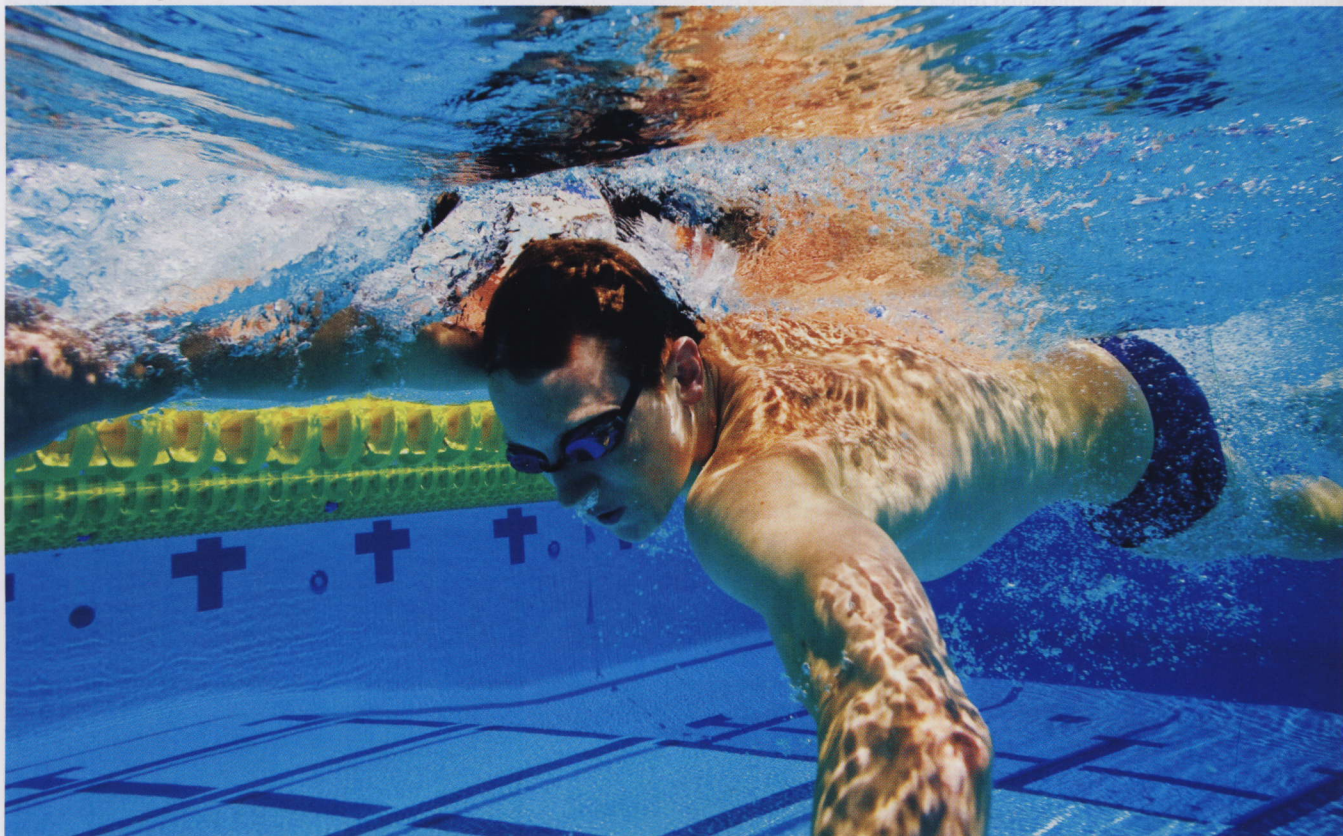


# THE SCIENCE BEHIND AQUATIC IMMERSION

UNDERSTANDING THE EFFECTS OF AQUATIC EXERCISE ON HUMAN HEALTH



Exercise is touted as a major health-promoting activity to reduce the potential risks of developing cardiovascular disease; swimming is often included within these recommendations.

BY DR. BRUCE E. BECKER

**A** considerable amount of research has been accumulated over the past 50 years on the effects of aquatic immersion on the human body, much of which began during the period NASA was planning to put an astronaut into space using aquatic immersion as a proxy for weightlessness.

These effects were profound and spurred further research on the cardiovascular, pulmonary, and renal effects of aquatic immersion. This research, however, was not focused on the effects of aquatic exercise. To this day, there are several important questions that remain either underexplored or unexplored about the place of aquatic exercise in the management of important health issues such as cardiovascular disease, diabetes, obesity, respiratory disease, and chronic neurologic diseases such as multiple sclerosis, Parkinsonism, and the late effects of polio.

This is a tragic lack of research for the industry, as the research that has been completed demonstrates a great potential for human health benefit across a wide range of diseases that cause untold economic cost upon societies across the globe.

## SWIMMING FOR HEART HEALTH

Non-communicable diseases cause 60 per cent of all deaths worldwide and nearly half of these are from cardiovascular disease. In fact, cardiovascular disease is the leading cause of death in the U.S. (one in every three deaths is from heart disease and stroke, equal to 2,200 deaths per day<sup>1</sup>), and the second in Canada (every seven minutes someone dies from heart disease or stroke<sup>2</sup>). The larger issue at hand, however, is these conditions are also the leading causes of disability, preventing people from working and enjoying family activities. Cardiovascular disease is also incredibly expensive—both heart

FIGURE 1

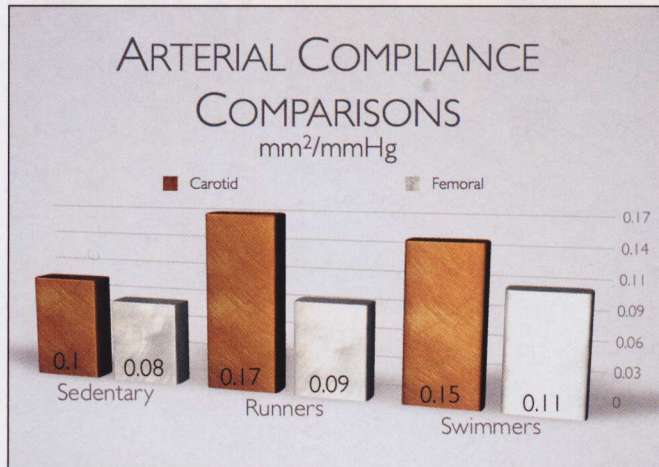
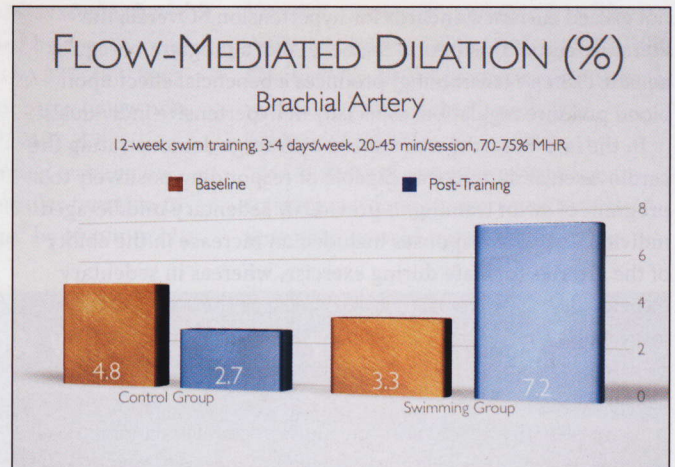


FIGURE 2



disease and stroke hospitalizations in the U.S. cost more than \$444 billion in health care expenses and lost productivity,<sup>1</sup> while it costs the Canadian economy more than \$20.9 billion every year.<sup>3</sup>

The factors that lead to cardiovascular disease are well publicized: smoking, hypertension, lack of physical fitness, diet, obesity, blood lipids, carbohydrate metabolism, and insulin sensitivity.<sup>4</sup> Exercise is touted as a major health-promoting activity to reduce the potential risks of developing cardiovascular disease; swimming is

often included within these recommendations, however, there has only been a small body of research assessing the impact of aquatic exercise and swimming upon cardiovascular risk factors.

*Studies show swimming can help lower blood pressure*

Swimming has been shown in several studies to lower blood pressure significantly, especially in hypertensive individuals.<sup>4,5,6,7,8</sup> Interestingly, some research has demonstrated a slight rise in blood pressure in

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## ■ AQUATIC FITNESS

normotensive individuals, but these blood pressure elevations did not exceed current standards for hypertension.<sup>5</sup> Overall, the literature certainly supports the belief that a program of regular aquatic exercise (swimming) produces a beneficial effect upon blood pressure regulation, especially in hypertensive individuals.

In the late '80s, research started to emerge demonstrating the cardiovascular system was capable of responding positively to a program of swim training in previously sedentary middle-aged individuals.<sup>10</sup> The responses included an increase in the ability of the arteries to dilate during exercise, whereas in sedentary individuals this ability is greatly reduced as the arterial system loses its elasticity without exercise. This loss in elasticity is a precursor to hypertension, which further raises the risk of cardiovascular disease.

More recent research has both supported and expanded these findings. For example, a study published in the *American Journal of Cardiology* showed a 12-week swimming exercise program, comprising a group of previously sedentary individuals, produced more than a 20 per cent increase in arterial compliance, a measure of arterial elasticity, and also a significant decrease in blood pressure compared to their control group (see Figures 1 and 2 on page 69).<sup>5</sup> An earlier study by this group of researchers compared regular middle-aged and older runners and swimmers with sedentary controls and showed that swimmers and runners both had major positive differences from sedentary controls in



**The industry must do a better job to increase public and professional awareness to the benefits of aquatic exercise, not only for the betterment of public health, but also for the pool and spa industry.**

arterial compliance.<sup>10</sup> These are important findings, as the ability of the vascular tree to quickly respond to the increased demands of exercise are extremely important in reducing the work of the heart in circulating blood throughout the body and reducing the risks of hypertension and cardiovascular disease.

### AQUATIC VERSUS LAND-BASED EXERCISE

Obesity has long been noted as a risk factor for cardiovascular disease, although it is less significant a risk than inactivity. In several studies, swimming and aquatic activity did not seem to produce as significant an effect on weight loss and per cent body fat as land-based activity did.<sup>11,12</sup> Further, swimming did not seem to produce significant increases in high-density lipoprotein cholesterol (HDL-C) when compared to land-based exercise as has been noted both in young and older swimmers compared to their land-exercising peers.<sup>4,11</sup>

Other studies, however, have shown when exercise intensity and duration are matched completely, both forms of exercise may be expected to produce both weight loss and an increase in lean body mass.<sup>13</sup> These and other studies have also shown swimming and other aquatic exercises do produce a decrease in total cholesterol and low-density lipoproteins (LDL-C).<sup>4,14</sup> Aquatic exercise and swimming are useful forms of exercise in obesity, especially because of the off-loading produced by buoyancy. Although an active aquatic exercise program may not produce major weight loss, such programs will produce an increase in overall fitness, muscle strength, balance, and perceived quality of life.<sup>15</sup>

### REDUCING THE RISK OF DEVELOPING INSULIN RESISTANCE

Linked with obesity and inactivity is a much higher likelihood of developing insulin resistance, a precursor to diabetes, one of the fastest-growing chronic diseases. The U.S. Centers for Disease Control (CDC) estimates if current trends are not intercepted, within the next four decades, the number of adults with diabetes

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could double or even triple, increasing the prevalence from the current one in nine adults to three adults out of nine.<sup>16</sup>

Aquatic exercise can be helpful in reducing the risk of developing insulin resistance or decreasing insulin resistance if already present as it lowers fasting insulin levels while raising insulin sensitivity. It has also been shown to reduce the level of hemoglobin (A<sub>1c</sub>), a measure of average blood glucose levels over time.<sup>4,11,17</sup> These findings can be important reasons to promote aquatics to those at risk of developing diabetes or those who have been diagnosed with it.

### PROMOTING AQUATICS FOR BETTER HEALTH

While all of the above effects of aquatic exercise and activity seem to be receiving increased recognition within the lay press and medicine, there remains a dramatic underuse of aquatic facilities for health promotion and maintenance.

Unfortunately, many aquatic facilities often lack imaginative programming for adults in need of healthful aquatic activity and physicians are unaware of the many potential health and cost-saving benefits of aquatics. Given the rates of cardiovascular disease, cardiac debility, obesity and diabetes, and their many medical complications, the costs of these health issues may eventually become unsustainable. Therefore, the industry must do a better job to increase public and professional awareness to the benefits of aquatic exercise, not only for the betterment of public health, but also for the pool and spa industry. ♦

#### NOTES:

<sup>1</sup> See "Be One in a Million this American Heart Month," *CDC Features* 2012 (Accessed Jan. 30, 2012). For more information, visit <http://www.cdc.gov/Features/HeartMonth/>.

<sup>2</sup> See Statistics Canada's "Mortality, Summary List of Causes 2008" (October 2011). For more information, visit <http://www.statcan.gc.ca/pub/84f0209x/84f0209x2008000-eng.pdf>.

<sup>3</sup> See The Conference Board of Canada's, "The Canadian Heart Health Strategy: Risk Factors and Future Cost Implications," (February 2010). For more information, visit <http://www.conferenceboard.ca/e-Library/abstract.aspx?did=3447>.

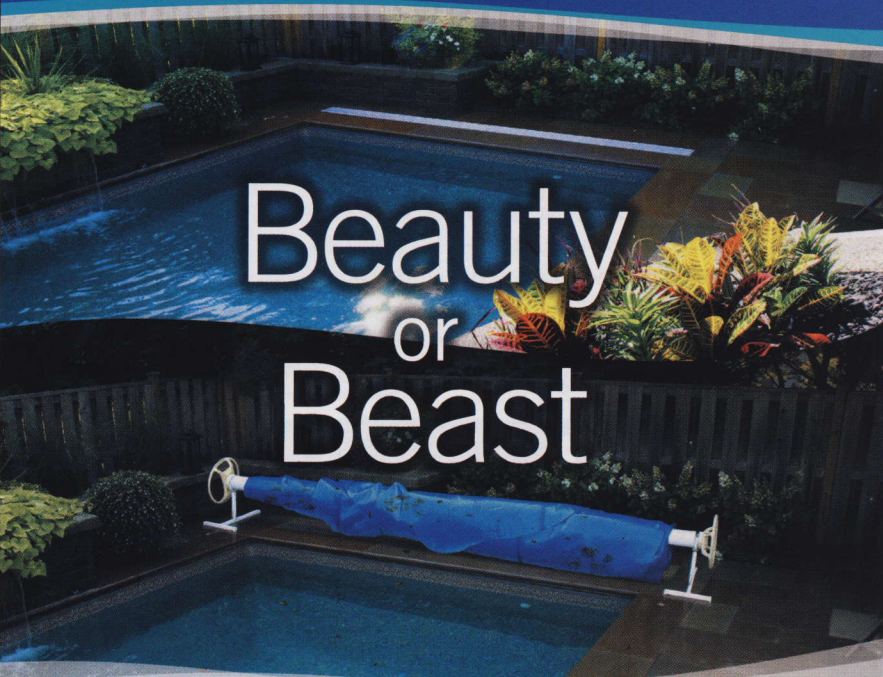
<sup>4</sup> See "Swimming exercise: impact of aquatic exercise on cardiovascular health," by Tanaka H., published by *Sports, Medicine* 2009; 39 (5): pp 377-387. For more information, visit <http://www.ncbi.nlm.nih.gov/pubmed/19402742>.

<sup>5</sup> See "Effects of swimming training on blood pressure and vascular function in adults > 50 years of age," by Nualnim N.,

Parkhurst K., Dhindsa M., Tarumi T., Vavrek J., Tanaka H., published by *The American Journal of Cardiology* 2012; 109 (7): pp 1005-1010. For more information, visit <http://www.ncbi.nlm.nih.gov/pubmed/22244035>.

<sup>6</sup> See "Effects of one-year swimming training on blood pressure and insulin sensitivity in mild hypertensive young


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<sup>6</sup> See "A long-term, comprehensive exercise program that incorporates a variety of physical activities improved the blood pressure, lipid and glucose metabolism, arterial stiffness, and balance of middle-aged and elderly Japanese," by Kawasaki T, Sullivan CV, Ozoe N, Higaki H, Kawasaki J, published by *Hypertension research : official journal of the Japanese Society of Hypertension* 2011; 34 (9): pp 1059-1066. For more information, visit <http://www.ncbi.nlm.nih.gov/pubmed/21753777>.

<sup>7</sup> See "Swimming training lowers the resting blood pressure in individuals with hypertension," by Tanaka H, Bassett DR, Jr., Howley ET, Thompson DL, Ashraf M, Rawson FL, published by *Journal of hypertension* 1997; 15 (6): pp 651-657. For more information, visit <http://www.ncbi.nlm.nih.gov/pubmed/9218185>.

<sup>7</sup> See "Blood pressure rise with swimming versus walking in older women: the Sedentary Women Exercise Adherence Trial 2 (SWEAT 2)," by Cox KL, Burke V, Beilin LJ, Grove JR, Blanksby BA, Puddey IB, published by *Journal of hypertension* 2006; 24 (2): pp 307-314. For more information, visit <http://www.lorenzinfoundation.org/PremioStresa%5C9.%20COX%20%20TESTO.pdf>.

<sup>8</sup> See "Cardiovascular adaptations to intense swim training in sedentary middle-aged men and women," by Martin WH, 3rd,

Montgomery J, Snell PG, et al., published by *Circulation* 1987; 75 (2): pp 323-330. For more information, visit <http://www.ncbi.nlm.nih.gov/pubmed/3802436>.

<sup>9</sup> See "Comparison of central artery elasticity in swimmers, runners, and the sedentary," by Nualnim N, Barnes JN, Tarumi T, Renzi CP, Tanaka H, published by *The American journal of cardiology* 2011; 107 (5): pp 783-787. For more information, visit <http://www.ncbi.nlm.nih.gov/pubmed/21247521>.

<sup>10</sup> See "Effects of swim training on body weight, carbohydrate metabolism, lipid and lipoprotein profile," by Tanaka H, Bassett DR, Jr., Howley ET, published by *Clinical physiology* 1997; 17 (4): pp 347-359. For more information, visit <http://www.ncbi.nlm.nih.gov/pubmed/19361146>.

<sup>11</sup> See "Weight loss without dietary restriction: efficacy of different forms of aerobic exercise," by Gwinup G, published by *Am J Sports Med.* 1987; 15 (3): pp 275-279. For more information, visit <http://ajs.sagepub.com/content/15/3/275>.

<sup>12</sup> See "Aerobic exercise in water versus walking on land: effects on indices of fat reduction and weight loss of obese women," by Gappmaier E, Lake W, Nelson AG, Fisher AG, published by *J Sports Med Phys Fitness* 2006; 46 (4): pp 564-569. For more information, visit <http://www.ncbi.nlm.nih.gov/pubmed/17119521>.

<sup>13</sup> See "Water-based exercise improves health-related aspects of fitness in older women," by Takeshima N, Rogers ME, Watanabe E, et al, published by *Med Sci Sports Exerc.* 2002; 34 (3): pp 544-551. For more information, visit <http://www.ncbi.nlm.nih.gov/pubmed/11880822>.

<sup>14</sup> See "Community-based aquatic exercise and quality of life in persons with osteoarthritis," by Cadmus L, Patrick MB, Maciejewski ML, Topolski T, Belza B, Patrick DL, published by *Med Sci Sports Exerc.* 2010; 42 (1): pp 8-15. For more information, visit <http://www.ncbi.nlm.nih.gov/pubmed/20010135>.

<sup>15</sup> See "Stay Healthy With Diabetes and Prevent Type 2," *CDC Features* 2011 (Accessed Oct. 31, 2011). For more information, visit <http://www.cdc.gov/Features/LivingWithDiabetes/>.

<sup>16</sup> See "Influence of body fatness on the coronary risk profile of physically active postmenopausal women," by Tanaka H, Clevenger CM, Jones PP, Seals DR, DeSouza CA, published by *Metabolism: clinical and experimental* 1998; 47 (9): pp 1112-1120. For more information, visit <http://www.sciencedirect.com/science/article/pii/S0026049598902864>.

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