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Properties and Benefits of Exercising in the Water

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Abstract

Water has traditionally been seen as a source of rejuvenation, even though this sentiment was based on intuitive judgments instead of scientific fact. But over the last decades of the 20th century and the beginning decades of the 21st century, more data and articulation of water's restorative properties have emerged. The aquatic medium's most recognized helpful feature is buoyancy. To those experiencing pain, stiffness, and difficultly weight-bearing, buoyancy "lightens" the load placed on the skeleton and joints, often resulting in pain relief and ease of movement. The present paper explores buoyancy and other properties of the water that often yield beneficial results with respect to any number of chronic conditions, and for some conditions that are not usually associated with aquatics as a resource such as dementia, COPD (Chronic Obstructive Pulmonary Disease) and childhood cancer. The second half of the paper provides a sampling of recent research supporting the beneficial effects of aquatic exercise for many of the aforesaid conditions.

Keywords: Aquatic exercise; Arthritis; Benefits; Chronic conditions; Feasibility

Introduction

Water has historically been seen as a life-giving, curative force. From the public baths of Rome to the spa movement of the 1920-1930's water has been an integral part of health maintenance and health improvement. Spas in conjunction with the emergence of rehabilitation medicine around the time of World War I served as a template for physiotherapy—notably at centres such Mayo Clinics, Cleveland Clinic, and North-western University. Hence, it should come as no surprise that use of aquatic settings for exercise and rehabilitation is encouraged. But it faces obstacles of physical resources and the expense of pools. Alternatives to using on-site pools include use of community recreation or private pools, but using those settings involve navigating other challenges.

Best Practices in Exercise

One authority on exercise is the Centres for Disease Control and Prevention (CDC), a commonly referenced source for physical activity recommendations [1].They recommend a minimum of 150 min of moderate aerobic exercise per week, preferably at a dosage of 30 min five times per week. Flexibility and stretching exercise should also be performed daily, with the addition of strength training at least twice per week. The fact that the emphasis is on moderate intensity exercise was intended to accomplish a couple of objectives. One was to show consumers that exercise is accessible to any person and one did not have to be an athlete to exercise. The second was to allow for a margin of safety in conjunction with the promise of improvement in health, or health maintenance. A final advantage of the CDC's exercise recommendation that facilitates participation is that daily bouts of exercise may occur in 10 min intervals; all 30 min do not have to be performed in one block of continuous time. Understandably, the CDC's exercise recommendation for children and teens is at a higher level. They should be exercising about one hour per day, and at a rate of 300 min per week.

Another organization working in the promotion of exercise is the Arthritis Foundation [2]. Although their emphasis is on persons with arthritis related chronic conditions such as osteoarthritis, fibromyalgia, and osteoporosis, and therefore disorders experienced primarily by older adults, their basic program is suitable for anyone who having difficulty conducting land-based exercise, including persons who are generally deconditioned because of a sedentary lifestyle. Because of the pain associated with weight bearing exercise among persons with arthritis-related conditions, one of their most popular program options is aquatic exercise. This is not to be confused with swimming, which would challenge older adults and in many cases constitute vigorous instead of moderate exercise. Aquatic exercise is generally conducted in waist-deep water (although depth of body immersion may vary, see below) and involves movements designed to improve muscle strength and endurance, flexibility and balance. If the participant has a fear of water flotation devices may be used to provide support and give a reassurance of safety.

Another option for the aquatic exercise is Ai Chi. It is designed as a flowing type of exercise in which the participant is constantly moving through a series of actions, rhythmically and under control. It represents the water-equivalent to Tai Chi in land-based settings. Like the Arthritis Foundation's aquatic exercise programs, Ai Chi is typically performed in waist-deep water. Ultimately the choice between the options listed above, and others, is a matter of personal preference, the participant's exercise tolerance, and perceived pain during exercise.

Properties of the Water Conducive to Benefits

What does exercise in the water offer that other exercise program do not? Koury [3] has enumerated and defined the properties of the water that hold promise for benefit. Many participants sense that the property of buoyancy, taking weight off the back, hips, knees, and ankles, those most apt to be issues for persons with arthritis, osteoporosis and spinal conditions. By the nature of movement in the

water it is innately low-impact. Moreover, although waist-depth for exercise is the norm, the participant and exercise leader can adjust the amount of weight bearing by having the exerciser move to deeper water (e.g., shoulder deep), or increase the amount of weight bearing by moving the person to shallower water (e.g., knee deep). As a rough guideline, the participant is bearing about seventy-five percent of body weight at knee depth, about fifty percent of body weight at waist depth and about twenty-five percent of body weight at shoulder depth.

In what might seem to be contradictory to the property of buoyancy, the water also provides resistance, which accounts for muscle strength and endurance improvements. Resistance is accomplished through instructor directions. The first is changing the frontal surface area used in any given exercise. For instance, conducting a forearm curl the hands in a fully supinated (palms facing upward) position increases frontal surface area and hence the amount of resistance. To reduce resistance in the same exercise would involve directing the exerciser to position the hands into a ninety degree supinated position (palms facing medically). A second technique for increasing resistance is speed of movement, faster movements in the water increase resistance. The third strategy for increasing resistance is to create turbulence of the water the exerciser is moving through. This usually requires an exercise group and can be as simple as two lines of participants walking past one another, creating a wake for the opposite line to navigate.

Hydrostatic pressure is another characteristic of the water that proves to be beneficial. The term refers to the weight of the water on the body, experienced by almost everyone during childhood while diving for some object at the bottom of a pool. It is commonly experienced at that depth as pressure, at some depths becoming very uncomfortable. Of course, deep water diving is not something customarily advocated for in aquatic exercise programs. Nevertheless, the hydrostatic pressure is still present but not at a level of discomfort. The benefit of hydrostatic pressure is to enhance venous return to the heart, especially from the lower extremities. Enhanced venous return generally lowers blood pressure and relieves some of the output burden on the heart. Hence, for any given rate of exercise, if done in the water, venous return and heart load will be better in the water compared to the same exercise done on land. In addition, for some hydrostatic pressure compresses and supports joints that may be swollen and irritated, serving as an aquatic compression sleeve so to speak.

Cushioning may seem to refer to concept as buoyancy, but although it takes advantage of buoyancy, it refers to something different. Here the exercise leader is concerned with the ability of the water to almost eliminate the risk of injury from a fall. Since so much of aquatic exercise based on working with older adults and those with chronic conditions, the exposure risk from falls is a major concern. Balance difficulties in combination with osteoporosis afford a "perfect storm" for injury on land that can be almost eliminated in the water.

The optimal temperature for aquatic exercise is between 83˚F and 90˚F. And when the agency has the facility and control, this range can be met without difficulty. Unfortunately, more often a municipal pool of private pool must be contracted to establish an aquatic exercise program. The problem is that public and private pools cater to a wide variety of consumers not only aquatic exercisers. Lap swimmers prefer lower temperatures as do aerobic exercisers, with both groups exercising at a vigorous rate instead of at moderate intensity levels. Those dedicated to using the water for relaxation purposes prefer high temperatures. In either case the temperature may well not be optimal for aquatic exercisers. If the temperature of the water is at or near the lower end of acceptable (about 83˚F), then the instructor can employ a couple of strategies to avoid hypothermia. First he/she should encourage participants to begin moving immediately when they enter the water; simple walking serves as a good warm up. Second, progression through the exercise routine should begin with large muscle activities to increase or preserve core body temperature. Third, the exercise leader should be vigilant for signs of hypothermia, such as shivering, blue lips, or facial expressions of discomfort. In the latter cases the person should be removed from the water right away.

Aquatic exercise is not the whole solution to an optimal and balanced exercise program; rather it should be combined with other forms of exercise as per the CDC's recommendations. Strength training and flexibility certainly should be built into the person's overall program of exercise. Moreover, prolonged exposure to chlorine may cause adverse skin reactions in some people, so varying exercise environments is a good practice.

Benefits

Apart from the intuitive appeal of the water as an exercise environment, considerable research has been completed over the last two decades attesting to the benefits of aquatic based exercise with various groups, ranging from chronic conditions to children with cancer. Below is a sampling of current research, reviews and meta-analyses on various forms of exercise in the water. It is representative of the findings on the topic but, given space limitations not thorough.

Two recent meta-analyses determined that exercise in general and aquatic exercises specifically were beneficial to people with musculoskeletal impairments. The first [4] analysed Randomized Control Trials (RCTs) and quasi-RCTs that compared aquatic exercise with no exercise or land-based exercise. Aquatic exercise showed significant improvement in pain, function and quality of life compared to no exercise controls, but no difference between land-based exercise and aquatic exercise on the same outcomes. The second study [5] investigated both RCTs and non-RCTs and defined aquatic exercise very specifically (exercise in the water with feet grounded). The results indicated that aquatic exercise proved especially effective at pain relief.

That more research has been oriented around arthritis and arthritis related conditions should come as no surprise since the Arthritis Foundation has long advocated for exercise in general and aquatic exercise specifically. In a review [6] of exercise in general for persons with hip and/or knee osteoarthritis, the authors concluded that exercise for persons with these conditions plays a vital role in symptom management. They added that exercise adherence was crucial to acquiring benefits from any of the types of exercise investigated (e.g., aerobics, aquatic, Tai Chi, etc.).

An intervention study [7] recently completed (2014) was intent on investigating the effectiveness and feasibility of a community-based aquatic exercise program for older adults with osteoarthritis. After ten weeks of aquatic exercise the participants improved range of motion and knee extension power. Functional reach and sit-to-stand tests also improved significantly. Likewise, another common malady that falls under the prevue of the Arthritis Foundation is osteoporosis. Another study [8] showed that aquatic exercisers did not lose bone density in the femoral trochanter while non-exercisers experienced a decrease in bone density at the same site. The results may have been the result of tendon action on the periosteum of the skeleton in combination with some weight bearing in the water (e.g., waist depth allows for 50% body weight bearing). Third, fibromyalgia is likewise part of the

Arthritis Foundation mission. Bidonde and associates [9] completed a systematic review of the effects of aquatic exercise on the symptom management of persons with fibromyalgia. In studies of aquatic exercise compared to non-exercise controls, aquatic exercise proved to produce superior results in stiffness, function and muscle strength. In comparing land-based to aquatic exercise, no advantage for aquatic exercise was detected.

Other chronic conditions besides arthritis have been exposed to aquatic exercise programs. Dementia has many causes and thus marks a transition between traditional arthritis-related areas and other conditions that have employed aquatic exercise. One study [10] attempted to determine the benefits and feasibility of aquatic exercise with nursing home residents diagnosed with dementia. Importantly the participants enjoyed the exercise in the water and did demonstrate significant improvement in grip strength with smaller improvements in other functional outcomes from pre-to post intervention. The authors concluded that despite some logistic challenges, such a program is feasible and justified for this group.

Chronic Obstructive Pulmonary Disease (COPD) is another common chronic condition that may benefit from aquatic exercise. One study [11] compared moderate to severe COPD patients participating in land-based and aquatic interventions in contrast with a control condition. Both exercise groups showed functional and quality of life benefits from low intensity exercise in either environment, but the aquatic group demonstrated additional benefits in physical capabilities. Similarly, high blood pressure plagues a significant percentage of people in Western Societies. One study [12] found that aquatic exercise was superior to land-based exercise and no exercise conditions in reducing systolic blood pressure among postmenopausal female subjects with hypertension. No changes in antihypertensive medications were made during the intervention. In a related vein, aquatic exercise has been used with subjects with heart failure [13]. A meta-analysis of eight studies and 156 total subjects showed that aquatic exercise for participants with heart failure was as effective as land-based training, with the authors suggesting that aquatic exercise was a useful alternative for those unable to exercise on land.

Space does not allow for detailed report of aquatic interventions with patients with lymphedema and children with cancer. But these investigations [14,15] reveal beneficial effects of aquatics on performance on a 6 min walk test in the former group, and tentative benefits (because of small sample sizes) in physical fitness in the latter group.

In conclusion, based on the properties of the water and studies showing generally positive benefits of aquatic exercise for varied groups, programs of exercise in the water are safe, feasible and beneficial for many conditions, chronic and otherwise. Like any exercise program, medical approval to start a physical activity program should be sought. Some health issues may not be consistent with aquatic exercise—a variety of reactive skin conditions, some heart conditions, and some allergies. Also, likely is the fact that aquatic exercise is best thought of as a part of a complete exercise program, which should include some land-based exercise, strength training and stretching.

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