

**PSYCHOMOTOR AND CARDIOVASCULAR PHYSIOLOGICAL  
CHANGES IN ELDERLY BY TRAINING WITH INTERACTIVE  
VIDEO GAMES**

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Thesis  
entitled  
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VIDEO GAMES**

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PSYCHOMOTOR AND CARDIOVASCULAR PHYSIOLOGICAL CHANGES IN ELDERLY  
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ABSTRACT

The aim of this study was to investigate the effects of exercise training with interactive video games on psychomotor and physiological responses in the elderly and to compare the physiological effects in older people with high blood pressure in the control group (CG) and training group with interactive video games. Thirty elderly females with an average age of  $68.4 \pm 6.3$  years participated in this study. They were divided into two groups: training (TG) and control (CG) groups. The TG were trained by interactive video games (30 min, 3 days per week for 8 weeks) and the CG was provided with normal activity for 8 weeks. The variables in this research were ankle brachial pressure index (ABPI), resting heart rate, tapping speed testing, percentage of fat (%FAT), hip circumference, waist circumference, hand grip strength, six minute walk test (6MWT) were all measured 3 times, at the baseline, 4th and 8th weeks, respectively. One-way repeated ANOVA and paired t-test were used to analyze the data. Significant differences were considered at the level of  $p < 0.05$ . The results showed that there were no significant changes in the hip circumference, waist circumference, grip strength, ABPI, heart rate at rest and finger tapping test of the right, left index fingers and right, left big toe. The results showed a significant decrease in body weight, percentage of fat and BMI. Six minute walk test (6MWT) increased in the TG and after training with interactive video game for 8 weeks. ABPI, muscle strength, systolic, diastolic blood pressure did not change after training for 8 weeks. In conclusion, the six minute walk test (6MWT) increased in the TG. Whereas, these were no differences in body composition and tapping speed testing. Furthermore, interactive video game exercise training did not significantly affect with their quality of life. However, interactive video game may improve the cardiovascular fitness in elderly.

KEY WORDS: PSYCHOMOTOR/ELDERLY / INTERACTIVE VIDEO GAMES

73 pages

ผลของการเปลี่ยนแปลงทางสรีรวิทยาด้านไซโคมอเตอร์และระบบไหลเวียนโลหิตในผู้สูงอายุด้วยการฝึกวิดีโอเกมแบบปฏิสัมพันธ์

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#### บทคัดย่อ

วัตถุประสงค์: เพื่อศึกษาผลของการฝึกด้วยวิดีโอเกมแบบปฏิสัมพันธ์และการตอบสนองทางสรีรวิทยาในผู้สูงอายุ และเพื่อเปรียบเทียบผลกระทบทางสรีรวิทยาในผู้สูงอายุที่มีความดันโลหิตสูงในกลุ่มควบคุมและกลุ่มฝึกด้วยวิดีโอเกมแบบปฏิสัมพันธ์ กลุ่มที่นำมาใช้ในการศึกษาครั้งนี้ คือ สูงอายุเพศหญิงจำนวนสามสิบคนที่มีความเฉลี่ย 68.4 ± 6.3 ปี โดยแบ่งออกเป็นสองกลุ่มคือกลุ่มที่ได้รับการฝึก และกลุ่มควบคุม โดยกลุ่มฝึกได้รับการฝึกด้วยวิดีโอเกมแบบปฏิสัมพันธ์ (ฝึก ครั้งละ 30 นาทีอาทิตย์ละ 3 วัน เป็นเวลา 8 สัปดาห์) และส่วนกลุ่มควบคุมจะใช้ชีวิตตามปกติเป็นเวลา 8 สัปดาห์ ตัวแปรที่ใช้ในการศึกษา คือ วัดความดันโลหิตแขนขา (ABPI) , อัตราการเต้นหัวใจขณะพักและทดสอบการเคาะนิ้ว ,เปอร์เซ็นต์ไขมัน (% FAT), รอบเอว-รอบสะโพก ,แรงบีบมือ ,การเดินหกนาที่ โดยทำการวัดจำนวน 3 ครั้ง คือ ก่อนฝึก, อาทิตย์ที่4 และ อาทิตย์ที่8 ของการฝึกตามลำดับ สถิติที่ใช้คือ One way, repeated ANOVA และ Paired t-test โดยกำหนดค่านัยสำคัญทางสถิติที่ระดับ 0.05 ผลการศึกษาพบว่ารอบเอว รอบสะโพก แรงบีบมือ, ABPI, อัตราการเต้นหัวใจขณะพัก และการเคาะนิ้วมือทั้งสองข้างและในหัวแม่เท้าขวา, หัวแม่เท้าซ้ายไม่พบการเปลี่ยนแปลงอย่างมีนัยสำคัญทางสถิติ แต่พบการลดลงของน้ำหนักตัว, เปอร์เซ็นต์ไขมัน และค่าดัชนีมวลกาย ภายหลังจากการฝึกเป็นเวลา 8 สัปดาห์พบว่าการทดสอบเดินหกนาที่พบว่า มีระยะทางที่เพิ่มขึ้นในกลุ่มการฝึก ส่วนการทดสอบ ABPI, ความแข็งแรงของกล้ามเนื้อ, ค่าความดันโลหิตขณะพัก ไม่พบการเปลี่ยนแปลงหลังการฝึกด้วยวิดีโอเกมแบบปฏิสัมพันธ์ สรุป: ในกลุ่มการฝึกพบว่าการทดสอบเดินหกนาที่มีปริมาณเพิ่มขึ้น แต่สำหรับองค์ประกอบของร่างกายและการทดสอบความเร็วการเคาะนิ้วไม่พบความแตกต่าง นอกจากนี้การฝึกออกกำลังกายด้วยวิดีโอเกมแบบปฏิสัมพันธ์ไม่ได้มีผลต่อปรับเปลี่ยนคุณภาพชีวิตอย่างมีนัยสำคัญ วิดีโอเกมแบบปฏิสัมพันธ์จะเป็นตัวช่วยให้เพิ่มสมรรถนะของหัวใจและหลอดเลือดในผู้สูงอายุ

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## LIST OF ABBREVIATIONS

|                 |  |
|-----------------|--|
| CG              | Control group  |
| TG              | Training using interactive video game group            |
| SD              | Standard deviation                                     |
| BMI             | Body mass index  |
| %FAT            | Percentage of fat                                      |
| ABPI            | Ankle brachial pressure index                          |
| 6MWT            | Six minute walk Test                                   |
| PAD             | Peripheral vascular disease                            |
| RI              | Right index finger                                     |
| LI              | Left index finger                                      |
| RBT             | Right big toe  |
| LBT             | Left big toe   |
| WHOQOL-BREF     | The World Health Organization Quality of Life (WHOQOL) |
| -THAI           | -BREF  |
| Kg              | Kilogram (s)   |
| mm              | Millimetre (s)   |
| s               | second   |
| mm <sup>2</sup> | Square Millimetre (s)                                  |

## **CHAPTER I**

### **INTRODUCTION**

According to National Statistical Office (NSO) of Thailand, the number and proportion of the elderly population has been increasing. In 1994, the number of elderly people aged over 60 years old and above were 6.8 percent of the total population and increased to 9.4 percent and 10.7 percent in 1994 and 2003, respectively(1). In Thai population, the change of aging structure is rapidly leading the country toward ageing society. As a person gets older, many systems of body, such as musculoskeletal, neurological and cardiopulmonary systems change. These factors are the main causes that make the elderly having considerable risk of health problems and often limit their capacity to fulfill functional activities of daily living. These may force the elderly to have independent lifestyle and decreased quality of life (2). From aging process, several studies showed that the elderly has declined in both sensory and motor process e.g. structure of the body including posture, percentage of body surface hair, nails, weight and fat layer and physiological changes such as the circulatory system, respiratory system, kidneys, endocrine system, transmission of the nervous system and the nervous of light to eye and the sound and other senses.(3), In addition to hypertension, diabetes, hyperlipidemia, obesity, and physical inactivity, are highly prevalent and the duration of exposure may be quite long (4).

Hypertension is a major public health problem (National Institute for Clinical Excellence (NICE) 2004; World Health Organisation, 2002; World Health Organization and International Society of Hypertension Writing Group, 2003) and a major risk factor for cerebrovascular and ischaemic heart diseases (5). Physical activity that promotes health and prevents diseases is recommended to all adult age 50 years up. Exercise in elderly people can improve maximal and submaximal aerobic capacities, augment cardiac output and reduce resting heart rate and blood pressure. (6). The American College of Sports Medicine (ACSM) recommends that elderly

people should accumulate 30 minutes or more of moderate-intensity physical activity for 5 days/week and vigorous-intensity physical activity for 3 days/week(7).

Interactive video games are the one kind. I exercise for helping people of all ages to improve lifestyle and health habits and reduce the risk of chronic diseases. Recent research showed that exergames have significant benefits for older adults by providing cognitive stimulation and a source of social interaction, exercise, and fun (Science Daily, 2012.)(8).The research on exergames has confirmed their significant contribution in increasing the participation of individuals in exercise programs (Chin et al., 2008; Patsi et al., 2011) (9). It was found that energy expenditures during playing interactive video game were sufficient for the daily amount of exercise according to the guidelines from American College of Sports Medicine (ACSM) and the American Heart Association (AHA)(10). The oxygen consumption and heart rate after playing interactive video game Wii sports boxing increased significantly in comparison with those of the treadmill walking (11).

Lamoth et al. (2012) reported that the combination of active video gaming and exercise (exergaming) is suggested to improve elderly people's balance, thereby decreasing fall risk. Exergaming has been shown to increase motivation during exercise therapy (12). Novel uses of interactive video games for rehabilitation therapy are emerging, following promising research regarding their use to improve physical fitness in healthy populations. Moreover, Kho et al (2012) reported that the video game activities provide important motor learning opportunities and training for cardiovascular, musculoskeletal, and balance systems (13).

According to Papastergiou (2009) the exergames are appealing to young people and effective in helping them improve their fitness levels and develop motivation for physical exercise. The exergames are a popular alternative to the involvement of people with physical activities (14).

Many research studies have focused on the physiological response of a video game or interactive play in children and adolescents, but a few studies in elderly. This study was to investigate the effects of long term exercise training using the interactive video games on physiological responses such as ankle brachial pressure index, and percentage of fat in the elderly with hypertension.

### **Purpose of the study**

1. To investigate the effects of long term exercise training using the interactive video games on cardiovascular and psychomotor responses such as ankle brachial pressure index (ABPI), and percentage of fat in the elderly with hypertension.
2. To compare cardiovascular and psychomotor responses in hypertension in elderly people between control and exercise training groups by using the interactive video games.

### **Research hypothesis**

Long term exercise training by using the interactive video games can improve psychomotor and cardiovascular functions in elderly.

### **Advantages of the study**

The results of this study will possibly provide an alternative exercise mode to promote healthy elderly in psychomotor and cardiovascular systems.

## **CHAPTER II**

### **LITERATURE REVIEW**

#### **2.1 CARDIOVASCULAR SYTEM CHANGE IN THE ELDERLY**

As people become older, the risk of having various diseases such as cardiovascular disease, respiratory disease, stroke, hypertension, type 2 diabetes, osteoporosis will increase, and functions of their bodies decline (3). Prasansuk et al. (2004) found that almost half of the men and women over the age of 65 had balance disturbances, hypertension (32.4%), diabetes (13.8%), rheumatoid arthritis (8.1%) and heart diseases (4.4%) (15). For over 100 years, clinicians have used upper arm BP to define hypertension, assess associated risk and guide therapy. The two BP values recorded during each measurement represent the maximal pressure of the blood within the brachial artery during cardiac contraction (systolic blood pressure; SBP) and the minimal pressure during relaxation (diastolic blood pressure; DBP). These give an estimate of the BP occurring within other blood vessels in the body. (16) The elderly have a peak of cardiac output at a lower intensity of work less than does that in adults (Brandfonbrener, Landowne, & Shock, 1955; Shephard, 1978a). The elderly have more rigid arteries which it resists the volume of blood when the heart pumps. This resistance is even greater if the person has atherosclerosis, the buildup of plaque on the artery walls. In turn, this resistance raises resting pulse pressure (the difference between systolic and diastolic blood pressure) and systolic blood pressure. The blood pressure increases during exercise depends on the health of the cardiac muscle fiber and their ability to tolerate an increased workload. A lifestyle including regular physical activity is associated with lower systolic blood pressure (Reaven, Barrett-Connor, & Edelstein, 1991)(17) A high BP level is a chronic risk factor for ischemic organ damage, and a low BP level is an acute risk factor for syncope or an ischemic episode, which may lead to the loss of postural stability. (15) Hypertension is one of the major potentially modifiable risk factors for cardiovascular disease and death. Most of this risk results from structural damage to the heart (which is required the

heart to work harder) and also the large and small blood vessels, and the organs they supply. (16) Approximately 29% of the Australian population have hypertension. (16) Furthermore in patients with hypertension reported dizziness and vertigo more frequently (41.5%) than people with normal BP (21.3%). (15) Hypertension is a leading contributor to premature death and disability from cardiovascular disease. Lifestyle modification that includes regular physical activity is often recommend to the patients with hypertension as one of the first line treatments for reducing BP, as well as improving overall risk for cardiovascular events. It is recognised that allied health care professionals play an important role in helping patients to achieve BP control by influencing and reinforcing appropriate lifestyle behavior.(16) Primary prevention programmers, based on the reduction of modifiable risk factors such as cigarette smoking, hypercholesterolemia and hypertension in an entire general population, have proved expensive and only partially successful at reducing incidence of disease, suggesting that supplementary approaches are required to reduce the burden of disease further. Current secondary prevention strategies have proved effective in reducing the rate of further cardiovascular events in individuals with symptomatic cardiovascular disease, but the vast majority of cardiovascular events occur in the ‘healthy’ population, with only 20% occurring in subjects with pre-existing clinical disease. The major public health challenge is therefore to prevent new cases of clinical disease from developing in the apparently healthy but ‘at risk’ population. One approach is the identification of people with markers of asymptomatic atherosclerosis, who may be at increased risk of developing symptomatic cardiovascular disease, followed by targeted preventive measures. (18)

## **2.2 EXERCISES IN THE ELDERLY**

### **2.2.1 TRAINING WITH EXERCISE IN THE ELDERLY**

Gerontology and sports sciences suggest that regular physical activity and exercise can help to maintain and enhance functioning, health and psychological well-being among elderly people. It has been documented that aerobic exercise training has a beneficial effect on the cardiovascular function (Paffenbarger et al.. 1986). aerobic

fitness (Dustman et al., 1984), muscle strength (Fiatarone et al., 1994), osteoporosis (Chow et al., 1987), blood pressure (Tipton, 1984). Obesity (Sidney et al., 1977) increases the social contacts (Sheperd, 1990) in older adult population. (20) Exercise also seems to lead to greater life-satisfaction (Kelly et al., 1987). It has also been postulated that exercise training may improve performance on tasks that involve cognitive processes, including short- and long-term memory, psychomotor capability, attention span and problem solving (Tomporowski and Ellis, 1986). It has been suggested that improvement in neuropsychological functions is correlated with the increase in aerobic fitness and maximal oxygen consumption following exercise (Dustman et al., 1984). These may be enhanced the feeling of mastery or the elevation in plasma opioid levels (De Coverly Veale, 1987). Aerobic or anaerobic exercises are stimulants which lead to physiological arousal of the brain and an increased sympathetic tone. (20) The benefits of activity and exercise across a broad spectrum of medical conditions are widely recognised for both the general population and, specifically, amongst the elderly. Recently, the association between physical fitness and outcome following major surgery has been harnessed in the use of cardiopulmonary-exercise-derived variables as a predicting risk. (21)

Regular exercise has long been considered as a therapeutic modality. Furthermore, exercise training has been shown to reduce mortality in patients with heart failure. More recently, the American College and Sports Medicine (ACSM) and the American Heart Association (AHA) recommend that physical activity in older adults should incorporate moderate-intensity aerobic activity, muscle strengthening activity. Furthermore, there has been an increase in public awareness of the benefits of regular physical activity. A variety of reports have promoted the fact that regular physical activity reduces the chance of chronic disease, increases health-related quality of life (HRQL), with reduce anxiety and depression. (21) Aerobic exercise training caused a significant decrease in diurnal heart rate, reduce BP in hypertension patients. (19) A review of studies have indicated a strong relationship between physical activity and several diseases including cardiovascular, cerebrovascular, and hypertension. Epidemiological studies have shown a decreased incidence of mortality from heart disease in men who regular physical activity (22) Some studies have also reported significant reductions in morbidity and mortality from cardiovascular disease in

aerobically active versus sedentary individuals. Regular walking has been recommended to improve cardiovascular capacity. (22)

### **2.2.2 TRAINING WITH INTERACTIVE VIDEO GAME**

Physical activity is valuable for health and the motoric development in young people. But in the case of late childhood and adolescence, it becomes less important compared to other leisure activities which do not contain any physical activity. Specifically, balance's ability has a fundamental role in many athletic activities and skills in postural control affecting peoples' successful performance (Erkmen, Taskin, Sanioglu, Kaplan, & Basturk, 2010; Hrysomallis, 2011). Results from prospective studies reinforce the perception that balance training can be a worthwhile supplement to the usual training of non-elite athletes to enhance certain motor skills (Hrysomallis, 2011). Traditional balance programs have included a variety of exercises to increase balance by performing single and double leg stance activities on different stable and unstable surfaces, performing simultaneously other distracting tasks. Although these activities have proven helpful in improving balance they can be considered by young people performing them, boring and not very stimulating. This lack of interest in the exercises can lead to limited engagement and lower performance. Hence, strategies are required to maintain the young people's motivation in physical activity is video games, which are enjoying. Active video games or exergames are becoming increasingly popular among children and adolescents (Coveart, 2008; Papastergiou, 2009). It is a new innovative technologies that provide an interactive with the screen game play by using gestures and movements of the upper or lower extremities in a real time. (14) While Lomoth et.al. (2012) reported that active video gaming or exergame could improve elderly people's balance, thereby decreasing fall risk.(12)

Saposnik G. et al 2010 have studied about effectiveness of virtual reality by using Wii game technology in stroke patients for rehabilitation. They compared in feasibility, safety and efficacy of Nintendo Wii system with recreational therapy. The result showed that in training group with Nintendo Wii was significant improvement in motor function (Wolf motor function test) and virtual reality gaming are safe, feasible and potentially effective options to assisted rehabilitation therapy. (23)

According to Tony and Andrew, 2010 investigated about feasibility and benefit of using Nintendo Wii fit for balance rehabilitation in the older adult. A patient has trained by Wii fit game system (Ski Slalom, Table tilt and Deep breathing). Berg balance score, Activities specific balance confidence scale, Timed up and go and Gait speed were measured pre and post exercise. They were suggested that patient have improvement in all of the selected outcomes measure went and Bisson et al have studied about postural biofeedback training in older adults. They found that postural biofeedback training could improve balance by decreasing sway during standing posture. (24)

## **2.3 PHYSIOLOGICAL MEASUREMENT**

### **2.3.1 THE ANKLE-BRACHIAL PRESSURE INDEX (ABPI)**

To assess the cardiovascular diseases, there are many techniques which such as angiography, intimal thickness and endothelial function measurements are expensive, operator-dependent and not suited for large scale population studies. However, in the past decade, measurement of the ankle-brachial index (ABPI) using a simple ultrasound technique have been increasingly used. Initially developed as an indicator for peripheral vascular disease, it is becomingly used as an indicator of generalized atherosclerosis , being regarded as a risk predictor for future cardiovascular events, as a research tool to study the genetic and environmental factors for cardiovascular disease, and as a predictor for lower extremity functioning. Furthermore, the ABPI has the advantage that it is easy to incorporate in large scale epidemiological studies where field workers can be easily trained to take the measurement at low cost. (25) The principle of ABPI determination is to obtain a systolic blood pressure reading at the brachial artery of the right and left arms and at the right and left ankles. At the ankles, either or both the dorsalis pedis and tibialis posterior artery are used. The perforating peroneal artery is sometimes used when a signal is not detected from the dorsalis pedis artery. Current practice advocates that the systolic ankle reading is divided by the brachial reading to give the ABPI. There are problems with this formula because the ABPI can be obtained using different

methods/equations as well as different cut-off values indicating the presence of peripheral artery disease (PAD) (26). Systolic blood pressure was measured on the right brachial artery and in both posterior tibial arteries. The ABPI was calculated for each legs and was defined as posterior tibial systolic blood pressure divided by brachial systolic blood pressure. The normal value of ABPI were defined: low ( $ABPI < 0.90$ ), normal ( $0.90 \leq ABPI \leq 1.40$ ), and high ( $ABPI > 1.40$ ) (7). Hypertension was defined as systolic blood pressure  $\geq 140$  mm Hg or diastolic blood pressure  $\geq 90$  mm Hg or self-reported use of hypertension medications. (27) A high ABPI (greater than 1.30) is also associated with increased cardiovascular (CV) risk. (28)

Many researches claimed that ABPI can be used as a predictor of mortality with peripheral arterial disease. McKenna et.al (1991) studied the relationship between the ankle brachial index and mortality in 744 patients between 1977 and 1985. Death certificates were obtained on all patients through 1987. The median follow-up of the patients was 3.28 years. A total of 482 patients with ankle brachial index  $< 0.85$  were classified with peripheral arterial disease and 262 patients with ankle brachial index 0.85 to 1.50 were classified without peripheral arterial disease. The average age of peripheral arterial disease patients was  $68 \pm 10$  years versus  $63 \pm 14$  years for patients without peripheral arterial disease, and 46% of each group were men. Ten year cumulative survival probabilities were 33% of the patients with ankle brachial index  $< 0.40$ , 51% of the patients with ankle brachial index 0.40 to  $< 0.85$ , and 77% of the patients with ankle brachial index 0.85 to 1.50. Peripheral arterial disease patients were categorized according to their ankle brachial index into severe disease (ankle brachial index  $< 0.30$ ), moderate disease (ankle brachial index 0.30 to 0.49) or mild disease (ankle brachial index 0.50 to  $< 0.92$ ). Mortality from cardiovascular disease was highest among patients with ankle brachial index  $< 0.40$  and lowest among patients with ankle brachial index 0.85 to 1.50. The ankle brachial index 0.40 to 0.85 was associated with a 2.02- fold increased risk of mortality compared with patients with ankle brachial index 0.85. Greater severity of peripheral arterial disease was associated with higher total mortality. Patients with peripheral arterial disease with an ankle brachial index  $< 0.30$  had highest total mortality (29). Gornik and co-worker (2005) stated that normally, the blood pressure in the ankles was the same or slightly higher than the blood pressure in the legs. Common risk factors of peripheral arterial

disease (PAD) were smoking, diabetes, high blood pressure, high cholesterol and advanced age (greater than 70 years). Virtanen and co-worker (1982), who demonstrated that the central action of clonidine inhibits peripheral release of norepinephrine, but was insufficient to attenuate cardiac stimulation by physical exercise. The fact that propranolol caused higher plasma norepinephrine concentrations than metoprolol during exercise may explain the difference in blood pressure responses during exercise in hypertensive patients. Long et al. (2003) studied the correlation between ABPI and HRQL. In correlating SF-36 scores with ABPIs, the greatest correlation coefficient was found for Physical Component Score ( $r = 0.25$ ). (30) These data indicate that clinicians can use the ankle brachial index to predict mortality risk among patients with peripheral arterial disease. (29)

### **2.3.2 THE FINGER TAPPING TEST**

The finger tapping test (FFT) was originally called finger oscillation test (FOT). Finger tapping, one of Halstead's original tests, measure motor speed and motor control. Using a specially adapted tapper (Denominator), the subject is instructed to tap a key as fast as possible using his index finger or big toe. The tappings require rapid information processing, also reveal something of the status of the central nervous system. Neuropsychologically, the finger tapping test is useful left big toe. The subject was instructed to use his sole as the fulcum and fix it when tap the key. The maximum tapping performance score was computed separately for each organ and was the mean of three consecutive 10-second trials within a range of three taps. (31)

### **2.3.3 THE SIX-MINUTE WALK TEST**

Panrampai et al reported the average 6MWD was  $434 \pm 75$  m. The age ( $r = -0.390$ ,  $p < 0.01$ ), BMI ( $r = -0.215$ ,  $p < 0.01$ ), height ( $r = 0.196$ ,  $p < 0.05$ ), functional reach test ( $r = 0.630$ ,  $p < 0.01$ ), hand grip strength ( $r = 0.447$ ,  $p < 0.01$ ), FVC ( $r = 0.429$ ,  $p < 0.01$ ), FEV1 ( $r = 0.417$ ,  $p < 0.01$ ) and SF-36 physical functioning part ( $r = 0.319$ ,  $p < 0.01$ ) were significantly correlated with 6MWD. Stepwise multiple regression analysis showed that functional reach distance, SF-36 physical functioning score and FEV1 were the independent predictors of 6MWD ( $p < 0.05$ ), explaining 54 % of the variance (2). McDermott studied leg functioning in peripheral arterial disease, the PAD patients

with intermittent claudication, distance achieved on the 6-minute walk is significantly correlated with physical activity levels, ABI level, and performance on a treadmill graded exercise test. In 64 intermittent claudication patients who performed the 6-minute walk twice during 1 week, the coefficient of variation for the two tests was 10.4%, indicating a very reliable test.(32) It is probable that the relationship between health status and 6MWT-distance reflects the influence of the status of the cardiovascular system on the general fitness. Studies of exercise physiology have revealed a direct relationship between muscle strength and physical exercise. Decreased physical activity (i.e., inactivity) usually leads to altered muscle metabolism, decreases in muscle mass and lower physical capacity.(33)

## **CHAPTER III**

### **MATERIALS AND METHODS**

#### **3.1 Participants**

Thirty elderly people with age range 60-75 years old from Baan-salawan Hospital participated in this study. All participants were screened and excluded using a specific-modified questionnaire. Prior to participate in this study, the purpose, experimental of the study, possible of risk, discomforts associated with the experimental were clearly explained. The anthropomorphic variables such as age, weight, height and BMI were measured. Subjects were divided into two groups as follows;

Group 1: No exercise (Control group; CG, n = 15)

Group 2: Training using interactive video game (TG; n = 15)

Their medical histories were recorded before testing. Inclusion and exclusion criteria were as follow;

##### **3.1.1 Inclusion criteria**

- Females with aged range 60-75 years old
- Blood pressure was not greater than 140/80 mm Hg, after taken high blood pressure medicine
- Signed consent form
- No history of injuries of joint, muscle, and bone within 3 months

##### **3.1.2 Exclusion criteria**

- Smoking
- Alcohol beverage or caffeine within 24 hours prior to the study
- Having infection or fever

### **3.1.3 Criteria to terminate the tests**

- The study is complete
- The participants in exercises training groups exercised less than 2 times per week during training
- The participants voluntarily aimed to stop
- Occurrence any signs and symptoms of physical or mental deteriorations
- Unable to follow the procedure

## **3.2 Design of the study**

This study was to investigate the effects of long-term exercise training using interactive video games on the physiological responses in the elderly who suffer from hypertension.

## **3.3 Instrumentation**

### **3.3.1 Subject characteristics**

- Physical activity questionnaires. (Mahidol, Thailand)
- Digital body composition monitoring (Omron, Japan)



**Figure 3.1 Digital body composition monitoring (Omron, Japan)**

### 3.3.2 Instruments for measuring cardiovascular response

-Telemetry heart rate monitor (Polar, Kempele, Finland)



**Figure 3.2 Telemetry heart rate monitoring (Polar, Kempele, Finland)**

-Sphygmomanometer (AIL, KII, Japan) and Stethoscope (Hico medical Co., Ltd, Japan)



**Figure 3.3 Sphygmomanometer (AIL, KII, Japan) and Stethoscope (Hico medical Co., Ltd, Japan)**

-Grip dynamometer (Takei A5401 Digital Hand Grip Dynamometer, Japan)



**Figure 3.4 Grip dynamometer (TKK, Japan)**

### **3.3.3 Instruments for measuring psychomotor response**

-Denominator Tapping speed Testing (Lafayette, USA)



**Figure 3.5 Denominator tapping speed testing**

### 3.3.3.2 Stop watch (Citizen watch Co., Japan)



**Figure 3.6 Stop watch (Citizen. Co., Japan)**

### 3.3.4 Interactive video game

#### 3.3.4.1 Nintendo Wii console game and television screen.

Interactive video game in this study is Nintendo Wii console game together with Wii balance board (Nintendo, Japan).



**Figure 3.7 Nintendo Wii console game, Wii balance board and Wii Fit CD game (Nintendo, Japan)**

## 3.4 Parameter of interest

### 3.4.1 Vital signs

3.4.1.1 Heart rate (beats/min) was measured the experiment by using a telemetry heart rate monitor (Polar, Kempele, Finland)

3.4.1.2 Sphygmomanometer (CK-101 Mercurial, Sphygmomanometer, Germany, Spirit) and Stethoscope Grandeur (Spiri) was measured the experiment by blood pressure.

### **3.4.2 General characteristics**

3.4.2.1 Weight (kg) was measured by using digital scale (Omron body composition monitor: hbf-362) Weight measurement players, subjects stand on equipment. Record is kilogram

3.4.2.2 Height (cm) was measured by height scale (Nagata S/N CH 2882, Taiwan)

3.4.2.3 Body mass index (BMI). The body mass index (BMI) was calculated from weight and height. The formula was as followed:

$$\text{BMI} = \text{weight (kg)} / \text{height (m}^2\text{)}$$

3.4.2.4 Percentage of fat. The body fat was measured by Omron body composition monitor (hbf-362). The subjects stand and base feet on the machine, then it will display the distribution of substances of body fat.

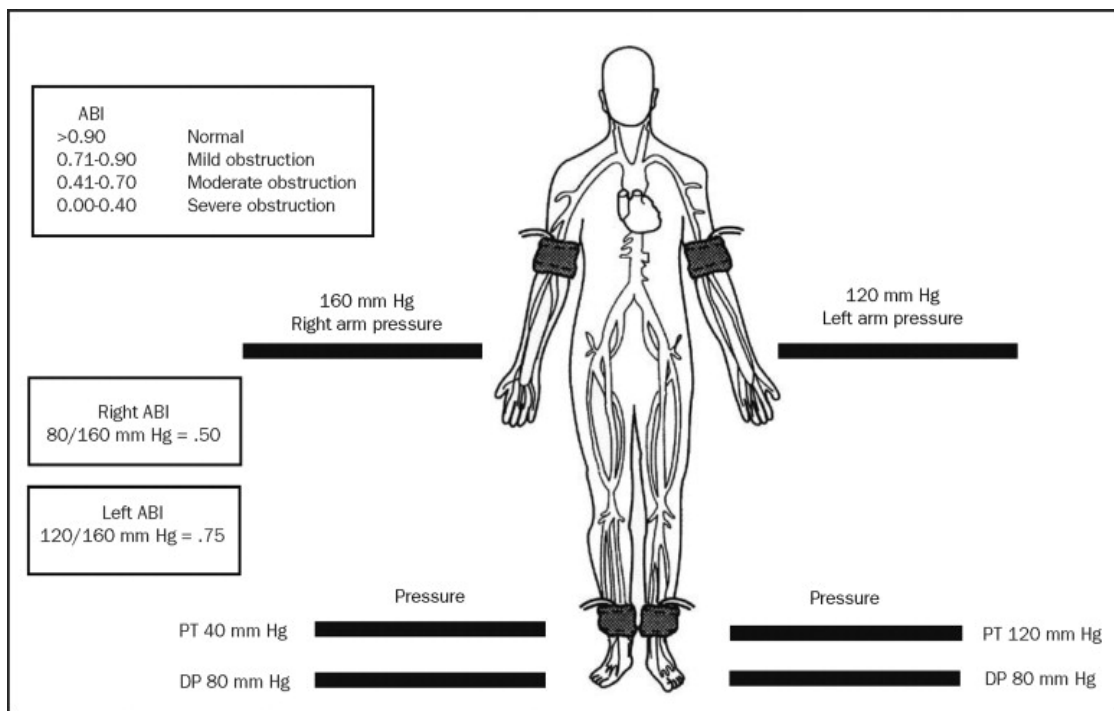
3.4.2.5 Muscle strength: Grip dynamometer (kg) by digital Hand Grip Dynamometer (Takei A5401, Japan). Used to monitor the development of grip strength by recording the maximum reading (kg) three times by using the dominant hand, and chooses the best one.

### **3.4.3 Ankle brachial pressure index (ABPI)**

The ankle brachial index test (ABPI) before horizontal rest for 5-10 minutes. Starting the test, resting heart rate, blood pressure and the ratio of the blood pressure in the lower legs to the blood pressure in the arms were measured. Blood pressure of the left arm, right arm, left leg, and right leg were measured and recorded for 3 times each. Compared to the arm, lower blood pressure in the leg is an indication of blocked arteries (peripheral vascular disease). The ABPI is calculated by dividing the systolic blood pressure at the ankle by the systolic blood pressures in the arm.

The criterion used to assess APBI is the ratio of the highest ankle to brachial artery pressure. An ABPI between 0.9 - 1.2 considered normal (free from significant peripheral vascular disease: PAD), while a lesser than 0.9 indicates arterial

disease. An ABPI value greater than 1.3 is also considered abnormal, and suggests that there has a calcification of the walls in the arteries and incompressible vessels, reflecting severe peripheral vascular disease. There are no other significant conditions affecting the arteries of the leg. The following ABPI ratios can be used to predict the severity of PAD as well as a assessment the various types of leg ulcers



**Figure 3.8 Ankle brachial pressure index interpretations**  
([www.journals.elsevierhealth.com](http://www.journals.elsevierhealth.com))

### 3.4.4 Psychomotor

#### 3.4.4.1 Tapping speed Testing

The tapping speed testing was using a dominator (The Denominator Company Inc. Woody bury, (CT)). The subjects are instructed to tap the denominator as fast as possible for 10 seconds. Three repetitions are determined for the right index finger (RI), left index finger (LI), right big toe (RBT), and left big toe (LBT). The tapping speed test recorded maximum tapping speed and the average of three sessions of tapping for 10 seconds.

Speed of finger tapping correlated with performance. It does not have the quality of life that it is an indicator of the performance of activities of daily life, even if it is not strong one. This finding suggests that the speed of hand ipsilateral stroke is a useful measure of recovery, although other factors such as the level of functional independence is important.



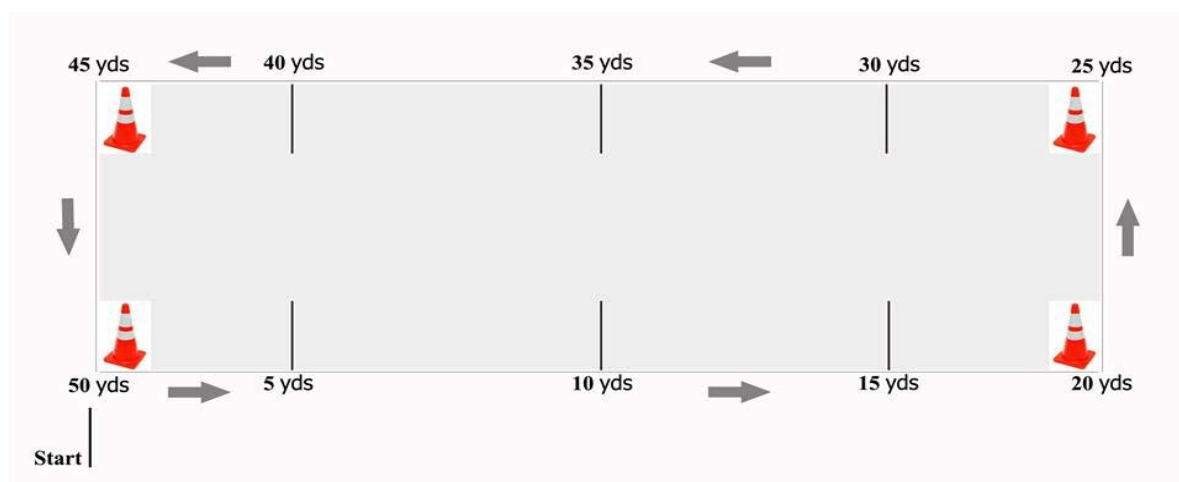
**Figure 3.9 Denominator tapping speed testing**

#### **3.4.5 Six minute-walk test (6MWT)**

The six-minute walk test is used as a tool to evaluate the functional exercise level of patients with moderate to severe heart or lung disease. In our study, it is used as baseline indicators of exercise tolerance.

The six-minute walk test last of many subject and it takes a long time. Subject performs stretching and warm up for 5-10 minutes.

The walk is done on a flat surface with a staff member measuring the distance walked. The subject walked at his own pace as far as he can in a six-minute period. The distance walk and any symptoms or pain were recorded. The blood pressure, pulse rate and oxygen saturation were be measured before and after the walk.



**Figure 3.10 Six-minute walk test (Rikli & Jones, 2001)**

### 3.4.6 Quality of life assessment

The WHOQOL-BREF-THAI is the Thai version of a brief form (WHOQOL-BREF) of a generic and transcultural QOL assessment instrument developed by WHOQOL-100. It is a 26-item scale with 5 point Likert responses, having four subscales measuring physical health, psychological well-being, social relationships and satisfaction with the environment. The four subscale scores are calculated by summing up the scores of the corresponding items in each subscale. The overall score is the summation of all subscale scores and two global item scores. The scores then are classified into three QOL groups by the criteria according to Mahatnirunkul (Table 1)

**Table 3.1 Subscale and overall QOL scoring criteria of WHOQOL-BREF-THAI**

| Subscale                           | Items | Bad   | Average | Good   |
|------------------------------------|-------|-------|---------|--------|
| Physical health                    | 7     | 7-16  | 17-26   | 27-35  |
| Psychological well-being           | 6     | 6-14  | 15-22   | 23-30  |
| Social relationship                | 3     | 3-7   | 8-11    | 12-15  |
| Satisfaction with the environmenta | 8     | 8-18  | 19-29   | 30-40  |
| Overall                            | 26*   | 26-60 | 61-95   | 96-130 |

\*Another 2 global subscales for overall QOL and general health condition are included in overall scores

### 3.5 Exercise training program

Subjects in the exercise training group had will trained using the interactive video game for 30 minutes, 3 days/week for 8 weeks and divided the intensity of training into 2 phases as the followings :

1. Phase 1 (0th – 4th wk.): the intensity of exercise training was set as 55% maximum heart rate.
2. Phase 2 (5th – 8th wk.): the intensity of exercise training was set as 65% maximum heart rate.

Prior to participation, each subject was clearly explained about the purposes, the experimental process, the benefit and possible risks in this study. Physical activity questionnaire was used to assess a physical examination and exercise activity. This information was recorded and kept confidentially. Warm up and training durations were 10 minutes and 20 minutes, respectively.

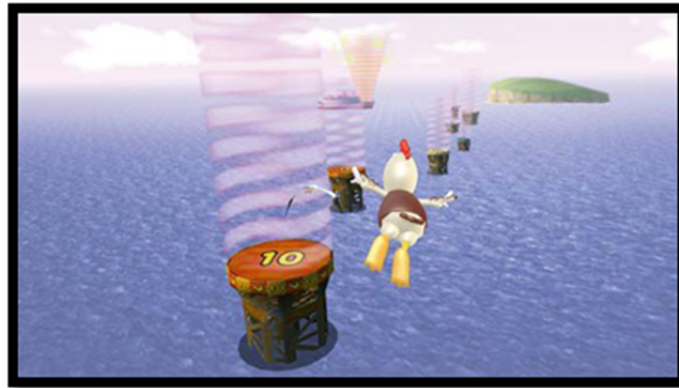
Example of interactive video game as follow;

1. “Free Step” and “Basic Step” were used to warm up and training. Subject steps up-down between a balance board and the floor. A rhythm of the steps was followed the simulator from the game which was displayed on monitor.



**A) Free Step and Basic Step (Nintendo, Japan)**

2. “Bird fly” game, participants stand on the balance board and control the direction by shifting the body weight to left, right, forward or backward. During controlling the direction, they always move their arms up and down like a flying bird.



**B) Bird fly (Nintendo, Japan)**

3. “Hula hoop” game, participants stand on the balance board and move their body like the hoop around the stomach and control direction by shifting the body weight to left or right to receive more hoop.



**C) Hula hoop (Nintendo, Japan)**

4. “Penguin Slide” subjects were shifted body weight left and right to tilt the iceberg in either direction and eat a fish by the blue ones are 1 point, the green are 2 point and the rare red ones are 10 point. A penguin will then slide downhill whichever way it's tilting. But be careful that he doesn't slide off the side, otherwise subject need to wait several seconds for him to hop back on.



**D) Penguin Slide (Nintendo, Japan)**

5. “Free runner” game, participants training and run on the balance board.

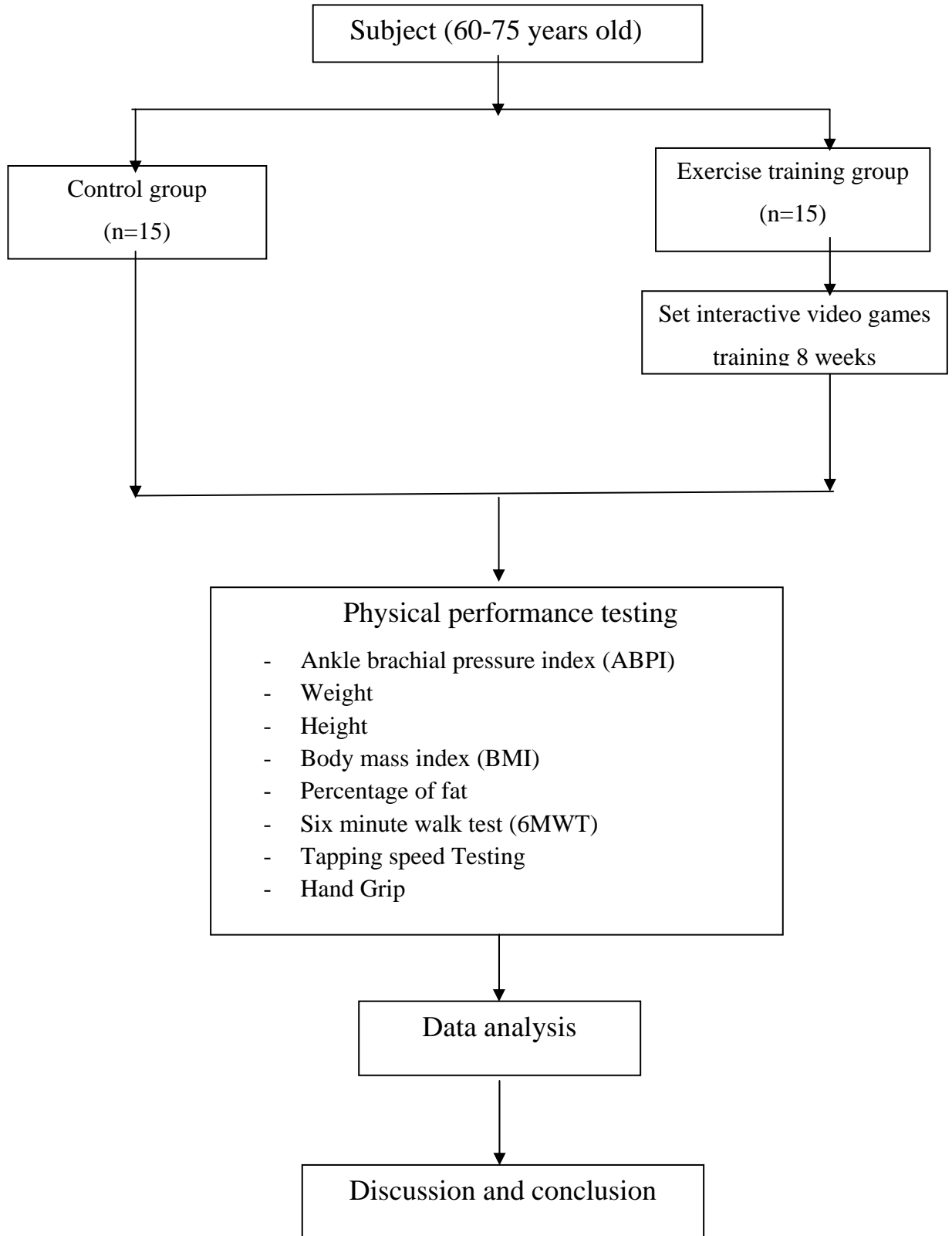


**E) Free runner (Nintendo, Japan)**

### 3.6 Statistical Analysis

Independent t-test was used to analyze the differences between the two groups. One-way ANOVA with repeated were used to analyze the repeated factors of physiological responses at the first week (0 wk.), 4th week and 8th week, respectively. Level of significance will set at  $p < 0.05$ . All analyses were performed using the statistical software package SPSS 22 for windows.

### 3.7 Experimental Protocol



## CHAPTER IV

### RESULTS

#### 4.1 Physical characteristics

Thirty people were recruited to participate in this study with age between 64-79 years. They were divided into two groups. One was control group. (CG, n = 15) and the other was training group (TG, n = 15). Descriptive characteristics of subjects were presented in Table 4.1 as mean and standard deviation (SD). There were no significant differences between two groups.

**Table 4.1 Physical characteristics of the subjects. Data were mean  $\pm$  SD**

| Physical characteristics                | C group (n=15) |       | T group (n=15) |       | p-value |
|---|----------------|-------|----------------|-------|---------|
|   | Mean           | SD    | mean           | SD    |         |
| Age (year)                              | 68.40          | 5.33  | 69.60          | 5.06  | 0.585   |
| Height (cm)                             | 151.0          | 5.0   | 150.0          | 4.0   | 0.346   |
| Weight (kg)                             | 58.83          | 6.48  | 55.65          | 8.73  | 0.343   |
| BMI (kg/m <sup>2</sup> )                | 25.68          | 3.09  | 24.61          | 3.34  | 0.429   |
| Percentage of fat (%)                   | 37.35          | 2.08  | 34.12          | 5.76  | 0.061   |
| Resting HR (bpm)                        | 70.53          | 11.51 | 68.2           | 8.9   | 0.358   |
| Resting systolic blood pressure (mmHg)  | 119.56         | 15.11 | 123.73         | 12.98 | 0.415   |
| Resting diastolic blood pressure (mmHg) | 66.26          | 7.23  | 69.13          | 5.9   | 0.651   |
| Hip circumference (cm)                  | 87.30          | 5.90  | 84.93          | 7.00  | 0.427   |
| Waist circumference (cm)                | 98.50          | 7.27  | 95.40          | 6.44  | 0.263   |

CG: Control group, TG: Training group - No Significant difference between groups.

## 4.2 Body composition

### 4.2.1 Body weight

The body weight of TG and CG were significant difference at the 4<sup>th</sup> week, and 8<sup>th</sup> week when compared with baseline. Body weight of TG was  $55.65 \pm 2.33$  kg,  $55.10 \pm 2.33$  kg, and  $54.55 \pm 2.33$  kg at baseline, 4<sup>th</sup> week, and 8<sup>th</sup> week, respectively. While those in CG were  $58.83 \pm 1.73$  kg,  $59.19 \pm 1.73$  kg, and  $59.47 \pm 1.74$  kg at baseline, 4<sup>th</sup> week, and 8<sup>th</sup> week, respectively. Body weight of TG was significant lower than CG at the 4<sup>th</sup> and 8<sup>th</sup> week, respectively as shown in Figure 4.1.

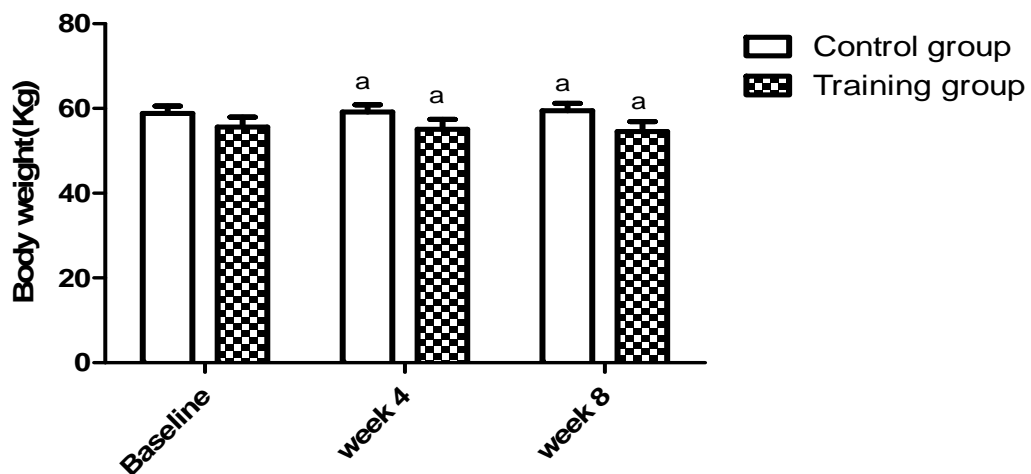
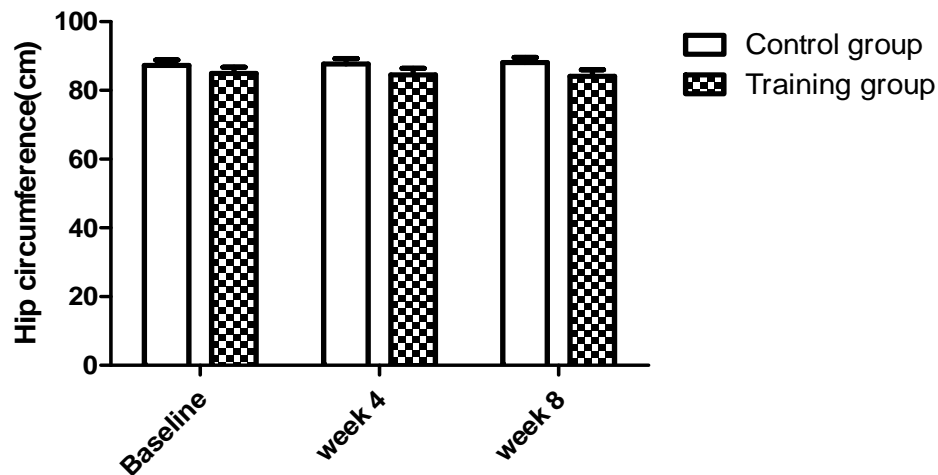


Figure 4.1 Body weight between CG and TG at baseline, 4<sup>th</sup>, 8<sup>th</sup> weeks, respectively. Data were mean  $\pm$  SEM.

a =  $p < 0.05$  compared within group at baseline

#### 4.2.2 Hip circumference

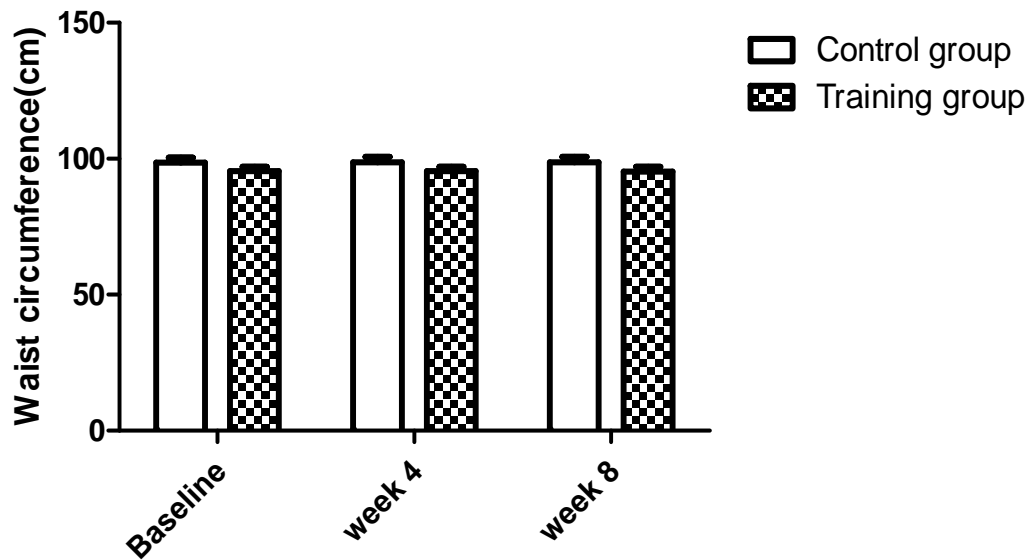
Hip circumference of TG lower than CG at the 4<sup>th</sup> week and 8<sup>th</sup> week, respectively but it was not significant difference within group and between groups. Hip circumference of TG was  $84.93 \pm 1.87$ cm,  $84.57 \pm 1.89$ cm, and  $80.23 \pm 1.91$ cm at baseline, 4<sup>th</sup> week, and 8<sup>th</sup> week, respectively. While that in CG was  $87.30 \pm 1.57$ cm,  $87.73 \pm 1.56$ cm, and  $88.10 \pm 1.56$ cm at baseline, 4<sup>th</sup> week, and 8<sup>th</sup> week, respectively as shown in Figure 4.2.



**Figure 4.2 Hip circumferences between CG and TG at baseline, 4<sup>th</sup>, 8<sup>th</sup> weeks, respectively. Data were mean  $\pm$  SEM.**

#### 4.2.3 Waist circumference

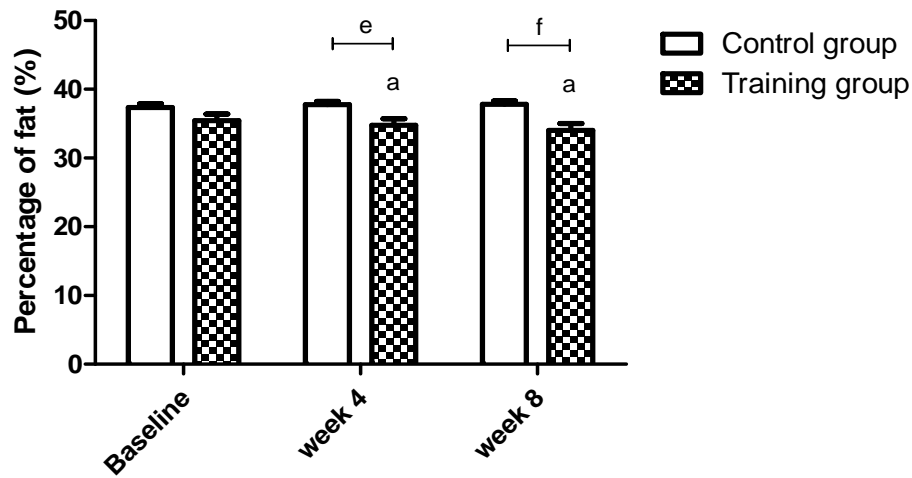
Waist circumference of TG lower than CG at the 4<sup>th</sup> week and 8<sup>th</sup> week, respectively but it was not significant difference within group and between groups. Waist circumference of TG was  $95.40 \pm 1.72$ cm,  $95.40 \pm 1.72$ cm, and  $95.33 \pm 1.71$ cm at baseline, 4<sup>th</sup> week, and 8<sup>th</sup> week, respectively. While that in CG was  $98.50 \pm 1.94$ cm,  $98.73 \pm 1.93$ cm, and  $98.73 \pm 1.93$ cm at baseline, 4<sup>th</sup> week, and 8<sup>th</sup> week, respectively shown in Figure 4.3.



**Figure 4.3** Waist circumferences between CG and TG at baseline, 4<sup>th</sup>, 8<sup>th</sup> weeks, respectively. Data were mean  $\pm$  SEM.

#### 4.2.4 Percentage of fat

Percentage of fat (%FAT) of TG was significantly lower than CG at the 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. There was significant within group of TG at the 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. Percentage of fat (%FAT) of TG was  $34.12 \pm 0.96$ ,  $33.44 \pm 0.96$ , and  $34.03 \pm 0.98$  at baseline, 4<sup>th</sup> week, and 8<sup>th</sup> week, respectively. While that in CG was  $37.35 \pm 0.55$ ,  $37.78 \pm 0.46$ , and  $37.82 \pm 0.49$  at baseline, 4<sup>th</sup> week, and 8<sup>th</sup> week, respectively as shown in Figure 4.4.



**Figure 4.4 Percentage of fat (%) between CG and TG at baseline, 4<sup>th</sup>, 8<sup>th</sup> weeks, respectively. Data were mean  $\pm$  SEM.**

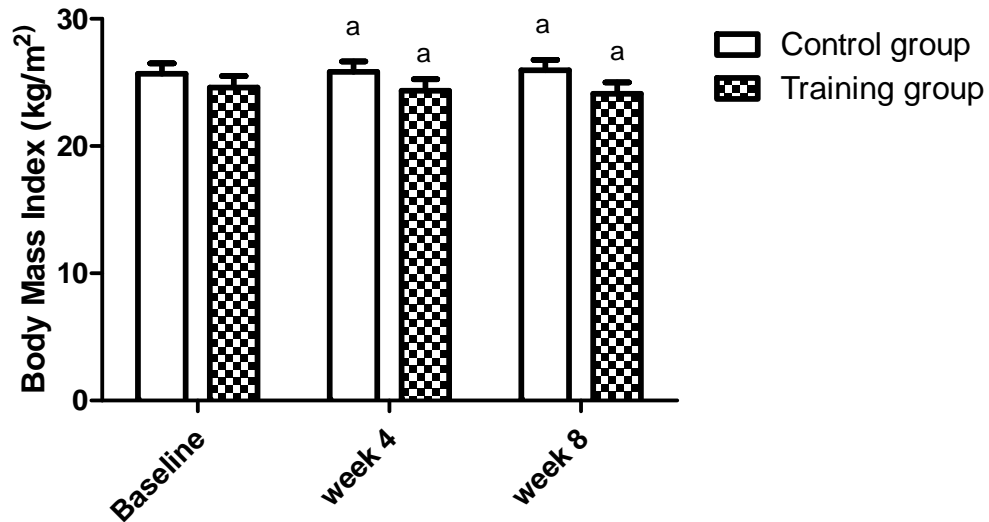
a =  $p < 0.05$  compared within group at baseline

e =  $p < 0.05$  compared between CG and TG at 4<sup>th</sup> week

f =  $p < 0.05$  compared between CG and TG at 8<sup>th</sup> week

#### 4.2.5 Body mass index (BMI)

BMI of TG was significantly lower than CG at the 4<sup>th</sup> and 8<sup>th</sup> week, respectively. There was significant difference within group of TG and CG at the 4<sup>th</sup> week and 8<sup>th</sup> week, respectively, when compared with baseline. BMI of TG was  $24.61 \pm 0.89$  Kg/m<sup>2</sup>,  $24.37 \pm 0.89$  Kg/m<sup>2</sup>, and  $24.12 \pm 0.88$  Kg/m<sup>2</sup> at baseline, 4<sup>th</sup> week, and 8<sup>th</sup> week, respectively. While that in CG was  $25.68 \pm 0.82$  Kg/m<sup>2</sup>,  $25.84 \pm 0.83$  Kg/m<sup>2</sup>, and  $25.96 \pm 0.82$  Kg/m<sup>2</sup> at baseline, 4<sup>th</sup> week, and 8<sup>th</sup> week, respectively.



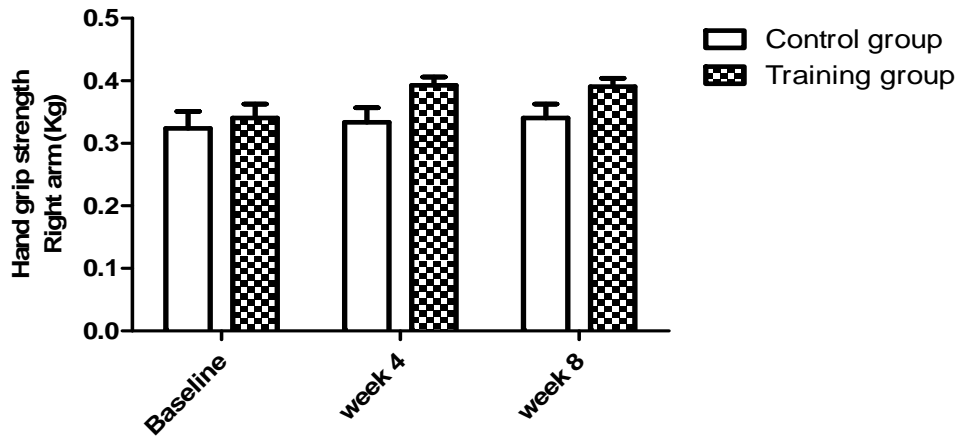
**Figure 4.5** Body mass index between CG and TG at baseline, 4th, 8th weeks, respectively. Data were mean  $\pm$  SEM.

a =  $p < 0.05$  compared within group at baseline

## 4.3 Muscle strength

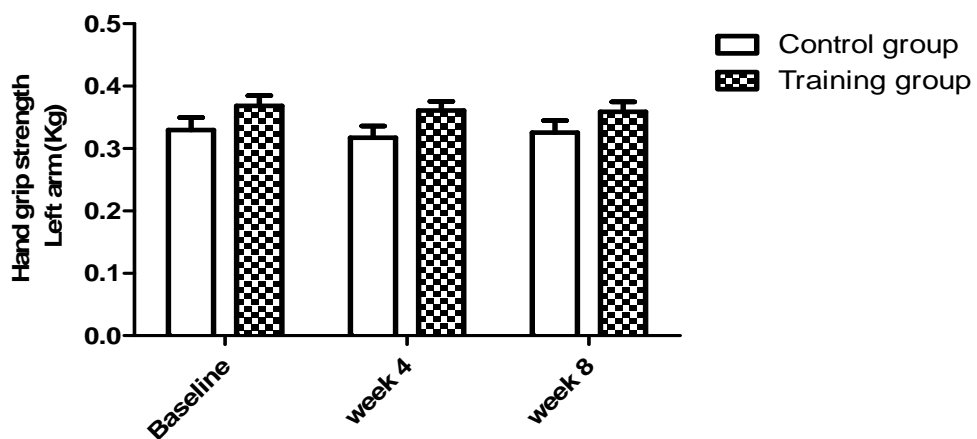
### 4.3.1 Hand grip strength

Hand grip strength (right arm) of TG was not significantly lower than CG at the 4<sup>th</sup> and 8<sup>th</sup> week, respectively. There was no significant difference within group of TG and CG at the 4<sup>th</sup> week and 8<sup>th</sup> week, respectively, when compared with baseline. Hand grip strength (right arm) of TG was  $0.39 \pm 0.05$  kg,  $0.39 \pm 0.05$  kg, and  $0.39 \pm 0.05$  kg at baseline, 4<sup>th</sup> week, and 8<sup>th</sup> week, respectively. While that in CG was  $0.32 \pm 0.10$  kg,  $0.33 \pm 0.09$  kg, and  $0.34 \pm 0.08$  kg at baseline, 4<sup>th</sup> week, and 8<sup>th</sup> week, respectively.



**Figure 4.6 Hand grip strength (right arm) CG and TG at baseline, 4<sup>th</sup>, 8<sup>th</sup> weeks, respectively. Data were mean ± SEM.**

Hand grip strength (left arm) of TG was not significantly lower than CG at the 4<sup>th</sup> and 8<sup>th</sup> week, respectively. There was no significant difference within group of TG and CG at the 4<sup>th</sup> week and 8<sup>th</sup> week, respectively, when compared with baseline. Hand grip strength (left arm) of TG was 0.37±0.06 kg, 0.36±0.06 kg, and 0.36±0.06 kg at baseline, 4<sup>th</sup> week, and 8<sup>th</sup> week, respectively. While that in CG was 0.33±0.07 kg, 0.32±0.07 kg, and 0.33±0.07 kg at baseline, 4<sup>th</sup> week, and 8<sup>th</sup> week, respectively.



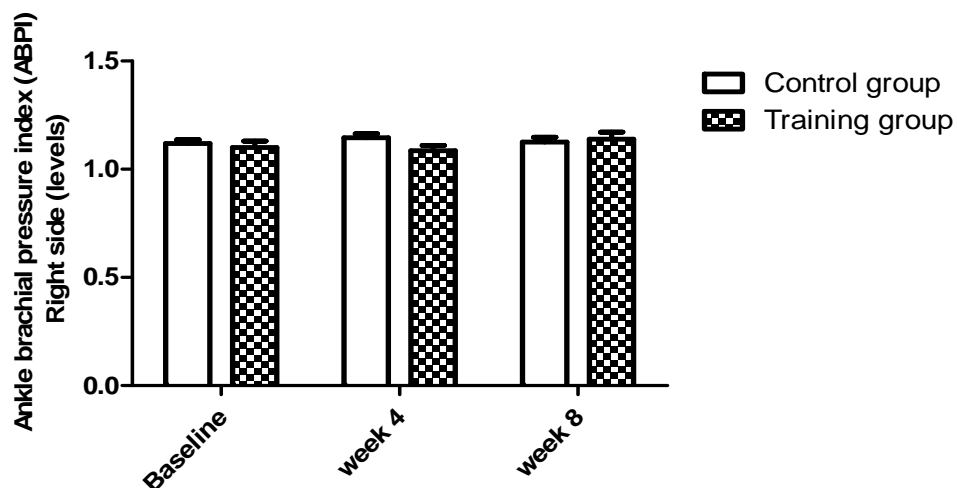
**Figure 4.7 Hand grip strength (left arm) CG and TG at baseline, 4<sup>th</sup>, 8<sup>th</sup> weeks, respectively. Data were mean ± SEM.**

## 4.4 Cardiovascular parameters

The cardiovascular parameters were ankle brachial pressure index (ABPI), six minute walk test (6MWT), resting blood pressures (mmHg) and resting heart rate (beat/min)

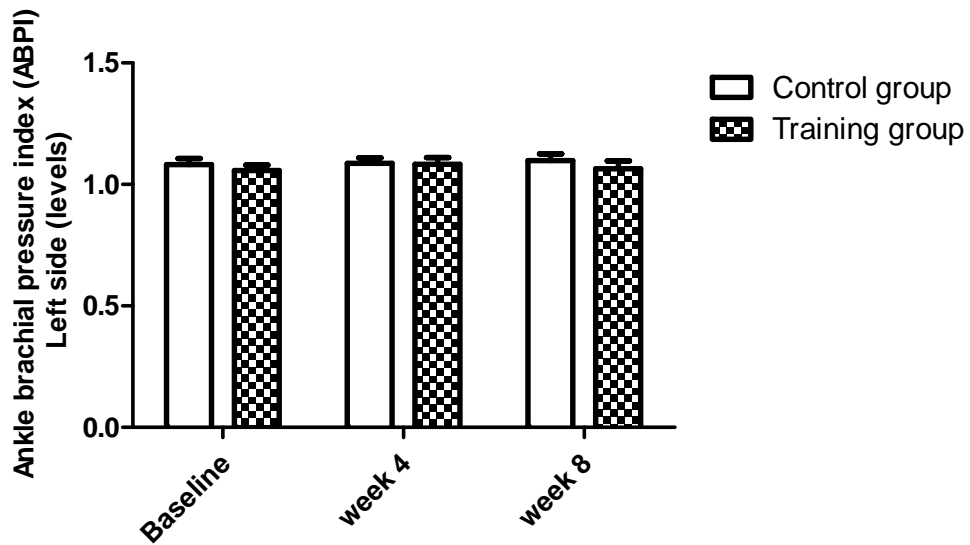
### 4.4.1 Ankle brachial pressure index (ABPI)

Right ABPI of TG was not significantly lower than CG at the 4<sup>th</sup> and 8<sup>th</sup> week. ABPI was no significant difference between 2 groups at baseline, 4<sup>th</sup> and 8<sup>th</sup> week, respectively. Right ABPI of TG was  $1.10 \pm 0.03$ ,  $1.09 \pm 0.02$ , and  $1.15 \pm 0.03$  at baseline, 4<sup>th</sup> week, and 8<sup>th</sup> week, respectively. While that in CG was  $1.12 \pm 0.03$ ,  $1.15 \pm 0.02$ , and  $1.14 \pm 0.03$  at baseline, 4<sup>th</sup> week, and 8<sup>th</sup> week, respectively.



**Figure 4.8** Right ankle brachial pressure index (ABPI) between CG and TG at baseline, 4<sup>th</sup>, 8<sup>th</sup> weeks, respectively. Data were mean  $\pm$  SEM.

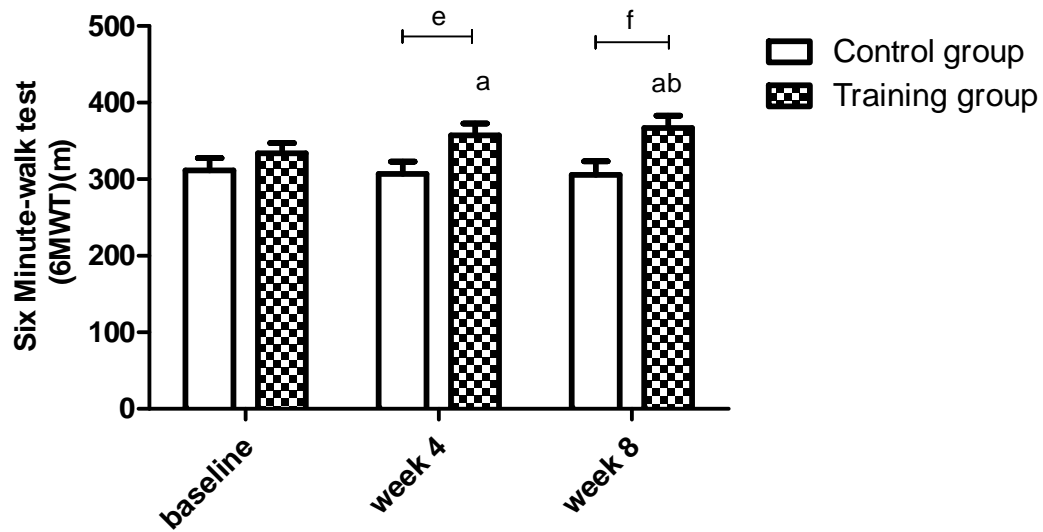
Left ABPI of TG was not significantly lower than CG at the 4<sup>th</sup> and 8<sup>th</sup> week. ABPI was no significant difference between 2 groups at baseline, 4<sup>th</sup> and 8<sup>th</sup> week, respectively. Left ABPI of TG was  $1.00 \pm 0.02$ ,  $1.08 \pm 0.02$ , and  $1.08 \pm 0.03$  at baseline, 4<sup>th</sup> week, and 8<sup>th</sup> week, respectively. While that in CG was  $1.09 \pm 0.02$ ,  $1.09 \pm 0.02$ , and  $1.12 \pm 0.02$  at baseline, 4<sup>th</sup> week, and 8<sup>th</sup> week, respectively.



**Figure 4.9 Left ankle brachial pressure index (ABPI) between CG and TG at baseline, 4<sup>th</sup>, 8<sup>th</sup> weeks, respectively. Data were mean ± SEM.**

#### 4.4.2 Six minute walk test (6MWT)

Six minute walk test (6MWT) of TG was significantly higher than that in CG at the 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. There was significant difference within group of TG at the 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. When compared 6MWT of TG was 333.80±13.44 m, 357.33±15.38 m, and 367.00±16.09 m at baseline, 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. While that in CG was 311.60±16.29 m, 306.87±16.33 m, and 305.80±17.67 m at baseline, 4<sup>th</sup> week and 8<sup>th</sup> week, respectively as shown in Figure 4.10.



**Figure 4.10 Six minute-walk test (6MWT) between CG and TG at baseline, 4<sup>th</sup>, 8<sup>th</sup> weeks, respectively. Data were mean  $\pm$  SEM.**

a =  $p < 0.05$  compared within group at baseline

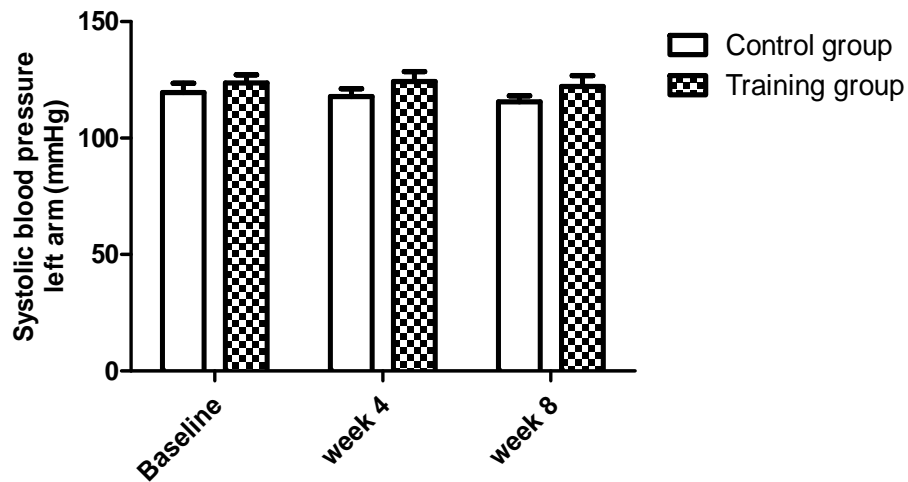
b =  $p < 0.05$  compared within group at 4<sup>th</sup> week

e =  $p < 0.05$  compared between CG and TG at 4<sup>th</sup> week

f =  $p < 0.05$  compared between CG and TG at 8<sup>th</sup> week

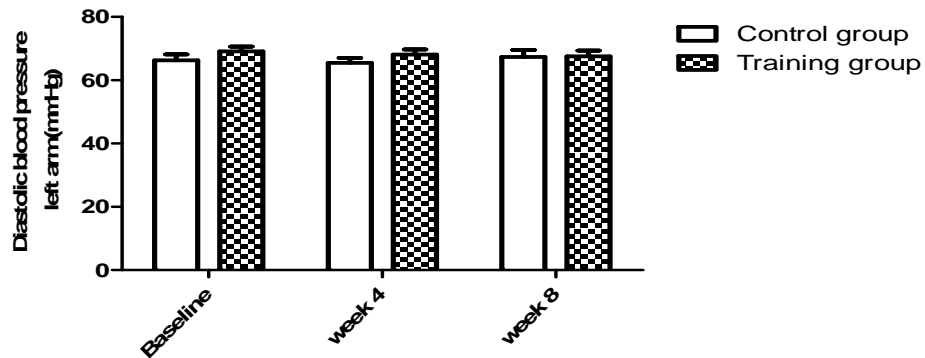
#### 4.4.3 Resting blood pressures (mmHg)

The systolic blood pressures (left arm) of TG were not significantly lower than CG at the 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. There was no significant difference between 2 groups at baseline, 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. Systolic blood pressures (left arm) of TG were  $123.73 \pm 3.47$  mmHg,  $124.33 \pm 4.18$  mmHg, and  $122.14 \pm 4.61$  mmHg at baseline, 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. While that in CG was  $119.56 \pm 4.01$  mmHg,  $118.11 \pm 3.26$  mmHg, and  $116.33 \pm 2.64$  mmHg at baseline, 4<sup>th</sup> week and 8<sup>th</sup> week, respectively as shown in Figure 4.11.



**Figure 4.11 Systolic blood pressure (left arm) between CG and TG at baseline, 4<sup>th</sup>, 8<sup>th</sup> weeks, respectively. Data were mean  $\pm$  SEM.**

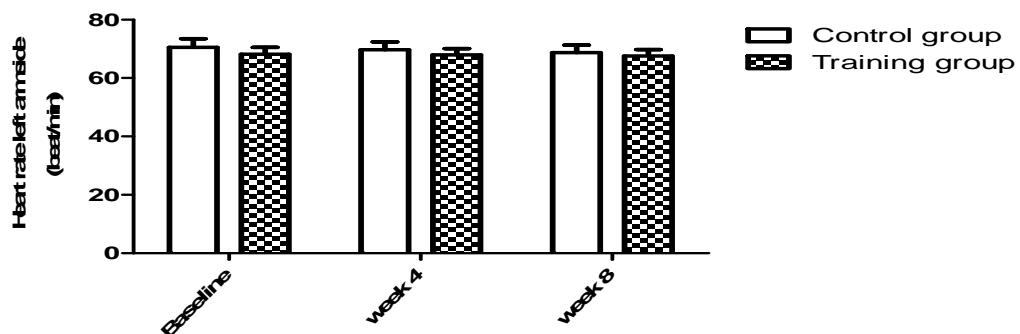
Diastolic blood pressures (left arm) of TG were not significantly lower than CG at the 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. There no significant difference between 2 groups at baseline: 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. Diastolic blood pressures (left arm) of TG were  $69.13 \pm 1.52$  mmHg,  $68.13 \pm 1.55$  mmHg, and  $67.6 \pm 1.75$  mmHg at baseline, 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. While that in CG was  $66.26 \pm 1.86$  mmHg,  $65.46 \pm 1.58$  mmHg, and  $67.33 \pm 2.2$  mmHg at baseline: 4<sup>th</sup> week and 8<sup>th</sup> week, respectively as shown in Figure 4.12.



**Figure 4.12 Diastolic blood pressure (left arm) between CG and TG at baseline, 4<sup>th</sup>, 8<sup>th</sup> weeks, respectively. Data were mean  $\pm$  SEM.**

#### 4.4.4 Resting heart rate (HR) (beat/min)

Resting heart rate of TG was not significantly lower than CG at the 4<sup>th</sup> and 8<sup>th</sup> week, respectively. There was no significant difference between 2 groups at baseline, 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. Resting heart rate of TG was  $64.93 \pm 2.32$  beat/min,  $67.93 \pm 2.15$  beat/min, and  $68.57 \pm 2.15$  beat/min at baseline, 4<sup>th</sup> week and 8<sup>th</sup> week respectively. While that in CG was  $70.89 \pm 2.97$  beat/min,  $69.56 \pm 2.61$  beat/min, and  $67.89 \pm 2.58$  beat/min at baseline, 4<sup>th</sup> week and 8<sup>th</sup> week respectively as shown in Figure 4.1

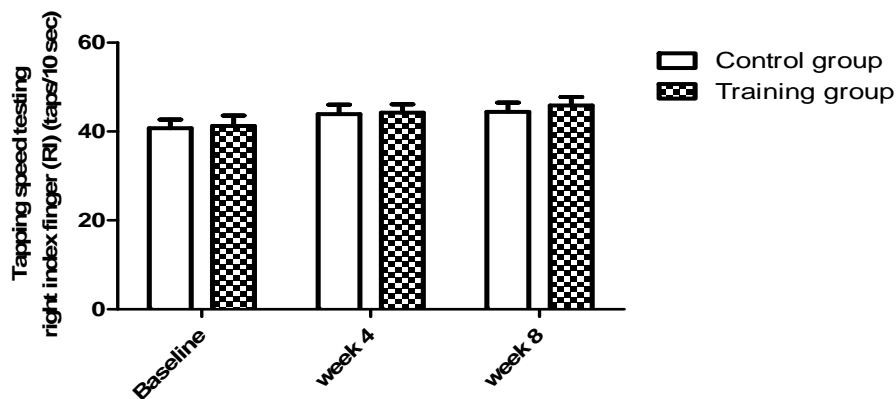


**Figure 4.13 Resting heart rate (left arm) between CG and TG at baseline, 4<sup>th</sup>, 8<sup>th</sup> weeks, respectively. Data were mean  $\pm$  SEM.**

## 4.5 Psychomotor performances

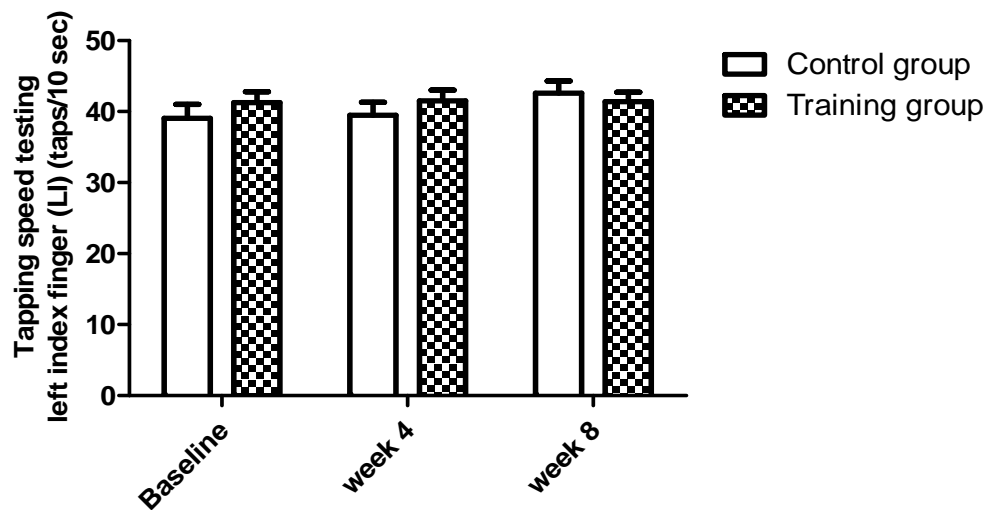
### 4.5.1 Tapping speed testing

Tapping speed testing right index finger of TG was not significantly higher than CG at the 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. There was no significant difference between 2 groups at baseline, 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. Tapping speed testing right index finger of TG was  $41.27 \pm 2.36$  taps/10 sec,  $44.27 \pm 1.84$  taps/10 sec, and  $45.87 \pm 1.91$  taps/10 sec at baseline, 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. While that in CG was  $39.67 \pm 1.91$  taps/10 sec,  $44.11 \pm 2.13$  taps/10 sec, and  $43.67 \pm 2.14$  taps/10 sec at baseline, 4<sup>th</sup> week and 8<sup>th</sup> week, respectively as shown in Figure 4.14.



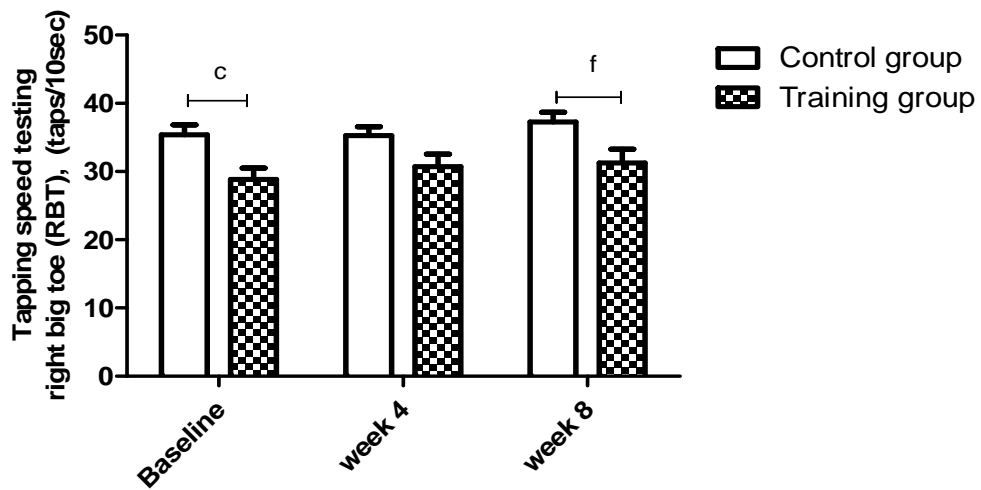
**Figure 4.14 Tapping speed test right index finger (RI) between CG and TG at baseline, 4<sup>th</sup>, and 8<sup>th</sup> weeks, respectively. Data were mean  $\pm$  SEM.**

Tapping speed testing left index finger of TG was not significantly higher than CG at the 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. There was no significant difference between 2 groups in baseline, 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. Tapping speed testing left index finger of TG was  $41.27 \pm 1.56$  taps/10 sec,  $41.53 \pm 1.48$  taps/10 sec, and  $41.40 \pm 1.32$  taps/10 sec at baseline, 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. While that in CG was  $38.33 \pm 1.94$  taps/10 sec,  $38.33 \pm 1.85$  taps/10 sec, and  $40.56 \pm 1.7$  taps/10 sec at baseline, 4<sup>th</sup> week and 8<sup>th</sup> week, respectively as shown in Figure 4.15.



**Figure 4.15 Tapping speed test left index finger (LI) between CG and TG at baseline, 4<sup>th</sup>, and 8<sup>th</sup> weeks, respectively. Data were mean  $\pm$  SEM.**

Tapping speed testing right big toe of TG was significantly higher than CG at the 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. There was significant difference between the 2 groups was found at baseline and 8<sup>th</sup> week. Tapping speed testing right big toe of TG was  $28.87 \pm 1.64$  taps/10 sec,  $30.73 \pm 1.83$  taps/10 sec, and  $31.27 \pm 2.01$  taps/10 sec at baseline, 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. While that in CG was  $34.89 \pm 1.46$  taps/10 sec,  $35.44 \pm 1.3$  taps/10 sec, and  $38.44 \pm 1.42$  taps/10 sec at baseline, 4<sup>th</sup> week and 8<sup>th</sup> week, respectively as shown in Figure 4.16.

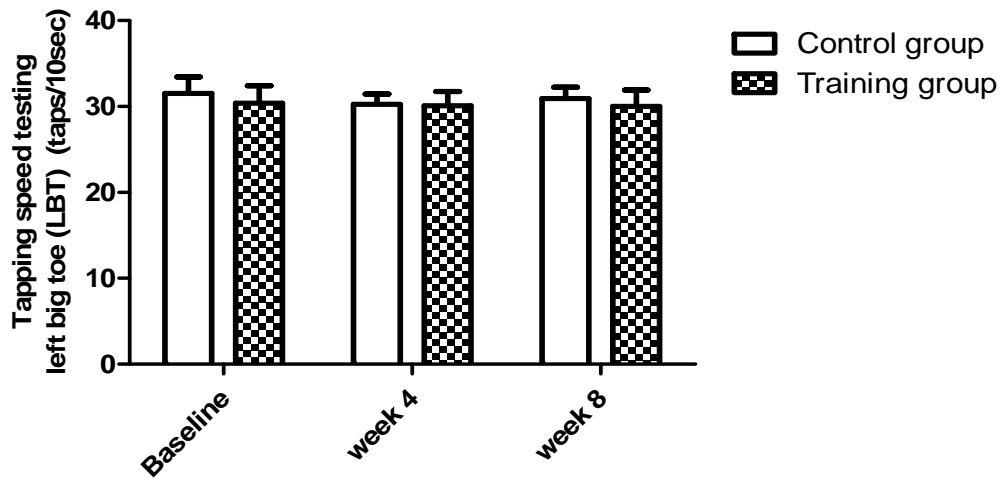


**Figure 4.16 Tapping speed test right big toe (RBT) between CG and TG at baseline, 4<sup>th</sup>, and 8<sup>th</sup> weeks, respectively. Data were mean ± SEM.**

c = p < 0.05 compared between CG and TG at baseline

f = p < 0.05 compared between CG and TG at 8<sup>th</sup> week

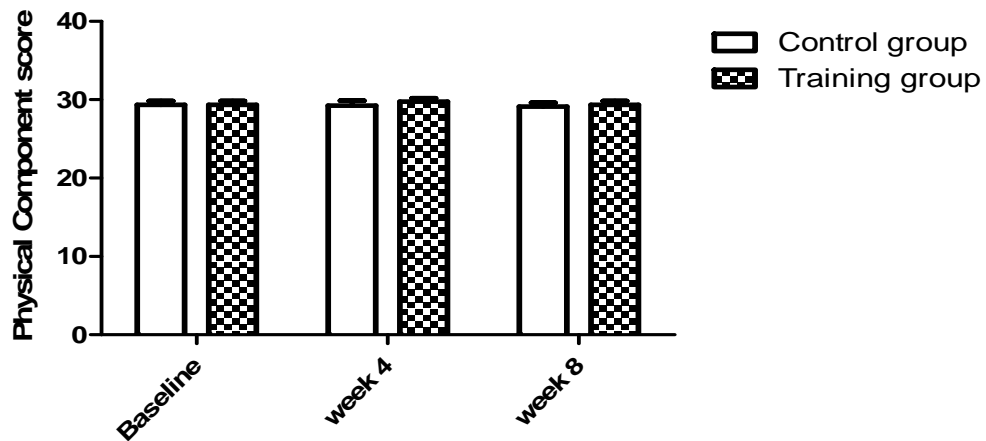
Tapping speed testing left big toe of TG was not significantly higher than CG at the 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. There was no significant difference between 2 groups in baseline, 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. Tapping speed testing left big toe of TG was 30.40±2.0 taps/10 sec, 30.07±1.68 taps/10 sec, and 30.00±1.9 taps/10 sec at baseline, 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. While that in CG was 31.33±1.92 taps/10 sec, 29.67±1.19 taps/10 sec, and 31.56±1.31 taps/10 sec at baseline, 4<sup>th</sup> week and 8<sup>th</sup> week, respectively as shown in Figure 4.17.



**Figure 4.17 Tapping speed test left big toe (LBT) between CG and TG at baseline, 4<sup>th</sup>, and 8<sup>th</sup> weeks, respectively. Data were mean  $\pm$  SEM.**

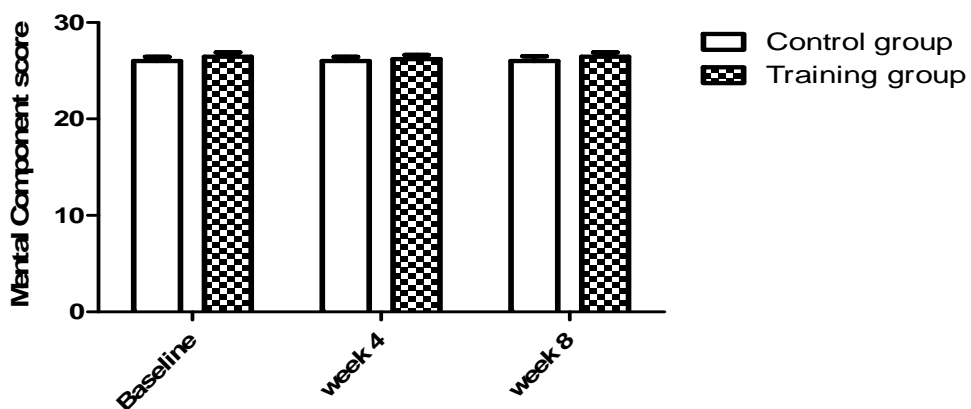
#### 4.6 Quality of life

Physical Component scale of TG was not significantly lower than CG at the 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. There was no significant between 2 groups at baseline, 4<sup>th</sup> and 8<sup>th</sup> week, respectively. Physical Component scale of TG was  $29.33 \pm 0.51$ ,  $29.73 \pm 0.44$ , and  $29.33 \pm 0.51$  at baseline, 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. While that in CG was  $29.33 \pm 0.52$ ,  $29.27 \pm 0.62$ , and  $29.13 \pm 0.46$  at baseline, 4<sup>th</sup> week, and 8<sup>th</sup> week, respectively as shown in Figure 4.18.



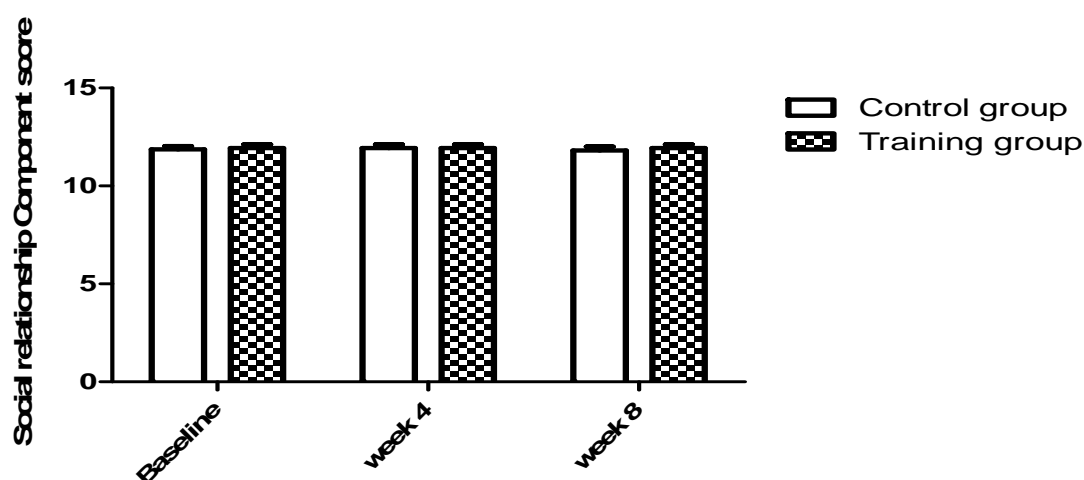
**Figure 4.18 Physical component score between CG and TG at baseline, 4<sup>th</sup>, and 8<sup>th</sup> weeks, respectively. Data were mean ± SEM.**

Mental Component scale of TG was not significantly lower than CG at the 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. There was no significant difference between 2 groups at baseline, 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. Mental component scale of TG was 26.47±0.45, 26.20±0.44, and 26.47±0.45 at baseline, 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. While that in CG was 26.00±0.43, 26.00±0.43, and 26.00±0.52 at baseline, 4<sup>th</sup> week, and 8<sup>th</sup> week, respectively as shown in Figure 4.19.



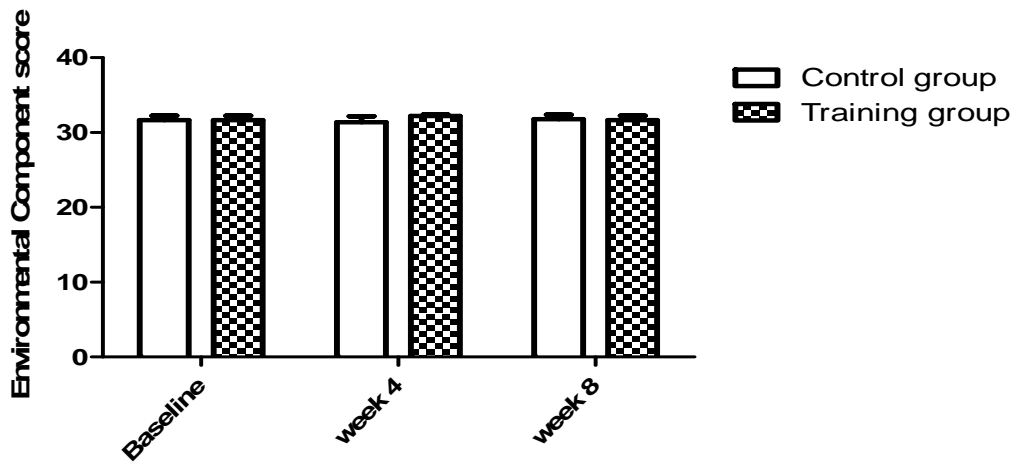
**Figure 4.19 Mean±SEM of mental component score parameter between CG and TG in baseline, 4<sup>th</sup>, and 8<sup>th</sup> weeks, respectively. Data were mean ± SEM.**

Social relationship Component scale of TG was not significantly lower than CG at the 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. There was no significant difference between 2 groups at baseline, 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. Social relationship Component scale of TG was  $11.93 \pm 0.59$ ,  $11.93 \pm 0.2$ , and  $11.93 \pm 0.59$  at baseline, 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. While that in CG was  $11.87 \pm 0.58$ ,  $11.93 \pm 0.78$ , and  $11.80 \pm 0.57$  at baseline, 4<sup>th</sup> week, and 8<sup>th</sup> week, respectively as shown in Figure 4.20.



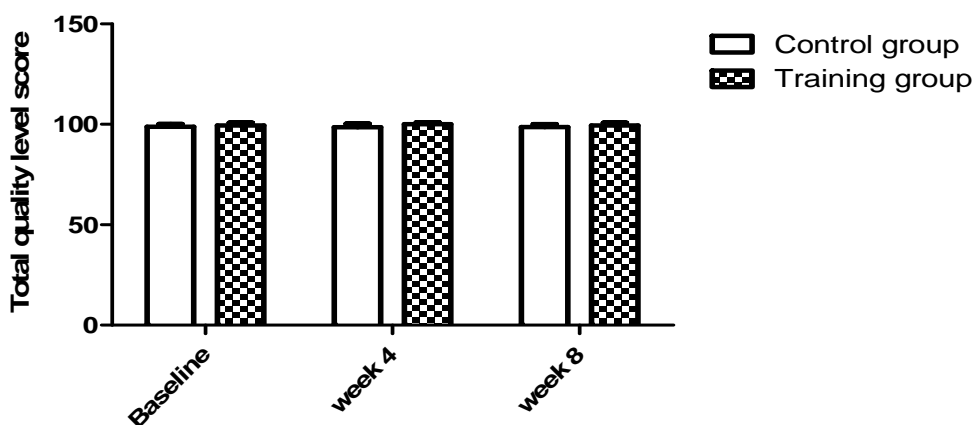
**Figure 4.20 Social relationship component score between CG and TG at baseline, 4<sup>th</sup>, and 8<sup>th</sup> weeks, respectively. Data were mean  $\pm$  SEM.**

Environmental Component scale of TG was not significantly lower than CG at the 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. There was no significant difference between 2 groups in baseline, 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. Environmental component scale of TG was  $31.67 \pm 0.18$ ,  $32.20 \pm 0.18$ , and  $31.67 \pm 0.18$  at baseline, wk-4, and wk-8, respectively. While that in CG was  $31.67 \pm 0.16$ ,  $31.40 \pm 0.18$ , and  $31.80 \pm 0.2$  at baseline, 4<sup>th</sup> week, and 8<sup>th</sup> week, respectively as shown in Figure 4.21.



**Figure 4.21 Environment component score parameter between CG and TG at baseline, 4<sup>th</sup>, and 8<sup>th</sup> weeks, respectively. Data were mean ± SEM.**

Total quality level score of TG was not significant lower than CG at the 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. There was no significant difference between 2 groups in baseline, 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. Total quality level score of TG was 99.40±1.38, 100.10±0.93, and 99.40±1.38 at baseline, 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. While that in CG was 98.87±1.36, 98.60±1.73, and 98.73±1.38 at baseline, 4<sup>th</sup> week, and 8<sup>th</sup> week, respectively as shown in Figure 4.22.



**Figure 4.22 Total quality level score between CG and TG at baseline, 4<sup>th</sup>, and 8<sup>th</sup> weeks, respectively. Data were mean ± SEM.**

## **CHAPTER V**

### **DISSCUSSION**

To the best of our knowledge, the present work is done for the first time to investigate the effects of long term exercise training using the interactive video games on cardiovascular and psychomotor responses such as ankle brachial pressure index (ABPI), and percentage of fat in the elderly with hypertension and compared cardiovascular and psychomotor responses in the elderly with hypertension in between control and exercise training groups for 8 week by using the interactive video games.

In this study, ages of the participants were 60-75 years old and divided into two groups, group I: group exercise using an interactive video game and group II: control group (non-exercise group). The exercise training groups have to exercise for thirty minutes per day, three days per week, for eight weeks.

#### **5.1 The characteristics of subjects**

In this study, the physical characteristics of the age, body weight, height, body mass index (BMI), waist circumference, hip circumference, resting heart rate, resting systolic blood pressure, resting diastolic blood pressure, percent of body fat were measured at the beginning of the study.

The results after training for 8 weeks, weight, body mass index (BMI) and percentage of body fat were no significant different when compared with TG and CG group. However, TG group showed that body weight, body mass index (BMI), and percent of body fat (%FAT) were decreased after training for 8 weeks. Evrim C.et.al.,2010(39) found the significantly difference ( $p < 0.05$ ) of the body weight, body mass index, % body fat after 8 weeks of exercise training, which is similar to our study. Maddison R, 2011 (54) found that video games which the players physically interact with the images on the screen would help to increase physical activity and improved body composition. He concluded that the active intervention of the video

game could change BMI and body composition in children with overweight and obesity.

Steven Katz & Huxley, 2009(55) found that gender has a direct influence on body composition, and women have traditionally been shown to have more body fat when compared to men. Similar to Brooks, et.al, 2005(57) found that gender also has a direct influence on cardiovascular endurance, which would involve an individual's blood pressure. Furtherer Pollock B,2011(56) found that the changes associated with , percent of body fat and body weight could have been directly influenced by the large total number of women finding indicates the potential for the Wii Fit Plus to provide physiological benefits to an adult population. It supports Darren E.R. Warburton, 2007 that found College-aged males were stratified (aerobic fitness and body mass) and then assigned randomly to experimental ( $n = 7$ ) or control ( $n = 7$ ) conditions. Program attendance, health-related physical fitness (including maximal aerobic power ( $VO_{2\max}$ ), body composition, muscular strength, muscular power, and flexibility), and resting blood pressure were measured before and after training (60%–75% heart rate reserve, 3 d/week for 30 min/d for 6 weeks). There were no significant changes in body composition after either training program. Attendance mediated the relationships between condition and changes in health outcomes (including  $VO_{2\max}$ , vertical jump, and systolic blood pressure). The present investigation indicates that a training program that links interactive video games to cycle exercise results in greater improvements in health-related physical fitness than that seen after traditional cycle exercise training. It appears that greater attendance, and thus a higher volume of physical activity, is the mechanism for the differences in health-related physical fitness.

Darren E.R. et al., 2007 present investigation indicates that a training program that links interactive video games to cycle exercise results in greater improvements in health-related physical fitness than that seen after traditional cycle exercise training. It appears that greater attendance, and thus a higher volume of physical activity, is the mechanism for the differences in health-related physical fitness but this research found only little benefit maybe due to the game that used in this study was not efficient or the period of training was too short.(58)

## **5.2 Muscle strength**

Hand grip strength of the right and the left arm of TG were not significantly difference than CG at the 4<sup>th</sup> and 8<sup>th</sup> week, respectively. Hand grip strength of this study showed that the training interactive video game did not improve hand grip strength during play the games. Because the interactive game training was not controlled game by hand directly but used the nunchuck to control in every game during. Furthermore, interactive video game in this study used a form of aerobic exercise training with leg continued the pattern of the game.

According to Franco et al, 2012 included approximately 13 minutes of Wii Fit training and 15 minutes of supplemental home exercises (strengthening), and 2 studies designated 40 minutes of resistance training and balance exercises plus 10 to 15 minutes of a dance video game. Some studies included warming-up and cooling down during the sessions. (59) Chen et al, 2013 used 3/3 minutes (warming up/cooling down) and the others: 10/5, 21 5/5, 8/8, and only 5 minutes of warming up. The activities varied in the warming-up sessions of each study including stretching of all the muscles and massaging with a ball to improve blood circulation and relax the muscles; and cardiovascular training on a stationary bicycle. The cooling-down sessions included stretching and deep breathing and video game intervention. (60)

From the results provide no significant positive impact because small sample size and short duration of the study. It is suggested that future studies should increase both sample size and the length of the training period and employ an intent-to-treat design. A longer duration study might also allow participants to be tracked for falls and associated levels of Muscle strength.

## **5.3 Cardiovascular physiological system tests**

### **5.3.1 Ankle brachial pressure index (ABPI)**

The ABPI was done by calculating ratios of the pressure at the ankle and in the arm while a subject was at rest and in supine position. The brachial and ankle systolic pressure were measured. (Sacks et al, 2002)(42)

Right ankle brachial pressure index (ABPI) of TG was not significant lower than CG at the 4<sup>th</sup> and 8<sup>th</sup> week, respectively, but it was not significant difference. For right ankle brachial pressure index (ABPI), there was no significant difference between 2 groups at baseline, 4<sup>th</sup> and 8<sup>th</sup> week of training, respectively.

Left ankle brachial pressure index (ABPI) of TG was not significant by lower than CG at the 4<sup>th</sup> and 8<sup>th</sup> week, respectively. For the left ankle brachial pressure index (ABPI), there was no significant difference between 2 groups at baseline, 4<sup>th</sup> and 8<sup>th</sup> week, respectively after training. They have been studied previously by Colakoglu and Karacan, 2006(40) found that after training by walking and running 30 min/day, 3 day/week for 12 weeks, there was no significant difference between the tests of SBP and DBP.

The ABPI index is calculated through measuring the maximum systolic pressure at the ankle of dorsalis pedis artery then divided by the systolic pressure of the brachial artery. The ABPI was a quick non-invasive method of measuring the effect of the arterial disease. It developed as an indicator for peripheral vascular disease, such as atherosclerosis and can predict the risk of cardiovascular disease. (McGee, 1998; Resnick, 2004; Woo, 2005)(33, 35, 36). Gornik and coworker, 2005 (37), stated that normally the blood pressure in the ankles was the same or slightly higher than the blood pressure in the legs. This finding was supported by Virtanen and coworker, 1982 (38), who demonstrated that the central action of clonidine inhibits peripheral release of norepinephrine, was insufficient to attenuate cardiac stimulation by physical exercise. Reduction of ABPI is a strong independent predictor of cardiovascular mortality in all patients with peripheral arterial disease. (34)

### **5.3.2 Six minute walk test (6MWT)**

The result of this study found that six minute walk test (6MWT) of TG was significantly higher than that in CG at the 4<sup>th</sup> week and 8<sup>th</sup> week, respectively. There was significant difference ( $p < 0.05$ ) within group of TG at the 4<sup>th</sup> week and 8<sup>th</sup> week, respectively, compared to the baseline 6MWT. In accordance with Burr JF, 2001 (53) found the 6MWT indicated the severity of moderate to heavy of aerobics exercise which correlated with health status,

The result of this study found that six minute walk test (6MWT) of TG was significantly greater than that in CG at the 4th week and 8th week, respectively. There was significant difference within group of TG at the 4th week respectively, compared to the baseline. In accordance with Burr, 2001 (27), the 6MWT and correlated with health status indicated the severity of moderate to strong which were useful in the classification of exercise aerobics. Inclusion of further readily available variables, such as body weight, sex, resting heart rate, and age, greatly improved the discriminative ability of the 6MWT and allowed for the creation of a useful prediction equation. Inclusion of further measures, such as ejectional symptoms or body composition may have improved predictive abilities further, but were unavailable for the current investigation and may be cumbersome for inclusion by primary care physicians or other members of the health care team seeking a simple fitness estimation tool.

Although the six minute walk test has been used to detect changes following interventions to improve exercise tolerance for healthy older adults (28,29) as well as people with rheumatologic conditions such as knee or hip osteoarthritis (30) and fibromyalgia (31). The 6MWT has been used with a variety of other conditions such as heart failure (32,33), chronic obstructive pulmonary disease (COPD)(34) and stroke (35,36) It has also been used to predict hospitalization and mortality (37,38).

We found that elderly persons can safely perform the 6MWT to quickly measure their functional status and some effects of training with interactive video game.

It is probable that the relationship between health status and 6MWT-distance reflects the influence of the status of the cardiovascular system on the general fitness. Studies of exercise physiology have revealed a direct relationship between muscle strength and physical exercise. Decreased physical activity (i.e., inactivity) usually leads to altered muscle metabolism, decreases in muscle mass and lower physical capacity.(35) This relation is more obvious among patients with comorbid conditions, in which the rate of inactivity correlates significantly with 6MWD(40,41). Local data suggested there was a high prevalence of physical inactivity among Saudis, particularly those who are middle-aged.(42,43)

Zorba.et. al., 2000.(44) reported that of regularly conducted exercises, a decrease in thickness of subcutaneous fat and an increase in fat-free muscle mass can be expected similar to our study.

Geiger.et.al. 2007 (61) identify the 6MWT as safe, easy to perform and an acceptable method for determining functional exercise capacity in elder. Similar to the 12 minute test, the objective of the 6MWT is to walk as far as possible at a constant, uninterrupted pace in 6 minutes. Using a self-paced walking method to assess cardiorespiratory fitness has been found to accurately reflect submaximal functional capacity of healthy elder and patterns of their daily activities. The 6MWT has been increasingly used in elder due to the high degree of cooperation, coordination and motivation required to perform most cardiopulmonary exercise tests.

Lammers et al., 2007 (62) while all of the exercise by video game mentioned has several advantages, the 6MWT appears to be the most appropriate for elder. There is no elimination involved as all elder will walk for an equal amount of time. Additionally, having all elder participate for the same amount of time at their own pace avoids having the more fit participants being finished first and the less fit taking longer to finish.

Elderly can benefit from a videogame based exercise at improving balance, where people had to move a platform in response to stimulation from a game that was fun to play and challenging. The videogame might improve quickly it takes longer training. The videogame can be employed as attractive and motivational learning device for elderly. This videogame is an important characteristic of most of our daily activities and production of goal-directed movements within a specific environment. Moreover, the videogame create the balance, the ability to orient oneself in space, the motion-tracking to capture whole body movements.

## 5.4 Psychomotor performances

### 5.4.1 Tapping speed Testing

Tapping speed testing of TG and CG were not significant differences. In this study, it is anticipated that the training will have the effect of increasing the number of tapping times. However, the results of this study showed that right index finger tapping and left index finger tapping were not significant difference between both groups.

The result of this study found that right big toe tapping increased significantly at baseline and week-8 when compared between CG and TG groups. The left big toe was not significant difference. Since the tapping at baseline had a different effect from the beginning and practicing interactive video game has no effect on the development of tapping at the 4th week and 8th week, respectively

This may imply that, the psychomotor performances including speed of tapping (TST) in time were limited. These tests composed of various physiological components; the time integration of signals and decision making plus time spent in motor pathways and muscle contractions. The psychomotor speeds data have been shown to reflect quite well with physical fitness. Reilly and Smith, 1986 (45) suggested that the implications for activities where psychomotor task were superimposed on a requirement for high muscular power out levels. Beverly and co-worker, 2006 (44) found that the reaction time was not merely an indicator of age-related physiological deteriorations but rather an indicator of the brain's basic information processing ability. Chentanez and co-worker, 1990 (43) suggested that the measurement of reaction time could be used in confirming the location of lesion in the patient with neuronal circuit damaged in brain, spinal cord or peripheral nerve pathways (16). The tapping test has been originally developed as part of neuropsychological tests, is a simple measurement of motor speed and motor control which is used in neuropsychology as a sensitive test for brain damage. Mitrushina et al., 1999(48), Penteado and co-workers (1993)(46) reported that patient with sensorineural hearing loss was caused by vertebrobasilar obstructive disease. Spirduso, 1980 (47) suggested that measurement of the tapping speed test data had been shown to reflect the level of physical fitness, in which people who exercise

regularly usually had greater psychomotor speeds than sedentary subjects. Furthermore the age and gender may affect psychomotor. (49, 50)

## **5.5 Quality of life**

The quality of life at baseline in CG and TG were the same in all aspects. However, the quality of life after training was better than that at baseline in the both group but there was no significant difference between and within groups. It was supported by Saposnik et al., 2010 (51), and Nitz et al., 2010 (52) when compared participants before and after Wii Fit training. Therefore, the interactive video games can help for enjoying and health promotion in elderly.

Adair, G. 1984. Study about the Hawthorne effect, for the improvement of well-being among the elderly. It is possible that the elderly may appreciate the increased amount of attention paid to them during the intervention, which could have resulted in their improved well-being. However, the lack of significant positive changes in the control group negates the Hawthorne effect as both groups received the same amount of attention during the intervention. (63) According to, Younbo Jung, 2009. the results demonstrated the potential of Wii to impact diverse aspects of the elders' lives, from psychological to physical well-being. Not only do the significant improvements in the Wii-playing group demonstrate how Wii can be effective in improving the overall well-being of the elderly, they also reflect the multi-functional nature of the Wii and its unique ability to facilitate physical activity. While past research has generally proven the usefulness of technology and all its features on psychological well-being and interaction, there have been relatively a few studies that examined the multiple roles that a video game can have in the context of the elderly and healthcare. The confluence of psychological and physical aspects of playing Wii makes it a unique device that has the potential to be a source of entertainment, exercise, and interpersonal bonding. (64)

Lin et al. (2007) found each session lasted 40 to 60 minutes over a period of 4 months. Resulted showed did not improved quality of life for the exercise-training group. In comparison to the falls prevention education group, the exercise training group scored 2.1 points higher in the physical domain, 3.8 points higher in the

psychological domain, 3.4 points higher on the social domain, and 3.2 points higher in the environmental domain on the World Health Organization Quality of Life instrument. (65) Katula et al. 2008 compared the effects of progressive resistance strength training (ST) and high velocity power training (PT) on improving measures of quality of life in older adults. Over a period of 12 weeks, participants in the ST and PT groups completed three training sessions per week, with the intervention focus on lower body exercises using both Nautilus machines and dumbbells. Participants completed the Self-Efficacy for Strength (SE), the Satisfaction with Physical Function (SPF), and The Satisfaction With Life Scale (SWL). Results showed no significant change in SE, SPF, and SWL for the PT group versus control group and greater change in SE for the ST group versus control group. These results show that PT may affect more levels of quality of life for the older adult, although more evidence is needed. (66)

## **CHAPTER VI**

### **CONCLUSION**

The present study found that

1. After training for 8 weeks, weight, body mass index (BMI) and percentage of body fat were not significantly different when compared the TG and CG group. However, TG group showed that body weight, body mass index (BMI), and percent of body fat (%FAT) were decreased after training for 8 weeks.

2. Hand grip strength of the right and left arm of TG were not significantly different from CG at the 4th and 8th week, respectively. Hand grip strength of this study showed that the training interactive video game did not show improvement hand grip strength during play the games. This may be due to the interactive game training did not of control the game by hand directly but used the nunchuck to control in every game during. Furthermore, interactive video game in this study used a form of aerobic exercise training with leg to continue the pattern of the game.

3. The right ankle brachial pressure index (ABPI) of TG was not significant lower than CG at the 4th and 8th week, respectively, but it was not significantly different. For the right ankle brachial pressure index (ABPI), there was no significant difference between the 2 groups at baseline, 4th and 8th week of training, respectively.

4. The left ankle brachial pressure index (ABPI) of TG was not significant lower than CG at the 4th and 8th week, respectively, but it was not significantly different. For the left ankle brachial pressure index (ABPI), there was no significant difference between the 2 groups at baseline, 4th and 8th week, respectively after training.

5. The six minute walk test (6MWT) of TG was significantly higher than that in CG at the 4th week and 8th week, respectively. There was significant difference

( $p < 0.05$ ) within group of TG at the 4th week and 8th week, respectively, compared to the baseline 6MWT.

6. Tapping speed testing of TG and CG were not significantly different. In this study, it is anticipated that the training will have the effect of increasing the number of tapping times. However, the results of this study showed that the right index finger tapping and the left index finger tapping were not significantly different between both groups.

7. The result of this study found that the right big toe tapping increased significantly at baseline and week-8 when compared between CG and TG groups. The left big toe was not significant different. Since the tapping at baseline had a different effect from the beginning and practicing interactive video game has no effect on the development of tapping at the 4th week and 8th week, respectively

8. The quality of life at baseline in CG and TG were the same in all aspects. However, the quality of life after training was better than that at baseline in the both group but there was no significant difference between and within groups.

In conclusion, exercise training by using interactive video games for 8 weeks can affect the cardiovascular, and body composition in the elderly. Therefore, it can help to improve health in elderly.

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## **APPENDICES**

## APPENDIX A

### MU-IRB SUBMISSION FORM



COA. No. 2014/082.2207

**Certificate of Approval**  
**Mahidol University Institutional Review Board (MU-IRB)**

**Protocol No.:** MU-IRB 2014/061.0805

**Title of Project:** Psychomotor and Cardiovascular Physiological Changes in Elderly by Training with Interactive Video Games  
(Thesis for Master Degree)

**Principal Investigator:** Miss Kewalee Wiriyaweerawat

**Co-Investigator:** Associate Professor Thyon Chentanez

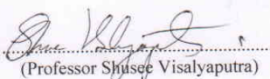
**Affiliation:** College of Sports Science and Technology

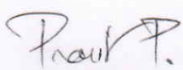
**Approval includes:** 1) MU-IRB Submission form version date 21 July 2014  
2) Participant Information Sheet version date 21 July 2014  
3) Informed Consent form version date 21 July 2014  
4) Data Recording form version date 20 June 2014  
5) Questionnaire for Screening version date 20 June 2014  
6) Recruitment Material version date 20 June 2014

Mahidol University Institutional Review Board is in full compliance with International Guidelines for Human Research Protection such as Declaration of Helsinki, The Belmont Report, CIOMS Guidelines and the International Conference on Harmonization in Good Clinical Practice (ICH-GCP)

**Date of Approval:** 22 July 2014

**Date of Expiration:** 21 July 2015

**Signature of MU-IRB Chair:**  ..... 22 July 2014  
(Professor Shusee Visalyaputra) version date

**Signature of Institute Representative:**  ..... 22 July 2014  
(Professor Prasit Palittapongarnpim) version date  
Vice President for Research

Office of the President, Mahidol University, 999 Phuttamonthon 4 Rd., Salaya, Phuttamonthon District, Nakhon Pathom 73170. Tel. (662) 8496224-5 Fax. (662) 8496274

COA MU-IRB version date 31 January 2013

## APPENDIX B

### PARTICIPANT CONSENT FORM

หนังสือแสดงเจตนายินยอมเข้าร่วมการวิจัยโดยได้รับการบอกกล่าวและเต็มใจ

วันที่..... เดือน..... พ.ศ.....

ข้าพเจ้า.....อายุ.....ปี อาศัยอยู่บ้านเลขที่.....

ถนน.....ตำบล.....อำเภอ.....

จังหวัด.....รหัสไปรษณีย์..... โทรศัพท์ .....

ขอแสดงเจตนายินยอมเข้าร่วม โครงการวิจัย เรื่อง ผลของการเปลี่ยนแปลงทางสรีรวิทยาด้านไซโคมอเตอร์และระบบไหลเวียนโลหิตในผู้สูงอายุด้วยการฝึกวิถีไอเกมส์แบบปฏิสัมพันธ์

โดยข้าพเจ้าได้รับทราบรายละเอียดเกี่ยวกับที่มาและจุดมุ่งหมายในการทำวิจัย รายละเอียดขั้นตอนต่างๆ ที่จะต้องปฏิบัติหรือได้รับการปฏิบัติ ประโยชน์ที่คาดว่าจะได้รับของการวิจัยและความเสี่ยงที่อาจเกิดขึ้นจากการเข้าร่วมการวิจัย รวมทั้งแนวทางป้องกันและแก้ไขหากเกิดอันตรายขึ้น ค่าตอบแทนที่จะได้รับค่าใช้จ่ายที่ข้าพเจ้าจะต้องรับผิดชอบจ่ายเอง โดยได้อ่านข้อความที่มีรายละเอียดอยู่ในเอกสารชี้แจงผู้เข้าร่วมการวิจัยโดยตลอด อีกทั้งยังได้รับคำอธิบายและตอบข้อสงสัยจากหัวหน้าโครงการวิจัยเป็นที่เรียบร้อยแล้ว

ข้าพเจ้าจึงสมัครใจเข้าร่วมในโครงการวิจัยนี้ :

หากข้าพเจ้ามีข้อข้องใจเกี่ยวกับขั้นตอนของการวิจัย หรือหากเกิดเหตุการณ์ที่ไม่พึงประสงค์จากการวิจัยขึ้นกับข้าพเจ้า จะสามารถติดต่อกับ รศ.ดร. ไถ่อน ชินชนะ ได้ที่เบอร์โทรศัพท์ 089-070-9804

หากข้าพเจ้า ได้รับการปฏิบัติไม่ตรงตามที่ระบุไว้ในเอกสารชี้แจงผู้เข้าร่วมการวิจัย ข้าพเจ้าสามารถติดต่อกับประธานคณะกรรมการจริยธรรมการวิจัยในคนหรือผู้แทน ได้ที่สำนักงานคณะกรรมการจริยธรรมการวิจัยในคน สำนักงานอธิการบดีมหาวิทยาลัยมหิดล ถนนพุทธมณฑล สาย 4 ตำบลศาลายา อำเภอพุทธมณฑล จังหวัดนครปฐม 73170 หมายเลขโทรศัพท์ 02-849-6223-5 โทรสาร 02-849-6223

ข้าพเจ้าได้ทราบถึงสิทธิ์ที่ข้าพเจ้าจะได้รับข้อมูลเพิ่มเติมทั้งทางด้านประโยชน์และโทษจากการเข้าร่วมวิจัย และสามารถถอนตัวหรืองดเข้าร่วมวิจัยได้ทุกเมื่อ โดยจะไม่มีผลกระทบใดๆต่อข้าพเจ้า และยินยอมให้ผู้วิจัยใช้ข้อมูลส่วนตัวของข้าพเจ้าที่ได้จากการวิจัย แต่จะไม่เผยแพร่ต่อสาธารณะเป็นรายบุคคล โดยจะนำเสนอเป็นข้อมูลโดยรวมจากการวิจัยเท่านั้น

ข้าพเจ้าเข้าใจข้อความในเอกสารชี้แจงผู้เข้าร่วมการวิจัย และหนังสือแสดงเจตนายินยอมนี้โดยตลอดแล้ว จึงลงลายมือชื่อไว้

ลงชื่อ.....ผู้เข้าร่วมการวิจัย/ผู้แทนโดยชอบธรรม/ วันที่.....

(.....)

ลงชื่อ.....ผู้ให้ข้อมูลและขอความยินยอม/หัวหน้าโครงการวิจัย/ วันที่.....  
(นางสาว เกวลี วิริยะวิรัตน์)

ในกรณีผู้เข้าร่วมการวิจัยไม่สามารถอ่านหนังสือได้ผู้ที่อ่านข้อความทั้งหมดแทนผู้เข้าร่วมการวิจัย  
คือ..... จึงได้ลงลายมือชื่อไว้เป็นพยาน  
ลงชื่อ..... พยาน/ วันที่.....  
(.....)

## APPENDIX C

### QUESTIONNAIRE

สำหรับคัดเลือกอาสาสมัครเข้าร่วมงานวิจัยวิทยานิพนธ์ สาขาวิทยาศาสตร์การกีฬา  
วิทยาลัยวิทยาศาสตร์และเทคโนโลยีการกีฬา มหาวิทยาลัยมหิดล

เรื่อง : ผลของการเปลี่ยนแปลงทางสรีรวิทยาด้านไซโตไคน์และระบบการไหลเวียนโลหิตใน  
ผู้สูงอายุด้วยการฝึกวิดิโอเกมส์แบบปฏิสัมพันธ์

คำชี้แจง : โปรดกรอกข้อมูลและตอบคำถามต่อไปนี้ ข้อมูลทั้งหมดในแบบสอบถามจะถูกเก็บเป็นความลับ และใช้  
ในงานวิจัยนี้เท่านั้น

1. โรคประจำตัว
 

|   |  |
|---|--|
| <input type="checkbox"/> ความดันโลหิตสูง  | <input type="checkbox"/> เบาหวาน             |
| <input type="checkbox"/> โรคหัวใจ         | <input type="checkbox"/> ข้อเข่าเสื่อม       |
| <input type="checkbox"/> เกาต์            | <input type="checkbox"/> ปวดหลัง             |
| <input type="checkbox"/> อัมพฤกษ์/อัมพาต  | <input type="checkbox"/> อื่นๆ โปรดระบุ..... |
| <input type="checkbox"/> ไม่มีโรคประจำตัว |  |
  
2. ปัจจุบันท่านต้องรับประทานยาเป็นประจำ หรือไม่
 

|                                 |  |
|---------------------------------|--|
| <input type="checkbox"/> ไม่ใช่ | <input type="checkbox"/> ใช่ โปรดระบุชื่อยา..... ระยะเวลาที่ใช้.....ปี |
|                                 | โปรดระบุชื่อยา..... ระยะเวลาที่ใช้.....ปี                              |
|                                 | โปรดระบุชื่อยา..... ระยะเวลาที่ใช้.....ปี                              |
  
3. ประวัติการสูบบุหรี่  ไม่สูบบุหรี่
 

|   |
|---|
| <input type="checkbox"/> สูบบุหรี่เป็นบางครั้ง                |
| <input type="checkbox"/> สูบบุหรี่เป็นประจำ ระบุ..... มวน/วัน |
  
4. ประวัติการดื่มเครื่องดื่มแอลกอฮอล์
 

|   |
|---|
| <input type="checkbox"/> ไม่ดื่ม เครื่องดื่มแอลกอฮอล์ใดๆ                            |
| <input type="checkbox"/> ดื่มเครื่องดื่มแอลกอฮอล์เป็นบางครั้ง                       |
| <input type="checkbox"/> ดื่มเครื่องดื่มแอลกอฮอล์ใดๆเป็นประจำ ระบุ..... วัน/สัปดาห์ |

5. ประวัติการผ่าตัด  ไม่เคย  เคยผ่าตัดข้อเข่า  เคยผ่าตัดข้อสะโพก  
 เคยผ่าตัดหลัง  อื่นๆ โปรดระบุ.....

6. การวัดสายตา  ใส่แว่น  ไม่ใส่แว่น

7. การได้ยิน  ได้ยินชัดเจน  ได้ยินไม่ชัดเจน

8. ประวัติการออกกำลังกาย

8.1 ท่านให้เวลากับการออกกำลังกายมากน้อยเพียงใด

- ไม่ได้ออกกำลังกายมาเป็นเวลามากกว่า 3 เดือน  
 ออกกำลังกายเป็นบางครั้ง 1 ครั้ง / สัปดาห์  
 ออกกำลังกายเป็นประจำ 2-3 ครั้ง / สัปดาห์  
 ออกกำลังกายสม่ำเสมอมากกว่า 3 ครั้ง / สัปดาห์

8.2 ประเภทกีฬา หรือ การออกกำลังกายชนิดใดที่ท่านปฏิบัติอยู่ ระบุ.....

ออกกำลังกายมานาน

- 3 – 6 เดือน  6 – 9 เดือน  
 9 – 12 เดือน  1 ปีขึ้นไป

8.3 ระยะเวลาของการออกกำลังกาย / เล่นกีฬาที่ท่านปฏิบัติในแต่ละครั้ง

- น้อยกว่า 20 นาที  20-30 นาที  
 30-60 นาที  มากกว่า 60 นาที

8.4 ลักษณะของการออกกำลังกาย / เล่นกีฬาที่ท่านปฏิบัติในแต่ละครั้ง

- ไม่ต่อเนื่อง (พักนาน มากกว่า 15 นาที)  ไม่ต่อเนื่อง (พักไม่เกิน 15 นาที)  
 ต่อเนื่อง เป็นเวลา.....นาที

8.5 ระดับความหนักของการออกกำลังกาย / เล่นกีฬาที่ท่านปฏิบัติ

- เบา (เริ่มรู้สึกเหนื่อย, ไม่มีเหงื่อออก)  
 ปานกลาง (รู้สึกเหนื่อย, เหงื่อออกเล็กน้อย)  
 หนัก (เหนื่อยมาก, เหงื่อออกค่อนข้างมาก, กระจายน้ำมาก)  
 หนักมาก (เหนื่อยมาก, เหงื่อออกมาก, กระจายน้ำมาก, ชีพจรเต้นเร็ว, ปวดเมื่อยกล้ามเนื้อ)

9. น้ำหนัก.....กิโลกรัม ส่วนสูง.....เซนติเมตร ดัชนีมวลกาย.....กก./ม2

10. ความดันโลหิต.....มม.ปรอท อัตราการเต้นของหัวใจ.....ครั้ง/นาที

11. ในระยะเวลา 6 เดือนที่ผ่านมา คุณเคยล้มหรือไม่

- ไม่เคย  เคย 1 ครั้ง  
 เคย 2 ครั้ง  มากกว่า 3 ครั้ง

(ถ้าคุณไม่เคยสัมผัสให้หยุดเพียงเท่านี้ หากเคยสัมผัสให้ทำแบบสอบถามต่อไป)

11.1 คุณสัมผัสที่ไหน

ภายในบ้าน :

- ขณะก้าวขึ้นหรือลงพื้นต่างระดับ ( ) ใช่ ( ) ไม่ใช่
- ขณะก้าวข้ามสิ่งกีดขวาง ( ) ใช่ ( ) ไม่ใช่
- ขณะลุกจากเตียง ( ) ใช่ ( ) ไม่ใช่
- ขณะลุกจากเก้าอี้ ( ) ใช่ ( ) ไม่ใช่
- ขณะอาบน้ำ ( ) ใช่ ( ) ไม่ใช่
- ขณะเข้าห้องส้วม ( ) ใช่ ( ) ไม่ใช่
- ขณะขึ้นหรือลงบันได ( ) ใช่ ( ) ไม่ใช่
- อื่นๆ โปรดระบุ .....

ทางเข้าบ้าน/ สวนบริเวณรอบบ้าน

- ขึ้นหรือลงบันได ( ) ใช่ ( ) ไม่ใช่
- ในสวน ( ) ใช่ ( ) ไม่ใช่
- ทางเดิน ( ) ใช่ ( ) ไม่ใช่
- อื่นๆ โปรดระบุ .....

ที่อื่นๆ :

- บาทวิถี ( ) ใช่ ( ) ไม่ใช่
- ขอบถนน/ท่อน้ำ ( ) ใช่ ( ) ไม่ใช่
- อาคารสำนักงาน ( ) ใช่ ( ) ไม่ใช่
- ขณะลงจากรถยนต์/รถโดยสาร ( ) ใช่ ( ) ไม่ใช่
- บ้านผู้อื่น ( ) ใช่ ( ) ไม่ใช่
- อื่นๆ โปรดระบุ .....

11.2 คุณสัมผัสได้อย่างไร (เลือกตอบได้มากกว่า 1 ข้อ)

- สะดุด ( ) ใช่ ( ) ไม่ใช่
- ลื่น ( ) ใช่ ( ) ไม่ใช่
- สูญเสียการทรงท่า ( ) ใช่ ( ) ไม่ใช่
- เข้าอ่อน ( ) ใช่ ( ) ไม่ใช่
- เป็นลม ( ) ใช่ ( ) ไม่ใช่
- วิงเวียนศีรษะ/มึนงง ( ) ใช่ ( ) ไม่ใช่
- ไม่แน่ใจ ( ) ใช่ ( ) ไม่ใช่

11.3 คุณได้รับบาดเจ็บจากการล้ม  ใช่  ไม่ใช่

11.4 ถ้าได้รับบาดเจ็บ บาดเจ็บอย่างไร

- ฟกช้ำ  ใช่  ไม่ใช่
- ถลอก  ใช่  ไม่ใช่
- ข้อมือหัก  ใช่  ไม่ใช่
- ข้อสะโพกหัก  ใช่  ไม่ใช่
- กระดูกซี่โครงหัก  ใช่  ไม่ใช่
- ปวดหลัง  ใช่  ไม่ใช่
- อื่นๆ โปรดระบุ.....

วันที่.....เดือน..... พ.ศ. ....

ความคิดเห็น

ผ่าน

ไม่ผ่าน

.....

.....

.....



## APPENDIX E

### เครื่องชี้วัดคุณภาพชีวิตขององค์กรอนามัยโลกชุดย่อ ฉบับภาษาไทย

#### (WHOQOL - BREF – THAI)

**คำชี้แจง**

ข้อคำถามต่อไปนี้จะถามถึงประสบการณ์อย่างใดอย่างหนึ่งของท่าน ในช่วง 2 สัปดาห์ที่ผ่านมา ให้ท่านสำรวจตัวท่านเอง และประเมินเหตุการณ์หรือความรู้สึกของท่าน แล้วทำเครื่องหมาย ✓ ในช่องคำตอบที่เหมาะสมและเป็นจริงกับตัวท่านมากที่สุด โดยคำตอบมี 5 ตัวเลือก คือ

ไม่เลย หมายถึง ท่านไม่มีความรู้สึกเช่นนั้นเลย รู้สึกไม่พอใจมาก หรือรู้สึกแย่มาก

เล็กน้อย หมายถึง ท่านมีความรู้สึกเช่นนั้นนาน ๆ ครั้งรู้สึกเช่นนั้นเล็กน้อยรู้สึกไม่พอใจ หรือรู้สึกแย่

ปานกลาง หมายถึง ท่านมีความรู้สึกเช่นนั้นปานกลาง รู้สึกพอใจระดับกลาง ๆ หรือ รู้สึกแย่ระดับกลาง ๆ

มาก หมายถึง ท่านมีความรู้สึกเช่นนั้นบ่อย ๆ รู้สึกพอใจหรือรู้สึกดี

มากที่สุด หมายถึง ท่านมีความรู้สึกเช่นนั้นเสมอ รู้สึกเช่นนั้นมากที่สุด หรือรู้สึกว่าสมบูรณ์ รู้สึกพอใจมาก รู้สึกดีมาก

| ข้อที่ | ในช่วง 2 สัปดาห์ที่ผ่านมา  | ไม่เลย | เล็กน้อย | ปานกลาง | มาก | มากที่สุด |
|--------|--|--------|----------|---------|-----|-----------|
| 1      | ท่านพอใจกับสุขภาพของท่านในตอนนี้เพียงใด  |        |          |         |     |           |
| 2      | การเจ็บปวดตามร่างกาย เช่น ปวดหัว ปวดท้อง ปวดตามตัว ทำให้ท่านไม่สามารถทำในสิ่งที่ต้องการมากนักเพียงใด |        |          |         |     |           |
| 3      | ท่านมีกำลังเพียงพอที่จะทำสิ่งต่าง ๆ ในแต่ละวันไหม (ทั้งเรื่องงาน หรือการดำเนินชีวิตประจำวัน)         |        |          |         |     |           |
| 4      | ท่านพอใจกับการนอนหลับของท่านมากนักเพียงใด  |        |          |         |     |           |
| 5      | ท่านรู้สึกพึงพอใจในชีวิต (เช่น มีความสุข ความสงบ มีความหวัง) มากน้อยเพียงใด                          |        |          |         |     |           |
| 6      | ท่านมีสมาธิในการทำงานต่าง ๆ ดีเพียงใด  |        |          |         |     |           |
| 7      | ท่านรู้สึกพอใจในตนเองมากน้อยแค่ไหน   |        |          |         |     |           |
| 8      | ท่านยอมรับรูปร่างหน้าตาของตัวเองได้ไหม   |        |          |         |     |           |
| 9      | ท่านมีความรู้สึกไม่ดี เช่น รู้สึกหงา เสร้า หดหู่ สิ้นหวัง  |        |          |         |     |           |

|        | วิตกกังวล บ่อยแค่ไหน  |        |          |         |     |           |
|--------|---|--------|----------|---------|-----|-----------|
| ข้อที่ | ในช่วง 2 สัปดาห์ที่ผ่านมา   | ไม่เลย | เล็กน้อย | ปานกลาง | มาก | มากที่สุด |
| 10     | ท่านรู้สึกพอใจมากน้อยแค่ไหนที่สามารถทำอะไร ๆ ผ่านไปได้ในแต่ละวัน  |        |          |         |     |           |
| 11     | ท่านจำเป็นต้องไปรับการรักษาพยาบาลมากน้อยเพียงใด เพื่อที่จะทำงานหรือมีชีวิตอยู่ไปได้ในแต่ละวัน   |        |          |         |     |           |
| 12     | ท่านพอใจกับความสามารถในการทำงานได้ อย่างที่เคยทำมาากน้อยเพียงใด   |        |          |         |     |           |
| 13     | ท่านพอใจต่อการผูกมิตรหรือเข้ากับคนอื่น อย่างที่ผ่านมามากแค่ไหน  |        |          |         |     |           |
| 14     | ท่านพอใจกับการช่วยเหลือที่เคยได้รับจากเพื่อน ๆ แค่นั้น  |        |          |         |     |           |
| 15     | ท่านรู้สึกว่าชีวิตมีความมั่นคงปลอดภัยดีไหม ในแต่ละวัน   |        |          |         |     |           |
| 16     | ท่านพอใจกับสภาพบ้านเรือนที่อยู่ตอนนี้มากน้อย เพียงใด  |        |          |         |     |           |
| 17     | ท่านมีเงินพอใช้จ่ายตามความจำเป็นมากน้อยเพียงใด  |        |          |         |     |           |
| 18     | ท่านพอใจที่จะสามารถไปใช้บริการสาธารณสุขได้ตาม ความจำเป็นเพียงใด   |        |          |         |     |           |
| 19     | ท่านได้รู้เรื่องราวข่าวสารที่จำเป็นในชีวิตแต่ละวัน มากน้อยเพียงใด   |        |          |         |     |           |
| 20     | ท่านมีโอกาสได้พักผ่อนคลายเครียดมากน้อยเพียงใด   |        |          |         |     |           |
| 21     | สภาพแวดล้อมคือสุขภาพของท่านมากน้อยเพียงใด   |        |          |         |     |           |
| 22     | ท่านพอใจกับการเดินทางไปไหนมาไหนของท่าน (หมายถึงการคมนาคม) มากน้อยเพียงใด  |        |          |         |     |           |
| 23     | ท่านรู้สึกว่าชีวิตท่านมีความหมายมากน้อยแค่ไหน   |        |          |         |     |           |
| 24     | ท่านสามารถไปไหนมาไหนด้วยตนเองได้ดีเพียงใด   |        |          |         |     |           |
| 25     | ท่านพอใจในชีวิตทางเพศของท่านแค่ไหน?<br>(ชีวิตทางเพศ หมายถึง เมื่อเกิดความรู้สึกทางเพศขึ้นแล้วจัดการทำให้ผ่อนคลายลงได้ รวมถึง การช่วยตัวเองหรือการมีเพศสัมพันธ์) |        |          |         |     |           |
| 26     | ท่านคิดว่าท่านมีคุณภาพชีวิต (ชีวิตความเป็นอยู่) อยู่ในระดับใด   |        |          |         |     |           |

## **BIOGRAPHY**

|                              |   |
|------------------------------|---|
| <b>NAME</b>                  | Miss Kewalee Wiriyaweerawat   |
| <b>DATE OF BIRTH</b>         | 10 July 1987  |
| <b>PLACE OF BIRTH</b>        | Ratchaburi, Thailand  |
| <b>INSTITUTIONS ATTENDED</b> | Silpakorn University, 2004-2008<br>Bachelor of Science (Sports Science)<br>Mahidol University, 2009-2014<br>Master of Science (Sport Science) |
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### **PRESENTATION**

Kewalee Wiriyaweerawat, Waree Widjaja, Metta Pinthong, and Thyon Chentanez (2014). Effects of interactive video games on psychomotor and cardiovascular responses in elderly. *Journal of sports science and technology*. 2014; 14 (2): 75 - 89