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Impact of Water Based Exercises on Balance in Elderly Women

Authors
Shrouk Ibrahim Salem[1], Zahra Mohamed Hassan[2], Samah M. Ismail[3]
[1]Physiotherapist at the National Neuro-Motor Institute, Imbaba, Giza, Egypt
[2]Assistant Professor in the Dept of Cardiovascular/ Respiratory Disorder and Geriatrics, Faculty of Physical Therapy, Cairo University
[3]Assistant Professor in the Dept of Cardiovascular/ Respiratory Disorder and Geriatrics, Faculty of Physical Therapy, Cairo University

Abstract
Aging has been shown to affect all of the systems causing poor balance in elderly subjects. Elderly subjects present serious problems due to poor balance such as falls and fractures which increase economical costs in health care.
Objective: *Purpose of the study was to find out the efficacy of aquatic exercises on balance in elderly women.*
Materials and Methods: *Thirty elderly women participated in the study. Their age ranged from 60 to 70 years old and their body mass index ranged from 25 to 34.9. All the subjects performed aquatic exercises program which was divided into three phases: aquatic environment adaptation phase, stretching phase and a phase of static and dynamic exercises for balance under water for 45 minutes/session/3times/week for six weeks. The intensity was low to moderate, with constant frequency and speed, for 6 weeks. Each series was performed continuously and between each one there was a one-minute rest.*
Results: *statistical analysis showed clearly that treatment by aquatic exercise program had significant positive effects on the results of berg balance scale and timed up and go test with percentage of improvement 11.64% and 21.19% respectively.*
Conclusion: *it was concluded that aquatic exercises can be used as safe, efficient, adjacent therapy and improve balance among elderly women.*
Keywords: *Water based exercises, Aquatic exercises, Balance, Elderly, and Aging.*

Introduction

Aging is a universal event that is inherent in the individual and occurs within biological and genetic parameters [(1)]. The last country profile of Egypt shows that the percentage of older people (more than 65 years) is 3.7% of the total population in 2009[(2)]. More than one third of community dwelling adults, aged 65 and older, falls each year, and the rate of falls increases for adults over age 8o from 33% to 40% or 50% [(3)].

Changes in motor functions in older adults include a decrease in both muscular strength (ability to produce force) and power (ability to produce force quickly) [(4)].

The losses of strength and power in elderly, often translate into impaired balance, gait and mobility, all of which are critical factors in preventing falls and carrying out activities of daily living (ADLs) [(5)].

Balance can be defined as the ability to maintain the body center of gravity over its base of support

with minimal sway or maximal steadiness [6]. Balance and loco-motor adaptation tend to become impaired with age. Several researches have shown an age-related decline in medio-lateral control of the center of mass resulting in decreased stability in the frontal plane in older adults. This mechanism probably explains the age related decline of gait speed in the 25-cm and 15-cm fast-pace corridor walks, which requires increased control of medio-lateral of the center of mass in response to the new restricted base of support [7].

Loss of balance and increased body sway are important risk factors for falls in the postmenop-ausal women. The age-associated increase in the incidence of osteoporotic fractures results from a combination of increased fall risk and reduced bone strength. Although various factors are associated with falls, impaired balance and mobility have been consistently identified as the main risk factors[8]. Decreased postural stability is also observed in postmenopausal period. Fall incidence is three times higher in postmenopausal women than in men within the same age group. Estrogen withdrawal in menopause is suggested to a Vect postural stability via reducing the speed of information processing of the brain [9].

Aquatic exercise therapy is a method of treatment that involves rehabilitative exercises performed in the water and specifically designed activity by qualified personnel to aid in the restoration, extension, maintenance of quality of functions for persons. The health benefits of engaging in water activities include improvement in strength, endurance, coordination and balance [10].

Hydrotherapy is a possible physical therapeutic resource to be recommended for increase balance and preventing falls among elderly people [11].

Exercise in water as an environment with disruptive balance due to low-risk nature can provide the context for challenging both balance and muscular systems and is an effective method to improve balance and lower extremity strength as well as preventing falls among the elderly [12].

The feeling of hydro static pressure and resistance of the water will help support individuals with balance deficit which may provide a sense of confidence in people that typically have fear of falling while ambulating or exercises [13]. Aquatic exercise offers a medium to affect these components of balance and postural control according to hydrodynamics principle [14].

Due to pain, limited ROM and strength, individuals with OA are at a higher risk for falls and loss of balance. The buoyant support of the water reduces the incidence of loss of balance that on land, would result in a fall or joint injury. Douris and colleagues showed that aquatic therapy improved balance scores for older adults living independently and for older adults in assisted living. The multi-planar and multidirectional input from the water, due to turbulence and equipment, can facilitate the neuro-motorsystem to respond with appropriate postural reactions. For example, the effort of performing scapular retractions would require the participants to engage their core postural and lower extremity muscles to maintain their balance. For participants with very poor balance, or who cannot independently support themselves in the water environment, specialized equipment or other supportive gait devices are utilized [15], [16].

Subjects

Thirty elderly women participated in the study. They were selected from the physical therapy outpatient department in the National Neuro-motor Institute Imbaba Giza governorate. The study was done at the physical therapy department in the hydrotherapy clinic at the National Neuro-Motor Institute. Their age ranged from 60 to 70 years old and Body Mass Index (BMI) ranged from 25-34.9 Kgm/m².

Subjects were excluded if they have the following conditions or diseases recent cardiac surgery, recent fractures, Uncontrolled cardiovascular problems, Infectious diseases, Recent Trauma, participant, Inner ear infections and Any neurological disorder affecting balance.

Materials

A. Evaluation Equipment

1. Weight and height scale for was used to measure body weight and height of each subject to calculate body mass index for each subject.
2. A questionnaire for interview, the Berg Balance Scale – Brazilian version, the Timed Up& Go test.
3. Arm chair and a seat height of 45 cm from the floor.
4. A chronometer (Sport Timer),
5. Tape measurement.

B. Training Equipment

1. Large swimming pool for underwater exercise with suspended plinth and suspended chairs (aquatic therapy) in the hydrotherapy department in the National Neuoromotor Institute, Giza, Egypt).
2. Swimming pool thermometer to adjust water temperature to be about 30◦ degrees.

Study Protocol

Before starting the study, the following were performed

- The procedures and the study protocol were explained in details for each subject before the initial assessment.
- A written informed consent was signed by each patient before participation in the study as an agreement to be included in the present study.
- Before starting the exercise program, a complete medical history was taken and physical examination was done by a physician for all subjects.
- Explain signs and symptoms that when occurred, patient must stop exercise or decrease the intensity in case of: chest pain, dizziness, headache, confusion, sever fatigue and noticeable change in heart rate or increase of blood pressure.
- The subjects were instructed not to have heavy meal for at least two hours before the exercise training.
- Each subject of both groups passed through the following steps of measurements by the physical therapist. The parameters recorded at the beginning and the end of the study period (6 weeks).

Evaluation Procedure

Measurement of Body Weight and Height: The weight and height of each subject were measured using weight and height scale and then BMI for each subject was calculated to select those with (BMI 25-34.5Kg/m²) using the following formula BMI= weight (Kg) / [height (m)] 2

Berg balance scale and timed up and go tests: BBS Brazilian version and timed up and go test will be applied before the treatment (pre-test) and after six weeks (post-test) of hydrotherapy.

The BBS consists of 14 items that are scored of 0 to 4. A score of 0 is given if the participant is unable to do the task and score of 4 is given the participant is able to complete the task. The items include simple mobility tasks (e.g transfers, standing unsupported, sit-to-stand) and more difficult tasks (e.g tandem standing, turning 360, single-leg stance) [17]. The scale evaluates static and dynamic balance based in 14 common items in daily life, such as reaching, turning around, moving away, standing up and getting up. The maximum score that can be attained is 56 points. It will be applied in accordance with the procedures described by the authors who translated and adapted it for Brazil [18].

TUG: The time it took for the elderly women to get up from a chair, walk a distance of 3 meters, turn around, walk back to the chair and sit down again was measured in seconds. The elderly women did the test once to become familiarized with it and, on the second attempt, the time was recorded [19].

Treatment Procedures

All subjects received the program 45 minutes per session three times a week for six weeks.

Each session was be divided into three phases: aquatic environment adaptation phase, stretching phase and a phase of static and dynamic exercises

for balance under water. . The intensity was low to moderate, with constant frequency and speed, for 6 weeks. Each series was performed continuously and between each one there was a one-minute rest.

Phase I – Aquatic environment adaptation.

Exercise 1: Respiratory control.

- **Positioning:** Semi-seated position without posterior support, with immersion to the shoulder level. Shoulders at 90º flexion and with extended elbows.
- **Activity:** Slow and prolonged expiration through the mouth over the water, then with the mouth immersed, and subsequently with both mouth and nose immersed

Phase II – Stretching. Each stretching exercise was maintained for 30 seconds.

Exercise 2: Stretching of the hamstring muscles.

Positioning: Orthostatic position with back supported against the wall.

Activity: Elevation of one of the lower limbs, maintaining knee extension and ankle dorsal flexion.

Exercise 3: Stretching of the triceps surae and iliopsoas muscles

Positioning: Orthostatic position with hands on the edge of the pool.

Activity: Taking a large step forward, while maintaining the anterior knee in flexion, the posterior knee in extension, and feet in contact with the bottom of the pool.

Phase III – Static and dynamic exercises for balance.

The speeds and frequencies indicated were approximate averages.

Exercise 4: Squatting.

Positioning: standing facing pool bar both hands holding the bar while maintaining extended back.

Activity: bending both knees together while maintaining the back in extended position (avoid leaning forward) and both feet on the pool ground (avoid raising heels)

Exercise 5: unilateral hip extension.

Positioning: standing facing pool bar both hands holding the bar while maintaining extended back.

Activity: extend one limb backwards while maintaining knees and back in extended position while standing on the other limb with alternating both limbs.

Exercise 6: unilateral abduction.

Positioning: standing giving side to the pools bar while the hand next to the bar holding it.

Activity: abduct one lower limb laterally while weight bearing on the other limb and maintain back extension (avoid leaning laterally).

Exercise 7: Walking backwards.

Exercise 8: Lateral walk with large steps.

Exercise 9: Walking with one foot in front of the other

Activity: Walking supporting one foot immediately in front of the other, and so on successively.

Exercise 10: walking with trunk rotation.

Activity: Walking forwards taking hand to opposite knee in flexion, alternately.

Exercise 11: Walking with one-leg support pauses.

Activity: Walking and, at the physical therapist's command, maintaining one-leg support with the opposite knee in flexion for 10 seconds.

Exercise 12: Bilateral shoulder flexion-extension

Positioning: Semi-seated position.

Activity: Performing shoulder flexion and extension, while keeping the elbows in extension. Starting with maximum shoulder hyperextension and going until 90º flexion (10 repetitions, frequency: 12 repetitions per minute).

Exercise 13: Bilateral horizontal shoulder abduction-adduction

Positioning: Semi-seated position, shoulders flexed at 90º, extended elbows.

Activity: Starting in adduction and going until 90º of horizontal abduction (10 repetitions, frequency: 12 repetitions per minute).

Exercise 14: Ankle pumping

Positioning: Orthostatic position, with immersion up to the xiphoid process level.

Activity: Extension of the knees associated with plantar flexion, maintaining this position for 5 s, and then knee flexion associated with dorsiflex-

ion, also maintaining this for 5 s (10 repetitions, frequency: 3 repetitions per minute).

Data Management

Wilcoxon Sign Ranks was used in the statistical analysis between the before and after tests in the BBS.

Paired t-test was used in the statistical analysis between the before and after tests in TUG test.

Consent

Authors declare that verbal consent was taken from the studied group before making the study.

Ethical approval

The ethical committee of faculty of physical therapy approved the study protocol.

RESULTS

1- Results of subjects' demographic data:

As observed in table (1) the mean value of age was (65.67±2.94 years). The mean value of weight was (73.57±9.11 kg). The mean value of height was (156.30±5.86 cm) and the mean value of BMI (29.98±1.78 kg/m²).

Table (1): Results of subject's demographic data.

Item	Age (years)	Weight (Kg)	Height (cm)	BMI (kg/m²)
Mean	65.67	73.57	156.30	29.98
Standard Deviation	±2.94	±9.11	±5.86	±1.78
Min	60.00	57.00	145.00	25.63
Max	70.00	92.00	167.00	32.99
Range	10.00	35.00	22.00	7.36

Berg Balance Scale

Table (2) and figure (1) represented the median values of before- and after-berg balance scale. The berg balance scale ranged from 22.00 to 42.00 with a median value 31.50 (27.75, 36.25) for before-treatment, while it ranged from 25.00 to 46.00with a median value 35.20 (31.00, 38.50) for after-treatment. The statistical analysis by Wilcoxon Signed Ranks test between before- and after-treatment revealed that there was a highly significant difference (P=0.0001; P<0.05) for berg balance scale with a percentage of improvement equal to (11.64%).

Table (2): Median values of Berg Balance Scale pre and post the study.

Items	Berg balance scale	
	Before-treatment	After-treatment
Median	31.50 (27.75,36.25)	35.20 (31.00,38.50)
± Standard deviation	±5.692	±5.499
Minimum to Maximum	22.00 – 42.00	25.00 – 46.00
Z-value	4.749	
Level of significance (P-value)	0.0001	
Significance (P<0.05)	HS	
Improvement percentage	11.64%	

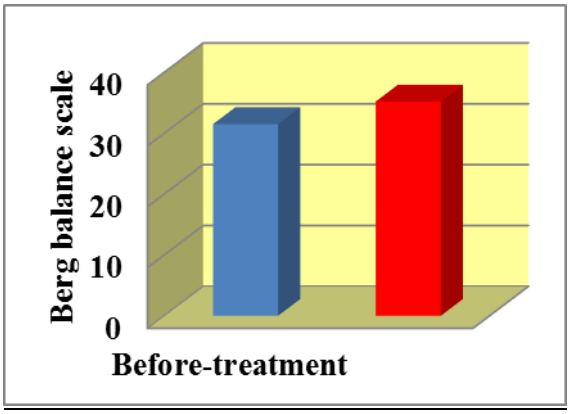

Figure (1): Show mean values of Berg Balance Scale pre and post the study.

Timed up and go test

Table (3) and figure (2) represented the mean values of before- and after- timed up and go test. The timed up and go test ranged from 12.00 to 20.00 with a mean value (16.20 ±1.88sec) for before-treatment, while it ranged from 10.00 to 15.00 with a mean value (12.77 ±1.54sec) for after-treatment. The statistical analysis by paired t-test between before- and after-treatment revealed that there was a highly significant difference (P=0.0001; P<0.05) for timed up and go test with a percentage of improvement equal to (21.19%).

Table (3): Mean values of Timed Up and Go test pre and post the study.

Items	Timed up and go test	
	Before-treatment	After-treatment
Mean ± Standard deviation	16.20 ±1.88	12.77 ±1.54
Minimum to Maximum	12.00 – 20.00	10.00 – 15.00
t-value	20.107	
Level of significance (P-value)	0.0001	
Significance (P<0.05)	HS	
Improvement percentage	21.19%	

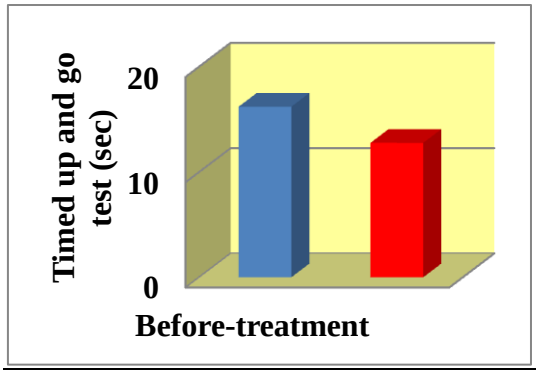

Figure (2): Show mean values of Timed Up and Go test pre and post the study.

Discussion

The aim of this study was to find out the effect of aquatic exercises on balance in elderly women.

Thirty elderly women participated in the study. They were selected randomly from the physical therapy outpatient department in the National Neuro-motor Institute. The study was done at the physical therapy department in the hydrotherapy clinic at the National Neuro-Motor Institute. Their age ranged from 60 to 70 years old.

All selected subjects received aquatic exercise program. Each session was divided into three phases: aquatic environment adaptation phase, stretching phase and a phase of static and dynamic exercises for balance under water. The intensity was low to moderate, with constant frequency and speed, for 6 weeks. Each series was performed continuously and between each one there will be a one-minute rest, three times a week for six weeks.

Results of this study showed that treatment by aquatic exercise program had significant positive effects on the results of berg balance scale and timed up and go test.

In this study, the percentage of improvement of berg balance scale and timed up and go test is 11.64% and 21.19% respectively.

Resende et al, implemented an aquatic therapy program for the elderly, with a 12 - week duration, twice a week. The program aimed to improve balance includes adaptation activities to the aquatic environment, aquatic therapy and aquatic exercise that challenged the balance. The results of this study indicated that the aquatic physical therapy exercise program provides an increase in balance and reduce the risk of falls in the elderly [(18)].

Nubia et al., comparing the efficacy of water exercise programs and soil body balance of elderly patients and found that aquatic exercises were significantly better for the balance of the elderly in the program on the ground [(20)]. In his study, we observed a significant increase in static and dynamic balance of elderly people who underwent the training protocol in the therapy pool. There is a growing indication in the clinical setting of aquatic exercises for individuals with fear and risk of falling [(21)].

It was believed that improvement in control of body position is the result of this fact that water allows people to do great range of movements without increasing the risk of falling or being injured[(20)]. It was believed that protective medium of water allows aged people to maintain a straight and flat posture independently. Also, existence of the forces which destroy the stability and balance provides a suitable medium for balance activities and for challenging the involved systems. Also, due to the increase in reaction time, these training are suitable for people with defect in balance, because due to the viscosity property of water, movements are performed slowly and so people have more time to create response and reaction. Combination of frequency and speed of movements may cause to increase in strength and improvement of flexibility reaction time [(22)].

When additional impairments such as joint pain, fear of falling, or decreased balance make

exercising on land difficult, AE may provide equal to or possibly greater benefits than LE. Because we failed to find significant differences between LE or AE interventions and an NE control group, conclusions regarding the potential benefits of AE should be interpreted with caution until further studies[23]. Balance increased significantly after conducting the hydrotherapy program, according to Sharpened Romberg test (static balance with eyes open and close) and the Timed Up & Go test [24].

The results of present research are in accordance with the findings of Douris et al. (2003) and Resende et al.(2008) Who found that there was a significant effect of doing aquatic training on improving the static and dynamic balance [15,18].

Conclusion

Finally, it was concluded that aquatic exercises can be used as safe, efficient, adjacent therapy and improve balance among elderly patients. The results of this study supported the importance of aquatic exercises and showed significant effect on improvement of the score of BBS and in the time used to perform TUG test

Conflict of interest

Authors have declared that no conflict of interests exists.

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Faculty of Physical Education and Sport Sciences, Ferdowsi University of Mashhad ,Mashhad-Iran

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