

A METABOLIC SYNDROME SELF-MANAGEMENT PROGRAM FOR OLDER ADULTS: A RANDOMIZED CONTROLLED TRIAL

โปรแกรมการจัดการตนเองในผู้สูงอายุกลุ่มอาการเมตาบอลิก: การทดลองแบบสุ่มและมีกลุ่มควบคุม

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บทคัดย่อ

การศึกษาครั้งนี้มีวัตถุประสงค์เพื่อประเมินผลของโปรแกรมการจัดการตนเองในกลุ่มอาการเมตาบอลิก ต่อ พฤติกรรมการดำเนินชีวิตและตัวชี้วัดทางฟิสิกส์ในผู้สูงอายุกลุ่มอาการเมตาบอลิก กลุ่มตัวอย่างที่ผ่านเกณฑ์การคัดเลือกทั้งหมด 66 คน สุ่มเข้ากลุ่มทดลองและกลุ่มควบคุม กลุ่มละ 33 คน กลุ่มทดลองได้รับโปรแกรมการจัดการตนเองในกลุ่มอาการเมตาบอลิกและการพยาบาลตามปกติขณะที่กลุ่มควบคุมได้รับการพยาบาลตามปกติเพียงอย่างเดียว โปรแกรมฯ ประกอบกิจกรรม 4 ขั้นตอนใช้ระยะเวลา 6 สัปดาห์ โดยมุ่งเน้นไปที่พฤติกรรมการรับประทานอาหาร การทำกิจกรรมทางกายและการออกกำลังกาย เก็บข้อมูลก่อนการทดลอง หลังการทดลอง (สัปดาห์ที่ 6) และระยะติดตามผล (สัปดาห์ที่ 12) โดยใช้แบบสัมภาษณ์พฤติกรรมการรับประทานอาหารและ ประเมินการมีกิจกรรมทางกาย และการออกกำลังกายของผู้สูงอายุ และประเมินตัวชี้วัดทางฟิสิกส์ ประกอบด้วย ระดับกลูโคสในเลือด ระดับไตรกลีเซอไรด์ ระดับเอชดีแอล ค่าเส้นรอบเอว และ ระดับความดันโลหิต วิเคราะห์ข้อมูลโดยใช้สถิติพรรณนา สถิติ ที่ ไคว์สแคว์ และ การวิเคราะห์ความแปรปรวน พหุคูณ แบบวัดซ้ำ

ผลการศึกษาพบว่าคะแนนพฤติกรรมการดำเนินชีวิตและตัวชี้วัดทางฟิสิกส์ในผู้สูงอายุกลุ่มอาการเมตาบอลิกที่ได้รับโปรแกรม MSSM ดีขึ้นกว่ากลุ่มควบคุมอย่างมีนัยสำคัญทางสถิติ (Pillai's Trace = .407, $F_{(8, 57)} = 4.88, p < .001$) และ คะแนนพฤติกรรมการดำเนินชีวิตและตัวชี้วัดทางฟิสิกส์ในผู้สูงอายุกลุ่มอาการเมตาบอลิกที่ได้รับโปรแกรม MSSM มีคะแนนเฉลี่ยของพฤติกรรมการดำเนินชีวิตและตัวชี้วัดทางฟิสิกส์เมื่อเปรียบเทียบระหว่างก่อนการทดลองหลังการทดลองและระยะ

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ติดตามผล พบว่าค่าเฉลี่ยแตกต่างกันอย่างมีนัยสำคัญในช่วงสามเวลาอย่างน้อยหนึ่งคู่ (Pillai's Trace = .723, $F_{(16, 49)} = 8.01, p < .001$).

ผลการศึกษาพบว่ากลุ่มทดลองมีการปรับเปลี่ยนในทางที่ดีขึ้นของพฤติกรรมการรับประทานอาหารและการมีกิจกรรมทางกายและการออกกำลังกายและตัวชี้วัดทางฟิสิกส์ชีวเคมีประกอบด้วยระดับน้ำตาลและไตรกลีเซอไรด์เมื่อเปรียบเทียบระหว่างหลังการทดลองและระยะติดตามผล ส่วนเส้นรอบเอวลดลงเฉพาะหลังการทดลอง แต่อย่างไรก็ตาม โปรแกรม MSSM ไม่มีผลต่อการปรับเปลี่ยนระดับ เอชดีแอล และระดับความดันโลหิตให้ดีขึ้น

Abstract

This study aimed to evaluate the effects of a specific Metabolic Syndrome Self-Management (MSSM) program on lifestyle behaviors and physiological indicators in older adults with metabolic syndrome. Sixty-six participants who met the inclusion criteria were randomly assigned to either the experimental (n=33) or control (n=33) group. The experimental group received the MSSM program based on self-management with usual care, while the control group received usual care only. The 6-week program focused on eating behavior and physical activity, and included four phases. Data were collected at pre-test, post-test (6th week), and follow-up (12th week). Eating behaviors were assessed using the Eating Behavior Questionnaire, while physical activity was assessed using The Rapid Assessment of Physical Activity. Physiological indicators included fasting plasma glucose, triglycerides, high-density lipoprotein, waist circumference, and blood pressure. Data were analyzed using descriptive statistics, independent t-tests, chi-square tests, and repeated measures MANOVA. The results showed that the scores of lifestyle behaviors and physiological indicators in older adults with metabolic syndrome (MetS) were significantly better for those receiving the MSSM program than the control (Pillai's Trace = .407, $F_{(8, 57)} = 4.88, p < .001$). There were significantly better of mean scores of lifestyle behaviors and physiological indicators on interaction of group and time (Pillai's Trace = .693, $F_{(16, 49)} = 6.92, p < .001$). In addition, older adults with MetS who received the MSSM program (experimental group) had different mean scores of lifestyle behaviors and physiological indicators when compare between pre-test, post-test, and follow-up. The mean scores differed significantly across the three time periods in at least one pair (Pillai's Trace = .723, $F_{(16, 49)} = 8.01, p < .001$). Results revealed that the experimental group had significantly greater improvements on eating behaviors, physical activity and physiological indicators including fasting plasma glucose and triglycerides at post-test and follow-up, and had significant improvement on waist circumference only at post-test. However, this program could not significantly improve high-density lipoprotein and blood pressure.

Keywords: metabolic syndrome; self-management program; randomized controlled trials; older adults; lifestyle behaviors; physiological indicators.

Introduction

Metabolic syndrome (MetS) is a group of factors that increases the risk of chronic disease, such as type 2 diabetes and cardiovascular disease (Deerochanawong, 2006; Dunkley et al., 2012). The prevalence of MetS is increasing worldwide, especially among older adults (Bechtold et al., 2006; Bo et al., 2009). Its prevalence varies from 10–40% in most Asian countries (Chan, 2006). The prevalence of MetS in older persons has been reported to occur in 6.7% of persons 20 to 29 years of age, in 43.5% of persons 60 to 69 years of age, and in 42.0% of persons age 70 years and older (Markides, 2007). The prevalence increased with age, affecting more than 40% of individuals age more than 60 years old (Ferri, 2010).

In Thailand, MetS is more prevalent in urban than rural men (23.1% vs 17.9%, $P < 0.05$), but more prevalent in rural than urban women (27.9% vs 24.5%, $P < 0.05$) (Aekplakorn et al., 2011). Low HDL and hypertriglyceridemia were more common in rural areas, while obesity, high blood pressure, and hyperglycemia were more common in urban areas (Aekplakorn et al., 2011).

MetS is characterized by a group of metabolic factors, including high blood pressure, low levels of high-density lipoprotein, high levels of triglycerides, impaired fasting glucose, and excess abdominal fat. Some underlying causes that contribute to the metabolic risk factors include overweight or obese, insulin resistance, physical inactivity, smoking, alcohol consumption, and genetic factors.

Reynolds and Wildman (2009) reported

that individuals with hypertension have an increased risk of MetS. Increasing rates of abdominal obesity and abnormalities in glucose metabolism accounted for an increasing prevalence of MetS in women (Hu et al., 2008). MetS primarily affects older adults, not only increasing the risk of chronic disease but also affecting the quality of life. In fact, Sakurai et al. (2010) showed that MetS was associated with impaired activities of daily living (ADLs) and cognitive decline.

MetS risk factors arise in tandem with aging; for example, as age increases, muscle mass decreases, muscles weaken, and changes within skeletal muscle fibers lead to a decrease in peripheral glucose uptake, ultimately leading to insulin resistance. Excess total body fat, specifically central obesity, is a risk factor for cardiovascular disease, insulin resistance, type 2 diabetes, hypertension, and dyslipidemia (Bechtold et al., 2006). Additionally, dietary factors and sedentary lifestyles contribute to the high prevalence of MetS (Hu et al., 2008). Lifestyle modification and weight loss, therefore, should be at the core of treating or preventing MetS and its components (Cornier et al., 2008; NCEP-ATP III, 2001). There is a consensus that other cardiac risk factors should be managed aggressively in individuals with MetS (Cornier et al., 2008). Since lifestyle behaviors are important factors associated with MetS, older adults with MetS should be able to manage this syndrome through lifestyle changes. Early management of the syndrome can control complications such as type 2 diabetes and cardiovascular disease. Self-management is an important factor for improving patient outcomes in

chronic diseases (Holroyd & Creer, 1986; Holman & Lorig, 1997; Lorig et al., 1999).

Self-management refers to the ability of an individual in conjunction with family, community, and healthcare professionals to manage symptoms, treatments, lifestyle changes, and the psychosocial, cultural, and spiritual consequences of health conditions (Richard & Shea, 2011; Schulman-Green et al., 2012). These abilities should be reinforced to manage MetS and prevent chronic disease. Thus, older people may benefit from self-management interventions that focus on specific health problems, cover all basic facets of well-being, and include those who proactively help maintain their well-being (Cramm et al., 2012; Steverink et al., 2005).

Only a few researchers have used a multifactorial approach for self-management in older adults with MetS. Most MetS interventions used a single component to manage behaviors, such as physical activity (Lakka & Laaksonen, 2007), exercise (Katzmaryk et al., 2003, Stewart et al., 2005), or diet (Azadbakht et al., 2005; Buakaew, 2012; Kim et al., 2010). In Thailand, most research related to MetS was descriptive (Chatngern, 2008; Khamklung, 2012; Pongchaiyakul et al., 2007; Srisala, 2007; Sukpimai, 2012). Previous MetS interventions were not specific to older adults, and did not include holistic dimensions of MetS. Thus, there is a need to develop and evaluate holistic interventions to manage lifestyle behaviors among older adults with MetS.

The purpose of this study was to evaluate the effects of an MSSM program on lifestyle

behaviors (eating behavior and physical activity) and physiological indicators (fasting plasma glucose, triglycerides, high-density lipoprotein, waist circumference, systolic blood pressure and diastolic blood pressure) in older adults with MetS.

Research methodology

Study design and sample

This study was a randomized controlled trial with 66 elderly participants at the outpatient department of BangBo Hospital in Samut Prakan Province, Thailand. All participants had to meet the following nine inclusion criteria:

- 1) Age between 60–74 years.
- 2) Diagnosed with metabolic syndrome for more than two weeks and having at least three of the five risk criteria as defined by the Third Report of the National Cholesterol Education Program-Adult Treatment Panel (NCEP-ATP III) using the waist circumference definition of the World Health Organization-Asia Pacific. The five MetS risk criteria were: increased waist circumference (≥ 90 cm. in men and ≥ 80 cm. in women), hypertriglyceridemia (triglyceridemia ≥ 150 mg/dL), low high-density lipoprotein cholesterol (HDL; < 40 mg/dL in men and < 50 mg/dL in women), high blood pressure ($\geq 130/85$ mmHg or use of anti-hypertensive medication), and high fasting plasma glucose (≥ 110 mg/dL or treatment for diabetes mellitus).
- 3) No cognitive impairment, as indicated by having a score of greater than 23 on the Thai Mental State Examination (TMSE).
- 4) No physical limitations, as identified by functional status using the Barthel Activity of Daily

Living (BAI), with score between 12 and 20.

5) No heart disease or severe hypertension (systolic ≥ 180 mmHg, diastolic ≥ 110 mmHg).

6) No osteoarthritis, including pain of knee and/or hip joints, or other health conditions that limits exercise.

7) Understand and speak Thai.

8) Live in Samut Prakan Province, Thailand.

9) Be willing and able to participate in all aspects of the program.

Sixty-six participants who met the inclusion criteria were assigned randomly using a simple randomization method (sealed-envelope with no replacement technique) to either the experimental (n=33) or control (n=33) group (Figure 1).

Sample size determinant formulas for repeated measurement analysis were used to calculate the sample size (Stevens, 2002). This study used a level of significance of 0.05 and a power of 0.80 (Cohen, 1988). Calculation of effect size was based on a previous study with a similar intervention and outcome (Nanri et al., 2012). G *Power version 3.1.6 measured the calculation of effect size (Faul et al., 2009); the effect size was 0.45 (Nanri et al., 2012). The required sample size was 30 participants per group, for a total of 60 participants (Stevens, 2002). The researcher collected data by interview and home visits, in order to limit drop out. However, to allow for potential attrition, a sample size of 33 per group, for a total of 66 participants, was recruited.

Ethical considerations

The Research Ethics Committee of the Faculty of Nursing at Burapha University in Thailand approved this study. Potential participants received an information sheet describing the study purpose, what would be involved in research participation, assurance of confidentiality and anonymity issues, and the ability to withdraw at any time without consequences. Individuals agreeing to participate in the study signed a consent form.

Instruments

Questionnaires: Three questionnaires were used for data collection:

1. The Demographic Questionnaire was comprised of questions to assess age, gender, religious affiliation, educational level, marital status, health insurance coverage, occupational status, income, household income, smoking status, alcohol consumption, health history, and previous disease.

2. The Eating Behavior Assessment was comprised of 15 items measuring the frequency of eating fruits and vegetables, foods high in salt, fatty foods, and high carbohydrate foods, as well as alcohol consumption. The total score of 75 was divided into four levels: very good eating behavior (≤ 36), good eating behavior (37–41), fair eating behavior (42–47), and poor eating behavior (≥ 48). The Cronbach's alpha coefficient was 0.73.

3. The Rapid Assessment of Physical Activity (RAPA) was comprised of 9 items to evaluate physical activity in two ways: 1) sedentary, regular, or vigorous activity, and 2) strength training and/or flexibility. Response options were yes or

no. Items 1–7 on the RAPA assessed levels of aerobic activity, using scores of 1 = sedentary, 2 = under active, 3 = under-active regular–light activities, 4 = under-active regular, and 5 = active. Items 8–9 used to assess strength training and flexibility were scored separately, with strength training = 1, flexibility = 2, or both = 3. The Cronbach's alpha coefficient was 0.72.

Intervention: the MSSM program. The experimental group received a four-phase intervention program over 12 weeks that included: 1) assessment and planning, 2) preparation, 3) self-management practice, and 4) evaluation.

Week 0: The researcher introduced program details to the participants and then collected baseline data (pre-test) on demographics, eating behaviors, and physical activity, which took about 30 minutes to complete. The participants were also assessed for physiological indicators, including fasting plasma glucose, triglycerides, high-density lipoprotein, waist circumference, and blood pressure.

Week 1: The first phase of the program began with establishment of relationships, assessment, needs identification, and acknowledgment of strengths. This phase was important to understanding the background of the participants. The researcher approached the participants individually in order to assess MetS knowledge and factors leading to preserving and promoting healthy behavior of older adults and their caregivers (in hospital).

Week 2: In the second phase of the program, a preparation phase, a group approach was used. Each group had 4–5 participants. The main purpose of this phase was for the older adults with MetS to increase

knowledge of MetS and to develop the skills for managing health behaviors, including exercise, food selection, depression, and medication management. The researcher provided MetS knowledge and medication management in an individual consultation. As patient education is an important component to manage MetS, the patients were educated about MetS symptoms, pathophysiology, course, outcome, and treatment. The more the patients know about MetS, the better they manage the syndrome (at hospital).

Week 3–4: The third phase of the program was self-management practice. The researcher provided motivation and skills for managing lifestyle behavior changes. Participants managed what they wanted to accomplish, alternative ways to accomplish their goals, short-term plans, action plans or agreements with themselves, how they wanted to carry out their action plans and check their results, changes they wanted to make, and rewards they wanted to receive (participant's homes).

Week 5: The fourth phase of the program assessed the process and outcomes of the older adult activities at weekly home visits. During the home visits, participants, caregivers, and the researcher assessed the outcomes of the self-management practices from participants' and caregivers' records on self-monitoring, self-reinforcing, self-evaluating, and maintaining behavioral change (participant's homes).

Week 6: The post-test assessment, using the Eating Behavior Assessment and the Rapid Assessment of Physical Activity, was conducted. Participants were also assessed for physiological indicators—waist circumference, blood pressure,

fasting plasma glucose, triglycerides, and high-density lipoprotein (at hospital).

Week 12: The follow-up assessment, using the Eating Behavior Assessment and the Rapid Assessment of Physical Activity, was conducted. The participants were also assessed for physiological indicators—waist circumference, blood pressure, fasting plasma glucose, triglycerides, and high-density lipoprotein (at hospital).

The usual care. The control group received usual care during the 12-week period as below:

Week 0: Baseline information (pre-test) was assessed using the Eating Behavior Assessment and the Rapid Assessment of Physical Activity. The participants were assessed for physiological indicators including fasting plasma glucose, triglycerides, and high-density lipoprotein, waist circumference, and blood pressure. The participants were educated about MetS, received usual care, and were given the opportunity to consult the researcher about any health concerns.

Week 6: Participants were assessed (post-test) using the Eating Behavior Assessment, the Rapid Assessment of Physical Activity, and all physiological indicators, including waist circumference, blood pressure, fasting plasma glucose, triglycerides, and high-density lipoprotein. A booklet about MetS was also distributed.

Week 12: The participants were assessed (follow-up) using the Eating Behavior Assessment, the Rapid Assessment of Physical Activity, and physiological indicators, including waist circumference, blood pressure, fasting plasma glucose, triglycerides, and high-density lipoprotein.

Data analysis

The demographic data of the participants were analyzed by descriptive statistics using frequency, percentage, mean, and standard deviation. Chi-square and independent t-test were used to examine the difference in characteristics between the experimental and control groups at pre-test. Multivariate Analysis of Variance (MANOVA) and repeated measures were used to compare lifestyle behaviors and physiological indicators in older adults with MetS at three points of time for each group: pretest, post-test, and follow-up. The assumption of MANOVA was tested before performing the analysis.

The assumptions for multivariate analysis of repeated measures are: 1) individual and independent; 2) variance-covariance matrices must be equal for all treatment groups; and 3) the set of dependent variables must follow a multivariate normal distribution (Hair, Black, Babin, & Anderson, 2010; Tabachnick & Fidell, 2007).

The assumptions were tested and the results revealed that all assumptions were met.

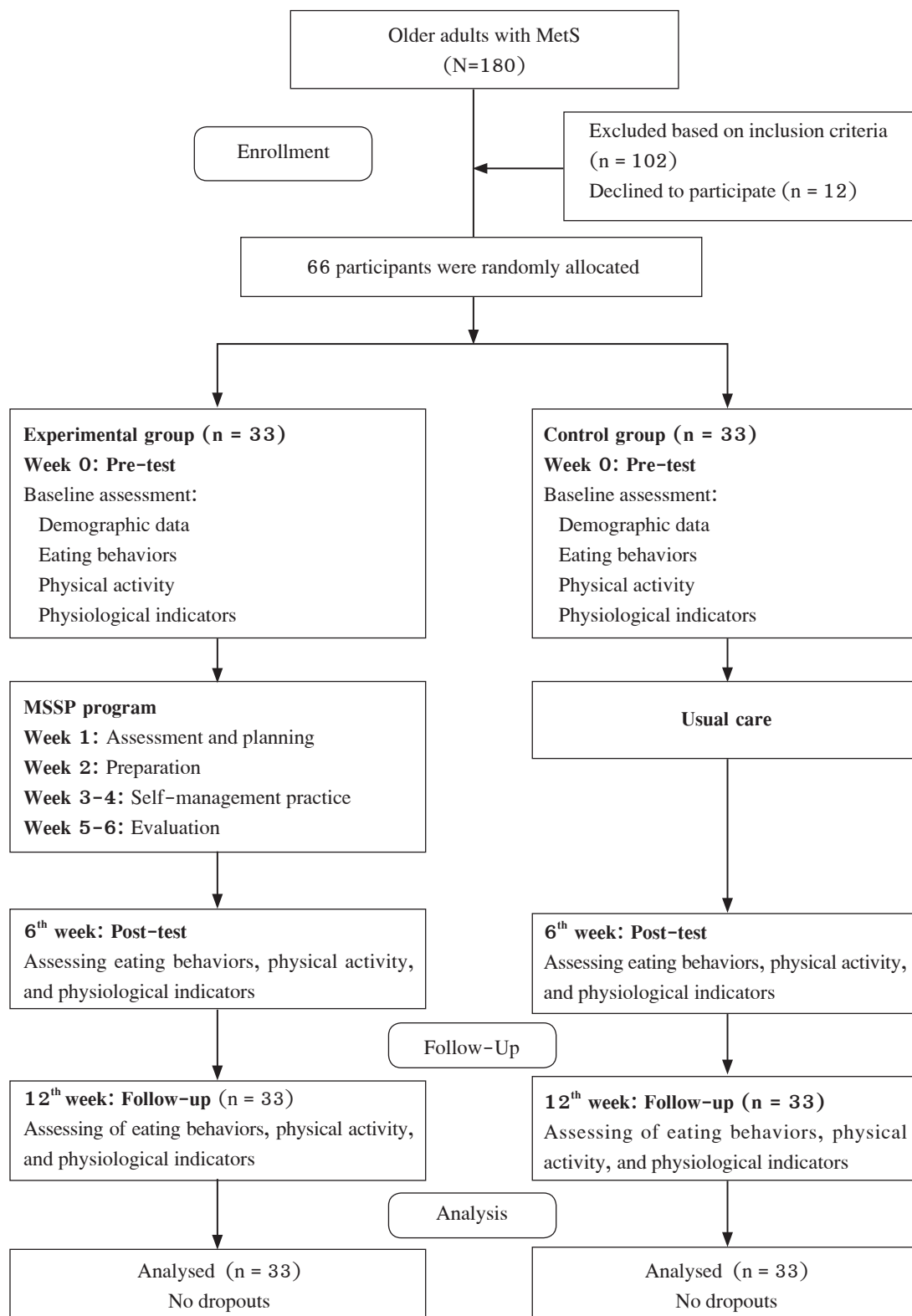


Figure 1 Flow chart of the participant recruitment, allocation, intervention, and follow-up

Results

Participants in the experimental and control groups were similar in age, gender, marital status,

education, income, number of MetS criterion determinants, and tobacco and alcohol use as shown in Table 1.

Table 1 The demographic characteristic of the experimental and control groups

Characteristics	Experimental group (n=33)	Control group (n=33)	p-value
	n (%)	n (%)	
Age (year)			.306 ^t
Mean (SD)	65.27 (4.09)	64.24 (4.02)	
Gender			.621 ^c
Male	14 (42.4)	16 (48.5)	
Female	19 (57.6)	17 (51.5)	
Marital status			.476 ^c
Single	0 (0)	1 (3.0)	
Married	20 (60.6)	22 (66.7)	
Widowed/Divorced/Separated	13 (39.4)	10 (30.3)	
Education			.585 ^c
Primary school	29 (87.9)	27 (81.1)	
High school	3 (9.1)	3 (9.1)	
Bachelor degree	1 (3.0)	3 (9.1)	
Income (Baht/month)			.090 ^t
Mean (SD)	8,339.39 (9,859.64)	15,151.52 (20,345.41)	
Smoke			1.000 ^c
No	29 (87.9)	29 (87.9)	
Yes	4 (12.1)	4 (12.1)	
Alcohol consumption			.352 ^c
No	30 (90.9)	28 (84.4)	
1–2 time / month	3 (9.1)	1 (3.0)	
2–3 time / week	0 (0)	2 (6.1)	
Everyday	0 (0)	2 (6.1)	
The number of MetS criterion			.387 ^c
3 criteria	7 (21.2)	12 (36.4)	
4 criteria	14 (42.4)	12 (36.4)	
5 criteria	12 (36.4)	9 (27.2)	

Note: t = t-test, c = chi-square test, p-value = .05

Effects of the Metabolic Syndrome Self-Management program on lifestyle behaviors and physiological indicators in older adults with MetS

MANOVA repeated measure analysis indicated effects of the MSSM program on lifestyle behaviors and physiological indicators among older adults with MetS. Table 2 shows the multivariate significant effect of the combination of eight dependent variables (eating behavior, physical activity, fasting plasma glucose, triglycerides, high-density lipoprotein, waist circumference, systolic blood pressure, and diastolic blood pressure) between the experimental and control groups (Pillai's Trace = .407, $F_{(8, 57)} = 4.88, p < .001$). There was a

significant effect across three time points (Pillai's Trace = .723, $F_{(16, 49)} = 8.01, p < .001$). There was a significant interaction effect between group and three time points (Pillai's Trace = .693, $F_{(16, 49)} = 6.92, p < .001$).

Table 3 illustrates the simple effects comparison of lifestyle behaviors and physiological indicators between time and interaction between time and group. Findings showed significant reductions of eating behavior, physical activity, fasting plasma glucose and triglycerides between three time points in the experimental group. Moreover, there were significant interaction effects between time and group for eating behavior, physical activity, fasting plasma glucose triglycerides, and waist circumference.

Table 2 MANOVA repeated measures of lifestyle behavior and physiological indicator score between groups, within groups, and interaction between time and group

Effect		Value	F	Hypothesis df	Error df	p-value
Between subjects						
Group	Pillai's Trace	.407	4.88	8	57	.000**
Within subjects						
Time	Pillai's Trace	.723	8.01	16	49	.000**
Time * Group	Pillai's Trace	.693	6.92	16	49	.000**

** $p < .001$

Table 3 The simple effects comparison of lifestyle behaviors and physiological indicators between time and interaction between time and group

Variables	Groups	Pre-test	Post-test	Follow-up	Effect			
		Mean (SD)	Mean (SD)	Mean (SD)	Time		Time * Group	
					<i>t-value</i>	<i>p-value</i>	<i>t-value</i>	<i>p-value</i>
EB	Experimental	27.93 (8.68)	17.60 (5.20)	18.78 (5.51)	5.75	.000**	-6.83	.000**
	Control	24.27 (4.97)	25.09 (5.58)	25.12 (5.79)				
PA	Experimental	2.63 (1.05)	4.60 (0.60)	5.21 (0.96)	-7.46	.000**	8.76	.000**
	Control	3.27 (1.15)	2.93 (1.02)	3.24 (1.06)				
FPG (mg/dl)	Experimental	155.81 (34.38)	130.57 (27.24)	130.69 (23.94)	2.72	.008*	-2.85	.005*
	Control	145.06 (32.51)	143.90 (32.69)	147.39 (41.67)				
TG (mg/dl)	Experimental	202.36 (100.56)	165.33 (79.41)	155.54 (64.95)	2.23	.029*	-2.88	.005*
	Control	156.81 (68.56)	173.15 (76.40)	151.21 (53.46)				
HDL (mg/dl)	Experimental	38.75 (7.57)	39.42 (8.14)	40.00 (9.50)	.48	.633	1.55	.123
	Control	42.81 (8.64)	41.54 (8.95)	40.48 (6.86)				
WC (cm)	Experimental	92.69 (11.98)	91.59 (12.02)	91.93 (10.53)	.88	.377	-2.47	.016*
	Control	91.54 (10.30)	91.57 (10.24)	92.39 (8.87)				
SBP (mmHg)	Experimental	130.90 (10.71)	128.42 (7.46)	131.21 (8.19)	.36	.722	-.47	.639
	Control	131.81 (10.14)	130.90 (9.13)	133.03 (11.03)				
DBP (mmHg)	Experimental	81.81 (7.26)	79.39 (7.04)	83.33 (7.77)	.19	.847	-.19	.847
	Control	83.93 (8.63)	84.24 (7.08)	83.63 (8.22)				

Discussion

The findings from this study support that the MSSM program is effective to improves the lifestyle behaviors (eating behaviors and physical activity) and physiological indicators, including fasting plasma glucose, triglyceride, high density lipoprotein, waist circumference, and blood pressure, of the older participants at post-test and follow-up. This result can be explained as follows.

This program helped the participants, through enhanced self-management skills, better control eating behaviors, and increase physical activity. The MSSM program included four phases. The first phase focused on understanding participants' background and needs in order to plan the level of activity appropriate to the background and needs to motivate self-management behaviors.

The second phase focused on increasing knowledge of MetS in older adults, including definitions, metabolic risk factors, signs and symptoms, progression and complications of the syndrome, treatment, metabolic syndrome management, and knowledge of age-related changes. Eating behavior guidelines determined a daily food plan. Physical activity and exercise guidelines include basic information about daily physical activity and problem solving of common issues, focusing on the kind of activity and exercise appropriate to older adults. The MSSM program, by imparting sufficient knowledge about MetS conditions and treatment, helped participants make decisions about changes in their health behaviors. Increasing knowledge and self-management skills are intrinsic to continuing self-management behavior. Cognitive processes play a crucial role in the social learning model of self-management. This component of the model targeted both coping skills and expectations that influenced coping performance (self-efficacy). Cognitive processes can: 1) monitor social and physical/environmental conditions, 2) monitor physiological processes, and 3) plan, initiate, and reward adaptive behaviors (Tobin et al., 1986). Cognitive processes help achieve goal setting for self-management behaviors.

The third phase promoted the effective performance of self-management skills (eating behaviors and physical activity) and increased self-efficacy. Perceived self-efficacy plays an important mediating role in self-management activities, adopting and maintaining lifestyle behavior changes, resulting in improved health outcomes (Marks, Allegrante, &

Lorig, 2005). The fourth phase used a behavioral approach that required self-regulation and self-monitoring. Participants recorded their daily eating behavior regarding the kind and quantity. The small group education and individual coaching approach increased participants' knowledge and self-management skills for collaborative goal setting and action plans, problem solving, and self-monitoring. Participants recorded the kind and duration of physical activity everyday.

The process of the program used empathic understanding, reflection, and enhanced self-efficacy that focused on physical activity for controlling physiological indicators, such as fasting plasma glucose, triglyceride, waist circumference, blood pressure, and body weight. The recording process also increased participant awareness of their sedentary activities and promoted change (Suwankruhasn et al., 2013). Our findings were in partial agreement with Suwankruhasn et al. (2013) who, using a self-management support program for Thais diagnosed with MetS, found a significant increase in physical activity at post-test and follow-up, but no changes in eating behavior.

The level of fasting plasma glucose correlates with food intake; foods that contain carbohydrates affect blood glucose levels the most. In addition, moderate-intensity physical activity has been shown to reduce fasting plasma glucose (Dragusha et al., 2010). Participants receiving the MSSM program managed lifestyle behaviors—such as controlling carbohydrate consumption, lowering sugar intake, and increasing physical activity—that positively affected the level of fasting plasma glucose.

Triglyceride comes from the food that one eats as well as being produced naturally by the body. Triglyceride levels usually respond well to dietary and lifestyle changes. Despite the experimental group having higher triglyceride levels at pre-test than the control group, they significantly decreased at post-test and follow-up compared to the control. High triglycerides are often a sign of other conditions that increase the risk of heart disease and stroke as well, including obesity and metabolic syndrome—a cluster of conditions that includes too much fat around the waist, high blood pressure, high triglycerides, high blood sugar and abnormal cholesterol levels (Mayo Clinic, 2016).

The MSSM that control diet and physical activity have been shown to reduce triglyceride levels. Moreover, physical activity can increase level of high-density lipoprotein. (Dragusha et al., 2010; Grundy et al., 2004; Mendelson, 2008). High-density lipoprotein is “good” cholesterol that benefits the body. High-density lipoprotein appears to benefit the body in two ways: 1) it removes cholesterol from the walls of the arteries and returns it to the liver for disposal from the body, it helps prevent oxidation of LDL.

Blood pressure included systolic and diastolic blood pressure. Pre-test, participants in the experimental group had blood pressure of nearly normal levels; participants in the MSSM program maintained their systolic and diastolic blood pressure levels.

These findings were congruent with Suwankruhasn et al. (2013), who studied a self-management support program for Thai people diagnosed with MetS. The results found a significant

decrease in blood glucose at follow-up (6 months). Moreover, previous studies by Jopa et al. (2010)—a study on the effects of a self-management program controlling metabolic syndrome among middle age people—and Moattari et al. (2012)—a study on the impact of self management on metabolic control indicators of diabetes patients—found significant improvements in fasting plasma glucose at post-test.

Findings in this research also showed high-density lipoprotein, blood pressure, and waist circumference were not improved at follow-up. This was in line with the results of Suwankruhasn et al. (2013) who showed no improvement in waist circumference and blood pressure following a self-management support program. Lee et al. (2014) also found no change in waist circumference in a study of the effects of a walking program on self-management and risk factors of MetS in older Korean adults. However, at follow-up, waist circumference slightly increased (Lee et al., 2014). In summary, the MSSM program studied here can improve the lifestyle behaviors and physiological indicators in older adults with MetS.

Limitation

This study had some limitations that may influence the generalizability of the results:

- 1 The MSSM program was provided to adults aged 60–74 years. Thus, its application to other ages may be limited.

- 2 The MSSM program was conducted with urban residents. Thus, its application to rural residents maybe be limited or need further verification.

Recommendation for application

Knowledge obtained from this study can be used to guide a MSSM program that promotes healthy eating and physical activity in older adults with MetS. The MSSM program was specifically developed for older adults with MetS so that nurses can use this program as a guideline to prevent progression of MetS. Community nurses can apply this program as a guide for providing care to other chronic diseases.

Recommendation for future study

The MSSM program is effective in changing healthy lifestyles of older adults with MetS towards eating behavior and physical activity. The program also improved fasting plasma glucose and high-density lipoprotein. Thus, the MSSM program should be applied in older adults with MetS to promote healthy lifestyles for preventing complications and risks, such as cardiovascular disease and stroke.

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