

Short communication

Effectiveness of water aerobics in improving chest mobility and pulmonary function in chronic stroke patientsC.K. Muralidharan¹, K. Kiruthika¹, P. Senthil², S. Swathi²¹Nandha College of Physiotherapy, Erode, Tamil Nadu, India²Chettinad School of Physiotherapy, Chettinad Academy of Research and Education, Kelambakkam, Tamil Nadu India

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ABSTRACT

Introduction and Aim: Stroke is one of the prominent causes of long-term disability. Stroke affects everyone uniquely depending on the level and location of the area affected in the brain and how long the brain tissue was deprived of oxygen. Individuals with stroke usually demonstrate changes in breathing patterns, decreased strength of respiratory muscles, and decreased ventilatory function. The aim of the study is to assess the effects of water aerobics on the pulmonary function of people with stroke.

Materials and Methods: This study was conducted in a clinical setup. A total number of 16 subjects were selected based on the inclusion and exclusion criteria. All the subjects received water aerobic exercises for 40minutes sessions for 4days per week for 12weeks. Pre- and Post-treatment assessments were done by measuring chest expansion and forced vital capacity.

Results: All the 16 subjects completed the 12 weeks water aerobics intervention. After 12 weeks post treatment assessments were taken. The outcome measures, of chest expansion and forced vital capacity showed a significant improvement.

Conclusion: The results of this study show that there is a significant improvement in the chest expansion and pulmonary function after giving water aerobics intervention.

Keywords: Stroke; water aerobic exercises; chest expansion; forced vital capacity.

INTRODUCTION

Stroke is one of the leading causes of long-term disability, happens when a part of the brain is deprived of blood, causing damage to the brain cells over time (1). In general, a Stroke is defined as a neurological deficit attributed to an acute focal injury of the Central Nervous System by a vascular cause, comprising cerebral infarction, intracerebral hemorrhage, and subarachnoid hemorrhage (2).

The consequences of a stroke are varying degrees of impairments of movement, speech, vision, memory, balance, emotion, and cognition. Individuals with stroke usually demonstrate changes in breathing pattern, decreased strength of respiratory muscles and decreased ventilatory function, and an elevated risk for respiratory complications. The above-mentioned difficulties vary from person to person affected by stroke, and it depends on the extent and location of the area affected in the brain (3).

After the stroke, one of the leading causes of nonvascular death is aspiration pneumonia which is caused due to the disabilities of the respiratory system like dysphagia and ineffective cough following stroke. The diminished exercise endurance, shortness of breath, and the risk of recurrent stroke are impeded

due to reduction in lung volumes and chest wall movements. Thus, employing interventions that have the possibility to improve respiratory muscle strength and pulmonary function in people with stroke is suggested (4).

Cardiorespiratory fitness is the proficiency of the body's circulatory and respiratory systems to supply blood and oxygen during continual physical activity. The interventions aimed at improving the strength and function of the respiratory muscles are extremely limited (5). In the post stroke population, the literature advocates that cardiorespiratory fitness is degraded by as much as 50% when compared to age-matched sedentary equivalents. It remains unclear whether reduced cardiorespiratory fitness after stroke is primarily due to premorbid conditions of the stroke, or post stroke physical inactivity. All are probable contributors, but it is important to assess the capacity of stroke survivors to physiologically adapt in response to aggressive rehabilitation therapy interventions (6).

Due to the association between the respiratory and musculoskeletal systems, numerous aerobic techniques have been suggested for the improvement of cardiorespiratory symptoms in post stroke (7). Water

Aerobics is an intervention proposed to improve chest wall mobility and pulmonary function. However, this technique is not widely used in clinical practice in some regions it is believed that, to date, there are no quantitative studies or clinical trials evaluating the effects of this technique. Aquatic therapy serves several functions, the natural buoyancy of water reduces the body weight of the patient. The viscosity of water offers resistance when the body moves and the pressure of the water on the body influences the body to work harder to circulate blood. As a result, the patient gets an excellent strength and cardio workout while consecutively protecting their joints and cushioning their body from falls. Submersion in water is a great way to increase cardiovascular fitness in a low impact way and thereby reduces the risk of patients suffering another stroke (8).

In combination with traditional physiotherapy, aquatic therapy can be used as an effective therapeutic modality in the rehabilitation of individuals after stroke. Therapy in the water permits the patients greater mobility because body weight is decreased considerably (up to 90%). Since the water assists balance, the patients have an easier time with flexibility and stretching. Buoyancy allows for increased movements with decreased efforts. The amount of hydrostatic pressure that is applied to the tissue depends on two factors, the density of the fluid and the depth of the submersion. When the fluid density increases so do the hydrostatic pressure. When an individual is standing or sitting submerged in water to the shoulder level, the hydrostatic pressure exerted will support the vital capacity while at the same time resisting inspiratory capacity. This effect will result in the strengthening of the diaphragm and intercostal muscles (9). The present study aimed to evaluate the effects of water aerobics on the pulmonary function of people with stroke.

METHODOLOGY

A total of 16 chronic stroke patients were recruited from the outpatient department, Nanda College of Physiotherapy, Erode. Inclusion criteria were both male and female, 40 to 60 years of age, minimum of one year post stroke, and independent in working with or without an assistive device. Medically stable. Exclusion criteria were age above 60 years, uncontrolled hypertension, and unstable cardiovascular status, individuals with significant spinal and skeletal deformities. Severe neuro muscular weakness, open wounds, urinary/ fecal incontinence. Unstable epilepsy, major medical complications following a stroke. Individuals with significant musculoskeletal problems from conditions other than stroke. Individuals with a lack of providing of consent to participate. All participants were asked to furnish informed consent before participation.

Study design

This study design is a quasi-experimental research design that involves a single group of subjects. Pretest and posttest measurements were taken before and after the treatment. If there is a significant difference between the scores, then the treatment is taken into consideration as effective.

Intervention

All the subjects in the group received an exercise program last for 40 minutes per session and 4 days per week for 12 weeks. The exercise session starts with initial warm up exercises and the main exercise program includes six water aerobic exercises and the session ends with cool down exercises (10,11)

Water aerobics

1. *Aqua cycling*: This combines pool aerobics and exercises with stationary cycling. The individual rides a bicycle like a machine that is a fixed to the bottom of the pool, with the saddle portion and handlebars sitting just on top of the water
2. *Aqua jogging*: Jogging all through the water from one side of the pool to the other. This exercise is made easier to walk back and forth in the pool or march in place according to the patient's convenience.
3. *Aqua squats*: Stand in deep water with hands supported on pool rails. Bend your knees as your thigh goes parallel to the floor of the pool. The breathing must be relaxed deep breathing.
4. *Arm curl*: Stand with shoulder distance in water. Keep arms straight to the side parallel to the bottom of the pool, palm facing downwards, holding the dumbbells. Push the dumbbells down as you bend the elbows together, with shoulders still, towards the armpits. Then extend the arms back to the starting position. Inhale while extending elbows and exhale while flexing the elbows.
5. *Cross-body punches*: Stand in the shallow end holding aqua dumbbells in both hands. Wide standing position. Twist your upper body to one side and punch one arm at a time. Return to the starting position. Repeat on the other side. Punch on one side with inhaling and exhale while returning to starting position.
6. *Active chest stretch*: Standing or seated position Reach hands forward and opens to the side as if doing a breaststroke. As arms move to the side squeeze shoulder blades together. The breathing must be relaxed deep breathing.

Outcome measures

Chest expansion

In the standing position, chest expansion was evaluated for all the subjects with the help of a

measuring tape in centimeters. Tape is placed circumferentially around the chest wall at the level of the xiphoid process. The circumference of the chest was measured at maximum expiration and maximum inspiration. At maximal expiration, subjects were asked to breathe out as much as possible and the measuring tape was drawn tight, and the measurement was recorded. At maximal inspiration, subjects were asked to breathe in as deeply as possible and the measurement was recorded. Values for chest expansion were recorded before and after 12 weeks of exercise protocol (12).

Forced Vital Capacity (FVC)

Forced vital capacity was measured in the patients by using a spirometer in the sitting position. The patient was asked to sit in a chair asked to breathe comfortably and a clip is placed over the nose and a mouthpiece is given to breathing into it. The subjects are cautioned not to allow air to escape through their nose or around the mouthpiece. Sealing your lips tightly over the mouthpiece, you are asked to inhale as deeply as possible and exhale as forcefully as you can. The tester carefully watched the needle to obtain the maximum reading. Forced vital capacity (FVC) is the maximal volume of air that can be exhaled following a maximal inspiratory effort (Normal: Males = 4.8 liters and Females = 3.1 Liters; 13).

Data presentation and statistical analysis

Pre-test and post-test measurements were collected by using the outcome measures of chest expansion and forced vital capacity. Mean difference and standard deviation were calculated. Statistical analysis was done by using SPSS software. Paired t test was done.

Table 1: Mean difference and standard deviation values of the outcome measures

Parameters	Mean Difference	Standard deviation values
Chest expansion	0.233	0.2
FVC	0.52	0.14

Table 2: The calculated t value and p value of the outcome measures

Parameters	Paired ‘t’ values	P value
Chest expansion	4.45	0.000234
FVC	14.3	0.00001

RESULTS

A total of 16 subjects were enrolled in the study. The mean age of the participants is 40 to 50. pre and posttest values of the outcome measures, chest expansion, and forced vital capacity were collected. The calculated mean difference and standard deviation

between the pre and posttest measurements of both the outcomes are represented in the table 1. The mean difference for chest expansion is 0.233 and the standard deviation is 0.2. The mean difference for forced vital capacity is 0.52 and the standard deviation is 0.14.

Statistical analysis was done by using SPSS software. Paired ‘t’ test was done. The t values and p values for the outcome measures were represented in the table2. For chest expansion the calculated p value is 0.000234 with 15 degrees of freedom, t value is 4.45 at a 95% confidence interval. As the p value is less than 0.05 the difference is considered as significant within the group. For forced vital capacity calculated p value is 0.0001 with 15 degrees of freedom t value is 14.3 at a 95% confidence interval. As the p value is less than 0.05 the difference is considered as significant within the group.

DISCUSSION

The present study demonstrates that 12 weeks of water aerobics improves chest pulmonary function by improving chest expansion and forced vital capacity. Regarding the collected data from 16 subjects in the age group 40 to 60 years, there was a significant difference between the pre- and post- test measurements of the outcome parameters. These findings have important clinical implications to improve pulmonary function as a part of stroke rehabilitation.

In a previous study, Song and Park reported by administering chest resistance and expansion exercises improved respiratory function and trunk control ability in stroke patients (14). Similarly, Young and Hee applied a 6-week aquatic exercise protocol to stroke survivors and witnessed an improvement in the cardiorespiratory fitness and walking endurance, and activities of daily living (15).

In an earlier study, Song and Kim reported that after doing 10 consecutive weeks of aquatic exercises there is a significant improvement in the physical and pulmonary function in people who had a stroke previously (16). In line with the results of the previous studies mentioned above, the subjects of the present study after administering 12 weeks of aquatic exercises showed a significant improvement in chest mobility and pulmonary function.

Moreover, water aerobics is cost effective and convenient means to promote fitness in individuals with stroke. The limitation of the present study is that the results of this study cannot be generalized to all the population as the sample size is small, further long-term studies with a large sample size are needed to generalize the results to the wider stroke population.

CONCLUSION

In conclusion, from the above results, the use of water aerobic exercises in improving chest expansion and forced vital capacity was effective and statistically significant.

CONFLICT OF INTEREST

There are no conflicts of interest among authors.

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