Aquatic exercise is an increasingly popular activity choice for people but is it the right choice for people with osteoporosis? Despite the fact that the water exercise sessions occur during a brief period of time compared to the time spent in weight-bearing activities each week, the water environment has been perceived as a limitation for slowing the rate of bone loss. For exercise to be effective, it must be maintained and the exercise type, dose and risk for injury must be considered carefully for each individual. It is well accepted that loading the bone with repeated high peak forces creates variable strain which maximizes the bones biomechanical response (Jiang, 1998). Can this be done effectively in water?

Studies have investigated the effect of exercising in water for women with osteoporosis and have shown that 10 to 20 week programs improved balance, strength and quality of life (Devereux et al, 2005, Arnold et al, 2008). While many studies have shown the positive effects of physical activity on strength, balance, and quality of life in postmenopausal women, positive effects on bone tissue have been more difficult to establish. The most recent systematic reviews of randomized controlled trials have reviewed studies investigating measures of areal bone mineral density, BMD, measured using the dual X-ray absorptiometry (DXA) and volumetric BMD, measured using a peripheral CT scan (PQCT) in postmenopausal women in response to land-based exercise interventions suggest a small, site-specific and statistically significant effect on BMD (Hamilton et al, 2010, Polidoulis et al, 2012). The evidence of the effect of aquatic exercise on bone mineral density in postmenopausal women is less clear. A recent study showed aquatic exercise improved the osteocalcin levels of bone in women with low BMD (Perambuco, 2013). Rotstein et al, (2007), investigated the effect of aquatic exercise on aBMD at the hip and lumbar spine in healthy, postmenopausal women, mean age (SD) 54 (4) years, and reported no significant differences between the exercise group, n = 20, and the control group, n = 10, pre and post a seven month aquatic intervention, in chest deep water. Bravo *et al*, (1997) reported a 2% loss of aBMD (0.009 g/cm²) in the lumbar spine and no loss in the hip, in 77 osteopenic women in a test-retest, cross-sectional, prospective study (no control group) after a 12 month aquatic exercise program, in waist deep water. There is no study that has reported loss of BMD in response to an aquatic exercise intervention. As in many studies, it is important to identify the population studied (age and stage of osteoporosis), methods of measurement (aBMD, vBMD, bone chemistry) and the aquatic exercise intervention in order to critically appraise the study and apply it to your practice.

There are thermal and mechanical advantages to aquatic exercise - the warmth helps with circulation and reduces spasticity; the buoyancy provides reduced joint compression and easy, graduated weightbearing activities; while the hydrostatic pressure controls oedema and increases the heart's stroke volume, reducing the heart rate (see Table 1). The aquatic environment also offers resistance in all planes of movement and safely works the muscles concentrically. Once you enter the water you immediately engage the trunk musculature isometrically to maintain a standing posture and any movement creates a turbulence which challenges those core muscles. The goal is often to "keep the hair dry"! Recent studies have indicated water-based exercises challenge the core balancing mechanism more than land-based exercises due to more proximal muscle work initiated earlier than peripheral (Han et al, 2014). To add to the balance training advantages, a pool is a low impact environment therefore minimizing fracture risk and enabling individuals to work outside their base of support for more targeted exercise while the viscosity of the water slows movement and allows more time for the balance reaction. With all these advantages and evidence of bone maintenance there is no reason to discourage a client with osteoporosis to pursue aquatic exercise. We know that exercise adherence is improved when the exercise is chosen by and tailored to the client.

It was this premise that lead me to do a Masters Thesis in 2009 in order to investigate the response of bone outcomes to aquatic exercise. Nine local women attended the Aldershot Public Pool 3x/week for 6 months and were measured in novel and standard ways to look at their bones before and after. The study was powered to produce results about the feasibility of doing a larger study. Valuable lessons learned included thorough screening for falls risk per participant and the need for increased gait aids on the pool deck. I worked with Dr Norma MacIntyre at McMaster University, Hamilton, whose research includes bone response to exercise and she was equally intrigued by the bone's response in the reduced weight-bearing environment. Returning to school after being out for 25 years was more of a challenge than I could of anticipated but it was intense and stimulating. It has set me on a scholarly path that just keeps growing. Seems a question breeds a question! My thesis is available through Digital Commons (google A.Bonnyman Thesis).

The Canadian Aquatic Rehab Institute (CARI) was founded in 2011, to provide Canadian physical therapists with up-to-date, post-graduate aquatic therapy training. There is a lot of amazing research going on globally investigating the effectiveness of aquatic physical therapy for clients with all conditions (ie. GB, MS, paeds, Ca, CVA, PD, chronic pain, osteoporosis, etc) which I witnessed at the first European Conference on Evidence-Based Aquatic Therapy (ECEBAT) in 2013. Aquatic

physical therapy has a strong presence in the World Congress of Physical Therapy, WCPT. The CARI mandate is to provide a support network for Canadian aquatic therapists and aquatic clients and provide education and promotion of aquatic physical therapy in Canada. To date, CARI courses have been held in Montreal, Ottawa, Toronto and Mississauga focusing on optimizing the use of the water environment in client recovery. For further information and upcoming courses please visit the website at www.aquaticrehab.ca.

The physiotherapy scope of practice and our role as consultants, educators and collaborators is growing as we bridge to the post-rehab setting to achieve successful client outcomes in the community and expand our role in health promotion. It is exciting to hear from community-based, private practice physiotherapists who are successfully integrating their clients into existing aquatic community programs throughout Canada. We also have a role consulting on those programs as the increased prevalence of comorbidities puts us in the forefront as the experts for optimal disease management. The aquatic environment is a natural fit for chronic condition management when effectively manipulated to address therapeutic goals.

In conclusion, individuals with osteoporosis do benefit from exercise in the water. It is my philosophy that the physical therapist and client goals extend beyond the rehab hospital and clinic setting and must encompass participation in community programming to encourage a healthy lifestyle suitable to the clients conditions and preferences.

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Table 1: Properties of Water and Application in Vertical Water Exercise

Properties	Definition	Exercise Application
Buoyancy	The upward force generated by the volume of water displaced	Assisted movement- Knee floats towards water surface, assisted arm abduction
Thermodynamics	A body immersed in a mass of water becomes a dynamic system to equilibrate	Increases viscoelasticity; earlier muscle warm up; increases available ROM
Viscosity	The magnitude of internal friction specific to a fluid during motion. Increases as a log function of velocity. Increased with speed and surface area	Increased speed of movement will increase the resistance – quick bursts of speed between slower – easy circuit set-up Lengthen lever arm, hand shape or move trunk through the water for more difficulty
Turbulence	:Water motion, created externally or by self Pressure drag is the negative pressure behind the rock or moving person	Client can purposefully create turbulence to test balance; therapist can directionally challenge client Allows eccentric muscle action as water's flow makes stopping harder
Hydrostatic Pressure	Related to the immersion depth Body immersed to 48in = 88mmHg at feet Graduated pressure:depth	Will control oedema in lower limb during exercise Increases heart stroke volume, reducing HR