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The Long-Term Effect of Aquarobics Exercise Program on Physical Function and Mental Health in Elderly Women

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Abstract

The purpose of this study was to identify the long-term effect of aquarobics exercise program on physical function and mental health in elderly women. Fifty elderly women were participated in this study. Their ages ranged from 70–75, with a mean age of 71.62 years. The participants were randomly assigned to one of two experimental conditions: 1. Aquarobics exercises group (n = 25). 2. Control group (n = 25). Data was analyzed using two-way ANOVAs with repeated measures of groups (aquarobics exercise group and control group) and time (pre-test and post-test). Dependent variables were cardio-respiratory endurance, muscle endurance, flexibility, balance, nimbleness, tension, depression, anger, fatigue, vigor, confusion and TMD (Total Mood Disturbance). The result of this study indicated that aquarobics exercise group had a significantly higher score than the control group in cardio-respiratory endurance, muscle endurance, flexibility, balance, nimbleness. The result of the analysis indicated that sub-factors of skill related fitness were improved. And the aquarobics exercise group had a significantly lower score than the control group in tension, depression, anger, fatigue and TMD. But the aquarobics exercise group showed higher score in vigor score relative to the control group. It was found that aquarobics exercise helped to improve physical function and enhance mental health in elderly women.

Keywords: Elderly Women, Mental Health, Physical Function, Quarobics Exercise

1. Introduction

Recently living standards and medical advancements have lengthened the longevity of the elderly, increasing their population. So South Korea is moving into an elderly society[1–5]. According to the Bureau of Statistics, the elderly population of South Korea amounts to 11.0 % at 2010 and 14.3 % at 2018 and is expected to reach 20.8 % at 2026[6]. Total medical payments by over 65 years old reach 29 % and are expected to increase due to such age-related illnesses as high blood pressure, diabetes, cardiac arrests, cancers and Alzheimer's[7]. As the population of elderly women is higher, hormonal changes related to pregnancy, child delivery and menopause are of particular attention amidst elderly problems[8]. Uprising medical costs by the increase of the elder population with or without age-related illnesses cause several social problems[3,5]. Due to the lack of policies or programs on "how to deal with the aging society" in contrast to the Western, social attention to its consequences is required[3,9]. Therefore, "Successful ageing" is the most important of all, in order for the elderly to live a decent life and take care of their physical and mental health without worrying much about medical costs[10]. "Successful ageing" emphasizes the positive side of ageing, and does not mean "not getting old" but means "getting old well"[11].

The health issues of the elderly get various and complicated as they experience physical and physiological

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changes, for example, their decreased ability in daily home chores, the loss of social roles, alienation, and economic burdens[12,13]. Physical problems are related to their activity and physical strength, therefore, it is a very important issue for them to maintain and strengthen physical strength because it is directly linked to their quality of life[4]. In addition, looking into recent researches[14–20] on physical activity of the elderly and psychological benefits from it, their involvement boosts physical strength so benefits not only to improve their health, but to remove negative feelings such as uneasiness, stress, lost or gloomy feelings and to contribute to psychological stability through positive feelings. But, although 38.4 % of people over 65 think that they are not in good shape and need regular exercises, only 33.8 % take part in practical regular exercises[21] which suggests that they overlook the necessity of physical fitness. So in order to achieve quality life, they need to keep a healthy lifestyle, in particular, regular exercises. Health benefits of regular exercises are worth to be considered through different approaches at the preventive levels.

Regular exercises are reported to improve cardiopulmonary function, elasticity of blood vessels and to prevent blood vessel damage[22–24], according to epidemiological studies, the physically active elderly have lower chronic disease and death rates, and have improvements and preventions for chronic diseases such as brain and cardiac diseases, diabetes, cancer, obesity, osteoporosis, fallen injuries, Alzheimer's, depression and stress[22,23.25–28]. But Shin et al[8]. reported that there are difficulties in doing regular exercises because of weakened physical, bone and muscle strength for 91 % over 65 who need long term treatments or convalescence even though exercises have many advantages[29]. Lee and Cheong[30] argue that while several programs have been used for research purposes to improve physical strength and health of the elderly, there are limitations as those have to be carried out without damaging joints or cardiopulmonary systems. So et al.[31] reported that as the risk of injury or wounds in the elderly from exercises is higher than other age groups, it is recommended for them to follow exercise instructions that no longer need safety issues[32].

Recently, aquarobics has emerged onto the surface as it reduces not only negative sides such as injuries or damages, but proves positive sides such as safety and injury prevention[8,31,33,34]. It derives from one of physical therapies, 'aqua-therapy', and has developed as a program for strengthening cardiovascular and muscular skeletal systems in several countries including Japan and USA[8]. It generally performs in the waist or shoulder-deep water walking, muscle exercise, aerobics, dance, stretching[8,27]. Human bodies get lighter because of buoyancy and feel less burden on joints, and water resistance functioning as loads is adjusted to body part resistance, so that effective exercises are possible[8,27]. Not only the homeostasis of body temperature try to raise up energy metabolism of muscle cells as water temperature is lower than body temperature[8,35,36], but it has effects on decreasing blood pressure, increasing blood supply to muscles and blood circulation for terminal tissues, decreasing edema, increasing respiration and cardiopulmonary function[3,6,37]. In this context, aquarobics is considered as right exercises for the physically weak elderly to be able to carry out without damages on joints and to be relieved mentally and psychologically with soothing music[36,37]. Recently, patients having chronic diseases such a obesity, joint disorders, cardiovascular ailments, stroke are exercising aquarobics, which are reported to have improved effects on reducing musculoskeletal stress and increasing muscle strength and respiratory ability[38,39]. Regular aquarobics revitalize health and menstruation of the elderly women who are physically and psychologically worn out. So for previous studies have conducted mostly focusing on changes on body reshaping, physical strength and blood lipids, so there are in lack of studies on defining factors in affecting physical and mental health of the elderly women. Moreover, gathering a sizable elderly subject for research purposes is not so easy that almost no researches have been performed requiring a large number of research participants. Although there are some studies showing positive results, of health-related changes through various programs, most results are based on short programs (8 to 12 weeks), and studies are poorly investigated using over 70 age groups who are in the stage of having muscle strength and endurance diminished.

Therefore, this study aims to investigate the long-term effect of aquarobics exercise program on physical function and mental health in elderly women.

2. Methods

2.1 Participants

The participants are elderly women who are over 70 and live in D city, and are selected based on the Stratified Cluster Random Sample. By basic examinations and surveys they were screened checking their health status

Table 1. Mean and standard deviations for age, height, and weight of participants

Group	Age (years)	Height (cm)	Weight (kg)
	M±SD	M±SD	M±SD
The Experimental Group	72.24±4.50	166.32±1.28	65.49±2.42
The Control Group	71.00±5.40	165.69±4.28	66.02±1.53

and blood pressure (less than 150/95 mmHg), and agreed under the written form on terms and scopes to our research purpose and means. The written agreements specified that gathered information will not be used elsewhere and they voluntarily participate, and can elect not to participate at any time. Fifty elderly women were participated in this study. The participants were randomly assigned to one of two experimental conditions:

- Aquarobics exercises group (n = 25).
- Control group (n = 25).

2.2 Measurement Apparatus and Examinations

2.2.1 Basic Examination

Body fat rates were measured using a bioelectricity resistance analyzer (Inbody, Bio-Space, Korea). Blood pressure in the artery of left upper arms was read two times using a digitized automatic electronic blood pressure gauge (HEM-400, Japan) 10 minutes after subjects who had empty stomach were stabilized while sitting on the chair at room temperature (18–22°C), and its mean value was calculated and Body Mass Index (BMI) was obtained from their heights and weights.

2.2.2 Measurements of Physical Function

To measure the physical strength of the elderly women, cardiopulmonary and muscle endurances, flexibility, nimbleness, etc were measured. Below are the detailed methods of measurements:

2.2.2.1 Cardio-respiratory Endurance Measurement

Harvard Step Tests were modified to be able to measure cardio-respiratory endurance of the elderly women. Pulses were recorded 3 times for 30 seconds with 30 seconds of interval in between after 3 minutes of moving up and down the stairs (20 cm height) with quadruple time beats of speed in 2 seconds, then 1 minute break. This pulse value was incorporated in Physical Efficiency Index. So, higher value means healthier cardiopulmonary endurance.

*Physical Efficiency Index = time of exercise duration (seconds) × 100 / total pulses × 2

2.2.2.2 Muscle Endurance Measurement

The number of times of sit-down and stand-up was measured ensuring a complete 'sit-down and stand-up' as one time, using a 30-Second Chair Stand method and that both arms were crossed on the chest in order for the muscle of the lower limb to be fully engaged.

2.2.2.3 Flexibility Measurements

Flexibility was measured with a Sit-and-Reach method as bending the upper body downward at the standing position could increase blood pressure in the elderly. Participants had sufficient warm-up exercises around the waist in particular, and measures were read in centimeters as the tester was in contact with the sole of the foot. The extent of finger tips reaching out forward was measured (+; forward or -; backward at the tiptoe, set as '0') while sitting without bending knees. The highest value in centimeters was taken after 2 times measurement.

2.2.2.4 Balance Measurements

Subjects were asked to remain in balance keeping one leg lifted up in the air with both eyes closed as soon as hearing calling out "start" by examiners while preparing positions ready with both arms lifted. Measurements were finished whenever their leg touched the ground or their arms move downwards. The duration time was measured in seconds, repeating 3 times and the length was taken.

2.2.2.5 Nimbleness Measurements

The Timed Up-and-go method estimates promptitude, speed, nimbleness of the elderly women, measuring a time (seconds) from stand-up from the chair, turning around the target object about 2.45 m away to returning to the chair.

2.2.3 Mood Measurements

McNair, Lorr and Droppleman[40] developed POMS (The Profile of Mood States) and its validity is confirmed not only Korea but elsewhere[41]. Six lower factors including tension, depression, anger, vigor, fatigue and confusion were measured. Except the vitality, lower points indicate healthy mental health. Total mental health can be estimated by Total Mood Disturbance (TMD). POMS is able to measure the mood of 'right now' and 'usually/chronic' by asking questions. The questionnaire was distributed before and after measurements to estimate the current mood, which is widely used both domestically and internationally in sports psychology[42–46]. The questionnaire used Cronbach's alpha index to fully reflect subject's inner mood expression correctly. For example if tension is .88, depression .90, anger .92, vitality .92, fatigue .86 and confusion .88, the index shows high reliability.

2.2.4 Aquarobics Program

For this study, aquarobics program performed both basic exercises and machine exercises up to 10 to 11 for total 24 weeks, each week had 3 times of warm-up (10 min), main exercises (45 min), and warm-up (5 min), 60 min in total. As a way of estimating the proper intensity of exercises, Rated Perceived Exertion (RPE) by Borg[47] was used. For 1 to 4 weeks, RPE 11~12 was instructed considering subjects' physical strength, RPE 13~14 (somewhat hard) for 5~24 weeks focusing on aquarobics effect.

2.3 Statistical Analysis

Data was analyzed using two-way ANOVAs with repeated measures of groups (aquarobics exercise group and control group) and times (pre-test and post-test). Dependent variables were cardio-respiratory endurance, muscle endurance, flexibility, balance, tension, depression, anger, fatigue, confusion and TMD (Total Mood Disturbance). The level of statistical significance was at $\alpha = .05$. And Turkey's HSD was used for post-experimental verification. All statistical analysis was performed by using SPSS 21.0 program.

3. Results

This study aims to investigate the long-term effect of aquarobics exercise program on physical function and mental health in elderly women. Below is what we found Table 2.

Table 2. Mean and standard deviations for physical function by groups

Group	Factor	Pre-test	Post-test
		M±SD	M±SD
The Experimental Group	Harvard step PEI)	61.32±.90	70.40±1.22
	Sitting down (time)	9.60±.58	15.32±.85
	Trunk Forward Flexion (cm)	.40±1.00	4.64±.91
	Standing on one foot with eyed closed (second)	3.88±1.01	9.08±.76
	up and go (second)	7.28±.74	5.32±.80
The Control Group	Harvard step (PEI)	61.08±.81	61.04±1.10
	Sitting down (time)	9.76±.44	10.20±.82
	Trunk Forward Flexion (cm)	.12±.88	.28±.54
	Standing on one foot with eyed closed (second)	4.24±.66	4.40±.58
	up and go (second)	7.32±.56	6.92±.57

3.1 Analysis of Physical Function

3.1.1 Harvard Step Test

The analysis of Harvard step test showed the significant main effects of group [$F(1, 48) = 590.27$, $p < .001$] and time [$F(1, 48) = 517.23$, $p < .001$]. A significant Group × Time interaction effect [$F(1, 48) = 526.84$, $p < .001$] was also significant. Post-hoc comparision revealed that the aquarobics group had higher step tests in the post-test than pre-test ($p < .001$). The control group did not show any significance between pre-test and post-test ($p > .05$) in Figure 1.

3.1.2 Sitting Down

The analysis of Harvard step test showed the significant main effects of group [$F(1, 48) = 329.49$, $p < .001$] and time [$F(1, 48) = 482.36$, $p < .001$]. A significant Group × Time interaction effect [$F(1, 48) = 354.39$, $p < .001$] was also significant. Post-hoc comparision revealed that the aquarobics group had higher Sitting down tests in the post-test than pre-test ($p < .001$). The control group did not show any significance between pre-test and post test ($p > .05$) in Figure 2.

Figure 1. Interaction effect of step test depending on the groups.

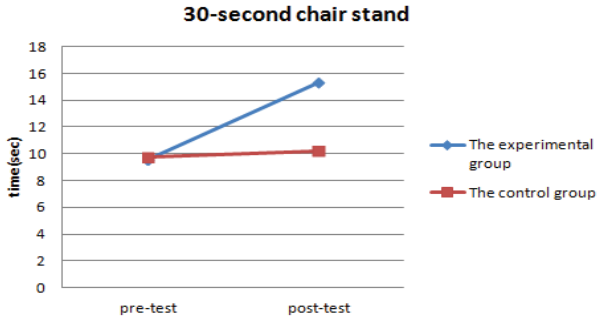

Figure 2. Interaction effect of 30-second chair stand test depending on the groups.

3.1.3 Trunk Forward Flexion (TFF)

The analysis of Trunk Forward Flexion test showed the significant main effects of group [F (1, 48) = 148.55, p < .001] and time [F (1, 48) = 223,73, p < .001]. A significant Group × Time interaction effect [(F (1, 48) = 192.37, p < .001] was also significant. Post-hoc comparision revealed that the aquarobics group had higher Trunk Forward Flexion tests in the post-test than pre-test (p < .001). The control group did not show any significance between pre-test and post-test (p > .05) in Figure 3.

3.1.4 Standing on One Foot with Eyes Closed (SOFEC)

The analysis of Trunk Forward Flexion test showed the significant main effects of group [F (1, 48) = 158.34, p < .001] and time [F (1, 48) = 397.55, p < .001]. A significant Group × Time interaction effect [F (1, 48) = 158.76, p < .001] was also significant. Post-hoc comparision revealed that the aquarobics group had higher Standing on One Foot with Eyes Closed tests in the post-test than pre-test (p < .001). The control group did not show any significance between pre-test and post-test (p > .05) in Figure 4.

Figure 3. Interaction effect of Trunk Forward Flexion test depending on the groups.

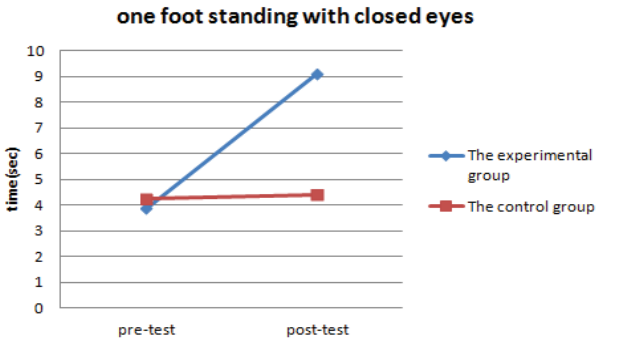

Figure 4. Interaction effect of Standing on One Foot with Eyes Closed test depending on the groups.

3.1.5 Up and Go

The analysis of Up and Go test showed the significant main effects of group [F (1, 48) = 25.80, p < .001] and time [F (1, 48) = 133.89, p < .001]. A significant Group × Time interaction effect [F (1, 48) = 58.50, p < .001] was also significant. Post-hoc comparision revealed that the aquarobics group had lower Up and Go tests in the post-test than pre-test (p < .001). The control group did not show any significance between pre-test and post-test (p > .05) in Figure 5.

3.2 POMS Score Analysis

Table 3 shows the analysis of subordinate factors in POMS.

3.2.1 Tension

The analysis of tension showed the significant main effects of group [F (1, 48) = 133.03, p < .001] and time [F (1, 48) = 382.43, p < .001]. A significant Group × Time interaction effect [F (1, 48) = 282.72, p < .001] was also significant. Post-hoc comparision revealed that the aquarobics group

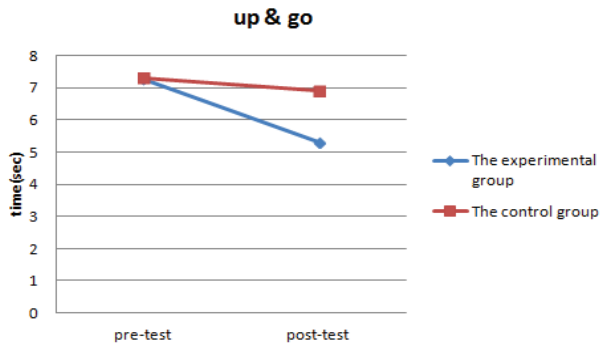

Figure 5. Interaction effect of Up and Go test depending on the groups.

Table 3. Mean and standard deviations for Mood by groups

Group	Factor	Pre-test	Post-test
		M±SD	M±SD
The Experimental Group	Tension	39.04±1.40	31.08±1.08
	Depression	48.52±1.23	40.68±.90
	Anger	46.08±3.58	40.28±2.11
	Vigor	52.44±2.16	61.76±2.63
	Fatigue	47.52±1.81	40.56±1.00
	Confusion	42.96±1.34	42.44±4.50
	TMD	171.68±4.96	133.28±4.68
The Control Group	Tension	38.84±1.31	38.24±1.45
	Depression	48.68±1.28	49.40±.82
	Anger	47.48±1.87	48.68±2.04
	Vigor	54.72±2.21	53.16±3.60
	Fatigue	46.56±2.00	45.60±1.61
	Confusion	44.08±1.71	44.52±2.28
	TMD	170.92±4.41	173.28±5.11

had lower tension score in the post-test than pre-test ($p < .001$). The control group did not show any significance between pre-test and post-test ($p > .05$) in Figure 6.

3.2.2 Depression

The analysis of depression showed the significant main effects of group [$F(1, 48) = 408.43$, $p < .001$] and time [$F(1, 48) = 285.87$, $p < .001$]. A significant Group × Time interaction effect [$F(1, 48) = 413.20$, $p < .001$] was also significant. Post-hoc comparision revealed that the aquarobics group had lower depression score in the post-test than pre-test ($p < .001$). The control group did not show any significance between pre-test and post-test ($p > .05$) in Figure 7.

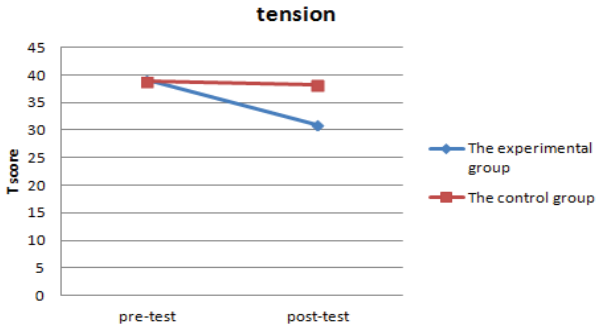

Figure 6. Interaction effect of tension score depending on the groups.

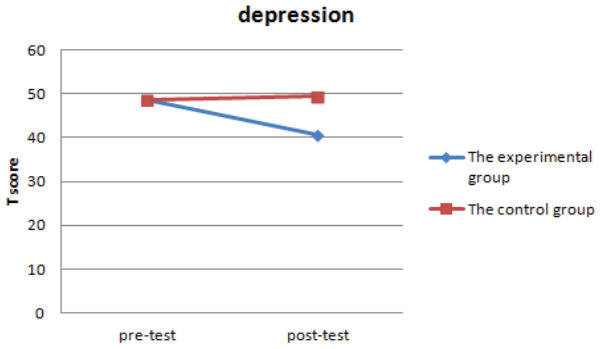

Figure 7. Interaction effect of depression score depending on the groups.

3.2.3 Anger

The analysis of anger showed the significant main effects of group [$F(1, 48) = 68.35$, $p < .001$] and time [$F(1, 48) = 35.86$, $p < .001$]. A significant Group × Time interaction effect [$F(1, 48) = 83.05$, $p < .001$] was also significant. Post-hoc comparision revealed that the aquarobics group had lower anger score in the post-test than pre-test ($p < .001$). The control group did not show any significance between pre-test and post-test ($p > .05$) in Figure 8.

3.2.4 Vigor

The analysis of vigor showed the significant main effects of group [$F(1, 48) = 24.69$, $p < .001$] and time [$F(1, 48) = 81.45$, $p < .001$]. A significant Group × Time interaction effect [$F(1, 48) = 160.11$, $p < .001$] was also significant. Post-hoc comparision revealed that the aquarobics group had higher vigor score in the post-test than pre-test ($p < .001$). The control group did not show any significance between pre-test and post-test ($p > .05$) in Figure 9.

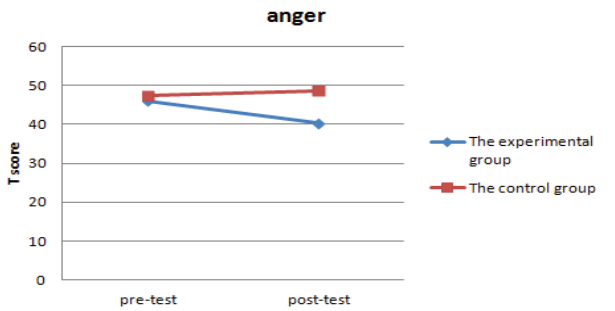

Figure 8. Interaction effect of anger score depending on the groups.

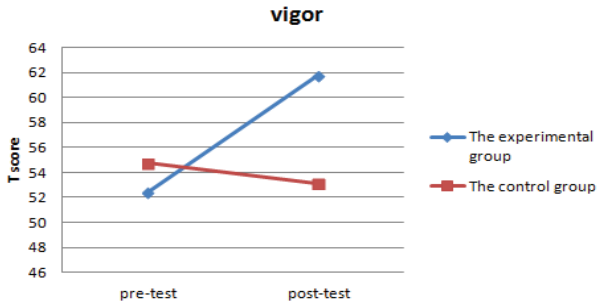

Figure 9. Interaction effect of vigor score depending on the groups.

3.2.5 Fatigue

The analysis of fatigue showed the significant main effects of group [F (1, 48) = 32.73, p < .001] and time [F (1, 48) = 174.31, p < .001]. A significant Group × Time interaction effect [F (1, 48) = 100.04, p < .001] was also significant. Post-hoc comparision revealed that the aquarobics group had lower fatigue score in the post-test than pre-test (p < .001). The control group did not show any significance between pre-test and post-test (p > .05) in Figure 10.

3.2.6 Confusion

No statistically significant main effects of time [F (1, 48) = .01, p > .05] and interaction between groups and time [F (1, 48) = 1.23, p > .05]. But there is the significant main effects of group [F (1, 48) = 6.16, p < .05]. Post-hoc comparision revealed that the aquarobics group had lower fatigue score in the post-test than pre-test (p < .05). The control group did not show any significance between pre-test and post-test (p > .05) in Figure 11.

3.2.7 Total Mood Disturbance

The analysis of Total mood disturbance showed the significant main effects of group [F (1, 48) = 348.50, p < .001] and time [F (1, 48) = 440.86, p < .001]. A significant Group × Time interaction effect [F (1, 48) = 563.89, p < .001] was also significant. Post-hoc comparision revealed that the aquarobics group had lower Total mood disturbance score in the post-test than pre-test (p < .001). The control group did not show any significance between pre-test and post-test (p > .05) in Figure 12.

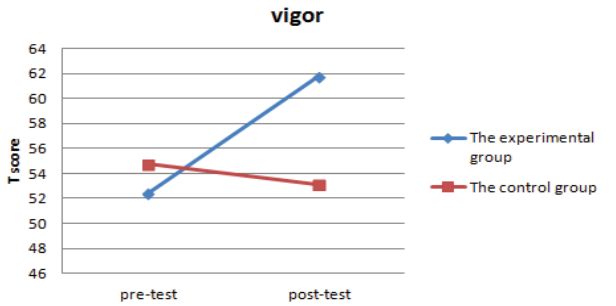

Figure 10. Interaction effect of fatigue score depending on the groups.

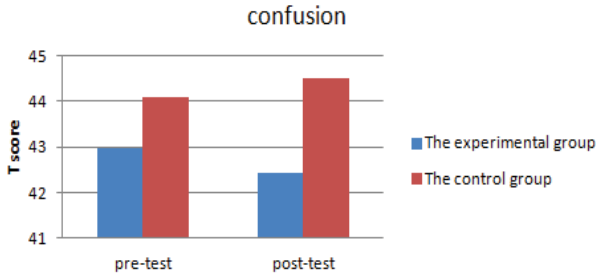

Figure 11. Confusion score difference according to the groups and time.

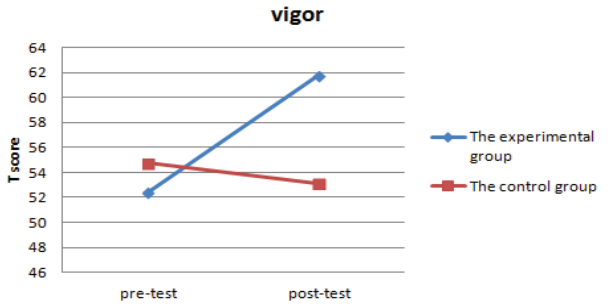

Figure 12. Interaction effect of Total mood disturbance score depending on the groups.

4. Discussion

We investigated the long-term effects of aquarobics on physical and mental health of elderly women. The

aquarobics group had higher values of cardiopulmonary and muscle endurance, flexibility, balance and nimbleness than the control group, which suggests that aquarobics resulted in significant changes on physical strength of the participated elderly women. Our results are in agreement with Lee et al.[48], Kim and Kim[49] and Rho et al.[50] who reported more significantly improved cardiopulmonary endurance of normal or obese elderly women by aquarobics, or than the group who actively performed physical exercises, respectively. Furthermore a higher increase in cardiopulmonary endurance was also reported in Heyneman and Premo[51] who trained subjects to walk randomly in the shoulder-deep pool three times a week for 8 weeks. Cardiopulmonary endurance is one of the requirements of health-related physical constituents for daily activities, such as walking, shopping, travel, recreation or sports[52]. Therefore, the reason why aquarobics strengthen the cardiopulmonary endurance of the elderly women was likely to result from vibrant and voluntary strength of individuals, movements and directions of several joints, centripetal and centrifugal muscle contraction of upper and lower limb performed at various angles through mental motivation.

In accordance with Noh[50] who reported higher muscle endurance in a multiplex aqua-exercise group than an aerobic exercise group, our study showed increased muscle endurance in the aquarobics group. Aquarobics improved muscle strength through walking, exercises of ankles, knees and lower limbs with less pain and burden in joints because of protective equipments, similar results found in Kim et al.[49]. As exercises in the water could be carried out with much less influence of gravity than in the ground and water resistance upon movements in every direction could create counter-resistance, both extensor and flexor muscles can be improved[53], therefore balanced muscle developments can be achieved[33]. Generally the elderly tend to walk, move up the stairs slowly and are easy to stumble, causing fractured joints[54] because of weak muscle strength. But aquarobics could enhance muscle endurance and avoid such accidents.

Similar results, that is, increased flexibility in the aquarobics group of obese elderly women[49] were also found in our study, supporting Lee et al.[48] result that a certain form of aquarobic exercises have positive effects on flexibility improvements. Flexibility is required for daily activities such as moving up stairs, dressed-up on their own, taking a bath and getting into or out of a car[55]. The elderly women could increase flexibility by activating muscle cells that are not normally used and enhancing muscle functions around the torso and waist through body spinning exercises.

Better balance and nimbleness in the aquarobics group in our results support that aquarobics increases static stability from physical balance and has positive effects on balance and nimbleness of elderly osteoarthritis patients[56]. Balance, the ability to maintain stability in any moving circumstances, and nimbleness are necessary for carrying out astute activities such as hoping in and out of the bus, avoiding moving cars or any objects, taking calls and visiting bathroom[52]. Slower response due to low cooperation between muscle and neuron, and a weak ability in information processing of central nervous system because of low oxygen and glucose supply resulting from cardiopulmonary malfunction or insufficient blood supply are expected to the elderly[57], and have negative effects on coping with emergency situations or maintain stability[58]. Our study showed that aquarobics built up balance and nimbleness because there were many movements to increase them by keeping one leg afloat, or jump and turns, and also improved muscle strength around knees, ankles and joints. Previous researches stress the significance of musculoskeletal, vestibular sensory systems as ways of improving a balance[59–60] even though we did not identify changes of vestibular or sensory systems. In summary, regular aquarobics exercises showed significant effects on physical strength and health of the elderly as they commonly encounter daily difficulties due to weakened physical strength, so it could help them to live and maintain an independent life.

The aquarobics group scored lower points in tension, depression, anger, fatigue, confusion, and total mood disorder, but higher in vigor, indicating that aquarobics could trigger changes in mental health. As few studies about its effects on mental health (mood changes) have been conducted, direct comparison is not possible, but we looked into the previous studies of mood changes caused by physical activities. One of negative emotions, nervousness was lower in the aquarobics group in our study, which is supported by Yoon[63], Harman et al.[64] and Taylor-Piliae et al.[65] who reported elderly arthritis patients are less nervous after exercising Tai-Chi for 12 weeks. Similar results are found in Ross et al.[66]. As people age, the elderly are likely to have chances of facing deaths of spouses or family, or economic difficulties, which cause chronic depression[67].But aquarobics helped them reduce mental depression while listening to music and reading a poem.

Aquarobics also helped to reduce depression, which supports the results of Sin et al.[68] and Kim[69] who showed the effectiveness of Tai-Chi and Aquarobics exercise to the depressed elderly. The elderly depression is more likely to be chronic and more frequently to occur and are dangerous factors of causing damages of their lives[70]. Aquarobics tend to reduce depression and develop positive relations and bondages in the group so give them mental stability. Aquarobics scored lower points in anger, one of negative emotions and this result is in good accordance with Ross et al.[66] and Jin[74] who showed that both elderly men and women involved in Tai-Chi exercises or during the exercises express less their anger. As the elderly are likely to have no social positions and their beings are not highly appreciated, they could be easily ignored by the young or family, or even by each other so often feel anger[71]. Aquarobics discouraged them to show anger and encouraged them to have social relationships and to appreciate their beings for each other. Quick and slow breath by aquarobics made them relax physical tension and maintain mental stability, and relieve anger points.

Aquarobics reduced fatigue, other negative emotions, which coincide with Lee and Suh[72] and Fukagawa et al.[73] who showed fatigue decrease after Tai chi exercises. Fatigue has to be considered as an important issue because it functions as an alert signal[70]. The reason why aquarobics decreased fatigue might pertain to the recovery of muscle power and activity from lowered breath capacity. As shown in Jin[74], the total mood disorder was decreased by aquarobics while vigor was increased by aquarobics. Similarly, it is reported that Tai chi could boost vigor and increase good mood, and generate psychological positive effects[75], Skeleton and McLaughlin[76]. Vigor is identified as a motive force or positive attitude to achieve goals or complete various tasks[77–79]. Schike[81] argued that positive mentalities through sports activities are directly related to satisfaction and happiness of the elderly life. Vigor, one of those positive mentalities is closely connected to psychological satisfaction and stability[81]. The fact that aquarobics decreased total mood disorder and increase vitality in this study suggest that the unity of body and mind, and mediation used to centralize inner energy in every movement may reduce negative feelings and retrieve mental stability via positive feelings. Vigor was thought to be increased while experiencing physical confidence and mental satisfaction while or after aquarobics.

Therefore, regular exercises like aquarobics could result in better effects on physical function of the elderly, not only reduce negative emotions such as nervousness, depression, anger, fatigue but increase positive emotions such as vitality. In general the elderly tend to decide the quality of life depending on whether they could live their own independent life or not[82]. As they experience several lowered physical functions and increased confusion, nervousness, anxiety etc, so eventually develop anger and hostility, but physical exercise could vent out those negative emotions[83]. Furthermore, because they have relatively weaker mental strength, exercises could give more mental benefits. Willingness to physical exercises is required to improve both mental and physical health. Ageing causes physical and mental recess and increases dependency on others, social isolation, and mental feelings of deprivation, but it could be alleviated through physical exercises. In the future studies, more systematic and scientific approaches are needed to point out kinds of necessary exercises, the way, and the importance of persistence and regular exercises.

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