ORIGINAL ARTICLE

Effectiveness of Thai mind-body exercise "Rusie Dutton" on blood pressure and quality of life in older adults in Bangkok, Thailand

Kanit Ngowsiri[1], Premwadee Karuhadej[2] and Kanya Napapongsa[3]

[1] *Ph.D., College of Nursing and Health, Suan Sunandha Rajabhat University, Thailand*
[2] *Ed.D., College of Nursing and Health, Suan Sunandha Rajabhat University, Thailand*
[3] *M.S., College of Nursing and Health, Suan Sunandha Rajabhat University, Thailand*

Corresponding author: *Kanit Ngowsiri* ***E-mail:*** *kanit.ng@ssru.ac.th*
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Abstract

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The aim of this quasi-experimental research was to examine the effects of the Thai mind-body exercise *"Rusie Dutton"* (RD) that conducted by Wat Po Thai traditional Massage School on blood pressure (BP) and quality of life (QOL) in older adults. Participants aged 60-75 years were recruited from two communities in Bangkok, Thailand and randomly allocated to two groups: the experimental group (n=23) attended the RD class once a week and practiced by following a poster at home every day for 13 weeks, and the control group (n=22) received no intervention. BP and QOL that using the WHOQOL-BREF-THAI questionnaire were assessed at the beginning and the end. Independent t-test and paired t-test were used for data analysis.

After the intervention, the experimental group showed significant improvement in decreased systolic blood pressure (SBP) (11.30 mmHg, $p < 0.001$), diastolic blood pressure (DBP) (6.61 mmHg, $p < 0.001$), and increased QOL scores in physical health (6.39 points, $p < 0.001$), psychological health (5.04 points, $p < 0.001$), satisfaction with the environmental domain (2.91 points, $p < 0.001$), and improvement in total QOL (14.87 points, $p < 0.001$). In addition, the experimental group demonstrated better performance in SBP (17.55 mmHg, $p < 0.001$), DBP (5.92 mmHg, $p < 0.05$), and QOL scores in physical health (3.89 points, $p < 0.001$), satisfaction with the environmental domain (1.96 points, $p < 0.05$), and total QOL (9.48 points, $p < 0.001$) compared to the control group. This study demonstrated that the Thai mind-body exercise *"Rusie Dutton"* has a potency to reduce BP and improve QOL in older adults especially in physical health and satisfaction with the environmental domain.

Present findings encourage the future studies are warranted to reveal the influence of *Rusie Dutton* on BP and vascular aging.

Keywords: mind-body exercise, Rusie Dutton, blood pressure, quality of life, older adults

วารสารสาธารณสุขและการพัฒนา
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ประสิทธิผลของการออกกำลังกายแบบผสมผสานของไทย ด้วยฤาษีดัดตนต่อความดันโลหิตและคุณภาพชีวิตของผู้สูงอายุในกรุงเทพมหานคร ประเทศไทย

กนิษฐ์ โง้วศิริ[1] เปรมวดี คฤหเดช[2] และกันยา นภาพงษ์[3]

[1] วท.ด. วิทยาลัยพยาบาลและสุขภาพ มหาวิทยาลัยราชภัฏสวนสุนันทา ประเทศไทย
[2] ศษ.ด, วิทยาลัยพยาบาลและสุขภาพ มหาวิทยาลัยราชภัฏสวนสุนันทา ประเทศไทย
[3] วท.ม. วิทยาลัยพยาบาลและสุขภาพ มหาวิทยาลัยราชภัฏสวนสุนันทา ประเทศไทย

บทคัดย่อ

กนิษฐ์ โง้วศิริ เปรมวดี คฤหเดช และ กันยา นภาพงษ์ ประสิทธิผลของการออกกำลังกายแบบผสมผสานของไทย ด้วยฤาษีดัดตนต่อความดันโลหิตและคุณภาพชีวิตของผู้สูงอายุในกรุงเทพมหานคร ประเทศไทย
ว. สาธารณสุขและการพัฒนา 2561;16(3):41-53

การศึกษานี้เป็นการวิจัยกึ่งทดลอง เพื่อศึกษาประสิทธิผลของการออกกำลังกายแบบผสมผสานของไทยด้วยฤาษีดัดตน (วัดโพธิ์) ต่อความดันโลหิตและคุณภาพชีวิตของผู้สูงอายุ กลุ่มตัวอย่าง คือ ผู้สูงอายุ (อายุ 60-75 ปี) ใน 2 ชุมชนของกรุงเทพมหานคร ประเทศไทย ซึ่งแบ่งเป็นกลุ่มทดลอง 23 คน เข้ากลุ่มฝึกฤาษีดัดตนสัปดาห์ละ 1 ครั้ง และให้ฝึกด้วยตนเองที่บ้านโดยดูจากโปสเตอร์ทุกวันเป็นระยะเวลา 13 สัปดาห์ และกลุ่มควบคุม 22 คน ใช้ชีวิตปกติ เก็บข้อมูลความดันโลหิต และคุณภาพชีวิตโดยใช้แบบสอบถาม (WHOQOL-BREF-THAI) ก่อนและหลังการทดลอง วิเคราะห์ข้อมูลโดยทดสอบความแตกต่างของค่าเฉลี่ยระหว่างกลุ่มด้วย independent t-test และภายในกลุ่มแบบจับคู่ ด้วย paired t-test

ผลการศึกษาพบว่า หลังการทดลองกลุ่มทดลองมีค่าเฉลี่ยความดันโลหิตลดลง และคุณภาพชีวิตดีขึ้น คือ SBP ลดลง (11.30 mmHg, $p < 0.001$), DBP (6.61 mmHg, $p < 0.001$), คุณภาพชีวิตเพิ่มขึ้นทั้งด้านสุขภาพกาย (6.39, $p < 0.001$), ด้านจิตใจ (5.04, $p < 0.001$), ด้านความพึงพอใจในสิ่งแวดล้อม (2.91, $p< 0.001$) และคุณภาพชีวิตโดยรวม (14.87, $p < 0.001$) และกลุ่มตัวอย่างมีค่าเฉลี่ยความดันโลหิตต่ำกว่ากลุ่มควบคุม และมีค่าเฉลี่ยคุณภาพชีวิตสูงกว่ากลุ่มควบคุม คือ SBP (17.55 mmHg, $p < 0.001$), DBP (5.92 mmHg, $p < 0.05$), คุณภาพชีวิตด้านสุขภาพกาย (3.89, $p < 0.001$), ด้านความพึงพอใจในสิ่งแวดล้อม (1.96, $p < 0.05$), ด้านคุณภาพชีวิตโดยรวม (9.48, $p < 0.001$) ผลการศึกษานี้ แสดงให้เห็นว่าการออกกำลังกายด้วยฤาษีดัดตน มีผลทำให้ผู้สูงอายุมีความดันโลหิตลดลง และมีคุณภาพชีวิตดีขึ้น โดยเฉพาะด้านสุขภาพกาย และด้านความพึงพอใจในสิ่งแวดล้อม

จากผลการวิจัยนี้ เสนอแนะให้มีการศึกษาเพิ่มเติมเพื่อยืนยันผลของการออกกำลังกายด้วยฤาษีดัดตนต่อความดันโลหิตและหลอดเลือดของผู้สูงอายุต่อไป

คำสำคัญ: การออกกำลังกายแบบผสมผสาน ฤาษีดัดตน ความดันโลหิต คุณภาพชีวิต ผู้สูงอายุ

Introduction

Aging is associated with a wide range of physiological changes, a decline in physical function and inactivity that leads to an increase chronic diseases, reduction in the capability of activity and quality of life (QOL) in older adults.[1] Among this population, hypertension (HT) was the major risk factor in the development of stroke, cardiovascular disease (CVD) morbidity and leading cause of death.[2, 3] At the time of the study, there were 9.5 million people aged 60 years and older in Thailand (14.7% of the Thai population) and this number was expected to be 14.4 million (> 20%) by the year 2025.[4] Moreover, HT is the most common disease in older Thai adults.[5] Therefore, intervention that can prevent the onset and progression of HT, as well as promote health and well-being in this population is needed.

Mounting evidence indicates that increased physical activity and exercise can result in a reduced risk for chronic disease and improvement of physical function in older adults.[6, 7] Mind-body exercises have been recommended as first line approach for the older adults. Many studies have shown that mind-body exercise has beneficial effects on numerous physical and mental health aspects among the healthy and clinically ill population. Exercise as yoga, tai chi and qigong have been associated with a reduction in body weight (BW) and body mass index (BMI),[8, 9] blood pressure (BP),[8-12] stress,[13-16] depression,[10, 17] pain,[9, 17, 18] and improvement in muscle strength,[16, 19] flexibility,[10, 16, 20] balance,[16, 19, 20] and QOL in older adults.[9, 10, 13, 17]

Rusie Dutton is a Thai mind-body exercise known as Thai Hermit exercise or Thai yoga that had originated and been developed over 200 years in Thailand. It includes slow and gentle movements, low to moderate-intensity range of motion incorporating elements of muscle-strength, balance, flexibility, and body alignment. It also combines meditation, controlled deep breathing and relaxation.[21] So, the main principles and techniques of *Rusie Dutton* are similar to other mind-body exercises.

Although *Rusie Dutton* is well-known among Thai people, simple to learn, non-invasive practice by requiring no equipment and used to promote health and well-being, there have been few studies examining its potential to improve health. A number of studies showed that *Rusie Dutton* can decrease back pain,[22] knee osteoarthritis,[23] blood glucose,[24] as well as increase flexibility,[25-28] muscle strength,[25] and improve QOL in menopausal women,[29] but no study has explored the effects of *Rusie Dutton* on BP and QOL in older adults. Therefore, the aim of the present study was to examine the effects of 13-week *Rusie Dutton* practice on the reduction of BP and improvement in QOL in older adults compared with no intervention.

Methods

Study design

This was a quasi-experimental study conducted on older adults. The two similar communities that far from each other were selected and randomly allocated to the practice of *Rusie Dutton* or to the maintenance of a daily routine. This study was approved by the Institutional Ethics Committee of Bangkok Medical Service (ID: E005q/59) and the Suan Sunandha Rajabhat University Institutional Review Board (ID: COA 1-007/2016). The study took place in a community of Bangkok, Thailand for 13 weeks between May and August 2016.

Participants

A total of 60 participants between the ages of 60-75 years were recruited through the Senior Citizens Club of the community in Bangkok, Thailand for the study following Cohen table at power 0.8, effect size 0.5[30]. They were pre-screened via the Physical Activity Readiness Questionnaire (PAR-Q)[31] and conducted a self-assessment on general characteristics and medical status consisted of questions regarding age, sex, marital status, chronic disease or health problems and medication, and body weight and height were measured which that there was no contraindications for any of the participants taking part in the *Rusie Dutton* practice. The screening assessment reported that 52 participants met the inclusion criteria that consisted of a body mass index (BMI) < 30 kg/m^2, the ability to provide informed consent and be willing to complete the intervention, no other regular physical activities and no presence of uncontrolled hypertension or musculoskeletal dysfunction that would prevent or hinder exercise. The exclusion criteria were: presence of unstable current or past medical condition; active musculoskeletal pain during the practice; unwilling to attend the group sessions; and attended the group less than 12 times (80% of 15 classes).

Procedures

Prior to participating in the study, 26 participants from each group signed an informed consent form and completed a baseline assessment to record BP and QOL. Outcomes were determined after the intervention at 13-weeks.

Participants allocated to the *Rusie Dutton* group received 15 classes over 13 weeks consisting of preparation for one week and practice for twelve weeks at the center of the community from 5.00-6.00 P.M. All classes and 16 poses were taught by the researcher, a certified *Rusie Dutton* trainer from the Wat Po Thai Traditional Massage School in Bangkok with over five years' experience in exercise training for older adults. To reduce the risk of injury and discomfort, 6 poses were modified sitting on a chair. The procedure for the *Rusie Dutton* practice was as follows:

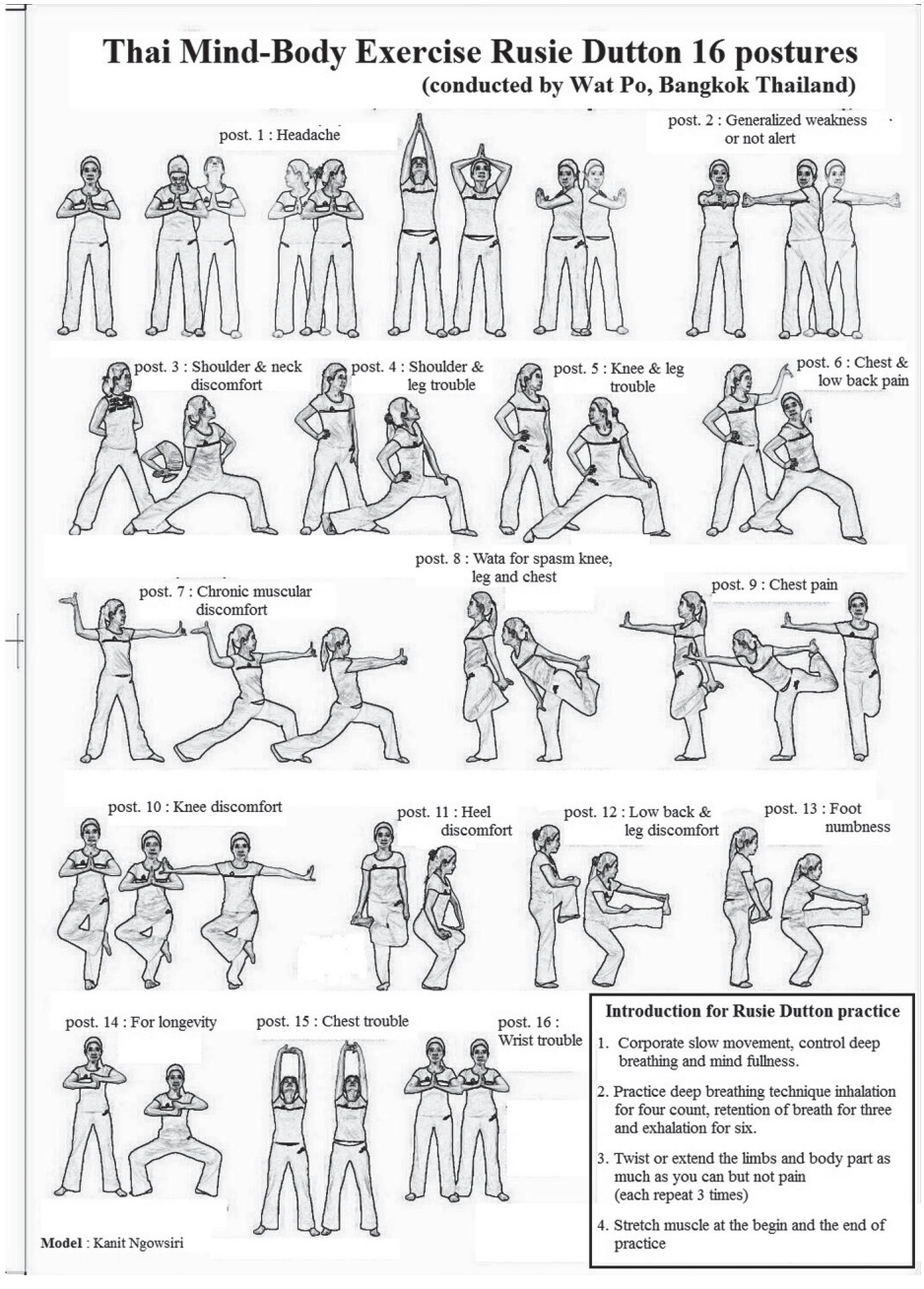
Preparation (week 1): The participants of the experimental group were given an explanation about *Rusie Dutton* practice, trained in the deep breathing technique with meditation and muscle stretching of the neck, shoulders, back and legs, and were encouraged to practice these techniques at home as often as possible.

Practice (weeks 2-13): The classes were performed three times in the second week gradually adding on more and more poses with easy postures followed by more difficult ones: poses 1-3 and poses 14-16 in the first time; adding poses 4-7 in the second time and adding poses 8-12 in the third time, then the classes were performed weekly for the next 11 weeks. Each class consisted of deep breathing meditation and stretching in pose 1 for the first 10 min, followed by poses 2-13 for 40 min (poses 2-7 in standing; poses 8-9 in standing and holding a chair for balancing; poses 10-13 sitting on a chair), and then stretching in poses 14-16 and deep breathing meditation for 10 min. During the practice, participants were encouraged to extend, stretch or twist the limbs and body as much as they could but not to the point of pain. They were instructed to focus on mindfulness meditation and deep breathing by inhalation while moving, retention of breath while holding the position and

exhalation while returning to the initial position in a relaxed manner. In addition, participants were asked to practice *Rusie Dutton* at home every day at any time they could by following an instructional poster (Figure 1).

Participants in the control group received no intervention but were offered the chance to take the *Rusie Dutton* practice for 13 weeks after the post test assessment was completed.

Figure 1



Measurement

Physical measurements

Height and body weight (BW) were measured without shoes, and body mass index (BMI) was calculated from height and BW measurement using the formula: BMI = BW (kg.)/height(m^2). Blood pressure (BP) was measured using a single digital sphygmomanometer property calibrated with appropriate cuff size with the arm supported at the heart level after the participants sat quietly for at least 10 minutes in a chair. If BP was higher than 140/90 mm.Hg., the second BP measurement was performed after 15-miniutes of rest.

Quality of life (QOL)

Quality of life (QOL) was assessed using the WHOQOL- BREF-THAI questionnaire,[32] which is a validated tool consisting of a 26-item scale with 5-point Likert responses within the 4 domains of physical health (bodily pain, energy and ability for daily living, sleep, and physical functioning and activities of daily living dependence on medical aids), psychology (body image, negative or positive feelings, self-esteem, and concentration), social relationship (personal relationships, social support, and sexual activity), and satisfaction with the environment (financial resources, safety and security, health and social care, home and environment, acquiring important information, opportunities for recreation, and transport). A higher score indicates a better QOL.[32]

Data analysis

All statistical analyses were performed using the Statistical Package for Social Sciences IBM (SPSS) Version 20.0. Descriptive statistics including mean and standard deviation, frequency and percentages were calculated for the characteristics of both groups. The homogeneity of the values of the variables measured between the experimental and control group at baseline were tested using a two tailed Independent t- test. The difference in means between the post-intervention and baseline were compared using a one tailed Paired t-test within groups and a one tailed Independent t-test for between group comparison. All assumptioms of the statistical methods were examined in this study. If p-value is less than 0.05, it indicates statistically significant.

Results

Figure 2 illustrates a flow diagram of the intervention and follow up. Twenty-three participants (88.5%) in the experimental group and 22 participants (84.6%) in the control group completed the study and were included in the final analysis. A total of seven participants were excluded because of they attended the group less than 12 times (3) or were lost to follow up (4). The characteristics of the participants are shown in Table 1. There were no participants characteristics between the two groups at the baseline. (Table 2)

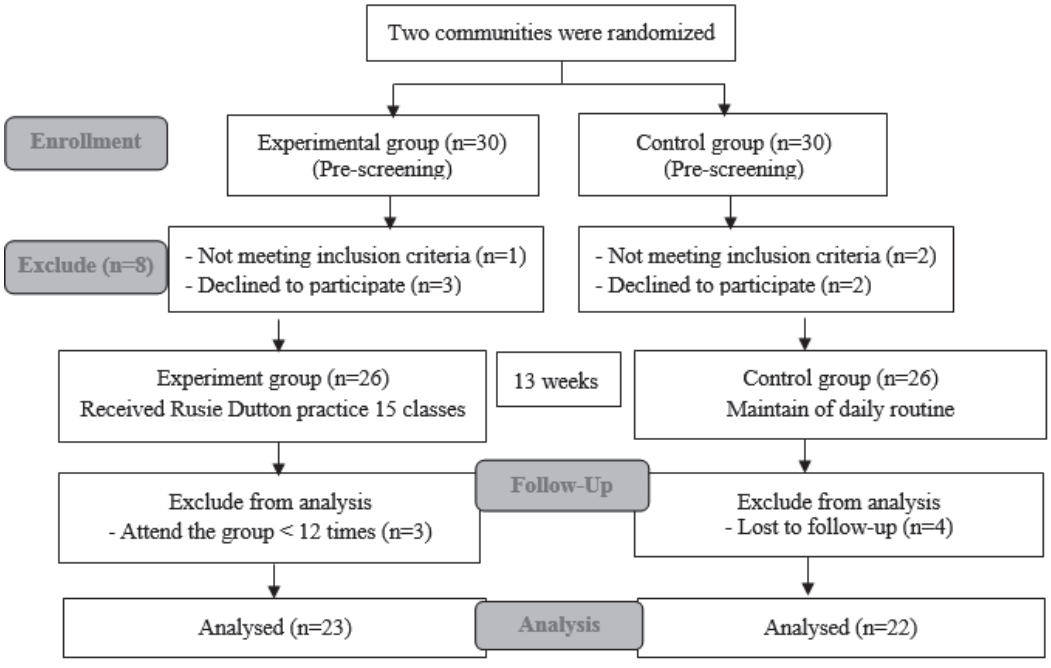


Figure 2 Flow diagram of the study

Table 1 Distribution of participants by general characteristics

Variables	**RD. group** *(n=23)*	**Cont. group** *(n=22)*	*p-value*
Age (year) (mean (SD))	65.3 (5.3)	66.7 (5.7)	.375
Body weight (kg) (mean (SD))	58.6 (12.0)	59.7 (11.3)	.748
Body mass index (mean (SD))	24.6 (4.3)	23.9 (3.8)	.570
Gender (n (%))			
Male	2 (8.7%)	8 (36.4%)	
Female	21 (91.3%)	14 (63.6%)	
Marital status (n (%))			.579
Single	7 (30.4%)	5 (22.7%)	
Married	12 (52.2%)	10 (45.5%)	
Separated /Divorced/Widow	4 (17.4%)	7 (31.8%)	
Chronic Disease (n (%))			.534
Hypertension	13 (56.5%)	11 (50.0%)	
Diabetes	4 (17.4%)	6 (27.3%)	
Heart disease	3 (13.0%)	2 (9.1%)	

Note. RD = Rusie Dutton, Cont.= control

Table 2 Mean and standard deviation by blood pressure and quality of life of participants at baseline

Outcome variable	RD group *(n=23)*	Cont. group *(n=22)*	t	*p-value*
SBP (mmHg)	128.5 (17.4)	131.7 (11.0)	-0.74	.466
DBP (mmHg)	79.7 (8.8)	78.5 (8.0)	0.49	.623
QOL (phy)	22.1 (3.2)	23.8 (3.1)	-1.81	.077
QOL (psycho)	20.4 (3.3)	22.1 (4.1)	-1.50	.141
QOL (social)	10.4 (1.6)	10.0 (1.8)	0.71	.484
QOL (env)	28.0 (3.1)	29.3 (4.4)	-1.12	.262
Total QOL	89.6 (9.6)	93.6 (11.3)	-1.29	.204

Note. RD = Rusie Dutton, Cont.= control, SBP = systolic BP, DBP = diastolic BP
QOL= quality of life, phy = physical, psycho = psychological, social = social relationship, env = environment

After 13 weeks, the *Rusie Dutton* group showed a significant within-group reduction in SBP (11.30 mmHg, $p < 0.001$) and DBP (6.61 mmHg, $p < 0.001$) while no change was observed within the control group. In addition, the study showed a significant improvement in physical health (6.39 points, $p < 0.001$), psychological (5.04 points, $p < 0.001$), satisfaction with the environmental domain (2.91 points, $p < 0.001$), and total QOL (14.87 points, $p < 0.001$) except social relationship was observed in the *Rusie Dutton* group but none was observed in the control group except for the psychological domain (2.27 points, $p < 0.05$).

There was a significant difference between groups in terms of the decrease in SBP (17.55 mmHg, $p < 0.001$) and DBP (5.92 mmHg, $p < 0.05$) in the Rusie Dutton group compared to the control group. In addition, there was a significant difference between groups in terms of the improvement in physical health (3.89 points, $p < 0.001$), satisfaction with the environmental domain (1.96 points, $p < 0.05$), and total QOL (9.48 points, $p < 0.001$) in the *Rusie Dutton* group compared to the control group, but no significance differences in the psychological and social relationship domain (Table 3). No adverse events (i.e., falls, significant joint pain or injury) were observed during the intervention period.

Table 3 Mean and standard deviation by blood pressure and quality of life of participants at baseline and posttest

Variables	Group	Baseline	13 weeks	Within group		Between group	
				MD (95%CI)	*p-value*	MD (95%CI)	*p-value*
SBP (mmHg)	RD	128.5 (17.4)	117.2 (14.7)	11.30 (7.36-15.25)	<.001***	-17.55 (-25.37 to -9.73)	<.001***
	Cont.	131.7 (11.0)	134.7 (10.9)	-3.05 (-7.17 to 1.08)	0.069		
DBP (mmHg)	RD	79.7 (8.8)	73.1 (9.8)	6.61 (4.16- 9.06)	<.001***	-5.92 (-11.26 to -0.58)	0.016*
	Cont.	78.5 (8.0)	79.1 (7.9)	-0.55 (-1.74 to 0.65)	0.178		
QOL (phy)	RD	22.1 (3.2)	28.5 (2.3)	-6.39 (-7.74 to -5.04)	<.001***	3.89 (2.41-5.36)	<.001***
	Cont.	23.8 (3.1)	24.6 (2.6)	-0.82 (-2.29 to 0.65)	0.130		
QOL (psycho)	RD	20.4 (3.3)	25.5 (2.7)	-5.04 (-6.37 to -3.72)	<.001***	1.12 (-0.92 to 3.15)	0.138
	Cont.	22.1 (4.1)	24.4 (4.0)	-2.27 (-4.10 to -0.44)	0.008**		
QOL (social)	RD	10.4 (1.6)	10.7 (2.0)	-0.35 (-1.05 to 0.35)	0.156	0.24 (-0.94 to 1.42)	0.342
	Cont.	10.0 (1.8)	10.5 (2.0)	-0.46 (-1.38 to 0.47)	0.159		
QOL (env)	RD	28.0 (3.1)	30.9 (3.2)	-2.91 (-4.44 to -1.39)	<.001***	1.96 (-0.29 to 4.21)	0.043*
	Cont.	29.3 (4.4)	29.0 (4.2)	0.32 (-0.90 to 1.54)	0.297		
Total QOL	RD	89.6 (9.6)	104.5 (7.9)	-14.87 (-1.74 to 0.65)	<.001***	9.48 (4.02-14.94)	<.001***
	Cont.	93.6 (11.3)	95.0 (10.2)	-1.36 (-5.25 to 2.52)	0.237		

Note. RD = Rusie Dutton, Cont.= control, SBP = systolic BP, DBP = diastolic BP, MD = mean difference
QOL= qaulity of life, phy = physical, psycho = psychological, social = social relationship, env = environment
*p-value < 0.05, **p-value < 0.01, ***p-value < 0.001

Discussion

This study is a quasi-experimental research and community-based program to explore the effects of the Thai mind-body exercise *Rusie Dutton* on BP and QOL in older adults. The findings of this study indicate that *Rusie Dutton* practices significantly improve in BP, QOL in the subdomain of physical health, psychology, and satisfaction with the environment and total QOL in older adults; however, the findings are unclear in QOL in the subdomain of social relationship.

The reduction in BP observed here is similar to that observed in previous studies which found that incorporated breath control, meditation and mindfulness in mind-body exercises such as yoga[8, 10-12, 33, 34] and Tai Chi[9] helped reduce BP. This might be the rise in heart rate and cardiac output during mind-body exercise lead to vasodilatation and arterial wall stretching, and these may improve endothelial function, reduce arterial stiffness, and mediated the lowering of BP in older adults[12] like yoga , and this should be further studied.

The improvement of physical health in the *Rusie Dutton* group is consistent with previous studies which found that the *Rusie Dutton* practice reduced back pain,[22] increased muscle strength,[25] and flexibility.[25-28] Also, other studies found that mind-body exercise that incorporated whole body stretch-

ing, some isotonic exercise and isometric contraction such as yoga or tai chi can reduce fatigue,[10, 17, 35] and pain,[9, 15, 17, 36, 37] as well as improve range of motion,[10, 16, 20, 37] mobility,[10, 13-15, 18] muscle strength and endurance.[16, 19] *Rusie Dutton* is similar in style to other mind-body exercises, so *Rusie Dutton* may improve physical health in reducing bodily pain in addition to increasing energy, the ability for daily living, physical functioning and activities. Furthermore, the *Rusie Dutton* group reported improvement in satisfaction with the environment. It may be that the participants had the chance to get involved in group discussions and received information about health promoting lifestyle habits before and after classes. Moreover, they reported enjoyment with their friends, relaxation, and satisfaction with participating in the group. Thus, *Rusie Dutton* practice may improve satisfaction with the environment in health and social care, acquiring important information, and the opportunities for recreation among older adults, whereas no significant improvement in social relationship. It may be an uncleared question in this domain; How satisfied are you with your sex life? Despite participants in *Rusie Dutton* group did not perceive improvement in all subdomains of QOL, they did report high scores in total QOL.

This study has some limitations. First, the number of participants in each group may be considered small, so the generalizability of these findings were restricted. Socend, the participants were asked to practice *Rusie Dutton* at home. At this stage we cannot answer the question, daily home practice might be effective. Third, it is unclear which mechanism in *Rusie Dutton* meditated the lowering BP in older adults.

Conclusion

Rusie Dutton has a potency to reduce BP and improve QOL especially in the physical health in older adults. It is a Thai mind-body exercise that is a safe, simple-to-learn, requiring no equipment. Therefore, *Rusie Dutton* can be recommended for reducing BP in HT, as well as promoting health and well-being of older adults. Supplementary data for *Rusie Dutton* practice can be found online on http:// www. watpomas sage.com/2014/ or in classes at the Chetawan Temple (Wat Po) Thai Traditional Massage School in Bangkok, Thailand.

Recommendations

Future studies are warranted to reveal the influence of *Rusie Dutton* on BP and vascular aging. Additionally, a self-daily record in total time, repetitions, and intensity of *Rusie Dutton* practice is also recommended.

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References

1. Veronese N, Cereda E, Stubbs B, et al. Risk of cardiovascular disease morbidity and mortality in frail and pre-frail older adults: Results from a meta-analysis and exploratory meta-regression analysis. Ageing Res Rev. 2017; 35: 63-73.
2. Mozaffarian D, Benjamin EJ, Go AS, et al. Heart Disease and Stroke Statistics-2016 Update: A Report from the American Heart Association. Circulation. 2016;133(4): 338-60.
3. Yan Q. Translational Bioinformatics and Systems Biology Methods for Personalized Medicine. Elsevier Inc. Academic Press; 2017.
4. Bureau of Policy and Strategy Ministry of Public Health. Health Status information. 2012, [Cited 2017 Dec 16]. Available from: http://bps.ops.moph.go.th/Webenglish/ Information. htm.
5. The International Health Policy Program Thailand. IHPP Fact sheet: Disability Adjusted Life Years (DALY) Thailand 2014, [Cited 2016 Dec 30]. Available from: http:// www. ihppthaigov. net/.
6. Guo Y, Shi H, Yu D, Qiu P. Health benefits of traditional Chinese sports and physical activity for older adults: A systematic review of evidence. J Sport Health Sci. 2016; 5(3): 270-80.
7. World Health Organization. Physical activity and older adults. [Cited 2016 Sep 08]. Available from: http:// www. who.int/dietphysicalactivity/factsheet_olderadults/en/.
8. Cramer H, Lauche R, Haller H, Steckhan N, Michalsen A, Dobos G. Effects of yoga on cardiovascular disease risk factors: a systematic review and meta-analysis. Int J Cardiol. 2014; 173(2): 170-83.
9. Sun J, Buys N. Community-Based Mind-Body Meditative Tai Chi Program and Its Effects on Improvement of Blood Pressure, Weight, Renal Function, Serum Lipoprotein, and Quality of Life in Chinese Adults With Hypertension. Am J Cardiol. 2015; 116(7): 1076-81.
10. Mooventhan A, Nivethitha L. Evidence based effects of yoga practice on various health related problems of elderly people: A review. J Bodyw Mov Ther. 2017; 21(4): 1028-32.
11. Brandani JZ, Mizuno J, Ciolac EG, Monteiro HL. The hypotensive effect of Yoga's breathing exercises: A systematic review. Complement Ther. Clin. Pract. 2017; 28: 38-46.
12. Patil SG, Aithala MR, Das KK. Effect of yoga on arterial stiffness in elderly subjects with increased pulse pressure: A randomized controlled study. Complement Ther Med. 2015; 23(4): 562-9.
13. Eric Lindahl KT, Nicole Eickholt, Lisa Ferguson-Stegall Yoga reduces perceived stress and exhaustion levels in healthy elderly. Complement Ther Clin Pract. 2016;24:50-56.
14. G.E. Furtado MU-C, H.M. Carvalho, N.R. Souza, J.P. Ferreira,, Teixeira AM. Effects of a chair-yoga exercises on stress hormone levels, daily life activities, falls and physical fitness in institutionalized older adults. Complement Ther Clin Pract. 2016; 24: 123-9.
15. Gina K. Alexander KEI, Terry K. Selfe, Cynthia J. Brown "More than I expected'' Perceived benefits of yoga. Complement Ther Med. 2013; 21: 14-28.
16. Wang C, Seo D-C, Li H. Tai Chi as an Intervention on Health Promotion for Older Adults: A

Systematic Review. Integr Med Res. 2015; 4(1): 117-26.

17. Naciye Vardar Yagli OU. The effects of yoga on the quality of life and depression in elderly breast cancer patients. Complement Ther Clin Pract. 2015; 21: 7-10.
18. Zhu Q, Huang L, Wu X, et al. Effects of Tai Ji Quan training on gait kinematics in older Chinese women with knee osteoarthritis: A randomized controlled trial. J Sport Health Sci. 2016; 5(3): 297-303.
19. Smith PD, Mross P, Christopher N. Development of a falls reduction yoga program for older adults-A pilot study. Complement Ther Med. 2017; 31: 118-26.
20. Huang Y, Liu X. Improvement of balance control ability and flexibility in the elderly Tai Chi Chuan (TCC) practitioners: a systematic review and meta-analysis. Arch Gerontol Geriatr. 2015; 60(2): 233-8.
21. Wat Pho Thai Tatraditional Massage School. Manual of *Rusie Dutton* traditional Thai exercise (18 postures). 2011. (in Thai).
22. Chan-ae P. The Effectiveness of Health Education Program by an Application of Self-Efficacy Theory and Social Support on Behavioral Modification for Low Back Pain with Ruesee-Dudton Exercises in Personnel at Rajamangala University of Technology Isan Sakon Nakhon Campus. [M.P.H. Thesis in Health Education and Health Promotion]. Khon Kaen University; 2014. (in Thai).
23. Chairat N. Using Hermit's Body Twist Rusie Dotton with Court Type Traditional Thai Massage for the Elderly with Knee Osteoarthritis. [M.Ed. Thesis in Health Promotion]. Chiang Mai University; 2014. (in Thai).
24. Buranruk O. Effects of Thai Yoga on Metabolism, Cardiovascular and Autonomic Nervous Systems in Diabetes., [Ph.D. Thesis in Public Health]. Khon Kaen University; 2009. (in Thai).
25. Laochar N. Effects of Hermit Self Stretching Exercise on Muscle Strength and Flexibility of Working Women. [M.Sc. Thesis in Sport Science]. Chulalongkorn University; 2010. (in Thai).
26. Peepathum P. The Effects of Applied Ascetics Exercise on Flexibility and Health. [M. Sc. in Sport Science]. Srinakharinwirot University; 2005. (in Thai).
27. Suttijit S. The Effects of Ruesee Exercises on Flexibility and Body Balance of the Ederly. [M.Sc. Thesis in Sport Science]. Chulalongkorn University. 2008.
28. Noolord R. A Development of Physical Exercise Program in the Thai Hermit Exercise Style to Reinforce Physical Flexibility for Matthayomsuksa 1 Students. [M.Ed. Thesis in Education Program]. Thepsatri Rajabhat University; 2013. (in Thai)
29. Ngowsiri K, Tanmahasamut P, Sukonthasab S. Rusie Dutton traditional Thai exercise promotes health related physical fitness and quality of life in menopausal women. Complement Ther Clin Pract. 2014; 20(3): 164-71.
30. Cohen, J., Statistical power analysis for the behavioral sciences. New York: Lawrence Erlbaum associates publishes. 1988: pp.16-8.

31. Lawrence A, Gary JB, Micheal JB, et al. ACSM's Guidelines for Exercise Testing and Prescription. 7 ed. American College of Sports Medicine, USA: Maryland; 2006.
32. Mahuntnirunkul S. The WHOQOL-BREF-Thai (26 items) [Online]. Department of Mental Health; 2002, [Cited 2015 Sep 28]. Available from: https:// www.dmh.go.th/ test/whoqol/
33. Manchanda SC. Yoga--a promising technique to control cardiovascular disease. Indian Heart J. 2014; 66(5): 487-9.
34. Ross A, Friedmann E, Bevans M, Thomas S. National survey of yoga practitioners: mental and physical health benefits. Complement Ther Med. 2013; 21(4): 313-23.
35. Sprod LK, Fernandez ID, Janelsins MC, et al. Effects of yoga on cancer-related fatigue and global side-effect burden in older cancer survivors. J Geriatr Oncol. 2015; 6(1): 8-14.
36. Hye Kyung Cho WM, Jaehee Kim Effects of yoga on stress and inflammatory factors in patients with chronic low back pain : A non-randomized controlled study. Eur J Integr Med. 2015; 7: 118-23.
37. Field T. Yoga research review. Complement Ther Clin Pract. 2016; 24: 145-61.