

Effects of Tai Chi on Cardiovascular Disease Risk Factors among the Korean Elderly

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[Abstract]

This study explored the effects of Tai Chi on cardiovascular disease(CVD) risk factors among the Korean elderly. 68 elderly were selected and divided into two groups: an experiment group(34 patients) and a control group(34 patients). The experimental group practiced Tai Chi for 60 minutes a day, five times per week for 6 weeks total. The control group continued their routine levels of activity. CVD risk factors evaluated in both groups including body mass index, fasting blood sugar, triglyceride, high density lipoprotein cholesterol(HDL-C), and low density lipoprotein cholesterol(LDL-C). Each factor was measured before and after the 6-week intervention. Results showed that the experimental group had a significant decrease in measurements of body mass index, fasting blood sugar, triglyceride, and LDL-C levels. The experimental group also had an increase HDL-C level. Based on such findings, we believe that Tai Chi exercise program would function as an effective intervention strategy for preventing CVD in the elderly. Therefore, it is recommended that health and medical service personnel should seek to apply Tai Chi intervention as a daily component of elderly care.

▶ **Key words:** Blood lipids, Cardiovascular disease, Metabolic syndrome, Tai Chi, Elderly healthcare

[요 약]

이 연구는 한국 노인들에서 심혈관질환의 위험인자에 대한 태극권의 효과를 알아보고자 시도되었다. 68명의 노인참가자를 실험군과 대조군으로 나눈 후, 실험군 34명에게 6주 동안 일주일에 5번씩, 하루 60분 동안 태극권운동을 하게 했다. 심혈관질환 위험인자로 알려진 것 중 체질량지수, 공복혈당, 중성지방, 고밀도 콜레스테롤, 저밀도 콜레스테롤을 6주간의 운동 전후에 측정하였다. 결과는 태극권운동군에서 체질량지수, 공복혈당, 중성지방, 저밀도 콜레스테롤이 유의미하게 감소하였고, 고밀도콜레스테롤은 유의미한 증가를 보였다. 이 연구결과는 태극권운동이 노인들에게 심혈관질환 예방에 효과적이라는 것을 보여주었다. 그러므로, 노인센터나 지역보건소에서 노인을 위한 건강프로그램에 태극권운동을 적용해 보는 것을 제안한다.

▶ **주제어:** 혈중지질, 심혈관질환, 대사증후군, 태극권, 노인건강관리

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 - Received: 2022. 08. 04, Revised: 2022. 10. 18, Accepted: 2022. 10. 18.

I. Introduction

The world's elderly population and is expected to double by 2050. As age increases, income generally decreases. This might explain why Korean elderly women are reported to not seek hospital treatment as they weight medical costs women are reported not to seek hospital treatment [1]. Of particular clinical concern in elder care is the prevalence of metabolic syndrome at significantly higher rates in individuals over 60 years compared to other age groups. Patients with metabolic syndrome have twice the risk of developing cardiovascular disease and more than 10 times the risk of developing diabetes [2-3].

Cardiovascular diseases is one of many ailments that plagues adults in modern times. According to Centers for Disease Control, leading risk factors for heart disease and stroke are high blood pressure, high low-density lipoprotein (LDL) cholesterol, diabetes, smoking and secondhand smoke exposure, obesity, unhealthy diet, and physical inactivity [4]. A recent reported indicate that one of the two or more adults over 30 years of age were suffering from prior cerebrovascular diseases such as obesity, hypertension, hypercholesterolemia and diabetes [5]. For subjects over 60 years old, the prevalence of obesity was 29.3% in men and 42.7% in women based on body mass; for hypertension, 48.5% in men and 48.8% in women; for diabetes in those over 65 years old, 25.0% in men and 29.4% in women [6]. Another study revealed that elderly patients' glucose metabolism was decreased due to the action of insulin, and patients also showed the accumulation of fat in the muscle and the liver [7]. Among adjustable influencing factors of cardiovascular diseases, exercise is an essential element for both maintaining one's health and recovering from chronic diseases as well as maintaining an independent life in the elderly; furthermore, it has also been reported to have a positive impact on patients in physical, psychological, and social dimensions [8]. Given

such extant findings, it is not surprising to see scholars advocating for the development and implementation of high-quality health promotion programs for to the elderly that into account patients' age, physical strength, health variables, and exercise intensity [9].

Tai Chi, as a Chinese national art, is a combination of fitness, health, and exercise; the action is lively, continuous, oscillating, and consistent with the psychological and physiological characteristics of the elderly [10].

In the United States, a Tai Chi Chuan (Tai Chi) has been suggested for the elderly as one form of physical health program that promotes walking and sense of balance [11]. Some studies have found that Tai Chi has many positive effects on the health of the elderly and is an exercise that is very suitable for the elderly [12-15]. A previous research revealed the usefulness of Tai Chi exercises for interventions in the elderly that include acquisition of flexibility and balance, reduction of cognitive-related falls, and improved health conditions [16]. After reviewing 36 studies on Tai Chi and Qigong, it was found that these martial arts programs improved physical function in the elderly and potentially decrease patients' blood pressure, fall rates, depression and anxiety [17]. One prior study presented that Tai chi is better than brisk walking in reducing several cardiovascular disease risk factors and improving psychosocial well-being in adults [18].

Despite the availability of promising results of Tai Chi in extant literature, there is little current research on Tai Chi exercise regarding cardiovascular effects among elderly Korean patients. To address the literature gap, this study was conducted to identify the effectiveness of Tai Chi as a physical exercise that may influence Korean elderly patients' risk factors for cardiovascular diseases. This study aimed to explore the positive effects of Tai Chi exercise on preventing and treating cardiovascular diseases and improving cardiopulmonary function in elderly people.

II. Materials and Methods

1. Subjects

Participants were recruited from an elderly care facility in a medium-sized city in Korea. Written informed consent was obtained from individuals who understood the purpose of study and accepted to participation on their own volition. Participants had to meet certain inclusion requirements: have no health conditions that would prevent their physical exercise, be aged 65 or older, be able to perform the physical activities of Tai Chi, have no regular exercise pattern up until six months prior. Participants were excluded when their results could not be measured, when their exercise intervention data could not be collected, or when they accumulated two or more absences in the intervention exercise program. Participants were 75 people when the study had started, but 7 participants didn't attend two or more times. Final participants were 68 persons after excluding (Table 1, Table 2).

Table 1. Homogeneity test for participants' general characteristics

Characteristics		EG (n=34)	CG (n=34)	p
		Mean±SD or n(%)	Mean±SD or n(%)	
Age(years)		72.4±3.8	71.2±5.1	.601
Sex	Male	11(32.4)	10(29.4)	1.000
	Female	23(67.6)	24(70.5)	
Exercise	Yes	11(32.4)	9(26.5)	1.000
	No	23(67.6)	25(73.5)	

EG: experimental group, CG: control group

Table 2. Homogeneity test for five dependent variables of cardiovascular disease risk factors

Variable	EG (n=34)	CG (n=34)	p
	Mean±SD	Mean±SD	
Body mass index(kg/m ²)	24.5±3.5	24.6±2.6	.937
TG (mg/dl)	217.5 ± 47.8	214.4 ± 37.4	.792
HDL-C (mg/dl)	52.7 ± 12.6	51.0 ± 12.8	.618
LDL-C (mg/dl)	130.3 ± 35.8	130.4 ± 35.6	.991
Glucose (mg/dl)	141.8 ± 41.6	141.2 ± 39.7	.954

EG: experimental group, CG: control group,

TG: Triglycerides,

HDL-C: High density lipoprotein - cholesterol,

LCL-C: Low density lipoprotein - cholesterol.

2. Study design

Participants in this study underwent a 6-week exercise program with 60-minute sessions five times per week. Considering that six weeks of exercise in the previous Tai Chi exercise study showed the psychological and physiological effects, this study designed six weeks of Tai Chi exercise intervention [19]. Also, It was judged that it could be effective even with six weeks of exercise because it was an exercise intervention that was conducted five times a week for an hour. The program consisted of Kanwal Tai Chi 24 forms, which comprise the martial arts' representative movements. The 24 forms of Kanwal Tai Chi were popularized by the National Sports Committee and Chinese Martial Arts Experts Association of the Chinese government in 1955 to uphold traditional martial arts and to improve national health [20]. The validity of this exercise program's content was verified by one family medicine doctor, one nursing professor with research experience related to exercise, and two sports medicine specialists.

3. Study tools

For blood component analysis, subjects were asked fast for a period of 12 hours. Then, 15 ml of blood was drawn from each participant through a disposable syringe before and after the training. An S-research center was asked to analyze the blood samples for the values of four variables: triglyceride (TG), high density lipoprotein cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C) and glucose.

4. Tai Chi Exercise Program

The intervention program of the study consisted of 60 minutes once, 5 times a week, and 6 weeks in a 24-style Kanwal Tai chi. Exercise intensity was maintained at RPE 11-13 by applying the Rating of Perceived Exception (RPE) of Borg's scale [21] in accordance with the recommendation of the American College of Sport Medicine [22]. The program was operated with 10 minutes of warm-up

exercise, 45 minutes of main exercise, and 5 minutes of cool-down exercise (Table 3).

Table 3. Tai Chi exercise program

Section/ Weeks	Contents	
Warm up (10 min)	Stretching and joint exercise with breathing exercise	
Main exercise (45 min)	1	(1) Commencing form (2) The wild horse's mane on both sides (3) The white crane spreads its wings (4) Brush knee and step forward
	2	(5) Playing the lute (6) Reverse reeling forearm (7) Left grasp the sparrow's tail (8) Right grasp the sparrow's tail
	3	(9) Single whip (10) Wave hands like clouds (11) Single whip (12) High pat on horse
	4	(13) Right heel kick (14) Strike to ears with both fists (15) Turn body and left heel kick (16) Left lower body and stand on one leg
	5	(17) Right lower body and bird stand on one leg (18) Works at the shuttle on both sides (19) Needle at sea bottom (20) Fan through back
	6	(21) Turn body, deflect, parry, and punch (22) Apparent close up (23) Cross hands (24) Closing form
Cool down (5 min)	Deep breathing & Meditation	

5. Ethical considerations

After explaining the purpose of the study, participants were informed that their data would remain anonymous and confidential. Subjects who agreed to participate completed written informed consent Forms.

6. Data analysis

The frequency, mean, and standard deviation of every variable before and after participating in the Tai Chi program were estimated. The mean difference test was conducted with an independent t-test and a paired t-test (SPSS, version 20.0 for Windows). The statistical significance level was $p < 0.05$.

III. Results

BMI level decreased $.6 \pm 1.0 \text{ kg/m}^2$ after Tai Chi exercise in the experimental group. And the change of BMI level in the experimental group was bigger than in control group ($p=0.004$).

TG level decreased $31.7 \pm 42.3 \text{ mg/dl}$ after Tai Chi exercise in the experimental group. And the change of TG level in the experimental group was bigger than in control group ($p=0.002$).

HDL-cholesterol level increased $10.4 \pm 9.1 \text{ mg/dl}$ after Tai Chi exercise in the experimental group. And the change of HDL-cholesterol level in the experimental group was higher than in control group ($p=0.001$).

LDL-cholesterol level decreased $26.1 \pm 27.9 \text{ mg/dl}$ after Tai Chi exercise in the experimental group. And the change of LDL-cholesterol level in the experimental group was higher than in control group ($p=0.001$).

Glucose decreased $17.6 \pm 29.0 \text{ mg/dl}$ after Tai Chi exercise in the experimental group. And the change of glucose level in the experimental group was bigger than in control group ($p=0.003$).

Table 4. Comparison of dependent variables pre and post experiment between groups

Variables		Difference (Pre-Post)	P
Body Mass Index (kg/m^2)	EG	$.6 \pm 1.0$.004
	CG	$-.3 \pm 1.0$	
TG (mg/dl)	EG	31.7 ± 42.3	.002
	CG	1.7 ± 20.4	
HDL-C (mg/dl)	EG	-10.4 ± 9.1	.001
	CG	0.5 ± 9.6	
LDL-C (mg/dl)	EG	26.1 ± 27.9	.001
	CG	-2.8 ± 18.7	
Glucose (mg/dl)	EG	17.6 ± 29.0	.003
	CG	-12.4 ± 42.9	

EG: Experimental group, CG: Control group

TG: Triglycerides,

HDL-C: High density lipoprotein-cholesterol,

LDL-C: Low density lipoprotein-cholesterol

IV. Discussion

The cardiovascular diseases including heart disease, hypertension, and atherosclerosis were threats to global health in the elderly. These diseases strongly affect the well-being of the elderly in aged society, this might give society a heavy burden. Therefore, looking for a suitable method to prevent the cardiovascular disease of the elderly population and effectively reduce the incidence of disease is needed.

The study results showed that Tai Chi exercise reduced cardiovascular risk factors in elderly participants so much that positive effects were noticed. Such findings are consistent with observations from previous studies. Some researchers have reported that Sun Style Tai Chi exercise had reduced body fat, weight and BMI in the elderly [23-24]. Another study applied Chen Style Tai Chi in a 12-week exercise program, which reportedly reduced body weight, percent body fat and W/H ratio in the hypertension group [25].

Tai Chi is a light and medium intensity aerobic exercise. In addition to an emphasis on slow movement and rhythmic deep breathing, but also stressing that "intention" and "calm" are good results of a relaxing spirit [26]. Related studies indicated that Tai Chi exercise played an important role on the human body's balance of metabolism and energy consumption of gas and on body sculpting and fitness [27-29].

Another group of scholars conducted a 12-week study with female elderly participants completing a program in the Yang Style Tai Chi movements, silver dance and resistance band exercise. They found significant pre- and post- changes in weight, BMI and diastolic blood pressure, but the band exercise did not show any significant differences. This was due to the resistance band exercise's insufficient resistance and lack of an individually customized exercise intensity setting suitable to induce increases of muscle mass and basal metabolic rate [30].

This present study revealed a number of statistically significant findings. For individuals in the experimental group, BMI, triglyceride and LDL-cholesterol values were significantly lowered, whereas HDL-cholesterol were significantly improved, compared to the control group. These values were consistent with results from other exercise intervention studies. For example, after a 12-week treadmill walking exercise program for middle-aged obese women, there were significant differences in improvements of fasting blood glucose and triglyceride levels [31-33]. It's important to consider that low density lipids are accumulated in blood vessels and adversely affect cardiovascular metabolism, while HDL-cholesterols collect waste products from the blood vessels. This would indicate that Tai Chi seems to have a positive impact as an interventions for cardiovascular risk factors because it reduces adverse effects on metabolism.

The blood glucose levels were measured to be higher than the normal range in both the experimental group and the control group before and after the Tai Chi intervention. Interestingly enough, however, blood glucose levels in the test group were lowered after the intervention while the blood glucose levels in the control group were rather elevated. Previous studies reported that regular aerobic exercise (conducted for at least 30 minutes, 3-6 times a week for 3 months) improved cardiovascular functions, thus preventing and reducing the risk of developing cardiovascular diseases; furthermore, it enhanced sensitivity to insulin action, improving insulin response to fasting insulin concentrations and to fasting blood glucose; finally, it increased the capacity to utilize the blood glucose [34]. Such exercise showed to be effective for changes in fasting blood glucose, insulin resistance, and glycated hemoglobin [35-36]. Among previous studies related to the elements that affect insulin secretion, it has been reported that yoga exercise lowered the stress index and it could get reduction of the average pulse rate, having a positive effect on sympathetic activity and

on autonomic nervous balance [37]. Given that yoga and Tai Chi are slow movements and exercises with large Qigong effects through respiration, it is considered that there is a need for further study to determine whether the reason for dropped blood glucose levels is simply due to changes by the exercise or it is due to Qigong effects [38-39].

Despite these favorable observations, there are some cases in the literature that seem to present conflicting results. Two studies did not report any significant differences in body fat and fat free mass [40-41]. These scholars indicated that intensity and frequency of the exercise had effects on the improvement of physical functions. However, our significant results shown in the six-week intervention was believed to have been influenced by frequent exercise of five times a week. In the future, it seems necessary to study the effect of cardiovascular disease risk factors after varying the number of applications per week (3-5 times a week) and the application period (12 weeks to 24 weeks).

This study has some limitations. First, The underlying diseases of the participants were not identified. Second, although this study found that Tai Chi can improve cardiovascular disease risk factors in elderly, it still requires multi-center randomized controlled clinical studies to confirm the findings.

Regular Tai Chi training as a proper aerobic exercise activates the metabolic functions and burns fat. Based on this study results, we believe that Tai Chi exercise program would function as an effective intervention strategy for preventing CVD in the elderly. Therefore, it is recommended that health and medical service personnel should seek to apply Tai Chi interventions as a daily component of elderly care.

V. Conclusions

In conclusion, Tai Chi exercise decreased significantly body mass index, fasting blood sugar,

triglyceride and LDL-Cholesterol levels. Also, Tai Chi exercise increased HDL-Cholesterol level. Based on such findings, we believe that Tai Chi exercise program would function as an effective intervention strategy for preventing CVD in the elderly.

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