

Effects of a Water Aerobics Program on the Blood Pressure, Percentage of Body Fat, Weight, and Resting Pulse Rate of Senior Citizens

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Ten men and 18 women aged 57 to 76 participated in a 16-week water exercise class at Rose State College, Oklahoma City. The class met for one hour twice a week for the 16 weeks and was composed of flexibility exercises, aerobic exercises, and cool-down exercises. Pre- and postclass measurements were taken for blood pressure, weight, percentage of body fat, and resting pulse rate and were compared using a paired t-test. Reductions significant at the .05 level were recorded for diastolic blood pressure, weight, and percentage of body fat. There were no significant reductions in systolic blood pressure and resting pulse rate. I concluded that water aerobics is an ideal modality for senior citizens' aerobic exercise because of the favorable changes it produces in the health parameters investigated and because it places little stress on the weight-bearing joints during exercise.

The benefits of aerobic exercise for the elderly are numerous. Significant increases in lung capacity, flexibility, and muscular endurance have been observed as a result of a six-month aerobic program (Massicotte, 1981). Gains in cardiorespiratory fitness in the form of improvement of maximum oxygen consumption may also occur (Sidney & Shephard, 1978). DeVries (1970) reports improvements in minute ventilation, vital capacity, and work capacity, whereas Paffenbarger, Hyde, Wing, and Hsieh (1986) suggest links between exercise and longevity. The elderly may derive substantial improvements in their mental health by participating in an exercise regimen. Perri and Templer (1985) found that exercise produced significant favorable changes in depression, anxiety, self-concept, locus of control, and short-term memory in men and women aged 60 to 79. Involvement in an exercise program is also a valuable social outlet for the aged population (Gorman & Brown, 1986).

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Many members of the elderly population cannot participate in traditional aerobic exercise such as running, bicycling, and aerobic dance. They are hindered by such physical problems as arthritis, osteoporosis, and poor physical condition caused by prolonged physical inactivity. Water aerobics may provide a means for the majority of the senior population to engage in aerobic activity. Water aerobics consists of a variety of movements done in waist- to chest-deep water, using the water to create movement resistance. These movements can be grouped and the intensity of exercise varied to create a traditional aerobic workout consisting of a warm-up phase, an aerobic phase, and a cool-down phase (Krasevec & Grimes, 1984). The purpose of this study was to determine if this particular aerobic activity had a significant effect on the blood pressure, percentage of body fat, body weight, and pulse rate of a group of senior citizens.

A thorough review of the literature yielded no evidence of the results of a water aerobics program on the parameters investigated in this study for any population. Studies were found, however, that dealt with the effects of other modes of exercise on these parameters. Systolic and diastolic blood pressures of elderly men decreased significantly as a result of a 20-week aerobic exercise program consisting of running and walking three times per week for 48 minutes (Allen, Teague-Baker, Lej, & Rotkis, 1984). An earlier study by DeVries (1970) showed similar results. Pollock, Dimmick, Miller, Kendrick, and Linnerud (1975) found that older adult men showed significant decrease in percentage of body fat, abdominal girth, and resting heart rate when they exercised for 30 minutes three times per week for 20 weeks. A significant reduction in weight occurred in subjects in this study who were assigned to the group that used running for the exercise. No significant weight changes occurred in walking and bicycling groups.

Exercising in the water is less strenuous on the knee, ankle, and hip joints because of the buoyancy of the water. If water aerobics can cause favorable reductions in the blood pressure, percentage of body fat, weight, and resting pulse rate of senior citizens, it would be a very beneficial form of aerobic exercise participation for that population.

Subjects

Subjects for this study were senior citizens enrolled in a community service water aerobics class at Rose State College, Oklahoma City. They ranged in age from 57 to 76 with a mean of 65.77. Of the 28 subjects—10 males and 18 females—only two had previously participated in an exercise program of any kind.

Procedure

After giving informed consent to participate in the study, the subjects filled out a demographic questionnaire and the before-treatment measurements were taken. A registered nurse took systolic and diastolic blood pressures with a sphygmomanometer while the subjects were seated. Resting pulse rates were also taken at this time. Percentage of body fat measurements were taken using a SKYNDEX electronic body fat computer programmed with the Durnin formula. This particular formula uses the sum of four skin folds, (bicep, tricep, subscapula, and iliac crest), and is adjusted for gender. Three measurements were taken from each of the 28 subjects. The measurement recorded for analysis was the mean of these three measurements. The researcher who took the skin fold measurements had considerable experience in assessing body composition and took the pre- and posttreatment measurements. Durnin formula body composition measurements correlate highly with measurements taken using underwater weighing techniques. Correlation coefficients range from .7 to .9 (Durnin & Womersley, 1974). Body weight was assessed using a Continental Health-O-Meter scale, inspected for accuracy by the Industrial Scale Company of Oklahoma City.

After the before-treatment measurements were recorded, subjects were instructed not to alter their food intake in any way during the 16-week program. Individual target heart rates were then calculated using the Karvonen method.

Subjects exercised twice a week for 16 weeks. Each exercise session included a warm-up phase, an aerobic phase, and a cool-down phase. The warm-up phase, done in the water, consisted of stretches designed to stretch the major muscle groups of the body. Forward, backward, and sideways movements of the neck, circumductions of the shoulder joints, side bends, and standing trunk twists were used to stretch the upper body. The gluteus muscles, hamstrings, quadriceps, and calf muscles were also stretched using passive stretching techniques.

The aerobic portion of the workout was composed of a series of calisthenic type exercises using the water for movement resistance. For example, while standing in waist- to chest-deep water, the subjects were instructed to swing the left leg upward through the water and touch the left toes with the right hand, then perform the same movement with the other leg and hand (the "alternate toe-touch"). Another example would be the "lunge." The person begins by flexing one hip forward and extending the other hip backward while keeping both knees straight. At the same time, the shoulder on the same side as the flexing hip extends,

keeping the elbow straight and the palmer surface perpendicular to the direction of movement. Likewise, the other shoulder flexes in conjunction with the extending hip on that side. These movements produce a rhythmic, striding, and arm-swinging motion to which the water offers resistance, creating an aerobic exercise that uses large muscles of the upper and lower body.

Other exercises included in the aerobic phase were running in place, a flutter kick with the legs while holding onto the side of the pool, and hopping forward and backward in the water. These and other similar exercises were performed for one minute each before switching to another exercise. The subjects were instructed to perform the exercises at a speed adequate to attain a target heart rate. Pulse rates were taken periodically to ensure attainment of this heart rate. The duration of the aerobic phase began at five minutes with one minute added every session for a total of 36 minutes for the final session.

The cool-down phase of the program involved exercises done in a standing position while holding onto the side of the pool. Two examples would be leg circles and side kicks. Leg circles were done by circumducting one hip while keeping the corresponding knee and ankle straight. Side kicks were simple hip abductions and adductions performed one after another. These and other similar exercises were performed for 30 seconds each until the five-minute cool-down period expired.

At the end of 16 weeks, variable measurements were taken again and compared to the initial measurements using a paired t-test.

Results

For results of the t-test along with variable means and standard deviations, see Table 1. Significant reductions were noted in diastolic blood pressure, percentage of body fat, and body weight. No significant reductions were found in resting pulse rate and systolic blood pressure.

Discussion

One possible explanation for the improvement of the physical parameters in this study is that all but two of the subjects led very sedentary lifestyles and were almost never physically active, leaving enormous potential for improvement. This finding may support Gorman and Brown's premise (1986) that over half of the physical decline

Table 1. An Analysis of Means and Standard Deviations Before and After the 16-Week Water Aerobics Program

Variable	Before	S.D.	After	S.D.	Dif.	Paired t
Systolic blood pressure	137.9	14.93	133.8	20.03	4.1	.707
Diastolic blood pressure	78.8	10.11	71.7	8.36	7.1	2.45*
% body fat	28.2	5.1	26.7	5.08	1.5	3.51*
Weight (lbs.)	156.3	26.22	154.9	27.38	1.4	6.06*
Pulse (beats per minute)	73.4	10.9	71.8	10.05	1.6	1.45

*Significant at the .05 level.

experienced in old age results from prolonged physical inactivity and not from the physiological changes associated with aging.

Reductions in blood pressure previously have been associated with aerobic exercise (Allen et al., 1984; DeVries, 1970). Aerobic exercise is now used as an alternative to continual drug therapy in mild hypertension cases (Dubbert et al., 1984). Water aerobics appears to produce reductions in the diastolic blood pressure of senior citizens. Future studies using hypertensive senior adults as subjects are needed to determine if this aerobic modality could be useful in treating mild hypertension in the elderly.

The weight loss and reduction of percentage of body fat occurring in this study do not support previous research findings in studies in which subjects exercised two days per week. Pollock et al. (1972) found no significant changes in body composition or body weight in middle-aged men who participated in a two days a week exercise program. Earlier studies by Pollock and others yielded similar results (Pollock, Cureton, & Greninger, 1969; Pollock, Tiffany, Gettman, Janeway, & Lofland, 1969). Although statistically significant, the reductions in weight and percentage of body fat are not of enough magnitude to be of practical significance. They do, however, represent a trend in a desirable direction.

One issue that must be addressed in this study is the caloric intake of the subjects during the 16-week exercise program. Although the subjects were instructed not to alter their dietary habits, daily caloric intake may have been reduced, possibly contributing to the reductions of the physical parameters. It is unlikely that such a change would result from the exercise program. Kusnitz and Fine (1983) report that appetite and

corresponding food intake were not significantly altered by aerobic exercise lasting 30 minutes or less. The possibility of this and other extrinsic factors causing a reduction in the dependent variable measurements, however, cannot be completely excluded.

Although other aerobic exercise programs for the elderly have demonstrated a reduction in resting heart rate, this one did not. Probably in this regimen, exercise duration and frequency were not adequate to produce a significant reduction in the resting heart rate parameter.

In conclusion, results of this investigation showed desirable reductions in diastolic blood pressure, weight, and percentage of body fat in senior adults as a result of a water aerobics exercise regimen. This type of aerobic program would seem ideal for the aged population because of the reduction in stress on the weight-bearing joints during exercise. Further study is needed to determine if this type of modality could be used in treating mild hypertension in the elderly population.

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