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The Effects of Aquarobics on Blood Pressure, Heart Rate, and Lipid Profile in Older Women with Hypertension

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Abstract

Objectives: To analyze the effects of aquarobics on blood pressure, heart rate, and lipid profile in older women with hypertension. **Methods/Analysis:** Fifty women, 65 to 75 years old, took part in this experiment. The subjects were split into one of the two experimental groups at random: (1) AEG (n=25) and (2) CG (n=25). To analyze the data, we used the two-way ANOVA test with repeated measures of groups (AEG and CG) and time (pre and post test). Dependent variables were BP, HR, and LP. **Findings:** The result of this study indicated a meaningful difference between AE group and CG in terms of SBP, DBP, and MBP and the lipid profile (TG, TC, LDL-C, HDL-C). It was found that aquarobic exercise helped to reduce the level of HR, SBP, DBP, MBP and decreased the level of TG, TC, LDL-C and enhanced the level of HDL-C in elderly women with hypertension. Performing regular physical exercise is an important step towards solving health problems of the elderly. **Applications:** Aquarobics could enable them to perform movements with safety and in a secured environment and help to improve their quality of lives.

Keywords: Aquarobic Exercise, Blood Pressure, Elderly Women with Hypertension, Heart Rate, Lipid Profile

1. Introduction

The elderly population has been increasing rapidly in recent times, particularly in the industrialized countries; therefore, an 'aging society' has become a global issue. In South Korea, the percentage of aging population was over 7% in 2000 and it continues to increase and is expected to reach 14% in 2019 and over 20% in 2026, by which time South Korea would be entitled a 'super aged society'[1]. Strategies and plans of individuals and the government to enhance the quality of life of the elderly, however, have not yet received the necessary attention[2].

Currently, 86.7% of the elderly population has chronic illnesses, and the percentage is rising[3]. Hypertension is one of the most harmful illnesses, and the proportion of elderly hypertensives has increased from 56.1% in 1998 to 64.9% in 2009, and this percentage is progressively increasing[3]. Women (63.8%) have a higher risk of developing diseases than men (55.6%)[4]. It could become a huge economic burden for

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patients worldwide[5–7]. Research on effective treatments and identification of the causes for developing hypertension, therefore, is actively being conducted and has revealed that the possible causes of hypertension are an unhealthy lifestyle, excess weight, less physical activity, and stress, in addition to genetic factors[8]. Hyperlipidemia, one of the risk factors for hypertension and a possible cause of chronic diseases, is caused by more than normal levels of LDL-C and smaller than normal levels of HDL-C; in addition, it increases death rates and lethality resulting from cardiovascular diseases[9]. Treatment options available for hypertension are drugs, exercise, and diet therapies; of which life style modification, accompanied with exercise and diet therapies is more recommended and preferred, except in patients for whom drug therapy is necessary[10]. Exercise therapy is highly recommended because it not only normalizes blood pressure levels, but also improves the quality of life and provides several health benefits like delaying the effects of aging and prevention of chronic diseases[11,12]. Aerobic exercise as a part of exercise therapy, in particular, removes wastes from the blood vessels, increases blood vessel diameter by reducing the abnormal enlargement of blood cells and decreases blood pressure by minimizing peripheral resistance[13]. Blood pressure could be reduced by 10 mmHg during regular exercise, and the subject may even require 40-60% of the maximum oxygen uptake rate if exercises are performed thrice a week[14]. Other studies have shown that regular exercise by hypertensive patients could be effective in normalizing SBP, DBP, MBP and optimizing myocardial oxygen consumption[15]. In[16] suggested that an exercise prescription with a duration of about 30–60 min, moderate to high intensity of aerobic activity for 4–7 days per week could potentially control the hypertension and cut down the consumption of antihypertensive drugs in hypertensive subjects. However, a few studies have showed that only 26% of patients with hypertension engaged in exercise and patients older than 70 years were least likely to participate[17].

Not only walking, jogging and biking, but also other exercises have been used to enhance health and stamina of the older people[18]. There are boundaries encountered by the elderly to perform exercise at intensities just short of damaging joints or cardiopulmonary systems[18]. Safe exercise therapy, approved by medical evaluation, is necessary because the elderly have a higher risk of exercise-related damage and injuries[19]. Aquarobics is better and safer than land-based physical activity for elderly individuals, where the joint compressive forces resulting from weight bearing are absent or minimized. Aquarobics is considered as a representative exercise program that could overcome the negative aspects, like exercise-related damages or injuries and bring positive effects, like safety and injury prevention[20,21]. In particular, muscular training in water is highly effective because of the resistance provided by water to movement[22–25].

In recent literature, In[22] proposed that aquarobics may be ideal for overweight or obese female patients with weak musculoskeletal function. In[26] reported that an underwater exercise led to reduced pain and improved function of muscle strength. In[27] indicated that a water exercise program increase the muscle strength and the power of the hip joint and musculoskeletal, whereas pain decreased. In[28] reported that aquatic exercise improved the blood lipid profile when for 12 weeks. Despite the fact that aquarobics is safe, effective and less likely to cause injuries and improves physical strength at the same time, its effects on BP, HR and hyperlipidemia in older population have not been studied in detail.

Thus, this study aims at analyzing the effects of aquarobics on HR, BP, and LP in elderly women with hypertension.

2. Methods

2.1 Subjects

The attendees of this study were older women aged 71 years and above residing in City D, selected using the stratified cluster random sampling method. They were surveyed for their blood pressure (higher than 140/90 mmHg were included) and health status by basic examination and interview. Fifty elderly women with hypertension took part in this experiment. The subjects were randomly split into one of the two groups: (1) AEG (n=25), (2) CG (n=25). The researchers explained the study purpose and methods to the subjects, after which informed consent was obtained. The consent clarified that the personal information obtained from the subjects during this study would not be used for any other purpose, that the subjects autonomously and independently took part, and that the subjects could withdraw at any point if they did not wish to participate. The individual characteristics of study subjects are presented in Table 1.

Table 1. Means and standard deviations of age, height, and weight for subjects

Group	Age (years)	Height (cm)	Weight (kg)
	M±SD	M±SD	M±SD
Aquarobics group	73.22±3.30	165.42±2.26	67.44±2.12
Control group	72.65±4.28	165.69±3.17	67.02±2.23

2.2 Measurement Tools and Tasks

2.2.1 Blood Pressure

BP measurements were done by an experienced nurse at the end of 2 minutes of each workload. Blood pressure was measured manually by an aneroid sphygmomanometer using the auscultatory method. The SBP was recorded at the appearance of the Korotkoff phase I sound and the DBP at the disappearance or muffling of the Korotkoff sounds (phase IV or V); preferably, at the complete disappearance of the Korotkoff sound, and in case of uncertainty DBP was not noted. Heart rates were measured online from the ECG recording by the cardiological software (GE Cardiosoft V6.51).

2.2.2 Blood Lipid Levels

BL levels (TG, TC, HDL-C, and LDL-C) were surveyed using enzymatic methods. The subjects in both the groups fasted from midnight until morning until the blood sample was taken.

2.2.3 Aquarobic Exercise Program

The members of the AEG attended a 50-min aquarobics class 3 times a week for 12 weeks (36 training sessions in total). The CG was not involved in any kind of targeted exercise. The program of aquarobics made by the age and abilities of the subjects. Exercise intensity was continually monitored, controlled and maintained at about 129–138 bpm of target heart rate (Polar S810i, Polar Electro, and Finland).

2.3 Statistical Analysis

To analyze the data, we used 2-way ANOVA with repeated measures of groups (AEG and CG) and time (pre and post test). Dependent variables were the cardiovascular parameters (SBP, DBP, HR, MBP) and lipid profile (HDL-C, LDL-C, TC, TG,). We set our significance level α *at* 0.05. Turkey's HSD test was used for post hoc analysis. All statistical data analyses were carry out using SPSS version 21.0.

3. Results

3.1 Analysis of Blood Pressures and Heart Rate

Table 2 presents the results of blood pressures and heart rate of both the groups.

Table 2. Mean and standard deviations of blood pressures and heart rate of both the groups

Group	Parameter	Pre-test	Post-test
		M±SD	M±SD
Aquarobics exercise group	SBP (mmHg)	152.28±1.43	138.76±5.98
	DBP (mmHg)	91.16±1.60	84.56±1.26
	MBP (mmHg)	111.53±1.11	97.63±2.29
	HR (bpm)	82.48±1.74	75.80±1.61
Control group	SBP (mmHg)	152.16±1.21	152.40±1.41
	DBP (mmHg)	91.00±1.66	90.52±.92
	MBP (mmHg)	111.15±1.14	111.15±.71
	HR (bpm)	82.56±1.58	81.68±1.22

3.1.1 Systolic Blood Pressure (SBP)

The results revealed a significant group effect, $F(1, 48) = 304.56$, $p < .001$, and time effect, $F(1, 48) = 303.05$, $p < .001$, and Group x Time interaction effect, $F(1, 48) = 316.25$, $p < .001$. When simple main effect analysis was conducted as a post-hoc test of the interaction, the AEG had lower SBP in the posttest than the pretest ($p < .001$). However, the CG did not show a statistically meaningful difference between pretest and posttest ($p > .05$) (Figure 1).

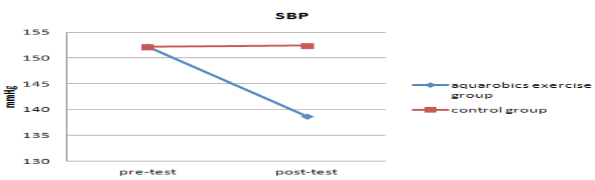

Figure 1. Change in SBP for groups pre and post-test.

3.1.2 DBP (Diastolic Blood Pressure)

The results revealed a significant group effect, $F(1, 48) = 211.89$, $p < .001$, and time effect, $F(1, 48) = 400.45$, $p < .001$, and Group x Time interaction effect, $F(1, 48) = 327.80$, $p < .001$. When simple main effect analysis was conducted as a post-hoc test of the interaction, the AEG had lower DBP in the posttest than the pretest ($p < .001$). However, the CG did not show a statistically meaningful difference between pretest and posttest ($p > .05$) (Figure 2).

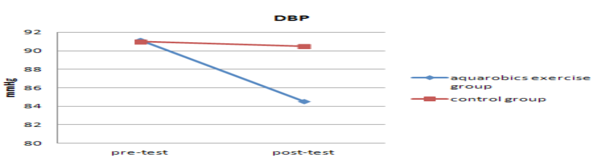

Figure 2. Change in DBP for groups pre and post-test.

3.1.3 MBP (Mean Blood Pressure)

The results revealed a significant group effect, $F(1, 48) = 442.15$, $p < .001$, and time effect, $F(1, 48) = 774.09$, $p < .001$. Group x Time interaction effect, $F(1, 48) = 722.45$, $p < .001$. When simple main effect analysis was conducted as a post-hoc test of the interaction, the AEG had a lower MBP in the posttest than the pretest ($p < .001$). However, the CG did not show a statistically meaningful difference between pretest and posttest ($p > .05$) (Figure 3).

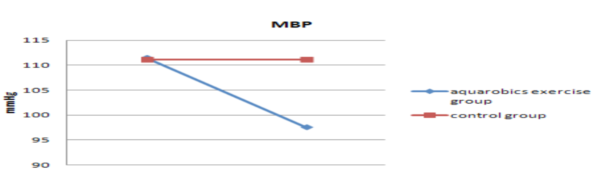

Figure 3. Change in MBP for groups pre and post-test.

3.1.4 HR (Heart Rate)

The results revealed a significant group effect, $F(1, 48) = 67.11$, $p < .001$, and time effect $F(1, 48) = 241.36$, $p < .001$. Group x Time interaction effect, $F(1, 48) = 142.06$, $p < .001$. When simple main effect analysis was conducted as a post-hoc test of the interaction, the AEG had lower HR in the posttest than the pretest ($p < .001$). However, the CG did not show a statistically meaningful difference between pretest and posttest ($p > .05$) (Figure 4).

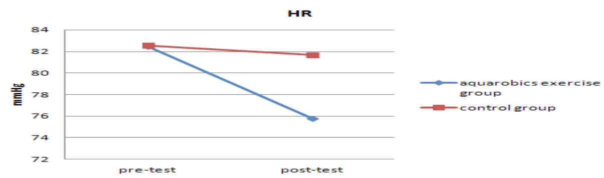

Figure 4. Change in HR for groups pre and post-test.

3.2 Analysis of blood lipid profiles

Table 3 presents the results of blood lipid profile of both the groups.

Table 3. Mean and standard deviations for blood lipid profile of both the groups

Group	Factor	Pre-test	Post-test
		M±SD	M±SD
Aquarobics exercise group	TC (mg/dl)	140.12±1.80	124.20±3.74
	TG (mg/dl)	175.96±4.44	165.52±4.34
	LDL-C (mg/dl)	159.48±6.78	145.48±7.78
	HDL-C (mg/dl)	34.00±2.31	43.32±2.34
Control group	TC (mg/dl)	140.60±1.76	139.76±1.39
	TG (mg/dl)	175.92±3.73	175.52±3.42
	LDL-C (mg/dl)	159.44±6.87	159.60±6.63
	HDL-C (mg/dl)	33.76±2.52	33.64±2.00

3.2.1 TC (Total Cholesterol)

The results revealed a significant group effect, $F(1, 48) = 235.61$, $p < .001$, and time effect, $F(1, 48) = 405.92$, $p < .001$. Group x Time interaction effect, $F(1, 48) = 328.62$, $p < .001$. When simple main effect analysis was conducted as a post-hoc test of the interaction, the AEG had lower TC in the posttest than the pretest ($p < .001$). However, the CG did not show a statistically meaningful difference between pretest and posttest ($p > .05$) (Figure 5).

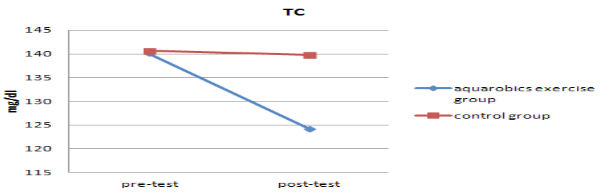

Figure 5. Change in TC for groups pre and post-test.

3.2.2 *TG (Triglyceride)*

The results revealed a significant group effect, $F(1, 48) = 22.14$, $p < .001$, and time effect $F(1, 48) = 180.70$, $p < .001$. Group x Time interaction effect, $F(1, 48) = 155.02$, $p < .001$. When simple main effect analysis was conducted as a post-hoc test of the interaction, the AEG had lower TG in the posttest than the pretest ($p < .001$). However, the CG did not show a statistically meaningful difference between pretest and posttest ($p > .05$) (Figure 6).

Figure 6. Change in TG for group's pre and post-test.

3.2.3 *LDL-C (Low Density Lipoprotein Cholesterol)*

The results revealed a significant group effect, $F(1, 48) = 13.15$, $p < .001$, and time effect, $F(1, 48) = 261.58$, $p < .001$. Group x Time interaction effect, $F(1, 48) = 273.82$, $p < .001$. When simple main effect analysis was conducted as a post-hoc test of the interaction, the AEG had lower LDL-C in the posttest than the pretest ($p < .001$). However, the CG did not show a statistically meaningful difference between pretest and posttest ($p > .05$) (Figure 7).

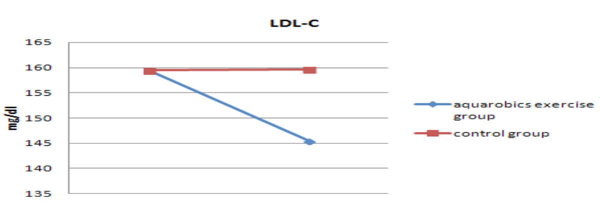

Figure 7. Change in LDL-C for group's pre and post-test.

3.2.4 *HDL-C (High Density Lipoprotein Cholesterol)*

The results revealed a significant group effect, $F(1, 48) = 72.94$, $p < .001$, and time effect, $F(1, 48) = 246.43$, $p < .001$. Group x Time interaction effect, $F(1, 48) = 259.45$, $p < .001$. When simple main effect analysis was conducted as a post-hoc test of the interaction, the AEG had higher HDL-C in the posttest than the pretest ($p < .001$). However, the CG did not show a statistically meaningful difference between pretest and posttest ($p > .05$) (Figure 8).

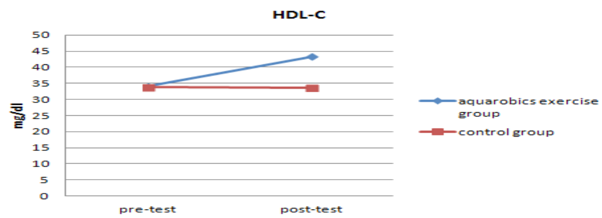

Figure 8. Change in HDL-C for group's pre and post-test.

4. Discussion

The objective of this research was to analyze if aquarobics could affect BP, HR and BL levels in older hypertensive women. The aquarobics exercise group showed lower SBP, DBP and MBP. This is in accordance with recent research that has reported similar effects on SBP, DBP and MBP with pilates gym exercise program in elderly with hypertension[3], and hypertension patients showed significant improvements in SBP, DBP and MBP after practicing 12 weeks of mixed exercises[29]. Another study showed that 12 weeks of aerobic exercise could have positive effects on SBP, DBP and MBP, and myocardial oxygen consumption[15]. Previous studies have also shown that regular aerobic exercise could improve blood pressure and heart rates, and aquarobics, which is a type of aerobic exercise, could similarly have positive effects on blood pressure and heart rates. According to ACSM[30], aerobic exercise could decrease SBP and DBP (up to 7.4/5.8 mmHg) in hypertensive patients who could not be managed satisfactorily with antihypertensive agents. In[31] also reported that aerobic exercise is effective in improving blood pressure. Aquarobics, therefore, may be recommended to enhance heart rate and blood pressure.

The aquarobics exercise group had decreased levels of TG, TC and LDL-C and increased HDL-C. This result is consistent in part with another study, which reported that 12 weeks of aquarobics exercise lowered TC (4.07%) and TG (10.38%)[32,33]. In[3] encouraged hypertensive elderly women to perform pilates gym exercise and found reduce levels of TC, TG and LDL-C and improve HDL-C. Previous studies reporting that walking, running, swimming and biking could also decrease TC and TG, and increase HDL-C, support our findings[34,35]. People who participated in consistent and regular aquarobics exercise have shown to improve cardiovascular systems by way of integrating physical exercise into their daily lives.

Our study indicates that aquarobics exercise has positive effects on blood pressure, heart rates and blood lipid levels of the elderly women with hypertension. Such effects could be obtained only when they participate in exercise regularly. As the aging population increases, health issues and accompanying expenditure also increase and are brought to a social attention[36]. The elderly who are over 65 years of age comprise of 5,193 (10.7%)[37]. About 95% of the elderly are known to have chronic diseases and 81% suffer from more than one disease, characteristically the degenerative chronic diseases[38]. Cardiovascular diseases are 3-4 times more common in this population than the younger age group, mortality rates are higher over 50 years of age due to cerebrovascular- or cardiovascular-related illness, and women have a higher risk of developing these illnesses[39]. In general, the risk factors for these are smoking, alcohol consumption, less physical activity (exercise), improper nutrition and obesity. In the elderly, however, lack of physical exercise, contributed to chronic illness up to 10-20% and lack of physical exercise lead to illness for over 60 (56.5%), over 70 (65.8%) and over 80 (80.6%), serious enough to bring attention[39]. Performing regular physical exercise is an important step towards solving health problems of the elderly. Aquarobics could enable them to perform movements with safety and in a secured environment and help to improve their quality of lives. Future studies may be aimed at designing efficient aerobic exercise programs like aquarobics for the elderly.

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