# Physical performance and cardiovascular endurance post aerobic exercise training in sedentary Thais

# สมรรถภาพทางกายและความทนทานของหัวใจร่วมหลอดเลือดภายหลังการฝึกออกกำลังกายแบบแอโรบิค ในคนไทยที่ออกกำลังกายไม่เพียงพอ

Katavut Phiwjinda (คทาวุธ ผิวจินดา)* Dr. Tunda Suttitum (ดร. ธัญดา สุทธิธรรม)**
Dr. Wilaiwan Khrisanapant (ดร. วิไลวรรณ กฤษณะพันธ์)*** Orapin Pasurivong (อรพิน ผาสุริวงษ์) **

## ABSTRACT

Physical performance and cardiovascular endurance post brisk marching exercise in Thais sedentary at Khon Kean University is investigated in the first time. Twenty-six Thai and healthy women, aged between 23 to 55 years were divided into 2 groups; control (n=16) and exercise (n=10) group. All subjects performed physical fitness test including hand grips, back and leg strength, trunk flexibility and 6-minute walk test (6MWT). The results showed the highly significant difference ($p<0.01$) in 6MWT of exercise group (734.5±103.6 m) and increased 19.48% when compared to control group (614.7±58.4 m). Moreover, the exercise group increased significant difference ($p<0.05$) in serum high-density lipoprotein (HDL) after 12 weeks (66.8±8.7 mg/dL, post-exercise) when compared to 0 week (60.1±9.8 mg/dL, pre-exercise). Therefore, the aerobic exercise training, brisk marching, can improve physical performance and cardiovascular endurance in sedentary Thai women.

## บทคัดย่อ

สมรรถภาพทางกายและความทนทานของหัวใจและหลอดเลือดหลังการออกกำลังกายแบบเดินเร็วและแกว่งแขน (Brisk marching) ถูกประเมินเป็นครั้งแรกในคนไทย ซึ่งออกกำลังกายไม่เพียงพอในมหาวิทยาลัยขอนแก่น ผู้หญิงไทยสุขภาพดีอายุระหว่าง 23-55 ปี แบ่งเป็น กลุ่มควบคุม (16 คน) และกลุ่มออกกำลังกาย (10 คน) อาสาสมัครถูกประเมินสมรรถภาพทางกายโดยวัดแรงบีบมือ ความแข็งแรงของหลังและขา ความยืดหยุ่นของลำตัว และการทดสอบเดินเร็วใน 6 นาที (6MWT) ผลการทดสอบแสดงความแตกต่างอย่างมีนัยสำคัญทางสถิติ ($p<0.01$) ของ 6MWT ระหว่างกลุ่มออกกำลังกาย (734.5±103.6 ม.) เทียบกับกลุ่มควบคุม (614.7±58.4 ม.) โดยเพิ่มขึ้น 19.48% ยิ่งกว่านั้นยังพบการเพิ่มขึ้นของไขมันตัวดี (HDL) อย่างมีนัยสำคัญทางสถิติ ($p<0.05$) หลังการฝึกเดินเร็ว 12 สัปดาห์ (66.8±8.7 มก./ดล.) เมื่อเทียบกับก่อนการฝึกเดินเร็ว (สัปดาห์ที่ 0, 60.1±9.8 มก./ดล.) ที่ $p<0.05$ จึงสรุปได้ว่า การฝึกออกกำลังกายแบบแอโรบิคสามารถเพิ่มสมรรถภาพทางกายและความทนทานของหัวใจร่วมหลอดเลือดในหญิงไทยที่ออกกำลังกายไม่เพียงพอ

**Key Words:** physical fitness, sedentary Thais

**คำสำคัญ:** สมรรถภาพทางกาย การออกกำลังกายไม่เพียงพอ

* *Master degree student, Department of Physiology, Faculty of Medicine, Khon Kaen University.*

** *Assist.Prof., Department of Physiology, Faculty of Medicine, Khon Kaen University.*

*** *Assoc. Prof., Department of Physiology, Faculty of Medicine, Khon Kaen University.*

## Introduction

Sedentary behavior refers to activities that do not increase energy expenditure substantially above the resting level such as sleeping, sitting, lying down, and watching television, and other forms of screen-based entertainment (Pate et al., 2008). Sedentary lifestyles are associated with obesity, heart diseases, diabetes, cancer, osteoporosis and muscles tone loss. International Obesity Taskforce (IOTF) surveyed in Thailand during 2004 found that 17.7 percent of men were overweight and 25.2 percent of women were overweight (BMI 25.0 to 29.9) (IOTF, 2009). World Health Organization (WHO) reported that 34 percent of men adult were overweight and 47 percent of women adult were overweight in 2005 and prevalence of overweight in Thailand is expected to increase in both man and woman over the next 10 years (WHO, 2011). The prevalence of Thai involving little exercise or physical activity or having a sedentary lifestyle is high - 67 % or 6 million of Thai in 2007 (Vachira Phuket Hospital, 2010).

Hulens M. et al (2002) investigated in physically active and sedentary obese women. They reported that in sedentary obese women, body attitude, walking ability, and aerobic fitness were poorer than active obese women. Ohta M et al (2004) investigated in 49 male workers and found that the active work group had superior exercise endurance and balance compared to the sedentary work group. Moreover, the adjusted muscle strength of elderly women is not associated with obesity but is higher in active subjects than in sedentary ones, especially in the lower limbs of obese subjects (Rolland Y, 2004).

Exercise is a division of physical activity that is structured, arranged and repetitive, for examples, cycling, brisk marching and hula-hoop. It can prevent any diseases and improve physical fitness (ACSM, 2009) and improve body composition, blood lipid profile as Zorba E et al. (2011) studied in the effects of regular exercise 12 weeks on 40 obese children at 11 years. They found that statistically significant difference in total cholesterol, triglyceride, low-density lipoprotein (LDL) and high-density lipoprotein (HDL) levels higher than in the non-exercising control group. Okamoto N et al. (2010) studied brisk walking at a target heart rate, for 20 minute or more a day on two or more days a week. Their results suggest that increasing the number of steps walked daily improves physical fitness. Moreover, regular 30 minutes brisk walking in the morning with 150 minutes per week is a good exercise. Regular exercise improves the cardiovascular status, reduces the risk of cardiac disease, high blood pressure and cerebrovascular disease. It can reduce body weight, improve insulin sensitivity, help in glycemic control, prevents obesity and diabetes mellitus. It is helpful for relieving anxiety, stress, brings a sense of well being and overall physical fitness (Siddiqui NI, 2010). Unfortunately, there are various studies on brisk marching in the short term exercise but not in long term exercise in sedentary subjects especially in Thai people.

In this study, we investigated the physical fitness including hand grips, back strength test, leg strength test, trunk flexibility test, 6 minute walk test and blood chemistry in healthy sedentary subjects from Khon Kaen University in Northeast Thailand, compared between pre and post brisk marching exercise.

## Materials and Methods

### Study design

In this study, the design was descriptive and analytical.

### Study population

Twenty six sedentary women subjects (BMI of 18.5-24.9 kg/m$^2$), aged between 23–55 years old were recruited. Sedentary lifestyles were defined as not having engaged in more than 10 min at a time or 2 h of planned exercise per week. Subjects with history of cardiovascular (i.e. coronary heart disease, arrhythmia and chronic heart failure), neuromuscular, arthritis, pulmonary or other debilitating diseases, alcohol drinking or smoking, hypertension, and diabetes mellitus were not accepted to this study.

### Ethical approval

A written informed consent from the participant was obtained before testing. The methods of this study has been reviewed and approved by the Khon Kaen University Ethics Committee for Human Research.

### Experimental Protocols

### Physiological examinations and health-screening questionnaires

All participants completed confidential health-screening questionnaires. Moreover, vital signs including systolic/diastolic blood pressures and pulse rate.

### Anthropometry and blood chemistry

Subjects were weighed by standing on a balance without shoes and with minimal clothing. Height was measured by an anthropometer with feet together, buttock and upper part of back touching the anthropometer They wore light clothing and no shoes. Body mass index (BMI) was calculated by weight (kg)/height (m$^2$). Blood chemistry was done in order to analyse for lipid profiles, fasting glucose and insulin.

### Six-minute walk test

The distance of six-minute walk test was measured based on American Thoracic Society (ATS) statement guidelines for the six-minute walk test (ATS, 2002). The walking course was 30 meters in length. The length of the corridor was marked every 3 meters. The turnaround points were marked with an orange traffic cone. This test measures the distance that a subject can quickly walk in a period of 6 minutes.

### Muscle strength and flexibility

Muscle strength was determined by a hand grip (Takei Physical Fitness Test, Grip-A), back and leg dynamometer (Takei Physical Fitness Test, Back-A). Flexibility was determined by trunk flexibility sit-and-reach box.

### Blood chemistry

Following a 10-h fast, a 10-ml blood sample was taken by venepuncture with the subject in a seated position. Samples were separated and analyzed for plasma total cholesterol, high-density lipoprotein (HDL) cholesterol, low-density lipoprotein (LDL) cholesterol and triacylglyceride (TAG) concentrations using enzymatic colorimetric techniques. Whole blood was analysed immediately upon collection for haemoglobin and haematocrit to monitor changes in plasma volume (Dill DB and Costill DL, 1974). All samples were analysed at Srinakarin Hospital, Faculty of Medicine, Khon Kaen University.

### Study protocol

All subjects were divided into two groups, control group (n=16) and exercise group (n=10). Both groups engaged to a run in period (participants submit walking 40-60 min/day for 2 weeks). Only the exercise group, subjects performed brisk marching exercise (brisk walking with arm elevation to shoulder level) 5 min warm-up, 20 min walking and 5 min cool down 30 min/session and 3-5 sessions /wk for 12 weeks.

### Statistical analysis

Data was expressed as mean ± standard deviation (SD) and medians. Statistical analyses were made using STATA version 10.0 (StataCorp, College Station, TX). Unpaired t test was used to compare differences in characteristics and all parameters between control and exercise. Additionally, two-sample Wilcoxon rank-sum (Mann-Whitney) test when data showed departure from normality was used. A p value less than 0.05 was considered to be statistically significant.

### Results and Discussion

Clinical characteristics of study population are shown in Table 1. All of parameters are no significant characteristic difference compare between control and exercise groups. However, age of exercise population (37.3±10.4 years) is quite elder than control group (33.3±9.7 years), but no significant difference.

**Table 1** Clinical characteristics of study population in control and exercise groups.

| | Control (n=16) | | Exercise (n=10) | | p |
|---|---|---|---|---|---|
| | Mean ± SD | Median | Mean ± SD | Median | |
| Age, years | 33.3±9.7 | 31.5 | 37.3±10.4 | 36 | NS |
| Height, cm | 158.9±6.7 | 159.5 | 158.3±7.4 | 155.5 | NS |
| Weight, kg | 51.3±6.3 | 50 | 52.3±6.5 | 52 | NS |
| BMI, $kg/m^2$ | 20.3±1.7 | 19.9 | 20.8±2.0 | 20.9 | NS |
| SBP, mmHg | 101.6±7.1 | 99 | 101.6±11.3 | 98 | NS |
| DBP, mmHg | 68.1±8.3 | 65 | 65.7±6.3 | 65 | NS |
| HR, /min | 74.5±8.3 | 72 | 72.6±7.9 | 70 | NS |

BMI, Body mass index; SBP, Systolic blood pressure; DBP, Diastolic blood pressure; HR, Heart rate

The results of physical fitness compare between pre (week 0) and post (week 12) brisk marching exercise are shown in the Table 2. They are no significant difference in hand grips, back strength test, leg strength test, trunk flexibility and distance of 6MWT. While the results of physical fitness parameters of exercise group are shown only significance difference ($p<0.01$) in distance of 6MWT (Table 3). It is increased 19.48% (614.7±58.4 m, control VS 734.5±103.6 m, exercise).

**Table 2** Physical fitness in control group compare between pre (week 0) and post exercise (week 12).

| | Week 0 (n=16) | | Week 12 (n=16) | | p |
|---|---|---|---|---|---|
| | Mean±SD | Median | Mean±SD | Median | |
| Hand grips, kg | 26.9±4.1 | 28 | 26.3±3.3 | 26.5 | NS |
| Back stength test, kg | 57.3±14.0 | 57.5 | 55.5±11.1 | 58 | NS |
| Leg stength test, kg | 70±19.6 | 71.5 | 64.1±11.0 | 65 | NS |
| Trunk flexibility, cm | 8.1±7.1 | 8.3 | 7±7.3 | 6.8 | NS |
| Distance of 6MWT, m | 603.1±65.4 | 625.5 | 643.5±69.9 | 621 | NS |

6MWT, Six-minute walk test

**Table 3** Physical fitness in exercise group compare between pre (week 0) and post exercise (week 12).

| | Week 0 (n=10) | | Week 12 (n=10) | | p |
|---|---|---|---|---|---|
| | Mean±SD | Median | Mean±SD | Median | |
| Hand grips, kg | 27±2.3 | 27 | 27.4±2.9 | 27.3 | NS |
| Back stength test, kg | 61.7±16.9 | 58.5 | 55.8±13.0 | 54 | NS |
| Leg stength test, kg | 64.9±20.2 | 65 | 65.4±17.4 | 63.5 | NS |
| Trunk flexibility, cm | 5.1±7.7 | 4.5 | 4.2±7.2 | 2.5 | NS |
| Distance of 6MWT, m | 614.7±58.4 | 624 | 734.5±103.6 | 729 | <0.01 |

6MWT, Six-minute walk test; $p<0.01$, Highly significant difference

The data indicates that the exercise population increases in cardiovascular endurance and lung function, while it is not altered in the sedentary control group. Prolong (12 weeks) of brisk marching exercise can improve heart and lungs physical fitness. However, we should investigate further the aerobic capacity and variables of anaerobic threshold to confirm heart and lung functions. We investigated the blood chemistry of exercise group in 8 women who can complete the test to indicate biological risk factors. The results are shown in Table 4. Only the high-density lipoprotein (HDL) is increased significant ($p<0.05$) after 12 weeks of brisk marching exercise in sedentary Thais women (60.1±9.8 mg/dL VS 66.8±8.7 mg/dL, 11.14% increased).

**Table 4** Blood chemistry in exercise group compare between pre (week 0) and post exercise (week 12).

| | Week 0 (n=8) | | Week 12 (n=8) | | p |
|---|---|---|---|---|---|
| | Mean±SD | Median | Mean±SD | Median | |
| Cholesterol, mg/dL | 208.8±44.8 | 210 | 202.6±37.8 | 197.5 | NS |
| Triglyceride, mg/dL | 78.5±30.8 | 71 | 82.5±53.2 | 55.5 | NS |
| HDL, mg/dL | 60.1±9.8 | 57.5 | 66.8±8.7 | 67 | <0.05 |
| LDL, mg/dL | 131.6±37.3 | 140.5 | 138.1±37.7 | 137.5 | NS |
| Glucose, mg/dL | 85.6±8.6 | 85.1 | 85.1±5.9 | 86 | NS |
| RBC, million/uL | 4.4±0.3 | 4.4 | 4.3±0.3 | 4.4 | NS |
| Hb, g/dL | 12.5±1.3 | 13 | 12.4±0.9 | 12.7 | NS |
| Hct, % | 37.3±3.3 | 38.2 | 37.4±2.3 | 37.3 | NS |
| WBC,$10^3$/uL | 6.3±2.3 | 5.7 | 6.2±2.4 | 6.1 | NS |
| Plt., $10^3$/uL | 244.6±34.7 | 251 | 245.4±29.5 | 253.5 | NS |

HDL, High-density lipoprotein; LDL, Low-density lipoprotein; RBC, Red blood cell; Hb, Hemoglobin; Hct, Hematocrit; WBC, White blood cell; Plt, Platelet; $p<0.05$, Significant difference.

HDL is its ability to serve as a cholesterol scavenger. It transports cholesterol from the arteries to the liver, where it is broken down and recycled or excreted from the body. Therefore, HDL eliminates harmful cholesterol from blood stream (Schaefer JR, 2012).

## Conclusion

After 12 weeks of brisk marching exercise, the results are highly significant difference ($p<0.01$) of 6-minute walk test and increase ($p<0.05$) of serum high-density lipoprotein in exercise group. Therefore, the aerobic exercise training, brisk marching, can improve physical performance and cardiovascular endurance in sedentary Thais women at Khon Kean University.

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