

# Trekking exercise promotes cardiovascular health and fitness benefits in older obese women

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Trekking includes downhill walking and enhances lower limb strength. Muscle fitness is a predictor of mortality and is associated with cardiovascular risk factors in adults. The purpose of this study was to investigate the effects of trekking on cardiovascular health and fitness in older obese women. The participants were randomly assigned to an exercise group (EG, n=32) and a control group (CG, n=48). The EG participated in the trekking program for 12 weeks, 3 times per week, and 90 min per session, at a moderate intensity. Cardiovascular health (BMI, percentage of body fat, blood pressure, glucose, triglycerides, and total cholesterol) and fitness (muscle strength, muscle endurance, balance, and

flexibility) were measured before and after the 12-week program. A two-way repeated ANOVA was used to compare and analyze the group differences. Body weight, systolic blood pressure, and muscle strength were significantly different between the groups. These results indicate that trekking played a significant role in the reduction of weight and systolic blood pressure in obese women. The results of this study can be utilized to reduce cardiovascular risk factors associated with aging.

**Keywords:** Trekking, Cardiovascular risk factors, Obese women

## INTRODUCTION

Lifestyle diseases, formerly known as adult diseases, are a result of a lack of exercise, hyper-nutrition, and an unhealthy lifestyle, and can cause cerebrovascular disease, cardiovascular disease, hypertension, and diabetes (Murray and Lopez, 1997). The causes of lifestyle diseases, such as insufficient exercise and an unbalanced nutritional status, lead to an increase in visceral fat and insulin resistance, both of which facilitate the development of various types of cardiovascular diseases (Satter et al., 2008). Lifestyle diseases end in mortality due to complications of circulatory disease and are associated with an overall higher mortality risk (Ho et al., 2008). The Korean National Statistical Office (2012) reported that the four leading causes of death from disease are cancer, cerebrovascular disease, cardiovascular disease, and diabetes.

Physical activity is significantly related to mortality and disease. From the results of a cross-sectional study, Anderson et al. (2000) concluded that lower mortality and overall death rates could be

found in people who participate in physical activity as compared to those who do not. Additionally, a longitudinal study of 10 yr reported a 20 to 35% lower rate of cardiovascular related diseases in participants who engaged in physical activity (Macera et al., 2003). The results of these studies emphasize the importance of physical activity; however, the Korean Centers for Disease Control and Prevention (KCDC, 2010) reported that the rates of participation in physical activity at a moderate level of intensity in males and females older than 19 yr of age were only 11.5% and 10.3%, respectively. American College of Sports Medicine (2014) recommends participation in exercise of moderate intensity three to five times per week in order to experience the associated health benefits. The overall guidelines for exercise from the World Health Organization (WHO) and the United States are similar; however, the Korean guidelines differ in that they emphasize walking as a form of exercise. Nevertheless, the participation rates for walking in Korean men and women are 42.8% and 39.6% respectively, and the rate has decreased since 2005. Furthermore, only one out

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of ten people participates in both aerobic and resistance exercise, implying a serious risk factor for the health of many Koreans.

Walking is the best-known physical activity for the improvement and maintenance of fitness and health. It is an easy, simple, accessible, and cost-effective activity that enhances fitness levels. In addition, walking has been found to have direct and rapid effects on an individual's metabolism. Various Dulle-Gil courses for walking and trekking recently have been introduced to Korea. The courses (trekking paths) are well developed and have been widely used for health management purposes. Trekking differs from mountaineering, which aims to conquer a summit, and hiking, which lasts for several hours. Trekking excludes the element of danger and can safely be enjoyed in an outdoor environment. Trekking is unique because it includes a downhill walking pattern, which enhances lower limb strength in healthy young adults (Rodio and Fattorini, 2014). Peterson and Martin (2010) reported that active males can successfully improve their endurance from trekking because of its downhill pattern of exercise. Therefore, trekking provides health benefits compounding those afforded by walking. Thus, the purpose of the present study was to investigate the effects of trekking on the cardiovascular health and fitness of older women with obesity.

## MATERIALS AND METHODS

### Participants

The participants of the present study were recruited from a community health center in a Korean city. All of them were obese, with a percentage of body fat (fat %)  $\geq 30\%$ , and had not participated in regular exercise during the 6-month period before the study. The participants were randomly assigned to an exercise group (EG,  $n = 32$ ) or control group (CG,  $n = 48$ ). Originally, 50 participants were assigned to each group, but during the 12 weeks of exercise, 18 participants from the EG and 2 from the CG dropped out. The physical characteristics of the participants are presented in Table 1.

**Table 1.** Characteristics of subjects

	EG		CG	
	M	SD	M	SD
Age (yr)	60.26	7.2	62.51	7.1
Body weight (kg)	59.86	8.2	58.47	6.9
BMI (kg/m <sup>2</sup> )	24.95	3.0	24.3	4.3
Fat (%)	35.32	4.9	35.9	4.8

EG, exercise group; CG, control group.

### Experimental procedures and measuring methods

All of the variables were measured before (pre-test) and after 12 weeks (post-test) of the trekking program, at the same place, and with the same methods.

### Exercise program

The Dulle-Gil courses (trekking paths) were originally developed in an area of Seoul used as a trekking course. Prior to the study, the author explored the courses with two professional instructors. The duration of the trek for one session was 90 min, including the warm-up and cool-down times. The intensity of the trek was managed by the instructors, who maintained it at a moderate level using a rated perceived exertion (RPE) scale ranging from 12 to 15. The participants in the exercise group were randomly assigned to two groups so that the trekking instructors could manage the session and provide guidance to the participants safely during the trek. Different trek courses were chosen for each group and the courses were switched during the study to avoid tedium.

### Fitness tests

Muscle strength tests were conducted using a dynamometer (Helmas 3, Japan). The participants used their right hand for two tests and the highest score was used as the measure of strength. The muscle endurance test involved performing sit-ups for 30 sec. Balance was evaluated by having participants stand on one leg with their eyes closed. Flexibility was measured by the sitting trunk flexion test. All tests were conducted twice, and the highest score was used.

### Blood analysis

All of the participants fasted for at least 10 h before a blood sample was taken and all exercise was restricted before and during the fasting period. Clinical pathology experts used disposable syringes to draw 20 mL of blood from the participants' brachial veins. Fasting blood glucose, triglycerides (TG), and total cholesterol levels (T-C) were analyzed by a community health center.

### Body composition

The percentage of body fat was measured by bioelectric impedance analysis (Inbody 8.0-Biospace, Korea), and body mass index (BMI) was calculated using the participants' height and weight.

### Blood pressure

Each participant's blood pressure from the brachial artery was measured twice and the mean of the two readings was used as the

measure of blood pressure. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were taken.

### Data analysis

A two-way repeated ANOVA was used to analyze the differences in the variables between the two groups of participants and the two measures (pre-test and post-test). All of the participants were enrolled in a community health center and a nutrition class program. We opened the program to all members while the present study was in progress because it was impossible to restrict this opportunity to the participants. The nutrition program consisted of 4 classes and some of our participants attended from 1 to 4 sessions. In order to elucidate the effect of the nutrition class on the exercise effects, nutritional education was used as a covariate. SPSS 12.0 was used and all of the results were expressed as the means and standard errors of the means. The significance level was set at  $P < 0.05$ .

## RESULTS

### Cardiovascular health components

The results of the participants' baseline measures (pre-test) and their measures after 12 weeks in the trekking program (post-test) are presented in Table 2. The results of the two-way repeated ANOVA are shown in Table 3. The exercise group improved their

**Table 2.** Mean and standard deviation of the cardiovascular health components

Variables	Time	EG		CG	
		M	SD	M	SD
Weight (kg)	Pre	59.86	8.2	58.47	6.9
	Post	45.5	26.6	57.4	11.2
BMI (kg/m <sup>2</sup> )	Pre	24.95	2.9	24.3	4.3
	Post	24.59	2.8	24.07	4.4
Fat (%)	Pre	35.3	4.9	35.9	4.8
	Post	33.65	5.1	35.2	5.4
SBP (mmHg)	Pre	131.6	13.1	130.8	23.9
	Post	118.2	12.4	127.6	15.3
DBP (mmHg)	Pre	83.09	8.1	81.4	15.5
	Post	77.96	8.8	79.9	9.7
Muscle strength	Pre	22.08	7.9	22.8	4.6
	Post	23.5	4.2	23.6	3.0
Fasting blood glucose (mg/dL)	Pre	110.96	31.09	101.67	22.0
	Post	106.81	17.7	103.08	12.2
Triglyceride (mg/dL)	Pre	140.06	79.04	140.93	81.2
	Post	153.65	75.3	140.28	81.2
Total cholesterol (mg/dL)	Pre	190.2	59.5	202.91	43.0
	Post	171.78	43.0	198.17	44.5

body weight, BMI, fat %, blood pressure, muscle endurance, balance, and flexibility. Body weight and systolic blood pressure (SBP) were significantly different between the two groups and pre and post-test measures. However, no significant differences were found for the fasting blood glucose, TG, and T-C levels. These results indicate that trekking is effective in reducing body weight and systolic blood pressure, but not is sufficient in improving glucose, TG, and T-C levels in our sample of older women who are obese.

When nutritional education was used as a covariate, only fat % was found to be significantly different between the groups and the pre- and post-test measures ( $F = 4.499$ ,  $P = 0.037$ ). These results confirm that participation in a nutrition class can have positive effects on fat % reduction when accompanied by exercise.

### Cardiovascular health components

The results of the pre-tests and post-tests are presented in Table 4, and the results from the two-way repeated ANOVA are shown in Table 5. The exercise group showed improved muscle strength, muscle endurance, balance, and flexibility at post-test. A one-way repeated ANOVA revealed group differences in muscle endurance between the pre and post-tests. However, there were no significant differences between the groups or times on measures of mus-

**Table 3.** Results from ANOVA for cardiovascular health components. \*Means  $P < 0.05$  compared to time and group differences

	df	F	Sig
Weight	1	11.981	0.001*
BMI	1	0.605	0.439
%fat	1	3.567	0.063
SBP	1	5.177	0.026*
DBP	1	1.344	0.250
Fasting blood glucose	1	0.984	0.324
Triglyceride	1	0.337	0.563
Total cholesterol	1	1.591	0.211

**Table 4.** Mean and standard deviation of fitness components

Variables	Time	EG		CG	
		M	SD	M	SD
Muscle strength	Pre	22.08	7.9	22.8	4.6
	Post	23.5	4.2	23.6	3.0
Muscle endurance	Pre	7.56	7.4	7.56	7.3
	Post	10.1	6.4	7.1	7.2
Balance	Pre	11.68	16.8	9.56	9.1
	Post	13.3	18.7	14.16	19.0
Flexibility	Pre	13.8	6.3	13.45	6.4
	Post	14.68	6.6	14.45	6.1

**Table 5.** Results from ANOVA for fitness components. \*Means  $P < 0.05$  compared to time and group differences

	df	F	Sig
Muscle strength	1	0.191	0.663
Muscle endurance	1	7.7.9	0.007*
Balance	1	0.486	0.488
Flexibility	1	0.016	0.899

cle strength, balance, and flexibility. These results indicate that trekking improves muscle endurance in the elderly population.

## DISCUSSION

The primary finding of this study indicates that 12 weeks of trekking at a moderate level of intensity, on a regular basis, decreases the body weight and SBP of elderly women who are obese and increases their muscle endurance. The results from this study support the findings of previous studies, namely, that exercise reduces cardiovascular disease. This study also confirmed the protective effects of moderate exercise against cardiovascular events in older obese women.

Non-pharmacological treatments and protective interventions such as exercise have been emphasized for the aging population. The elderly population tends to prefer easy access to exercise that can be performed anywhere. A meta-analysis revealed that walking can improve physical functioning, especially muscle strength of the lower limbs as well as overall muscle strength and flexibility. The decline of muscle strength in the lower limbs is the first loss of strength to appear with aging (Schoenfelder and Rubenstein, 2004), and the decline in functional capacity is the main health issue of the elderly population. Hence, walking is a very effective and recommended exercise for this population. In this study, muscle endurance was significantly improved in the trekker group. Although the improvements seen in muscle strength, balance, and flexibility were not significant, the results indicate that trekking can provide beneficial health effects.

There is an increasing amount of epidemiological evidence that low muscle fitness is a predictor of mortality and poorer health in middle age (Timpka et al., 2014) and older adulthood (Cooper et al., 2011). In addition, muscle strength is associated with all-cause mortality in adults, independent of cardiovascular risk factors (Manson et al., 2007). Moreover, muscle strength is correlated independently with metabolic risk (Aoyama et al., 2011). The present study consequently showed that trekking increased muscle endurance and this finding implies that trekking is beneficial in man-

aging cardiovascular risk factors.

When looking at the health benefits of exercise, intensity has to be considered. The elderly prefer to exercise at a low to moderate intensity. However, a large amount of exercise performed at a low level of intensity was found to have no relationship with physical fitness (Manson et al., 1992). On the other hand, a study (Morikawa et al., 2011) conducted with 666 participants more than 65 yr old found that walking at a high level of intensity four times in four months significantly improved their BMI, body fat %, blood pressure, glucose, muscle strength, and maximal oxygen uptake. Furthermore, exercise at a low level of intensity showed no relationship to physical fitness, while exercise at a high level of intensity showed a significant relationship to body fat %. These results suggest that exercise at a low level of intensity limits the likelihood of its having a significant effect on health (Blaes et al., 2011). Also, higher amounts of exercise are related to greater positive effects on health. However, if the exercise intensity is too low, an improvement in fitness is not likely, and the positive effects on health will be small. In this study, the trekkers were instructed to perform at a moderate level of intensity for safety and enjoyment. If we developed more difficult trekking courses with higher levels of intensity or alternated the intensities from moderate to high level one out of three days, then more fitness measures and blood levels (glucose, TG, T-C) might improve.

Hypertension is the most important risk factor for cardiovascular disease. In addition, postmenopausal hypertension is one of the leading causes of morbidity and mortality in women. Exercise training has been confirmed to decrease the risk factors for cardiovascular disease and cardiovascular events. The etiology of postmenopausal hypertension is complex and multi-factorial (Khalid et al., 2013), but a decrease in the estrogen/androgen ratio has been identified as an important factor (Reckehoff, 2004). Endothelial dysfunction, oxidative stress, activation of the rennin-angiotensin-aldosterone system, biological composition changes in the female body, and a lack of physical activity also have been suggested as factors in the causes of postmenopausal hypertension (Vincent et al., 2005). Previous epidemiological and experimental studies support the findings that exercise and physical activity provide substantial vascular and cardiac health benefits, including a 30% reduction in the risk of cardiac disease (Whyte et al., 2005). In keeping with these findings, walking has been found to significantly decrease blood pressure in hypertensive patients (Santaella et al., 2006). The participants in the present study were in their early 60s but were not hypertensive. Nonetheless, the exercise group showed a significant decrease in blood pressure after the 12-

week exercise program. Trekking recently has become more popular in the elderly population of Korea, so the fact that it demonstrates such effects on health and risk management should be emphasized.

In conclusion, the reduction in weight and SBP resulting from trekking plays a significant role in obese women. The results of this study can be utilized to reduce the cardiovascular risk factors associated with aging.

## CONFLICT OF INTEREST

The author has no potential conflicts of interest relevant to this article to declare.

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