



Physiological Effects of Immersion on Fitness

Hydrodynamics

Water has long been utilized to facilitate orthopedic rehabilitation with the intent to return the participant to normal functional levels as expediently as possible. The specific benefits of vertical exercise in the water need to be considered in program planning. Buoyancy – the force acting in the opposite direction of gravity. It is felt as an upward thrust. In water, the effect of gravity is reduced significantly by buoyancy. In neck deep water, weight bearing is reduced to 10%. An example – a participant that weighs 100 pounds out of water only has the impact of 10 pounds on bones and joints when vertical in neck deep water. Benefits of buoyancy includes decreased joint compression and weight bearing through Lower Extremities so movement throughout weight-bearing joints may be less painful, allows ease of movement in the direction of buoyancy, less effort is needed with slow movements, provides a reduced fear of falling and provides assistance for Range of Motion (ROM) re-training when muscles are weak.

Drag and Viscosity is the resistance felt to movement in the water. In the water you have a constant muscle load through the full range of motion when you are moving. Viscosity/drag forces are used to create movement progression. Resistance is the friction between molecules of a liquid which causes resistance to flow since molecules of a liquid tend to adhere to each other and the surface of the moving body, commonly referred to as drag forces. Every movement we make in the water is met by resistance. Water is 6 to 15 times more resistant (dependent on depth) than air creating benefits for muscle balance and toning. It is especially important to note that movement is required. Decreased movement equals decreased resistance. Resistance drops to zero immediately when motion stops.

Even without weights, the force of the water can promote strength. The resistance requires contractions of both muscles in a muscle pair when vertical. The larger the

surface area and the faster the movement, the more resistance is required. It is easy to vary resistance without switching equipment.

Greater energy expenditure occurs for those actions utilizing the same speed because more muscle fibers recruited for movement requiring added oxygen consumption.

Cardiac progressive overload requires greater energy expenditure for actions because of the requirement of more muscle fiber recruitment. Another benefit that it provides is resistance in all planes so one can initiate functional retraining early in the rehabilitation process.

Hydrostatic Pressure is the pressure exerted by molecules of a fluid upon a body immersed in water. This is the amount of pressure you feel when you are immersed in water. It gets stronger as you go deeper. The fluid pressure is exerted equally on all surface areas of an immersed body at rest and at a given depth. No movement is required to receive the benefits of hydrostatic pressure. This pressure assists with decreasing swelling in the lower extremities and improves circulation by increasing venous return (assists heat pumping) and the supply of oxygenated blood supply to the muscles. The decrease in swelling or edema can improve Range of Motion. It also supports our joints when we move.

Another important benefit of hydrostatic pressure is improved respiration. Because of the force exerted when submersed to chest or neck depth, inhalation is harder. For this reason, it strengthens the muscles of inspiration. The same pressure assists with expiration and enables improved exhalation. This force can also improve diaphragm strength just with immersion. This increases lung capacity (inspiration) resulting in deeper ventilations. It is important to recognize that along with the benefits, there are concerns.

Cardiorespiratory Fitness

For cardiorespiratory conditioning to occur in fit participants water running heart rates must equal the training rates of land. When training at same intensity and frequency water affects fitness gains approximately the same as land training. Increasing water running speed and/or adding resistance increases the metabolic cost of water running. The metabolic costs of water running equals land running in its effect on VO₂ max when training intensities and frequencies are matched.

Core strength requires awareness of the responsibilities of the roles of local and global muscles. The local muscles are deep and are stabilizers for the lower spine and considered postural muscles. These muscles include the Transverse Abdominus, Multifidus, Diaphragm, and the pelvic floor. Core conditioning for stability training involves a mind-body Global muscles are the muscles of large movement. They include the Rectus Abdominus, Obliques, Erector Spinae, Quadratus Lumborum, Hip flexors, Gluteals, and Hamstrings. These two groups work together to allow movement with correct alignment and diminish the possibility of low back pain.

Deep water exercise is one of the most popular and researched areas in aquatic therapy and exercise. Deep water provides a non-impact exercise option with freedom of movement and complete decompression. It is important for anyone with weight bearing issues that restrict shallow water programs or land-based exercise. The water is of a depth that participants are suspended in the water to prevent rebounding or accelerating off of the pool bottom. Deep water exercise occurs in an unstable environment because it lacks the solid surface that traditionally provides a stable base of support. Flotation equipment is worn to maintain correct alignment.

A checklist for vertical body alignment includes head up (aligned), chest lifted and open, shoulders positioned directly above hips, abdominals tight (don't hold your breath!), and buttocks squeezed together and slightly tucked under.

Deep water running is an effective form of cardiovascular conditioning for anyone needing less musculoskeletal stress than land running or a low-impact workout. A four to six week period of inactivity can lead to a 14-16 percent reduction in VO2 max if sedentary. Participants with weight bearing issues can often do deep water running to maintain fitness.

Aqua Running for Special Populations

Aqua running has also been incorporated into fitness and rehabilitation programs. These include patients with lumbar spine disorders, arthritis and degenerative joint disease (DJD), patients who have undergone orthopedic surgery, lower extremity amputees, overweight/obese. Upright alignment is emphasized for individuals with lumbar spine disease. These mechanics are then incorporated into land-based exercises. This upright posture challenged in deep water is key to postoperative orthopedic individuals so they can exercise within pain free ranges.

ALIGNMENT & BALANCE BENEFITS

Body alignment is basic to the execution of all exercises in order to achieve improvement. Core strength is the foundation of balance & movement. Key force in water is alignment of the base of support over the center of buoyancy. Buoyancy supports an upright posture. Movement is facilitated in the direction of buoyancy. Deep water exercise challenges alignment because it occurs in an unstable environment and it lacks a solid surface that traditionally provides a stable base of support. Studies have shown that without core stabilizing muscles the spinal column buckles under a 20 lb. load. Deep "core" muscles take on the job of stiffening the spine while still allowing range of motion by the large outer muscles. Water assists with range of motion, core strength & general strength re-training of extremities. Muscle blood supply is increased, improving oxygen delivery. Immersion reduces edema and aids in joint lubrication.

Simply stated, AMPT-IT mission is to support the mission of the ACMC's Marine Total Fitness Initiative (Physical Resiliency Pillar)