นิพนธ์ต้นฉบับ • Original Article

ผลของการออกกำลังกายด้วยท่ารำมวยไทยโบราณสกลนครประยุกต์ต่อสมรรถภาพกายและความสามารถในการทำงานของหัวใจและปอดในหญิงไทยวัยสูงอายุ

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The Effect of Applied Sakon Nakhon Traditional Thai Boxing Dance on Physical Performance and Cardio-pulmonary Capacity in Thai Elderly Females

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หลักการและวัตถุประสงค์: สตรีไทยวัยสูงอายุเป็นวัยที่ต้องการพัฒนาสมรรถภาพกายให้แข็งแรง เพื่อคงไว้ซึ่งสุขภาวะและยังเป็นกลุ่มเสี่ยงต่อการเกิดโรคเรื้อรังต่างๆ วัตถุประสงค์ของการศึกษานี้เพื่อศึกษาผลของการฝึกออกกำลังกายด้วยโปรแกรมมวยไทยโบราณสกลนครประยุกต์ต่อสมรรถภาพกายและความสามารถในการทำงานของหัวใจและปอดในหญิงไทยวัยสูงอายุ

วิธีการศึกษา: สตรีไทยวัยสูงอายุ 61-70 ปีมีค่าดัชนีมวลกาย (BMI-Body mass index) 23.0-29.9 กก/ ตรม.จำนวน 30 ราย สุขภาพทั่วไปแข็งแรงสมบูรณ์ไม่มีโรคติดต่อหรือโรคเรื้อรังร้ายแรงใดๆ เป็นอาสาสมัครที่ถูกคัดเลือกเข้าทำการศึกษา ในครั้งนี้โดยแบ่งเป็น 2 กลุ่มคือ กลุ่มควบคุม 15 รายและกลุ่มออกกำลังกายด้วยท่ารำมวยไทยสกลนครแบบประยุกต์ (applied SNTB, Sakon Nakhon Tradition Thai Boxing dance) 15 ราย ทั้งสองกลุ่มได้รับการประเมินลักษณะข้อมูลพื้นฐานทางคลินิก (base-line clinical characteristics) และสมรรถภาพกายได้แก่ แรงบีบมือ (hand grips) ความแข็งแรงของกล้ามเนื้อหลังและขา (Back and leg strength test) ความอ่อนตัวของกล้ามเนื้อหลัง (Trunk flexibility) และความสามารถของการทำงานของหัวใจและปอด (Cardio-pulmonary capacity) โดยการประเมินจากระยะทางการเดินเร็วใน 6 นาที (6MWT, Six- minute walk test) กลุ่มควบคุมให้ปฏิบัติตัว และดำเนินชีวิตตามปกติในการออกกำลังกายและการ

Background and objective: Thai females in the elderly ages need to develop physical performance for maintaining their good health and good quality of life because they are in a high risk group of various chronic diseases. The objective of this study is to investigate the effects of 12-week applied exercise model of SNTB on physical performance and cardio-pulmonary function in Thai elderly females.

Methods :Thirty Thai elderly females aged 61-70 years, body mass index (BMI) 23.0-29.9 kg/m^2 with good health, no infectious diseases or severe chronic diseases are recruited as volunteer subjects. They are divided into two groups; control group (n=15) and applied SNTB exercise group (n=15). Both groups were assessed base-line clinical characteristics and physical performance such as hand grips, back and leg strengths and trunk flexibility tests including cardio-pulmonary capacity by measurement 6-minute walk test.Control subjects behave as their normal life styles in both exercise and eating behaviors all for a long 12 weeks of the study,while exercise groups are trained with applied SNTB exercise for 30 min/session (5 min warm up, 20 min exercise of 60-70% HR-max and 5 min cool down)

รับประทานอาหาร ขณะที่กลุ่มออกกำลังกายจะได้รับมอบหมายให้ออก กำลังกายด้วยท่ารำมวยไทยสกลนครโบราณแบบประยุกต์ 30 นาที/ครั้ง (อบอุ่นกาย 5 นาที ออกกำลังกาย 20 นาที คลายอุ่นหรือผ่อนคลาย 5 นาที) สัปดาห์ละ 3 ครั้งเป็นอย่างน้อยและต่อเนื่องนาน 12 สัปดาห์ ในอัตราร้อยละ 60-75 ของอัตราการเต้นของหัวใจสูงสุด และรับประทานอาหารตามปกติ

ผลการศึกษา : หลัง 12 สัปดาห์ของการออกกำลังกายด้วยท่ารำมวยไทยโบราณสกลนครประยุกต์ พบว่า กลุ่มทดลองเมื่อเปรียบเทียบกับกลุ่มควบคุม มีการเพิ่มขึ้นของแรงบีบมือร้อยละ30.85 และความแข็งแรงของกล้ามเนื้อหลังร้อยละ68.87 อย่างมีนัยสำคัญทางสถิติ ($p<0.01$) ขณะที่ความแข็งแรงของกล้ามเนื้อขาเพิ่มขึ้นร้อยละ 69.58 ระยะทางในการเดินเร็ว 6 นาทีเพิ่มขึ้นร้อยละ 39.93 อย่างมีนัยสำคัญทางสถิติ ($p<0.001$)

สรุป: การออกกำลังกายด้วยท่ารำมวยไทยโบราณสกลนครประยุกต์มีผลเพิ่มต่อสมรรถภาพกาย และความสามารถในการทำงานของหัวใจและปอดในหญิงไทยวัยสูงอายุดังนั้นท่ารำมวยไทยโบราณสกลนครประยุกต์ จึงสามารถใช้เป็นการออกกำลังกายรูปแบบใหม่ เพื่อส่งเสริมสุขภาพหญิงไทยวัยสูงอายุ

คำสำคัญ: สมรรถภาพกาย ความสามารถในการทำงานของหัวใจและปอด หญิงไทยวัยสูงอายุ

at least 3 days/week in 12 consecutive weeks and eat as their normal life styles.

Results: After 12 weeks of applied SNTB exercise, it was found that in exercise group versus control group there was an increase in high significance in hand grip test 30.85% and back strength test 68.87% ($p<0.01$), while there was an increase in high significance in leg strength test 69.58% and six-minute walk test (6 MWT) 39.93% ($p<0.001$).

Conclusions: Twelve weeks of applied SNTB could increase physical performance and cardio-pulmonary capacity in Thai elderly females.Therefore, this applied SNTB exercise can be used as new exercise training for health promotion in Thai elderly females.

Key words: Physical performance, cardio-pulmonary capacity,Thai elderly females

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Introduction

The world's population is getting older and the percentage of elderly people is continually increasing. It is clear that ageing is increasing in Thai society. Thailand's total population grew by 31 percent between 1,980 and 2,000. The older population is increasing faster than the total population[1]. In 2010 the percentage of elderly persons above 65 years was approximately 8% of the global population. The projection for 2050 is approximately 16%, which will represent around 1.5 billion people[2]. 'Elderly' refers to persons aged 60 years or more,during which the deterioration of the organs occurs in the body.In developed countries, the age of 60 or 65 years is set to be the beginning of old age.[3]Besides, elderly people happen to be chronically ill, or disabled and have risks of several diseases such asdiabetes, hypertension, heart disease, arthritis and other chronic conditions[4-6]. One of the best established interventions capable of improving health at all ages, including older ages, is exercise. The goal of exercise is to encourage 55 people and older to be more physically active[1]. Sakon Nakhon Traditional Thai Boxing danceexercise is a Thai cultural boxing that has been used for a long time in self-protection, body promotion with a good image, increasing force and self-esteem in the northeastern part of Thailand. This dance exercise is composed of beautiful, smart and strong postures. It is also a kind of folk cultural heritage inherited from antiquity. Therefore, applied Sakon Nakhon Traditional Thai Boxing dance (SNTB) is a choice

as a Thai elderly exercise model due to its interested story. Furthermore, no one has done a research on applied SNTB dance as an exercise model to promote health in Thai elderly females. It is interesting whether applied SNTB dance can improve physical performance and cardio-pulmonary capacity in Thai elderly females or not. The Objective of this study is to determine the effects of applied SNTB exercise on physical performance and cardio-pulmonary capacity inThai elderly females.

Methodology

Study design and population

The study is a quasi-experiment in humans and conducts by evaluation ofbaseline clinical characteristics, anthropometry and physical performance such as hand grip test, back and leg strength test, trunk flexibility test and cardio-pulmonary capacity by using distance of 6-minute walk test. Thirty of Thai elderly females are divided into control group (n=15) and exercise group (n=15) by random sampling. All subjects have completed a confidential health screening questionnaire and have been physically examined by a doctor (physician). Subjects have no history of chronic illness such as cardio-vascular disease, coronary heart disease, arrhythmia, chronic heart failure, hypertension, stroke, arthritis, neuromuscular disorders, pulmonary diseases, diabetes mellitus and other diseases. Subjects are asked to assess on physical performance, anthropometry, and cardio-pulmonary capacity by using distance of 6MWT at Vejvichakarn Building in Srinagarind hospital, Faculty of Medicine, KhonKaen University KhonKaen, Thailand and Charoensin district, Sakon Nakhon province. The number of participants in this study is calculated by using sample size formula (nd=n/(1-R)).

Study protocol

Thai elderly females, aged between 61 to 70 years, BMI 23.00-29.9kg/m^2, participated as volunteer subjects in this study.Elderly control group behaves as normal life styles with no aerobic exercise program, while elderly exercise groupis assigned to practice aerobic exercise of applied SNTB 30 min/session (5 min warm-up, 20 min exercise of 60 to 75% HR max, 5 min cool-down) 3 days/week, for 12 consecutive weeks. All subjects also behave as normal life styles in eating behaviors. All parameters were measured at before and after 12 weeks of aerobic exercise program. SNTB dance is composed of all 15 postures. In-warm-up exercise, there are 5 postures such as Wai Kuru, NokYoong, Na Kee Mound Hang, LorkaewMakkara and Swing arms. For exercise postures, there are 10 postures such as Ka Tent KonTai, Kai Leablao, KaungLeaw Lung, Chag Mound Whong, Mar KaTeebLoung, ToungHakQuak Chu, Leaw Ta La KaTidPek, LorLeabToop , LubHokMokkasak and WaPai. Finally, cool-down exercise has 5 postures the same as in warm-up exercise.

Parameter measurement

Subjects are investigated baseline clinical characteristics, anthropometry, and physical performance such as hand grips, back and leg dynamometer test and cardio-pulmonary capacity by using 6MWT. Physical performance test measures muscle strength by using hand grips, back and leg dynamometer test, while 6MWT will be measured based on American Thoracic Society (ATS) statement, guidelines for the 6MWT. The walking course must be 30 m in length. The length of the corridor should be marked every 3 meters. The turn-around points should be marked with cone (such as an orange traffic cone). This test measures the distance that a subject can quickly walk in a period of 6MWT[7]. The 6MWT is indicated cardio-pulmonary capacity test.

Ethical approval

The written informed consent from the participants were obtained before testing. The method of this study has been reviewed and approved by the Khon Kaen University Ethics Committee for Human Research (HE 561426).

Statistical analysis

Data are expressed as mean ± SD. The STATA 12 Statistical software license of the Faculty of Medicine, Khon Kaen University is used to perform the statistical analysis. Unpairedt-testis used to compare differences in characteristics of all parameters between control and exercise groups. Paired t-test is used to compare differences in all parameters between pre-and post-test in both groups. Two-sample Wilcoxon rank-sum Mann-Whitney test is used when data deviate from normality, and P-value less than 0.05 is considered to be statistically significant.

Results

The results of baseline clinical characteristics, anthropometry, hand grip test, back and leg strength test, trunk flexibility test and 6MWTshow no significant differences between control and exercise groups in the pre-test (Table 1). From Table 3, the data of pre-test (week 1) and post-test (week 12) in exercise group show the increase from 19.94 ± 2.99 kg to 23.12 ± 2.93 kg in hand grip test ($p<0.001$), from 43.53 ± 13.96 to kg to 57.53 ± 15.72 kgin back strength test ($p<0.001$), from 43.93 ± 15.36 kg to 62.00 ± 21.50 kg in leg strength test ($p<0.001$) and from 16.21 ± 3.98 to 20.00 ± 4.02 cm in trunk flexibility test ($p<0.001$) consecutively, while the data of pre-test (week 1) and post-test (week 12) in control group show the decrease from 18.73 ± 3.10 kg to 17.67 ± 3.74 kg in hand grip test ($p<0.05$), from 35.93 ± 14.49 kg to 34.07 ± 12.39 kg in back strength test ($p<0.05$), from 38.62 ± 14.15 kg to 36.56 ± 11.18 kg. in leg strength test ($p<0.05$) and from 18.87 ± 5.91 to 17.30 ± 5.68 cm in trunk flexibility test ($p<0.05$) consecutively. In regard to comparison of results in control group versus exercise group, hand grip test, back strength test show the increase of highly significant difference at $p<0.01$ and leg strength test show highly significant difference $p<0.001$ in control group versus exercise

Table 1 Base-line clinical characteristics, anthropometry, six-minute walk test, hand grips, back strength, leg strengths and trunk flexibility in control (n=15) and exercise (n=15) elderly groups at pre-exercise (week 1).

Variables	Elderly aged 61-70 years			p-value
	Control (n=15) Mean ± SD (at week 1)	Exercise (n=15) Mean ± SD (at week 1)	% Mean Difference	
Age (years)	64 ± 3.35	64 ± 3.46	0	0.660 NS
BW (kg)	56.59 ± 7.74	56.54 ± 9.52	0.44	0.490 NS
Height (cm)	149.00 ± 5.88	150.71 ± 4.58	0.67	0.690 NS
BMI (kg/ m^2)	25.11 ± 3.58	24.81 ± 3.35	1.19	0.470 NS
Total body fat (%)	36.25 ± 5.88	37.04 ± 5.66	2.18	0.770 NS
Total body water (%)	52.62 ± 6.08	50.24 ± 7.84	12.21	0.430 NS
WC (cm)	86.27 ± 10.17	87.72 ± 8.36	2.34	0.410 NS
HC (cm)	100.33 ±11.76	95.28 ±10.98	4.69	0.060 NS
WHR	0.84 ± 0.07	0.88 ± 0.11	4.76	0.180 NS
6MWT (m)	429.00 ± 81.22	464.68 ± 42.14	8.31	0.100 NS
Hand grips (kg)	18.73 ± 3.10	19.94 ± 2.99	6.45	0.289 NS
Back strength test (kg)	35.93 ± 14.49	43.53 ± 13.96	21.14	0.214 NS
Leg strength test (kg)	38.62 ± 14.15	43.93 ± 15.36	13.75	0.457 NS
Trunk flexibility (cm)	18.87 ± 5.91	16.21 ± 3.98	14.10	0.113 NS

BW, Body weight; BMI, Body mass index; WC, Waist circumference; HC, Hip circumference; WHR, Waist to hip ratio; SBP, Systolic blood pressure; DBP, Diastolic blood pressure; MAP, Mean arterial pressure; HR, Heart rate; 6MWT, six-minute walk test; Data are presented as mean mean ± SD and tested by unpaired t-test, significant difference in control versus exercise group; NS, No significant difference.

group. while the result of trunk flexibility test show no significant difference (Table 2).

Cardio-pulmonary capacity

In exercise group, data of 6MWT increased from 464.68 ± 42.14 m to 533.12 ± 51.53 m. It shows highly significant difference at p<0.001 in post-exercise at week 12, while in control group, data of 6MWT show significant difference decreased from 429.00 ± 81.22 m to 381.00 ± 70.83 m (p<0.05) (Table 3). Data of 6MWT in control group versus exercise group show highly significant difference (p<0.001) in post-exercise at week 12 (Table 2).

Discussion

Muscle strength is a factor of physical performance parameter. In this study, hand grip test, back and leg strength test are used for measurement of muscle strength. Strength is defined as the ability of a muscle group to develop maximal contractile force against a resistance in a single contraction[8]. Poor handgrip strength predicts accelerated dependency in activities of daily living and cognitive decline in the elderly. Measuring hand grip strength can be a useful instrument in geriatric practice to identify those elderly patients at risk for this accelerated decline[9]. Grip strength is a good marker of physical performance in this age group and may be more feasible than completing a short physical performance battery in some clinical settings[6]. Our resultsconfirm that aerobic exercise is attenuating age-related detriments in muscle force production. Strength of the knee extensors is a strong predictor of fall incidence in the elderly adults,[10,11] and grip and knee extensor strength normalized to body weight is an excellent predictor of physical function[12,13]. Human and animal studies have shown that physical activity can increase strength[14,15].

An aerobic exercise training by applied SNTB dance 30 min/ session, 3 days/week for 12 consecutive weeks is performedin Thai elderly females. The results of muscle strength such as hand grip test, back and leg strength test in exercise group are significantly increased in pre-exercise and post-exercise group.

Muscle strength gradually decreases from the 30th year until about the 50th year of life. In the 6th decade of

Table 2 Anthropometry, six-minute walk test, hand grips, back strength, leg strength and trunk flexibility in control (n=15) and exercise (n=15) elderly groups at post- exercise (week 12).

Variables	Elderly aged 61-70 years			p-value
	Control (n=15) Mean ± SD (at week 12)	Exercise (n=15) Mean ± SD (at week 12)	% Mean Difference	
BW (kg)	56.87 ± 8.11	56.23 ± 10.21	1.13	0.321 NS
BMI (kg/ m^2)	25.24 ± 3.67	24.63 ± 3.58	2.42	0.302 NS
Total body fat (%)	36.33 ± 6.07	36.62 ± 5.92	0.80	0.963 NS
Total body water (%)	50.57 ± 5.49	51.76 ± 7.97	2.35	0.363 NS
WC (cm)	86.93 ± 10.63	87.76 ± 9.05	0.99	0.873 NS
HC (cm)	100.47 ± 12.35	95.88 ± 10.66	4.56	0.074 NS
WHR	0.86 ± 0.11	0.84 ± 0.07	2.70	0.274 NS
6MWT (m)	381.00 ± 70.83	533.12 ± 51.53	39.93	0.000***
Hand grips (kg)	17.67 ± 3.74	23.12 ± 2.93	30.85	0.002**
Back strength test (kg)	34.07 ± 12.39	57.53 ± 15.72	68.87	0.002**
Leg strength test (kg)	36.56 ± 11.18	62.00 ± 21.50	69.58	0.001***
Trunk flexibility (cm)	17.30 ± 5.68	20.00 ± 4.02	15.61	0.090 NS

BW, Body weight; BMI, Body mass index; WC, Waist circumference; HC, Hip circumference; WHR, Waist to hip ratio; 6MWT, six-minute walk test; Data are presented as mean ± SD and tested by unpaired t-test, significant difference in control versus exercise group; NS, No significant difference.

Table 3 Base-line clinical characteristics, anthropometry, 6MWT, hand grips, back strength, leg strength test and trunk flexibility each group of of elderly subjects (n=30) in control and exercise group at pre-test (week 1) and post-test (week 12).

Variables	Control (n=15)				Exercise (n=15)			
	Elderly (week 1) Mean ± SD	Elderly (week 12) Mean ± SD	% Mean Difference	p-value	Elderly (week 1) Mean ± SD	Elderly (week 12) Mean ± SD	% Mean Difference	p-value
BW (kg)	56.59 ± 7.74	56.87 ± 8.11	0.49	0.352NS	56.54 ± 9.52	56.23 ± 10.21	0.54	0.417NS
BMI (kg/ m^2)	25.11 ± 3.58	25.24 ± 3.67	0.51	0.244 NS	24.81 ± 3.35	24.63 ± 3.58	0.72	0.365 NS
Total body fat (%)	36.25 ± 5.88	36.33 ± 6.07	0.22	0.935 NS	37.04 ± 5.66	36.62 ± 5.92	1.13	0.053 NS
Total body water (%)	52.62 ± 6.08	50.57 ± 5.49	3.89	0.426 NS	50.24 ± 7.84	51.76 ± 7.97	3.02	0.401 NS
WC (cm)	86.27 ± 10.17	86.93 ± 10.63	0.76	0.244 NS	87.72 ± 8.36	87.76 ± 9.05	0.04	0.598 NS
HC (cm)	100.33 ±11.76	100.47 ±12.35	0.13	0.844 NS	95.28 ±10.98	94.88 ± 10.66	0.41	0.391 NS
WHR	0.84 ± 0.07	0.86 ± 0.11	2.38	0.250 NS	0.88 ± 0.11	0.84 ± 0.07	4.54	0.072 NS
6MWT (m)	429.00 ±81.22	381.00 ±70.83	11.18	0.019*	464.68 ± 42.14	533.12 ± 51.53	14.72	0.001***
Hand grips (kg)	18.73 ± 3.10	17.67 ± 3.74	5.65	0.023*	19.94 ± 2.99	23.12 ± 2.93	15.94	0.001***
Back strength test (kg)	35.93 ± 14.49	34.07 ± 12.39	5.17	0.039*	43.53 ± 13.96	57.53 ±15.72	32.16	0.001***
Leg strength test (kg)	38.62 ± 14.15	36.56 ± 11.18	5.33	0.017*	43.93 ± 15.36	62.00 ± 21.50	41.11	0.001***
Trunk flexibility (cm)	18.87 ± 5.91	17.30 ± 5.68	8.32	0.001***	16.21 ± 3.98	20.00 ± 4.02	23.38	0.001***

BW, Body weight; BMI, Body mass index; WC, Waist circumference; HC, Hip circumference; WHR, Waist to hip ratio; Data are presented as mean mean ± SD and tested by paired t-test, Significant difference in control and exercise group at pre-test (week1) and post-test (week12); NS, No significant difference. *p< 0.05, Significant difference.

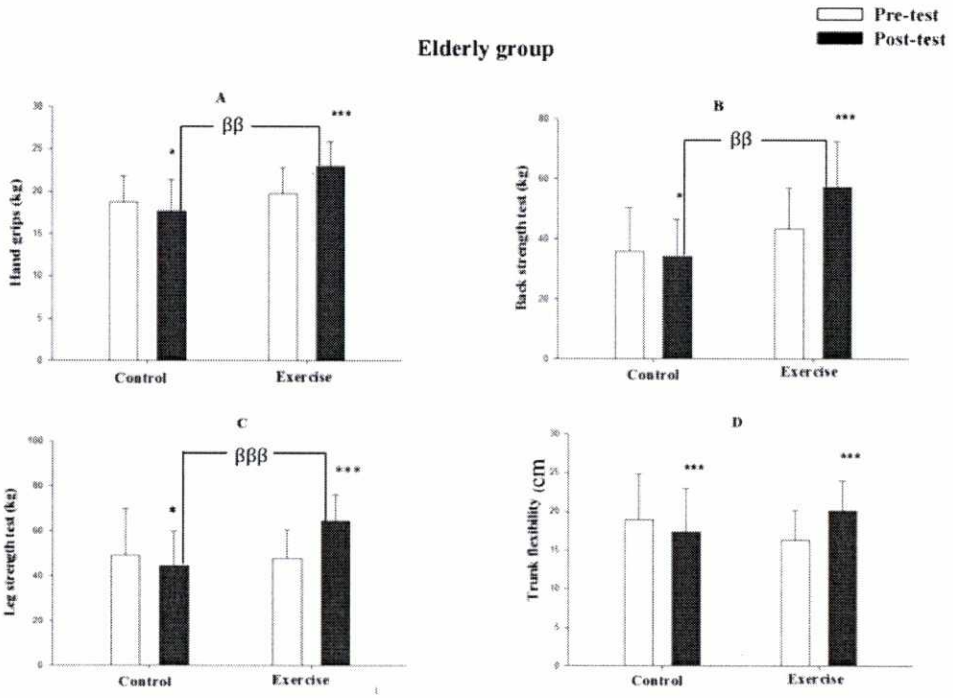

Figure 1 The measurements of (A) Hand grips, (B) Back strength test, (C) Trunk flexibility, (D) Leg strength test during pre-test and post-test after 12 weeks of SNTB exercise in elderly group control (n=15); exercise (n=15) *p<0.05 significant difference and ***p<0.001 Highly significant difference in pre-versus post- test by paired t-test.##p<0.01 High significant and###p<0.001 Highly significant difference in control versus exercise post- test by unpaired t-test.

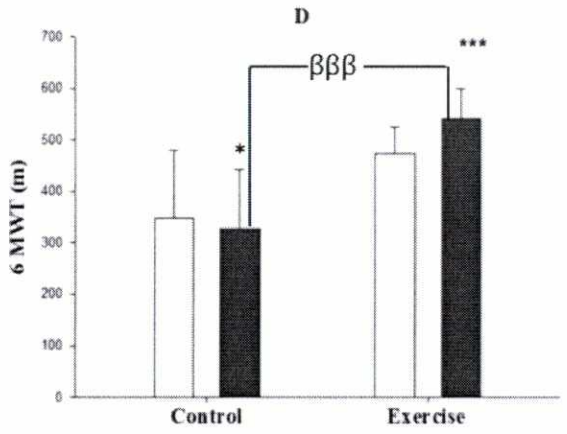

Figure 2 The measurements of 6MWT during pre-test and post-test after 12 weeks of SNTB exercise in elderly groupcontrol (n =15); exercise, (n= 15)*p<0.05 significant difference***p<0.001 Highly significant difference in pre-versus post- test by paired t-test.###p<0.001 Highly significant difference in control versus exercise post-test group by unpaired t-test.

life, an accelerated, non-linear decrease by 15%has been observed, and by the 8th decade, this may be up to 30%. Several studies have shown that strength resistance training can counteract age- related impairments.[16] The crucial factor in maintaining strength capacity is the increase in muscle mass.

Previous research indicates that regular participation in physical activity has a positive impact on muscle strength.[20] Activities of daily living are composed of static and dynamic conditions such as sitting or walking.[21]Our study reports a significant increase in strength of lower limbs after the aerobic exercise in elderly females. These findings supported previous findings in relevant literature. Improvement of muscle strength in lower limbs as well as the increase of coordination in these muscles has improved gait ability and balance of subjects regarding the improvement of lower limb strength after conducting a period of SNTB exercises.

The flexibility values of post-test in elderly exercise group are significantly increased when comparing pre-exercise group and control group after 12 weeks. Evidence suggests that the effects of stretching exercise training on muscle performance are dependent on the type of stretching dynamic and staticand muscular activity performed. Static stretch with an isometric contraction of the muscle group to be stretched is an effective means of improving muscle relaxation and may enhance the development of flexibility.[17]Flexibility is an important, yet often neglected, component of physical fitness. Flexibility is the ability of a joint, or series of joints, to move fluidly through a full range of motion (ROM). Standard sit-and-reach or trunk flexibility test was used to assess flexibility in this study. The American College of Sports Medicine Position Stand recommends using the standard sit-and-reach test to evaluate low back and hip flexibility.[18]Jackson and Landford reported that the sit-and-reach test had excellent criterion-related validity as a test of hamstring flexibility but not only in men. For women, the sit-and-reach test had moderate criterion-related validity as a test of hamstring flexibility but was poorly related to lower back flexibility.[19]

This study shows the increase of distance in 6MWT in SNTB pre- and post-exercise groups after 12 weeks. The results of this study, similar to the previous study, showed that the 6MWT increase during a weight reduction program, indicating improvement of physical fitness intensity and physiological responses to the 6MWT in middle-aged and older adults, a comparison with cardio-pulmonary exercise testing. The 6MWTis a simple field test that is widely used in clinical settings to assess functional exercise capacity and evaluate 6MWT intensity in middle-aged and older adults[22]. The results of 6 MWT also show the increase of distance after 12 weeks of SNTB in exercise group versus in control group. However, age is a variability in the 6 MWT distance[23]. Therefore, aerobic capacity is very important for the elderly, especially regular training activity. In corresponding of this study, SNTB showed that it could improve exercise capacity both in Thai elderly females after 12 week of aerobic training SNTB program. In conclusion this study shows that, after 12 weeks of aerobic exercise of applied Sakon Nakhon Traditional Thai Boxing dance (SNTB), it can improve physical performance and cardio-pulmonary capacity in exercise groups of elderly

female Thais, aged between 61 to 70 years. Therefore, this applied SNTB exercise can be used as new exercise training for health promotion in Thai elderly females.

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