>	0.758
7.1–8.0	20 (64.5)	20 (64.5)		
8.1–9.0	6 (19.4)	6 (19.4)		
> 9.0	5 (16.1)	5 (16.1)		
Body mass index (BMI) (Kg/m <sup>2</sup> )	26.71 $\pm$ 5.03	25.91 $\pm$ 3.82	0.709 <sup>a</sup>	0.481
18.5–22.9	7 (22.6)	7 (22.6)		
23.0–24.9	5 (16.1)	7 (22.6)		
25.0–29.9	14 (45.2)	12 (38.7)		
> 30.0	5 (16.1)	5 (16.1)		

Note. T2DM = type 2 diabetes, <sup>a</sup>Independent t-test, <sup>b</sup>Chi-square, <sup>c</sup>Fisher's exact test

The mean score of DR prevention behavior, and HbA1c did not differ significantly between groups at baseline. However, the post-test mean scores of DR prevention behavior of the experimental group were significantly higher than those of the control group ( $t = 23.314$ ,  $p < 0.001$ ) (Table 2). Moreover, in comparison with the control group, the experimental group's post-test HbA1c was significantly lower ( $t = -6.954$ ,  $p < 0.001$ ) (Table 2).

From within-group comparison, we found significant increases in the experimental group's post-test mean scores of DR prevention behavior ( $t = 18.750$ ,  $p < 0.001$ ), whereas the control group had a non-significant increase in DR prevention behavior ( $t = 3.527$ ,  $p = 0.091$ ) (Table 2). Moreover, we observed a significant decrease in HbA1c at post-test in the experimental group ( $t = -5.175$ ,  $p < 0.001$ ) while the control group showed a non-significant decrease in HbA1c ( $t = -1.830$ ,  $p = 0.064$ ) (Table 2).

**Table 2.** Within-group and between-group comparison of the mean score of diabetic retinopathy prevention behavior, and HbA1c (n = 62)

Variables	Experimental group (n = 31)		Control group (n = 31)		Effect size (95 % CI)	t <sup>a</sup>	p-value <sup>b</sup>
	Mean	SD	Mean	SD			
<b>Diabetic retinopathy prevention behavior</b>							
Pre-test	2.74	0.48	2.78	0.35		-0.056	0.978
Post-test	3.83	0.97	2.88	0.98	0.97 (0.83, 1.18)	23.314	< 0.001
t <sup>c</sup>	18.750		3.527				
p-value <sup>d</sup>	< 0.001		0.091				
<b>HbA1c</b>							
Pre-test	7.89	1.16	7.80	0.91		0.032	0.896
Post-test	6.71	0.91	7.60	0.90	0.98 (0.77, 1.35)	-6.954	< 0.001
t <sup>c</sup>	-5.175		-1.830				
p-value <sup>d</sup>	< 0.001		0.064				

Note. SD = Standard deviation, ES = Effect size using Cohen’s *d*, <sup>a,b</sup> = Independent t-test, <sup>c,d</sup> = Paired t-test, 95%CI = 95% Confidence interval of the difference between groups

## Discussion

This study demonstrated that a Multidisciplinary Team Education Program (MTEP) was effective in improving DR preventive behaviors and hemoglobin A1c levels among adults with type 2 diabetes. This improvement may be attributed to the enhanced health education provided by the multidisciplinary team, who addressed DR prevention behaviors from the perspective of their respective specialties. Participants learned about the risks and severity of DR from the health education provided by doctors. This raised their awareness about the threat and the need for prevention behaviors, as fear of blindness and its consequences on daily life were important factors driving adults with T2DM to perform DR prevention behavior.<sup>32</sup> Furthermore, greater perceptions of benefits and minimized perceptions of barriers through discussion with nurses led to confidence in practicing behaviors to prevent DR by eating, exercising, taking medication, eye care, and regular checkups. At the same time, nutritionists suggested individualized diet plans, taking into account the

individual’s health condition, preferences, and ability to follow the plans, while pharmacists advised on medications. These recommendations by the multidisciplinary team helped to address the participants’ behaviors from multiple perspectives.<sup>16</sup> The finding echoed an earlier HBM-based education program that contributed to better eye care performance among T2DM adults.<sup>19</sup>

The experimental group had better DR prevention behavior than the control group. The usual care provided to the control group included only general advice on controlling blood glucose, which might not suffice for DR prevention behavior. DR prevention calls for complex self-care that involves maintaining a healthy diet, exercise, adherence to medications, and eye care.<sup>9,12</sup> Thus, maintaining motivation to perform these DR prevention tasks can be difficult,<sup>11</sup> and requires a harmonic combination of medical expertise and dedication to practice these complex behaviors.<sup>9</sup> In response to these issues, a multidisciplinary team can provide all-encompassing support that attends to the various facets of the DR to keep adults with T2DM

motivated using a person-centered care approach, which can reduce non-adherence to diabetes self-management.<sup>33</sup>

After receiving the MTEP, the experimental participants had lower HbA1c than before receiving it, which was consistent with other multidisciplinary team-based interventions led by nurses.<sup>15-17</sup> Participation in the MTEP led to the acquisition of better health beliefs, resulting in greater motivation to prevent health complications.<sup>20,27</sup> The education and advice from the multidisciplinary team contributed to greater awareness of DR prevention and how to perform different types of DR prevention behaviors. These proactive lifestyle adjustments are crucial in facilitating efficient management of blood glucose<sup>9</sup> and lead to a reduction in HbA1c through various mechanisms, such as a low-carbohydrate diet that enhances insulin sensitivity,<sup>23,24</sup> aerobic exercise that promotes oxidative enzymes,<sup>22</sup> and medication taking that ensures efficacy of hypoglycemic drugs.<sup>26</sup>

The experimental participants had lower HbA1c than the control participants. In contrast to the usual care that offered general health recommendations, the MTEP included care from nurses, nutritionists, doctors, and pharmacists who provided health information on the consequences of uncontrolled blood glucose, which raised the experimental group's awareness of hyperglycemia. Additionally, the multidisciplinary team, coordinated by nurses, provided training on DR prevention, which targeted glycemic control through medication, healthy diets, and exercise. By working together, the team ensured that the patient's medical, psychological, nutritional, and educational needs were met, which greatly lowered risk factors for inadequate glycemic control.<sup>14</sup> Congruently, earlier multidisciplinary team interventions increased motivation for glycemic control, resulting in a reduction in HbA1c.<sup>16,17,34</sup> This finding suggests that a multidisciplinary team led by nurses should be incorporated into standard T2DM care to enhance patient-centered care, allowing T2DM adults to acquire knowledge and skills for efficient

disease self-management based on their own choices, thereby achieving ideal glycemic control.<sup>35</sup>

## **Limitations**

This study is not without limitations. This was a quasi-experimental study using a relatively small sample size, which may limit causal interpretation. The same person (PI) conducted both the intervention and the data collection, which may introduce detection bias, including expectancy bias from the PI and response bias from the participants completing self-report questionnaires. The two self-developed questionnaires used to measure DR prevention behavior were content validated but not thoroughly tested for construct validity. DR prevention behavior and HbA1c were assessed immediately after the program ended, which might not reflect the sustained effect of the program. Moreover, this study took place at a 500-bed general hospital in western Thailand. Thus, generalizability to other contexts might be limited. Further randomized studies are recommended to confirm the program's effects over an extended period and in other settings. Further investigations are needed to assess the construct validity of the newly developed instruments.

## **Conclusions and Implications for Nursing Practice**

The program was effective in improving DR prevention behavior, and lowering HbA1c in adults with T2DM. Policy-makers should promote a seamless coordination of a multidisciplinary team in diabetes care to offer specialized insights to raise health beliefs, which will motivate behaviors for preventing DR. Nurses should be trained as the primary coordinators or advanced practice nurses (APN) with practical communication skills to pass on information of treatment plans from doctors to other team members. At the same time, nurses can collaborate with other healthcare professionals to use this program to

provide patient-centered care that focuses on addressing individuals' DR prevention behavior by raising awareness of the potential threats of DR and equipping T2DM adults with skills to achieve HbA1c control.

### **Author Contributions**

Conceptualization: P.S.

Method and design, Tool development and validation, Data collection, Final approval of the submitted version: P.S., P.D., N.B.

Data analysis and interpretation, Drafting and reviewing the manuscript, Editing the manuscript: P.S., P.D.

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## Appendix

**Appendix, Table A1.** Description of program contents

Session/ Topic/Duration	HBM/Theoretical component	Description of intervention
<b>Session 1</b> Perceived susceptibility and perceived severity of diabetic retinopathy (At hospital) Week 1 (45 minutes)	- Perceived susceptibility - Perceived severity - Multidisciplinary team	<b>Group activities:</b> - Doctors explain about DR, its severity, and the possibility of diabetic retinopathy in adults with T2DM. - An adult with DR shares their experience of how they developed DR and how DR affects their life. - Participants analyze their own risk behaviors and the impact of complications from DR. - Doctors tailor the treatment plans to suit each participant.
<b>Session 2</b> Perceived benefits and perceived barriers of diabetic retinopathy prevention (At hospital) Week 1 (45 minutes)	- Perceived benefits - Perceived barriers - Multidisciplinary team	<b>Group activities:</b> - A role model with T2DM and good DR prevention behaviors shares their experience and behaviors. - Participants analyze the benefits and barriers to appropriate DR prevention behaviors. - Participants make a plan to address the barriers and implement behavioral changes to prevent DR.
<b>Session 3</b> Perceived self-efficacy for diabetic retinopathy prevention (At hospital) Week 1 (60 minutes)	- Perceived self-efficacy - Multidisciplinary team	<b>Group activities:</b> - Multidisciplinary team gives education and skill training as follows: <ol style="list-style-type: none"> <li>1. A demonstration and practice on relaxation techniques (breathing exercises, muscle relaxation), aerobic exercise, eye care, and eye drop use by nurses</li> <li>2. Diet by nutritionists (lecture, menu planning, reading nutritional labels, counting carbohydrates)</li> <li>3. Recommendations on medication adherence, and individually addressing medication-related issues and side effects by pharmacists</li> <li>4. Eye examination and how to observe DR-related complications by doctors                             <ul style="list-style-type: none"> <li>- Positive reinforcement to encourage DR prevention behaviors</li> <li>- Setting behavioral goals to perform DR prevention behaviors</li> </ul> </li> </ol>

**Appendix, Table A1.** Description of program contents (Cont.)

<b>Session/ Topic/Duration</b>	<b>HBM/Theoretical component</b>	<b>Description of intervention</b>
<b>Session 4</b> Cues to action for diabetic retinopathy prevention - At home, Week 2 (60 minutes) - On telephone, Weeks 3-11 (30-40 minutes)	- Cues to action	<b>Individual activities by the research team:</b> - Conduct home visit to discuss and give feedback on behavior change, and problems and barriers, and seek solutions together. <b>Individual activities by the research team:</b> - Ask about problems and barriers and how to solve them, along with providing advice, information, and encouragement to motivate participants to maintain behavior change.
<b>Session 5</b> Follow up (At hospital) Week 12 (60 minutes)	- Cues to action	<b>Group activities by the research team:</b> - Ask about the progress of DR prevention. - Provide feedback on appropriate DR prevention behavior and remind the participants of their beliefs regarding DR prevention behavior.

Note. T2DM = type 2 diabetes, DR = diabetic retinopathy

## การป้องกันเบาหวานขึ้นจอตาผ่านการให้ความรู้โดยทีมสหสาขาวิชาชีพใน ผู้ใหญ่โรคเบาหวานชนิดที่ 2 : การวิจัยกึ่งทดลอง

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**บทคัดย่อ :** เบาหวานขึ้นจอตาสามารถป้องกันได้ด้วยการควบคุมระดับน้ำตาลในเลือดโดยการปฏิบัติพฤติกรรมสุขภาพที่เหมาะสมซึ่งได้รับอิทธิพลจากความเชื่อด้านสุขภาพ การให้ความรู้โดยทีมสหสาขาวิชาชีพ นำโดยพยาบาลสามารถส่งเสริมความเชื่อด้านสุขภาพ แต่ยังไม่มีการศึกษาผลในการป้องกันเบาหวานขึ้นจอตา การวิจัยกึ่งทดลองแบบสองกลุ่มวัดผลก่อนหลังนี้ศึกษาผลของทีมสหสาขาวิชาชีพต่อพฤติกรรม การป้องกันเบาหวานขึ้นจอตา และค่าน้ำตาลสะสมในเลือด ผู้เข้าร่วมวิจัยประกอบด้วยผู้ใหญ่โรคเบาหวานชนิดที่ 2 ที่มีค่าน้ำตาลสะสมในเลือดมากกว่า 7% จำนวน 62 คน คัดเลือกจากโรงพยาบาลทั่วไปในจังหวัดหนึ่งทางภาคตะวันตกของประเทศไทยโดยใช้การสุ่มตัวอย่างแบบง่าย แบ่งเข้ากลุ่มทดลอง (n = 31) ได้รับความรู้โดยทีมสหสาขาวิชาชีพ 12 สัปดาห์พร้อมกับการดูแลตามปกติ และกลุ่มควบคุม (n = 31) ได้รับการดูแลตามปกติเพียงอย่างเดียว เก็บข้อมูลระหว่างเดือนพฤษภาคม พ.ศ. 2566 ถึงเดือนกุมภาพันธ์ พ.ศ. 2567 โดยใช้แบบสอบถามพฤติกรรมป้องกันการป้องกันเบาหวานขึ้นจอตา และการทดสอบค่าน้ำตาลสะสมในเลือด วิเคราะห์ข้อมูลด้วยสถิติเชิงพรรณนา การทดสอบที่แบบจับคู่ และการทดสอบที่แบบอิสระ

หลังจากเข้าร่วมโปรแกรม กลุ่มทดลองมีคะแนนเฉลี่ยของพฤติกรรมป้องกันการป้องกันเบาหวานขึ้นจอตาสูงขึ้น และค่าน้ำตาลสะสมในเลือดลดลง เมื่อเทียบกับกลุ่มควบคุมและก่อนรับโปรแกรม อย่างมีนัยสำคัญทางสถิติ พยาบาลควรได้รับการฝึกให้ใช้โปรแกรมนี้เพื่อส่งเสริมความเชื่อด้านสุขภาพเกี่ยวกับเบาหวานขึ้นจอตา และกระตุ้นให้เกิดการเปลี่ยนแปลงพฤติกรรมเพื่อควบคุมระดับน้ำตาลในเลือด อย่างไรก็ตามควรมีการทดลองแบบสุ่มและมีกลุ่มควบคุมในหลายพื้นที่ก่อนนำโปรแกรมนี้ไปใช้

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**คำสำคัญ :** เบาหวานขึ้นจอตา การควบคุมน้ำตาลในเลือด การให้ความรู้โดยทีมสหสาขาวิชาชีพ  
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