

Effect of Lifestyle Modification Program with Arm Swing Exercise on Health Behavior, Nutritional Status and Capillary Blood Sugar of Persons with Pre-diabetes in the Community



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Abstract

OBJECTIVES: This quasi-experimental research was conducted to assess the effect of lifestyle modification program with arm swing exercise on health behavior, nutritional status and capillary blood sugar of pre-diabetes in the community.

MATERIAL AND METHODS: The participants selected according to the inclusion criteria, were 28 pre-diabetes participants who received lifestyle modification programs with arm swing exercise for 8 weeks. Data were collected twice, before and immediately after the intervention, using the health behavior questionnaire (HBQ), nutritional status, including waist circumference, and body mass index, and capillary blood sugar. Data were analyzed using descriptive statistics and paired t-tests.

RESULTS: After receiving the lifestyle modification program with arm swing exercise, the participants showed significant improvement of health behavior specially food consumption and stress management aspect as compared to before the program ($p < 0.05$), but waist circumference, body mass index, and capillary blood sugar were not significantly different.

CONCLUSION: The lifestyle modification program with arm swing exercise helps in developing better health behaviors and nutritional status. Therefore, this program should be applied to persons with pre-diabetes to prevent diabetes and there should be follow-up at least one year later.

Keywords: lifestyle modification program with arm swing exercise, health behavior, nutritional status

Diabetes is one of the major global public health burdens. It was reported by the International Diabetes Federation (IDF) that in 2012, 371 million people worldwide had diabetes and the figure has been predicted to increase to 552 million people in 2030.¹ The Ministry of Public Health Thailand published that the diabetes morbidity rate within the Thai population rose from 675.74 per 100,000 population in 2008 to 1,050.05 per 100,000 population in 2012.² Similarly, the number of people who are at risk of developing diabetes has also been predicted to rise to 398 million people in 2030 from 280 million people in 2011 worldwide.¹ The prevalence rate of the Thai population who are at risk of diabetes has been estimated to be between 4.1-12.6% with the likelihood to develop the disease within 5-10 years with a ten-fold higher probability.³⁻⁶ Diabetes may cause health complications such as cardiovascular diseases, neuropathy, retinopathy, and nephropathy in addition to mental, social, and economic factors causing Disability-adjusted Life Years (DALYs) loss in Thailand.⁷ Moreover, diabetes may also reduce quality of life and induce stress.⁸⁻¹⁰ The total expenditure spent on diabetes worldwide has been estimated to be 471 million US dollars with an average of 1,270.04 US dollars per person meanwhile the average for Thailand has been estimated to be 244.58 US dollars per person.¹ Therefore, it is important to implement a prevention plan for the people with pre-diabetes.

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The strategies for diabetes prevention include lifestyle modification emphasizing dietary control, exercising, and stress management.^{1,11-14} It has been shown that dietary control and

exercising for at least 30 minutes a day can lead to weight reduction by 6%, decreasing the incident rate of diabetes by 40-60%.¹⁵ Stress management by meditation and arm swing exercise can help control blood glucose levels because reduction in stress can reduce the blood glucose levels.^{11,16} Programs that aim to minimize the risk behaviors of pre-diabetes groups are essential. A number of studies have reported that after receiving lifestyle modification programs including diabetes information, group discussions, home visits, and encouraging letters from 8 weeks to 1 year, participants have shown a significant improvement of health behavior, reduction in body mass index (BMI), waist circumference, and blood glucose levels than at the baseline^{17,19-21} However, there are limited studies in persons with pre-diabetes and there is a lack of pre-diabetes' participation to plan lifestyle modifications in their context.

Mahasawat community is one of Thailand's urban communities under the responsibility of Mahasawat Sub-district Health Promoting Hospital, Nakhonprathom Province. Thailand has a policy of "**No drink, no dip, no adding**" (Mai duem, mai jim, mai term) to prevent diabetes since many people conduct high-risk behavior including consuming sugars, fats, and salts. Even though physical activities and exercise are regularly practiced, the tendency of developing chronic diseases, especially diabetes, has continuously increased. Hence, it is important that the lifestyle modification program based on Bandura's Self-efficacy Theory and emphasized community participation should be performed in persons with pre-diabetes. It is believed that if people are aware that they possess the potential to manage and obtain the expected outcome, they will decide to choose a healthy behavior that leads to the anticipated outcome.²² Thus, if persons with pre-diabetes believe that they have the capabilities to change their health behavior and expect to be successful in preventing diabetes, they will perform that health behavior to prevent the disease. Perception of self-efficacy can be developed from 4 resources namely (1) enactive mastery experience, (2) vicarious experience, (3) verbal persuasion, and (4) physiological and affective stages. The activities of the lifestyle modification program include diabetes education, group participation to select healthy diet and exercises for at least 30 minutes a day three times a week, home visits and/or telephone follow-ups, group discussions to encourage participatory problem-solving for continuously behavioral changes. Therefore, researchers are interested in studying the effect of a lifestyle modification program with arm swing exercise on health behavior, nutritional status and capillary blood sugar of pre-diabetes in the community.

Materials and Methods

Design, population and sample

A one group pre-post test design was used for this study. The population and sample of this study was pre-diabetes participants in the Mahasawat community under the responsibility of Mahasawat Sub-district Health Promoting Hospital, Nakhonprathom Province, Thailand between October and November 2014.

Participants were selected using the following inclusion criteria: participants (1) aged \geq 18 years old, (2) with a risk score for predicting diabetes ≥ 6 , (3) with a telephone for communication, (4) with awareness and no communication difficulties, and (5) with a signed consent form after receiving the research information.

The sample size was calculated by power analysis using G Power software sufficient for paired t-test statistics²³ (Power of test value = 0.80, *p*-value = 0.05, effect size of 0.59 was used from a study by Suksan Intaravicien,²⁰ and the calculated sample size = 19 participants) equals 19 participants. However, the researchers met more persons with pre-diabetes, more than the calculated sample size, so it was decided to enroll 28 participants because of the potential benefits in preventing diabetes.

Instruments

The instruments in this study consisted of the lifestyle modification program with arm swing exercise and instruments for data collection. The lifestyle modification program with arm swing exercise was developed by the researcher from literature review consisting of:

- Exhibition of diabetes education concerning food consumption, exercise, stress management, smoking and alcohol consumption
- Recording namely "Vital Table, Overcoming Diabetes" adapting from metabolic syndrome assessment form of Aekplakorn et al.²⁴ and vital sign form
- Demonstration and return demonstration exercise on chairs
- Arm swing exercise selected by participants for practicing at least 30 minutes a day three times a week to reduce stress, blood glucose, and fat levels.²⁵
- Group discussions and home visits and/or telephone follow-ups for 20 minutes per appointment

There were instruments used for data collection as follows:

- 1). A questionnaire that consisted of three parts:
 - **Part 1:** Personal information including sex, age, marital status, occupation, average monthly income, family history for diabetes, personal illness, alcohol consumption and smoking habits.

- **Part 2:** A risk score for predicting diabetes adopted by Aekplakorn et al.²⁴ consisting of age, BMI, waist circumference, blood pressure, and family history for diabetes. The score range is between 0 and 17. Participants with a score of 6 or higher are considered to be in the high-risk group.
- **Part 3:** Health Behavior Questionnaire (BHQ) adopted from Winvat.²⁶ consisted of thirty-six questions divided into three aspects: food consumption (14 items), exercise (10 items), and stress management (12 items). The questions were designed with the Likert scale with the score of 0 point for being never/none and 4 points for always. The possible range score is between 0 and 144 points. The higher score reflects good behaviors that can help prevent diabetes. Sixty percent cut off point was used as a criterion for the total health behavior and its aspects. Cronbach's alpha demonstrated an acceptable reliability of 0.75, and 0.70 for the main study.

2) Medical equipment such as measuring tape, BMI scale, automatic blood pressure meter, and blood glucose meter were used in this study.

3) A recording namely "Vital Table, Overcoming Diabetes" was used to assess and predict diabetes.

4) A document recording waist circumference, BMI, blood pressure (mmHg), and capillary blood sugar (mg%) from the at risk group.

5) A form to monitor the arm swing exercise including date, time, and duration.

Data Collection

This study was part of a Diabetes Youth Ambassador Program: Lifestyle modification for pre-diabetes group approved by the Institutional Review Board (IRB), Faculty of Medicine Ramathibodi Hospital, Mahidol University, Thailand (2014/371). All participants received written and verbal explanations, learned of the objectives, methods, risks, benefits, and the right to withdraw from the study at any time throughout this study before giving informed consent. Then, the researcher and assistant researcher collected all data and gave intervention for pre-diabetes. All procedures were completed within 8 weeks as described in Table 1.

Data Analysis

Computer software was used to analyze data using descriptive statistics and paired t-test to compare the health behavior scores, waist circumference, BMI, and capillary blood sugar before and after the program.

Results

A total of 28 pre-diabetes participants who successfully met the inclusion criteria were enrolled in this study. There were 17 female (60.7%) and 11 male (39.3%) participants with an average age of 60.96 years old (range: 43-85 years old, SD = 10.03). Seventy-five percent of the participants were married and 50% had a high school education level. The majority of the participants were unemployed (64.4%), with an average monthly income of 14,156.52 Thai baht (range: 600-38,800 Thai baht,

Table 1 : Research protocol.

Item	October 2014				November 2014		
	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6	Wk 7
First evaluation, (90 min.)							
• Pre-test: assess health behavior, Measure waist circumference, BMI, capillary blood sugar	↔						
• Intervention based on self-efficacy concept: exhibition of diabetes education; demonstration of exercise and arm swing exercise; assign arm swing exercise ≥ 30 min/day 3 times/week							
Follow up by home visit and/or telephone (20 min/participant)							
• Ask for difficulties with lifestyle modification program with arm swing exercise	↔				↔		
• Problem solving together with participants, and encouraging continuous participation					↔		
Second evaluation							
• Assess health behavior, Measure waist circumference, BMI, capillary blood sugar for positive reinforcement			↔				
• Group discussions to encourage lifestyle modification continuously							
Third evaluation						↔	
• Assess as the first week							

Table 2 : Frequency and percentage of persons with pre-diabetes information (n = 28).

Persons with pre-diabetes	n (%)
Total persons with pre-diabetes (n)	28 (100)
Male	11 (39.3)
Female	17 (60.7)
Marital Status	
Single	3 (10.7)
Married	21 (75.0)
Widowed/Divorced/Separated	4 (14.3)
Highest Education Level	
No education	1 (3.6)
Primary School	14 (50.0)
High school	9 (32.1)
Bachelor's Degree or higher	4 (14.3)
Occupation	
Unemployed	18 (64.4)
Government/State Enterprise	2 (7.1)
Agriculture	2 (7.1)
Employee	4 (14.3)
Merchant	2 (7.1)
Religion	
Buddhist	27 (96.4)
Christian	1 (3.6)
Family History of Diabetes	
Yes	16 (57.1)
No	12 (42.9)
Personal Illness	
Yes	14 (50.0)
No	14 (50.0)
Alcohol Consumption	
Yes	8 (28.6)
No	20 (71.4)
Smoke	
Yes	3 (10.7)
No	25 (89.3)
Risk Score Developing Diabetes	
Medium	7 (25.0)
High	7 (25.0)
Very High	14 (50.0)

(SD) = 10,481.32). Most of the participants were Buddhists (96.4%). Over half of the participants had a family history of diabetes (57.1%). Half of the participants have personal illnesses including hypertension, hyperlipidemia, and cardiovascular diseases. Most of the participants do not smoke (89.28%) and do not consume alcohol (71.42%). (Table 2)

Prior to the lifestyle modification program with arm swing exercise, the average total health behavior score was equal to 88.82 (SD = 12.40) indicated high level, food consumption score was equal to 32.21 (SD = 3.68) shown as low level, exercise score was equal to 28.54 (SD = 6.74) shown as high level, and the stress management score was equal to 28.07 (SD = 5.96) indicated low level. The participants had an average waist circumference of 91.68 centimeters (SD = 7.01), a BMI of 26.62 kg/m² (SD = 3.94), and a capillary sugar level of 113.68 mg% (SD = 19.01) considered to be at risk of developing diabetes. All variables had a normal distribution (Table 3).

After receiving the lifestyle modification program with arm swing exercise, the participants had statistically significant higher scores for food consumption behavior ($t = -2.56, p < 0.05$) and stress management ($t = -1.48, p < 0.05$) than those at baseline. The results suggest that the participants had more improvement in food consumption and stress management leading to a higher total health behavior score, yet smaller waist circumference, and lower BMI, were not statistically significant (Table 3).

Discussion

The findings of this study partially support the hypotheses as follows. After receiving the lifestyle modification program with arm swing exercise, the participants with a higher total mean score on food consumption behavior and stress management were significantly higher than those at baseline being congruent with the self efficacy theory²² assisting to change health behavior. This was due to participants in this study having an expectation of diabetes prevention and the activities in the program focused on community participation in their context, especially food consumption behavior and arm swing exercise. Besides this, the researcher constantly gave positive reinforcement via home visits and/or telephone follow-ups and in group discussions throughout the study resulting in participants' continuous practice. The findings of this study are similar with the results from previous studies.^{17,27} However, although waist circumference and BMI in this study decreased, these were not statistically significant being different from previous studies^{17,27,25} because the duration of the study of only 8 weeks period was insufficient to reduce the waist circumference and BMI.

In this study, the participants had a lower score for exercise after the program that was lower than the required amount by this study (at least 30 minutes a day three times a week) because during the program, the participants had other activities in their community such as dengue fever campaign, elderly group activities, and religious events, this lower score for exercise may have contributed to higher capillary blood glucose levels.

Table 3 : Comparison of the average health behavior scores, nutritional status, and capillary blood sugar before and after the lifestyle modification program with arm swing exercise using paired t-test (n = 28).

Variables	Possible Range	Before			After		t [#]	p
		Range	Mean	SD	Mean	SD		
Total health behavior scores	0 - 144	52.0 - 111.0	88.82	12.40	93.93	11.31	-1.69	0.103
Food consumption	0 - 56	22.0 - 38.0	32.21	3.68	34.75	4.40	-2.56	0.016*
Exercise	0 - 40	16.0 - 39.0	28.54	6.74	28.46	4.17	0.06	0.953
Stress management	0 - 48	13.0 - 41.0	28.07	5.96	30.71	7.46	-1.48	0.013*
Waist circumference (cm)	-	76.0 - 99.0	91.68	7.01	89.70	7.85	1.84	0.077
BMI (kg/m ²)	-	20.8 - 35.5	26.62	3.94	26.08	4.11	2.04	0.052
Capillary blood sugar (mg%)	-	90.0 - 176.0	113.68	19.01	114.50	34.73	-0.10	0.918

* p < 0.05, # Statistical analysis on the mean differences between before and after program using paired t-test

Conclusion

The lifestyle modification program with arm swing exercise can be utilized to improve the health behavior of people with pre-diabetes in order to prevent the incidence of diabetes. This program should be adapted into communities by designating health care volunteers to monitor and encourage healthier behaviors continuously in an effort to try and reduce incident diabetes. Moreover, follow up on fasting blood sugar levels can be detected using HbA1c for higher accuracy.

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