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Effect of the culturally tailored diabetes prevention program for at-risk Thai Muslim people in semi-urban areas

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ORIGINAL STUDY

Effects of a Culturally Tailored Diabetes Prevention Program for At-risk Thai Muslim People in Semi-urban Areas

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Abstract

Background: **Lifestyle intervention is effective in preventing type 2 diabetes mellitus (T2DM). The efficacy of intervention components across different sociocultural settings is relevant for real world implementation. Thus, this study aimed to evaluate the effectiveness of a culturally tailored diabetes prevention program (CTDPP) for at-risk Muslim people in Thailand.**

Methods: **The CTDPP was developed and culturally adapted based on formative research. Participants at risk for diabetes were recruited and randomly assigned to either the intervention group ($n = 60$) or the control group ($n = 59$). Study group subjects participated in the CTDPP for 3 months. Control group subjects received only routine self-care recommendations for preventing diabetes. All participants were assessed for diabetes prevention knowledge and health outcomes at baseline and follow-up.**

Results: **At the 12th week, the intervention group and control group showed that diabetes prevention knowledge improved from baseline ($p < 0.05$). The score for knowledge was significantly higher in the intervention group than in control group. Other health outcomes demonstrated significant within-group improvements only in the intervention group, but not in the control group. Changes in participants' HbA_1c levels were not significant for within-group and between-group comparisons at baseline and 12 weeks. Adjusting for covariates at baseline, our ANCOVA analysis showed that differences in weight, body mass index, and waist circumference between the intervention and control groups were significant ($p < 0.01$).**

Conclusion: **This diabetes prevention program integrating Thai-Muslim culture and driven by community health leaders was successful. Our program empowered at-risk people with diabetes prevention knowledge.**

Keywords: Muslims people, Community health leaders, Diabetes prevention program, Thailand

1. Introduction

Type 2 diabetes mellitus (T2DM) is now the leading cause of death worldwide, with cases still on the rise [1]. In Thailand, the prevalence of T2DM in adults has increased from 2.3% to 8.0% from 1991 to 2015. There are now about 4 million Thai adults with diabetes. Nearly one-third of Thai adults with diabetes may still be undiagnosed, even though there have been large-scale healthcare campaigns to improve public awareness of diabetes in recent years [2]. As a result, identifying strategies to prevent diabetes is definitely a priority in public health. Primary prevention is possible by modifying the risk factors of diabetes. Large-scale randomized clinical trials on lifestyle intervention, such as the Diabetes Prevention Program (DPP) in the United States [3] and the Finnish Diabetes Prevention Study (DPS) [4] have demonstrated the efficacy of dietary modification and physical activity (PA) in reducing the cumulative incidence of diabetes by 58%. To date, cultural adaptation of T2DM prevention programs has mainly occurred at the community level, especially with specific ethnic groups [5,6]. Previous

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reviews have shown that culturally sensitive diabetes prevention programs helped promote knowledge of diabetes and led to healthy lifestyles. These programs also had a positive effect on glycemic control, at least in the short-term [7].

In Thailand, a mix of different cultures and religion can be found in many communities. The Thai Ministry of Public Health (MOPH) has developed and implemented several public health campaigns against T2DM. However, their campaigns have not focused on specific groups such as Muslim communities, which constitute about 4% of the national population. Some Thai reports suggest that Thai Muslims have food consumption behavior that increases the risk of developing diabetes, including a higher intake of calories, saturated fats, sugar, and salt. Moreover, Thai Muslims choose their foods based on the Holy Quran. Thus, they may have less awareness of the negative implications of an unhealthy diet on diabetes prevention [8]. Health issues of Muslims are often closely related to religion, as well as their cultural and scientific perspectives. In addition, health behavior also depends on the strictness of an individual's religious belief and practice [9,10]. With this in mind, it is important to provide a diabetes prevention program (DPP) designed specifically for these individuals. For example, previous studies that intended to help prevent diabetes have shown that integrating religion can improve the outcomes for Muslim individuals who are obese or at high health risk [11].

Previous studies that were conducted in Thailand successfully demonstrated the effectiveness of lifestyle modification programs for preventing diabetes in subjects at high risk of developing this disease [12–14]. However, studies of practical DPPs are rarely documented in Thai society, especially in Muslim communities. To address this critically important gap in evidence and practice, we developed a culturally appropriate diabetes prevention program based on formative research that was consistent with the way of life among Thai Muslims. Accordingly, the aim of the present study was to investigate the effectiveness of a culturally appropriate diabetes prevention program for at-risk Muslim people in terms of short-term health outcomes.

2. Methods

2.1. Study design and setting

This quasi-experimental study was conducted in Nakhon Nayok province in Thailand. We selected two primary care units (PCU) in a semi-urban area using similar criteria, including that more than 50% of the patients were Muslim, patients in the two units had similar social and cultural characteristics, and patients had a high prevalence of diabetes. Each of the PCUs were randomly assigned to be either an intervention PCU or a control PCU. Participants from the intervention PCU were enrolled in a culturally tailored diabetes prevention program. Participants from control PCU received only routine self-care recommendations for preventing diabetes.

2.2. Study population, sample size, and sampling

From a previous study of Arabic participants [11], the standard deviation (SD) of fasting glucose was estimated at 0.6. The true difference in mean levels of fasting glucose between the intervention and control group was assumed at 0.22 mmol/L. We utilized the G-power program to calculate the sample size for a two-group trial with a power of 80% and a level of significance of 0.05 in order to detect a difference of 0.22 mmol/L in fasting plasma glucose. Assuming a drop-out rate of 20% and to ensure adequate power would be established for most of the outcome measures, a total of 154 participants were required in this study, with 77 persons in each group.

To select participants, we examined measurements of the last three fasting blood sugar levels from 43 files of the database for 385 at-risk people (fasting blood sugar 100–125 mg/dl) in the two PCUs. We recruited people at risk for diabetes who met the inclusion criteria from the diabetes screening database before starting the intervention program. The inclusion criteria were: 1) aged between 25 and 60 years old, 2) body mass index (BMI) between 23 and 39 kg/m^2, 3) diabetes risk score $\geq$6 [15], and 4) being able to participate in the study. Exclusion criteria were: 1) being pregnant, 2) having a medical history of diabetes or being newly diagnosed with diabetes at the time of screening, 3) being an alcoholic or being a heavy smoker, 4) involved in another weight management program, 5) taking any herbal medications to lose weight, 6) having a medical history of cardiovascular diseases within six months prior to the screening, 7) having advanced arthritis, 8) having uncontrolled hypertension or any types of cancer. We identified 94 and 102 participants as eligible for the intervention group and comparison group, respectively. Each participant was separately coded and randomized. We enrolled 77 participants in the intervention group, and 77 participants in the control group. We followed up all the enrolled participants in both groups and analyzed their data.

2.3. Intervention development

The main theory underpinning the intervention program was the social support and Health Belief Model (HBM) [16]. The intervention program was adapted from the Diabetes Prevention Program (DPP) in the United States (US-DPP) [3] and the Finnish Diabetes Prevention Study (DPS) [4]. In order to connect with the cultural aspects of the Muslim community, formative research was conducted to get information for the situational analysis (SWOT analysis), needs assessment, and cultural translation. This adaptation process was guided by the Intervention Mapping Approach [17]. From the formative research in the initial phase, we found that the Muslim community has a powerful community sector that includes: 1) positive Islamic teachings for diabetes prevention, 2) unity and family support, and 3) role models and health volunteers in a dynamic social environment. Therefore, rather than implement and deliver the program directly through the healthcare system, we delivered our diabetes prevention program through experts and through the local resource people including village health volunteers and religious leaders). This delivery method reinforced the learning process in the context of the target group for continuous behavior change.

The culturally tailored diabetes prevention program consisted of two main parts, including peer leader training and delivering knowledge to at-risk people over a period of 12 weeks (Table 1). All

Table 1. Multiple components of culturally tailored diabetes prevention program for at-risk Thai Muslim people.

Facilitator	Activity	Time
Peer Leader Training		
Expert team	- Selection of 14 group leaders from the village health volunteers - Selection of 3 religion leaders (Imam) - Training on diabetes prevention knowledge with focus on risk factor modification through three sessions of group training and self-learning with video (VDO) clips via Line application - One-time group discussion about lessons learned regarding religion and diabetes	Before program implementation with at-risk people
Implementation with At-Risk Participants		
Expert team	**Small group session (approximately 3 h) − One time** - Introduce overall details of culturally tailored diabetes prevention program - Group learning and workshop with knowledge of diabetes prevention - Mindset session: 1 VDO clip with psychological support for lifestyle modification by religious leaders 2 VDO clip with role models 3 Participants make personal decisions regarding goal setting and planning	Week 1−2
Expert team and group leaders	**Home visit session (approximately 20 min) − One time** - Increase participants' knowledge about diabetes prevention to modify dietary pattern and physical activity to correspond with characteristics of the individuals - Encourage self-efficacy management for diabetes prevention with participants and family in individual's environment - Help patients to make sure they are self-monitoring - Support patients with problem solving and overcoming barriers	Week 3−4
Religious leaders	**Booster session − One time** - One time conversation about religion and diabetes prevention content during worship of Allah at the mosque. Use of one page poster with content about religion and diabetes prevention.	Week 5
Group leaders	**Booster session (approximately 20 min) − Three times** - Small group session for diabetes prevention content booster. Use of one page poster and problem discussion. - Encourage and motivate participants to adhere to prevention program	Week 6, 8, 10

During the booster session, group leaders forwarded behavior modification problems during the program via Line application to the expert team and group leaders in order to plan and solve problems suitable for their target audience.

sessions were conducted in local neighborhoods in community buildings (e.g., mosques, community halls) during weekends at convenient times for the participants. The objectives of the lifestyle intervention were to increase knowledge of diabetes and risk factors for diabetes development, improve knowledge to make healthy choices of food and eating patterns, promote weight loss management, and increase participants' physical activity.

2.4. Data collection

The following clinical factors were compared between the baseline and the end of the 12‾week study period:

1. **Clinical characteristics:** Participants' body weight, body mass index, and waist circumference were measured.
2. **Laboratory data:** Blood samples of the participants were assessed in a clinical lab to determine glycated hemoglobin (HbA_1c) levels. Moreover, plasma samples of the participants were obtained to determine high-density lipoprotein (HDL), low-density lipoprotein (LDL), triglycerides, and total cholesterol levels.
3. **Diabetes prevention knowledge test:** The knowledge questionnaire was developed specifically for the study to assess knowledge about diabetes prevention and related risk factors. The knowledge questionnaire consisted of three parts: 1) understanding of diabetes knowledge and general risk factors related to diabetes (total score = 23), 2) understanding of nutritional knowledge for diabetes prevention (total score = 34), and 3) understanding of physical activity and exercise knowledge for diabetes prevention (total score = 14). The overall total highest possible score was 71. We designed questions regarding food consumption or physical activity patterns taking into account the lifestyle of Thai Muslims. The content of the questions are in Table 2. The questionnaire was then reviewed by three experts for content improvement and validity. The score of the overall item objective congruence index was 0.8. The reliability of the knowledge questionnaire was tested with 30 community members from one sub-district in Nakhon Nayok province in Thailand who did not participate in the program. The questions within each section consistently corresponded to overall knowledge scores measured using Cronbach's alpha statistic, which was 0.72. Intervention and control groups were tested within a week of each other at both pre- and post-time periods. The target groups were asked to keep the content of the tests confidential.

2.5. Statistical analyses

The study examined the group of at-risk people for diabetes using the pre-test and post-test study design. Data from participants were entered into and analyzed by SPSS Windows version 20 (IBM statistics, NY, USA). Descriptive statistics were used to describe participants' characteristics. The Student's paired t-test, which was two-tailed, was used to compare scores of knowledge gain. Means and standard deviations were used to describe continuous measures; categorical responses were presented as numbers and percentages. To assess within-group changes from baseline to 12 weeks, the paired sample t-test was used for variables with normal distribution; the Wilcoxon matched-pairs signed-ranks test was used for non-normally distributed variables. Between-group changes were assessed using the Student's t-test for variables with normal distribution; the Mann–Whitney test for non-normally distributed variables. The distribution of continuous variables was examined using

Table 2. Example of questions from three parts of the diabetes knowledge questionnaire.

Part of questionnaire	Highest possible score for each part	Content of questions
Understanding of diabetes knowledge and general risk factors related to diabetes	23	- Definition and diagnosis of diabetes - Risk factors for development of diabetes
Understanding of nutritional knowledge for diabetes prevention	34	- Healthy eating guide based on Thai food based dietary guidelines and healthy food plate concept - Selection of food choices for diabetes prevention
Understanding of physical activity and exercise knowledge for diabetes prevention	14	- Basic knowledge of exercise for diabetes prevention - Appropriate exercise patterns for diabetes prevention

Shapiro–Wilk test. The differences between groups at baseline were adjusted using the analysis of covariance (ANCOVA). The assumption of homoscedasticity (homogeneity of variances between groups) was assessed using Levine's test. For results where $p > 0.05$, the assumption is met. The homogeneity of regression across groups was measured by assessing the interaction between independent variables (groups) and covariates (baseline data); when $p > 0.05$, there is no considerable interaction and the ANCOVA test is appropriate for analysis.

2.6. Ethical issues

The study protocol and consent forms were submitted to and approved by the Committee of Center of Ethical Reinforcement for Human Research on Human Rights Related to Research Involving Human Volunteers, Mahidol University (MU-CIRB 2018/102.0905).

3. Results

A total of 154 individuals were screened for eligibility and invited to be involved in the implementation phase. Thirty individuals did not participate due to reasons of inconvenience. After providing informed consent, the remaining 124 participants were divided into sixty-two participants for each group. Three individuals from the control group and two individuals from the intervention group dropped out of the study (total: 5 patients, 4%) as presented in Fig. 1. There were no significant differences in the variables between the intervention and control groups at baseline, except for age and knowledge. The participants in the intervention group were older than those in the control group. Moreover, the diabetes prevention knowledge scores were better in the control group compared to the intervention group (Table 3).

At the end of 12 weeks, the intervention group and control group showed improved diabetes prevention knowledge from baseline ($p < 0.05$). However, the increase in the end-of-study means scores for diabetes prevention knowledge was significantly higher in the intervention group than in the control group (Table 4). Other measures such as body weight, BMI and waist circumference, and HDL cholesterol demonstrated significant within-group improvements only in the intervention group, but not in the control group. The within-group and between-group differences in HbA_1c levels were not statistically significant when comparing the levels at baseline and 12-week endpoint. Between-group differences were significant only for diabetes prevention knowledge ($p < 0.001$), favoring the intervention group. In addition, when covariates at the baseline were adjusted for using ANCOVA, between-group differences on weight, BMI and waist circumference were significant ($p < 0.01$).

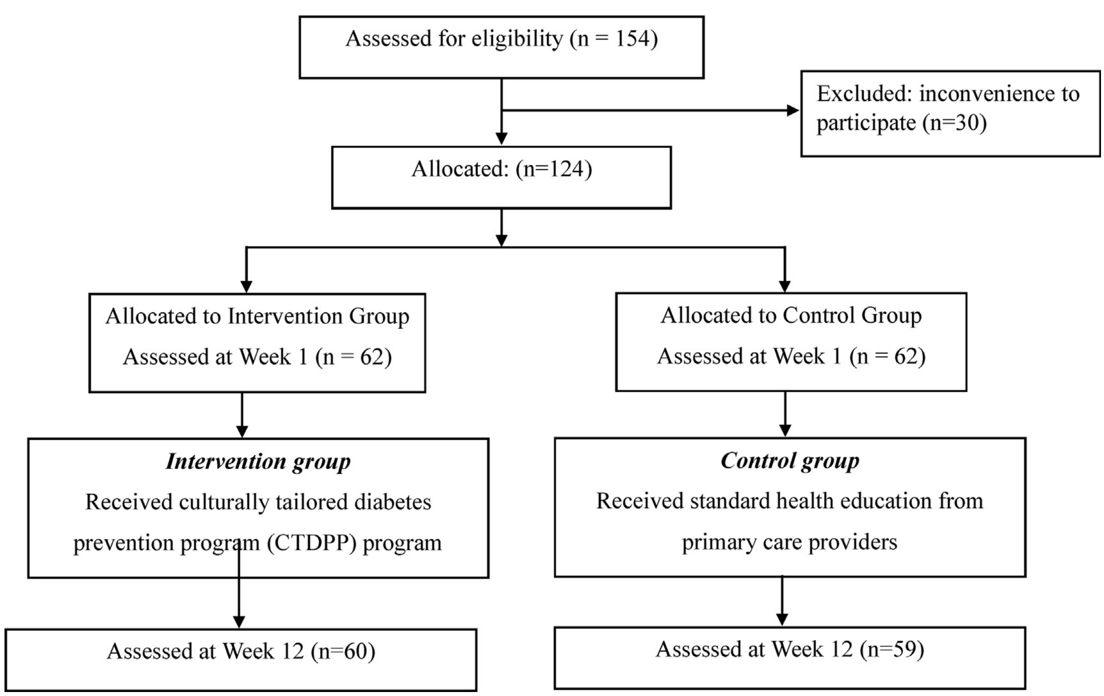

Fig. 1. Flow-chart of the study participants.

Table 3. Baseline characteristics of individuals in the intervention and control groups.

Characteristics	Control (N = 59)		Intervention (N = 60)		*p-value*
Age (years), mean (SD)	48.85	(7.04)	51.83	(7.32)	*0.025*[a]
Gender, n (%)					0.220
Male	21	(35.6)	28	(46.7)	
Female	38	(64.4)	32	(53.3)	
Status, n (%)					0.453
Single	5	(8.5)	6	(10.0)	
Married	50	(84.7)	46	(76.7)	
Widowed and/or divorced	4	(6.8)	8	(13.3)	
Education, n (%)					0.510
Bachelor's degree	2	(3.4)	1	(1.7)	
Vocational or High Vocational Certificate	4	(6.8)	2	(3.3)	
Secondary School	18	(30.5)	14	(23.3)	
Primary School	35	(59.3)	43	(71.7)	
Occupation, n (%)					0.138
Agriculture	15	(25.4)	15	(25.0)	
Laborer	17	(28.8)	25	(41.7)	
Own business	8	(13.6)	5	(8.3)	
Housewife	13	(22.0)	15	(25.0)	
Government officer	1	(1.7)	0	(0.0)	
Other	5	(8.5)	0	(0.0)	
Income per month (Thai Baht), n, %					0.054
5000 or less	16	(27.1)	29		
5001–10,000	31	(52.5)	21		
10,001 or more	12	(20.3)	10		
Diabetes Prevention Knowledge, mean (SD)	46.47	(6.20)	42.73	(6.84)	*0.002*[a]
Weight (kg), mean (SD)	72.31	(10.68)	72.49	(10.16)	0.924
Waist circumference (cm), mean (SD)	88.63	(9.93)	89.20	(11.06)	0.767
Body mass index (BMI), mean (SD)	28.26	(2.92)	28.19	(3.34)	0.910
Fasting plasma glucose (mmol/L), mean (SD)	111.97	(8.10)	109.73	(7.73)	0.127
Haemoglobin A1C (HbA_1c) % (mmol/mol), mean (SD)	6.01	(0.39)	5.92	(0.31)	0.163
Total Cholesterol (mg/dL), mean (SD)	203.75	(37.57)	209.18	(42.13)	0.459
Triglycerides (mg/dL), mean (SD)	143.19	(69.62)	151.82	(75.78)	0.524
HDL (mg/dL), mean (SD)	48.46	(10.58)	50.18	(12.65)	0.422
LDL, mg/dL mean (SD)	124.56	(35.02)	126.26	(38.79)	0.805

[a] Statistical significance was defined as p-value < 0.05. Differences between control and intervention group were examined using an independent t-test or chi-square test for continuous and categorical variables, respectively; mean ± SD.

4. Discussion

This study demonstrated the process of developing and conducting a culturally appropriate diabetes prevention program for Thai Muslim people in semi-urban areas at risk of diabetes and monitoring short-term outcomes. After participating in this program, participants showed some changes in health outcomes. The participants set practical weight loss goals, which motivated and supported the weight management of each person. The weight loss that we observed in the intervention group showed that the target groups could control their health behavior to reduce weight, BMI, and waist circumference. However, previous systematic studies revealed that weight reduction in the real world differs from and is typically lower than the weight reduction in the settings of intensive-efficacy clinical trials [18]. In a meta-analysis of Cardona-Morrell et al., researchers observed average weight loss of 1.6 kg over the course of 12 months [19]. During the short period of this study, the intervention group revealed weight reduction at 0.73 kg after 12 weeks. We suggest that the next step is that our program should continue to support participants' weight loss for longer periods.

According to a systematic review of 21 studies on diabetic self-management education, there was a significant reduction of 0.44% in HbA_1c levels at 6 months and of 0.46% at 12 months [18]. In our study, the mean reduction in HbA_1c levels between the intervention group and control group at week 12 was 0.12%, and was not statistically significant. A lower HbA_1c level indicates lower risk of developing diabetes. We hypothesize that if our study's duration had been longer, lasting either 6 or 12 months, and our study had a larger sample size, then the results may have shown statistical significance. The mean HbA_1c level in the intervention group of this

Table 4. Comparing the effects of a culturally tailored diabetes prevention program by group at baseline and at the 12th week of follow-up.

Factor	Control (N = 59)		*p*-value	Intervention (N = 60)		*p*-value	*p*-value	ANCOVA test
	Baseline	12th Week	Before-After	Baseline	12th Week	Before-After	after 12th week Control vs. Intervention	after 12th week Control vs. Intervention F value (P-value)
Diabetes prevention knowledge test score	46.47 ± 6.20	47.69 ± 6.15	0.002*	42.73 ± 6.84	51.53 ± 6.18	<0.001*	0.001*	138.995 (<0.001) *
Weight, (kg)	72.31 ± 10.68	72.78 ± 10.39	0.040*	72.49 ± 10.16	71.76 ± 10.00	0.003*	0.657	9.801 (0.002) *
BMI, (kg/m^2)	28.26 ± 2.92	28.46 ± 2.85	0.034*	28.19 ± 3.34	27.91 ± 3.31	0.004*	0.155	9.961 (0.002) *
Waist circumference, (cm)	88.63 ± 9.93	89.49 ± 10.05	<0.001*	89.20 ± 11.06	88.58 ± 11.13	0.001*	0.608	29.407 (<0.001) *
HbA_1c, (%)	6.01 ± 0.39	6.02 ± 0.40	0.404	5.92 ± 0.31	5.90 ± 0.27)	0.475	0.061	0.703 (0.404)
Total Cholesterol, (mg/dL)	143.19 ± 69.62	146.17 ± 56.20	0.520	151.82 ± 75.78	149.96 ± 65.90	0.638	0.667	0.456 (0.501)
Triglycerides, (mg/dL)	130 ± 71.0	135 ± 52.0	0.211	132 ± 88.0	145 ± 78.0	0.445	0.789	1.528 (0.219)
HDL, (mg/dL)	48.46 ± 10.58	48.22 ± 9.33	0.819	50.18 ± 12.65	51.20 ± 11.21	0.043*	0.118	1.754 (0.188)
LDL, (mg/dL)	124.56 ± 35.02	126.69 ± 33.33	0.417	126.26 ± 38.79	125.31 ± 37.24	0.696	0.746	0.552 (0.459)

Data presented as mean ± SD *Statistical significance was defined as p-value < 0.05.

study at 12 weeks was lower than that of the control group.

Combinations of community members, program participants, academicians, practitioners, and lifestyle coaches have helped define the areas of interest, the specific content, and the process of dissemination of health intervention programs [20,21]. The programs engaged the target population in all stages. Local community relevance is a key component of the intervention programs. Some of them incorporated culturally relevant messages, symbols, and strategies with respect for and inclusion of traditional foods, activities, religion, belief and knowledge. The diverse training strategies used to facilitate community members' learning in the current diabetes education program resulted in improved knowledge after a three-month period. Similarly, Ackerman and colleagues' study [22] showed that participants had improved knowledge of nutrition and better understanding of association of health and diet with diabetes after training from U.S. community health educators. We also encouraged community members and people at high risk of developing diabetes to understand the importance of the key concepts of diabetes prevention for those at risk. The training strategies also linked case and community-based application with knowledge acquisition. This approach may serve not only to increase the knowledge of the community about diabetes prevention; it may also provide a compelling learning model for prevention of other diseases.

The community-based diabetes program was designed to reach people outside of the traditional health care settings and to maximize the efforts of diabetes education. Various studies and meta-analysis have shown the effectiveness of diabetes prevention programs that involved stakeholders in the community to improve glycemic control of at-risk people [23]. A study in India showed that the strategy of bringing community peer leaders into the diabetes prevention program resulted in effectively reducing the risk of developing diabetes [24]. In Thailand, previous research has shown the creation of an effective program for improving diabetes prevention knowledge among community healthcare workers [25]. A subsequent study found that community healthcare workers were still unable to connect diabetes prevention knowledge to community-based risk groups [26]. There are many factors that impede knowledge transfer. For example, a heavy workload or an emphasis on primary care, which prioritizes screening rather than promoting health to prevent diabetes, are possible factors. The groups at risk of developing diabetes may not have a clear program for behavior modification to prevent diabetes. As such, this research is further enhanced by trying to find social capital and exploring the feasibility of religion to support the process of effectively transferring diabetes prevention knowledge to target groups. Numerous diabetes prevention programs [27,28] have been examined in different regions of the world to improve knowledge, behavior, and health outcomes among at-risk people of diabetes that are comparable to the present study. However, two aspects serve to differentiate ours from others that are specific to reach the Thai Muslim people. First, we used formative research to analyze the main types of support and barriers to diabetes prevention program development. Second, we used community social capital, including village health leaders and religious leaders, to be an intermediary connection between experts and target groups. In addition, effective learning and communication channels were developed through using the LINE application on smart phones. Use of this application resulted in health educators spontaneously communicating problems related to behavioral modification to prevent diabetes. It also led to researchers and health educators in the field developing a joint plan to solve problems effectively.

This study resulted in at-risk Thai Muslim participants gaining useful knowledge about diabetes prevention. However, the duration of the training program was too short to improve behavior of at-risk Muslim people regarding diabetes in their communities. This study did not examine the effect of education provided by the stakeholders on long-term diabetes outcomes. The stakeholders should learn about approaches that impart knowledge as key messages. They should also recognize that multiple strategies may be needed to truly address determinants and support behavior change in the Muslim communities. Moreover, this study had a relatively small sample size. This small sample size may have hampered our ability to see a statistically significant difference in most health outcomes being compared between the intervention and control groups. Further testing of this prevention program in a larger sample and in other Muslim communities is recommended.

5. Conclusions

In summary, this study explored the improvement and implementation of a community-based, culturally specific, group and individual lifestyle intervention to prevent diabetes. The study demonstrated the effectiveness and feasibility of this diabetes prevention program, which was adapted to be a lifestyle intervention among those at-risk of DM among Thai Muslim people. Our study provided convincing evidence that education focused on bridging the gap between scientific knowledge and misconceptions worked well to promote health. The model of diabetes education program in this study can be easily administered by other health professionals at a hospital promoting health. Our program can also be a model for other approaches translated into the context of other Muslim communities.

Conflict of interest

The authors declare that they have no conflict of interests.

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