Original Article

Effects of a healthy life exercise program on arteriosclerosis adhesion molecules in elderly obese women

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Abstract. [Purpose] The aim of this study was to investigate the change in the arteriosclerosis adhesion molecules after a healthy life exercise program that included aerobic training, anaerobic training, and traditional Korean dance. [Subjects] The subjects were 20 elderly women who were over 65 years of age and had 30% body fat. [Methods] The experimental group underwent a 12-week healthy life exercise program. To evaluate the effects of the healthy life exercise program, measurements were performed before and after the healthy life exercise program in all the subjects. [Results] After the healthy life exercise program, MCP-1 and the arteriosclerosis adhesion molecules sE-selectin and sVCAM-1 were statistically significantly decreased. [Conclusion] The 12-week healthy life exercise program reduced the levels of arteriosclerosis adhesion molecules. Therefore, the results of our study suggest that a healthy life exercise program may be useful in preventing arteriosclerosis and improving quality of life in elderly obese women.
Key words: Healthy life exercise program, Adhesion molecules, Elderly women

INTRODUCTION

Obesity among older women represents a serious public health problem and is strongly associated with cardiovascular diseases (CVDs)[1]. Also, obesity was reduced parasympathetic activity both contribute to coronary heart CVDs[4]. CVDs remain the biggest cause of deaths worldwide[2], and atherosclerosis, a disease of the large arteries, is a major cause of heart disease[3].

Inflammation plays an essential role in the atherosclerotic process, and chemokines such as monocyte chemoattractant protein-1 (MCP-1)[5], soluble vascular cell adhesion molecule-1 (sVCAM-1) and sE-selectin[6], seem to play a pivotal role in the pathogenesis of atherosclerosis. Also, increased plasma concentrations of MCP-1 were associated with several cardiovascular risk factors: older age, obesity, and higher levels of C-reactive protein (CRP)[7].

Adipose tissue is metabolically active and secretes CRP[8] and various chemokines such as MCP-1 and adhesion molecules[9]. Although adipose tissue accumulation only showed

borderline significant associations with sVCAM-1 and sE-selectin concentrations, and some extent of the relationship between insulin resistance and endothelial activation/dysfunction because significant association between fasting insulin as well as the HOMA-IR and sE-selectin levels[10]. Longitudinal study to demonstrate higher circulating inflammatory in the untrained state of older women that had no increased in fat free mass. However trained state of older women increased fat free mass following combined training. There have been a number of longitudinal studies demonstrating the powerful effects of weight loss as a result of both diet and exercise[11]. Exercise (aerobic and resistance exercise) might be indices for evaluation of cardio function including VO_2max, which represents the oxygen-carrying capacity of the active muscles during exercise[12].

The purpose of this study was to investigate the effects of a healthy life exercise program on arteriosclerosis adhesion molecules in elderly women with obesity. We hypothesized that a regular healthy life exercise program for elderly obese women would prevent cardiovascular diseases.

SUBJECTS AND METHODS

Participants were recruited from the general populations of local communities. We asked them to complete simple questionnaires related to aspects of their current lifestyle, such as physical activity, medication, alcohol consumption, and smoking, before the start of the sessions. In this study,

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however, 10 participants were excluded from data analysis. The reasons for exclusion included taking lipid- and/or glucose-lowering medication (n = 4), not being able to start the exercise program due to their condition levels (n = 3), a history of cardiovascular disease, and percentage of body fat < 30%. Thus, twenty participants were assigned into either the control (n = 10) or supervised healthy life exercise program (n = 10) group. The physical characteristics of the participants are shown in Table 1.

Physical and anthropometric variables were measured at baseline and after 12 weeks in both groups. Body mass and height were measured to the nearest 0.1 kg and 0.1 cm, respectively, using a Venus 5.5 body composition analyzer (Jawon Medical, Gyeongsan, Republic of Korea). Body mass index was calculated as weight in kilograms divided by the square of the height in meters. Arterial blood pressure was measured with a mercury sphygmomanometer after the participants had been seated at rest for 10 minutes. All participants were advised to avoid physical activity for 48 hours prior to each measurement.

The 12-week healthy life exercise program intervention consisted of 3 days of combined aerobic exercise, resistance exercise, and traditional Korean dance per week (i.e., Monday, Wednesday, and Friday). This program was modified from that in a previous study for obese elderly women. Each exercise session included 10 minutes of warm-up activities, 15 minutes for the exercise program, and 10 minutes of cooldown activites (i.e., 45 minutes in total). Aerobic exercise consisted of walking and the arm raise; jumping and swinging arms; side walking; the front, back, and side leg raise; jumping and brining the knees up; walking and the

leg raise; and walking and jumping. Resistance exercise consisted of arms fold and spread, arms raise to front and side, turn shoulder, waist bending, waist bending to side, twist trunk, knee up, stretch legs and raise to back and side. Finally, traditional Korean dance consisted movements of the arms, legs, trunk, and whole body including jumping upward and to the side and balance exercises such as one-leg standing and on-leg jumping. Participants performed each exercise program for 15 minutes at 50–60% of their maximum heart rate during weeks 1 through 6. After week 6, the emphasis was placed on reaching and maintaining an exercise intensity of approximately 60–70% of their maximum heart rate for 15 minutes (Polar heart monitor; RS400, Polar Electro, Kempele, Finland). The healthy life exercise program is shown in Table 2.

Fasting venous blood samples were collected from all participants at baseline and at 12 weeks. All samples were taken at 8:30 AM from an antecubital vein. Serum samples were obtained after centrifugation and stored at −80 °C. Serum C-reactive protein (CRP), MCP-1, sE-selectin, and sVCAM-1 were determined enzymatically using standard laboratory procedures. We determined blood sample levels in the serum using a sandwich-type enzyme-linked immunosorbent assay (ELISA) DueSet kit from R&D Systems (Minneapolis, MN, USA) according to the manufacturer's instructions as described previously. In each subject, the degree of insulin resistance was assessed from the fasting glucose and insulin concentrations according to homeostasis model assessment (HOMA), the following formula: HOMA-IR = fasting glucose (mg/dl)/18 × fasting insulin (μU/ml)/22.5.

All results were reported as the mean ± standard deviation. All data were analyzed using SPSS version 19.0 (IBM Corp., Armonk, NY, USA). The unpaired participations t-test was used to assess group differences in baseline variables. A two-way analysis of variance (ANOVA) was used to determine interaction (group × time) effects for all outcome variables. Statistical significance was accepted at the 0.05 level.

RESULTS

All participants in the exercise group attended each healthy life exercise program session, and no participants dropped out during the intervention. Body mass, BMI, percent body fat, SBP, and DBP, which were measured

Table 1. Physical characteristics of the participants

Variable	Exercise group (n=10)	Control group (n=10)
Age (years)	70.7 ± 2.2	71.3 ± 1.7
Body weight (kg)	62.8 ± 4.8	64.9 ± 3.1
BMI (kg/m^2)	26.3 ± 0.8	26.0 ± 0.6
Percent body fat (%)	31.8 ± 1.7	32.7 ± 1.7
SBP (mmHg)	129.4 ± 12.7	129.6 ± 4.9
DBP (mmHg)	80.8 ± 6.7	77.0 ± 4.3

Values are shown as the mean ± SD. BMI: body mass index; SBP: systolic blood pressure; DBP: diastolic blood pressure

Table 2. Healthy life exercise program

Warm-up	Stretching (arms, shoulder, hip, legs), breathing
Resistance exercise	Arms fold and spread, arms raise to front and side, turn shoulder waist bending, waist bending to side, twist trunk, knee up, stretch legs and raise to back and side
Aerobic exercise	Walking and the arm raise; jumping and swinging the arms; the front, back, and side leg raise; jumping and bringing the knees up; walking and the leg raise; and walking and jumping
Traditional dance	Arms and legs: Baechigy, yeo daji, gin-yeo daji, ban hwajang Trunk: yongteulim, jump up Whole body: jump to side, kkaekkili, hwalgae chagi, ppulil sawi Balance: one-leg stand, one-leg jump
Cooldown	Stretching (arms, shoulder, hip, legs), breathing

at baseline and after 12 weeks, are presented in Table 3. Two-factor ANOVA revealed group × time interaction for body mass (p=0.019) and DBP (p=0.001). Within-group analyses showed that body mass, BMI, and percent body fat were significantly decreased in the exercise group after 12 weeks relative to baseline values (p<0.05), but no significant change were observed in the control group. Insulin resistance, CRP, and adhesion molecules, which were measured at baseline and after 12 weeks, are presented in Table 4. Two-factor ANOVA revealed group × time interaction for CRP (p=0.045), sE-selectin (p=0.043), sVCAM-1 (p=0.003), insulin (p=0.019), and HOMA-IR (p=0.038). Within-group analyses showed that glucose, insulin, HOMA-IR, MCP-1, sE-selectin and sVCAM-1 were significantly decreased in the exercise group after 12 weeks relative to the baseline values (p<0.01, p<0.01, p<0.001, p<0.001, p<0.05, p<0.001, respectively), but no significant changes were observed in the control group.

DISCUSSION

In this study, we investigated the effects of a 12-week healthy life exercise program on arteriosclerosis adhesion molecules in elderly obese women. The exercises consisted of combined aerobic exercise, resistance exercise, and traditional Korean dance performed in three sessions per week. Each 45 minutes exercise program included 10 minutes of warm-up activities and 10 minutes of cooldown activities and resulted in a decrease in MCP-1 and arteriosclerosis adhesion molecules sE-selectin and sVCAM-1 in elderly obese women who exercised.

Strenuous exercise induces increased circulating levels of a number of cytokines, macrophage inflammatory proteins, and chemokines including MCP-1, sE-selectin, and sVCAM-1[13]. However, recent studies have shown that increasing levels of exercise or physical activity are associated with reduced levels of MCP-1, sE-selectin, and sVCAM-1 in healthy subjects[14]. Furthermore, in patients with cardio-vascular disease who have increased levels of chemokines and, adhesion molecules[15], it has been reported that moderate intensity exercise can reduce MCP-1, sE-selectin, and sVCAM-1[16]. MCP-1, sE-selectin, and sVCAM-1 were significantly decreased compared with baseline. A number of studies have reported reduced chemokine and adhesion molecules concentrations in obese adults following a combined with moderate physical exercise[17] and lifestyle-modification program (i.e., diet, exercise sessions and behavioral modification) in obese women[18]. Also, previous studies have indicated that knockout mice lacking receptors for MCP-1 exhibit significantly reduced progression of atherosclerosis[19] and trigger the firm adhesion of monocytes to vascular endothelium under flow conditions[20].

A number of studies have provided support for the hypothesis that insulin resistance may be associated with chronic subclinical inflammation[21]. High glucose concentrations have been found to induce the release of adhesion molecules in endothelial and smooth muscle cells, giving one possible explanation for the link between hyperglycemia, inflammation, and atherosclerosis[22]. Adipose tissue is metabolically active, and preadipocytes have been reported to secrete both MCP-1 and adhesion molecules[9]. Our finding of decreased glucose, insulin, and HOMA-IR levels may be one component mediating the beneficial effect of the healthy life exercise program in the elderly obese women. It is possible that the healthy life exercise program consisting of aerobic and resistance exercise was associated with decreased levels of markers of inflammation such as CRP[23].

In the present study, body mass, BMI, percent body fat,

Table 3. Changes in body composition between the groups at baseline and after 12 weeks

Variable	Group	Baseline	12 weeks
Body mass (kg)	Exercise	62.8 ± 1.6	61.2 ± 1.5*
	Control	64.9 ± 1.0	64.8 ± 0.9+
BMI (kg/m²)	Exercise	26.3 ± 0.8	25.6 ± 1.0*
	Control	26.0 ± 0.6	25.7 ± 0.6
Percent body fat (%)	Exercise	31.6 ± 1.8	31.1 ± 1.9*
	Control	31.5 ± 2.8	33.7 ± 4.1
SBP (mmHg)	Exercise	129.4 ± 12.7	124.5 ± 9.2
	Control	129.6 ± 4.9	129.5 ± 4.7
DBP (mmHg)	Exercise	80.8 ± 6.7	78.1 ± 6.7
	Control	77.0 ± 4.3	77.9 ± 4.0+

Values are shown as the mean ± SD. BMI: body mass index; SBP: systolic blood pressure; DBP: diastolic blood pressure
Data were analyzed by two-way ANOVA.
+Significant group × time interaction (p<0.05), *Analyzed by paired t-test (p<0.05)

Table 4. Changes in insulin resistance, CRP, and adhesion molecules between the groups at baseline and after 12 weeks

Variable	Group	Baseline	12 weeks
Glucose (mg/dl)	Exercise	80.3 ± 3.1	79.0 ± 3.1**
	Control	92.2 ± 6.6	92.1 ± 5.6
Insulin (μU/ml)	Exercise	8.13 ± 0.76	7.91 ± 0.67**
	Control	9.28 ± 1.18	9.55 ± 0.80+
HOMA-IR	Exercise	1.6 ± 0.2	1.5 ± 0.1***
	Control	2.1 ± 0.3	2.2 ± 0.2+
CRP (mg/l)	Exercise	0.08 ± 0.01	0.08 ± 0.01
	Control	0.09 ± 0.01	0.09 ± 0.01+
MCP-1 (pg/ml)	Exercise	685.0 ± 37.7	673.66 ± 33.6***
	Control	655.9 ± 64.3	654.40 ± 62.5
sE-selectin (ng/ml)	Exercise	55.5 ± 4.3	54.6 ± 4.0*
	Control	48.7 ± 4.0	49.0 ± 3.9+
sVCAM-1 (ng/ml)	Exercise	515.0 ± 21.7	504.5 ± 20.4***
	Control	532.2 ± 36.7	538.7 ± 40.2+

Values are shown as the mean ± SD. HOMA-IR: homeostasis model assessment; CRP: high-sensitivity C-reactive protein; MCP-1: monocyte chemoattractant protein-1; sVCAM-1: soluble vascular cell adhesion molecules-1
Data were analyzed by two-way ANOVA.
+Significant group × time interaction (p<0.05), *Analyzed by paired t-test (p<0.05), **Analyzed by paired t-test (p<0.01), ***Analyzed by paired t-test (p<0.001)

MCP-1, sE-selectin, sVCAM-1, glucose, and insulin were decreased after the 12-week healthy life exercise program in the elderly obese women. These data may imply that even an aerobic and resistance exercise program is effective in reducing reduce body composition (i.e., body mass, BMI, and percent body fat), arteriosclerosis adhesion molecules, glucose, and insulin. Combined exercise has been previously shown to decrease body mass and fat mass[24], and glucose and insulin[25]. Moreover, traditional Korean dance consists of movements of the arms, legs, trunk, and whole body including jumping upward and to the side and balance exercises such as one-leg standing and one-leg jumping. It might be beneficial effect aerobic and resistance exercise and more safety other exercise program (i.e. weight lifting and not under the supervision).

Nevertheless, although there is strong evidence that the healthy life exercise program affected arteriosclerosis adhesion molecules in this population, the present study has some limitations. CVD patients have various CVD risk factors, and they need exercise training with a longer term rather than a higher exercise intensity to reduce the CVD risk factors[26]. Also, the study period was short, and our study subjects were not patients with CVD or atherosclerosis. Therefore, more longitudinal studies are require to investigate the effects of intermittent exercise on patients with CVD or atherosclerosis. Finally, the sample size was small, and further larger populations studies required to confirm the relationships observed in this study.

In conclusion, this study indicates that a healthy life exercise program is an effective lifestyle intervention strategy for decreasing MCP-1 and adhesion molecules in elderly obese women. In addition, continuation of the healthy life exercise program for 12 weeks led to decreased glucose, insulin, and HOMA-IR levels. Therefore, these finding provide preliminary evidence indicating that a healthy life exercise program may represent an effective intervention strategy for preventing atherosclerosis, leading to improved cardiovascular health in elderly obese women.

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