Underwater Treadmill Running

The Low Impact, Pain-Free, Calorie-Burning Fitness Advantage

Alberto Salazar
Running Legend & Olympic Distance Coach

and Dr. Dennis Dolny
Professor & Department Head, Health & Physical Education
Utah State University

HydroWorx®

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Letters from Enthusiasts

When I began my career as a runner, training was pretty simple: Run, run some more, run more than that. The more miles you put in, the stronger you became. Sure, there were nuances of training that improved your endurance and performance, but they were incredibly basic by today's standards.

I am continuously amazed at what the miracles of science have enabled us to do as runners and coaches of runners. We are undoubtedly blessed to have numerous complementary training methods available at our disposal, including underwater treadmills.

As I have told people time and again, if you want to become a better runner, stay healthy for the long haul and avoid injuries, you have to embrace technology whenever possible. In terms of the elite runners I coach, this has meant introducing them to running underwater on a treadmill against resistance jets.

But don't worry. You don't have to be an Olympian to use an underwater treadmill. In fact, they are successfully used by individuals across all segments of the population for various reasons. Just because someone isn't out to win a gold medal doesn't mean he or she isn't interested in physical, emotional and psychological self-improvement through innovative exercise.

As you read through Underwater Treadmill Running, I encourage you to take notes in the margins and underline items that you want to remember. After all, this book has been written with you – the runner – in mind.

Happy, healthy running,

Alberto Salazar
American Distance Runner & Oregon Project Coach

Letters from Enthusiasts

I am a seeker of knowledge, and that thirst has led me to a lifetime career in research. Research is never dull – and neither are the scientific results revealed in this book.

My associates and I have had the chance to investigate the physiological and psychological responses of underwater treadmill running for many years, and we all feel we've unlocked the key to a breakthrough workout that's great for runners at all levels, ages and abilities.

Who could have imagined a generation ago that we would discover a fitness tool that mimicked the advantages of land-based running without burdening the body? Yet the results of many studies verify the hypothesis that underwater treadmill running is just as valuable as land-based treadmill running for persons who want to get faster, get fitter and/or get moving!

When I was asked to write Underwater Treadmill Running with Alberto Salazar, I immediately agreed. Alberto is one of the most well-known (not to mention vocal) advocates of underwater treadmill training. When you mix my scientific research with his anecdotal evidence, it's clear that we're on the cusp of an exciting movement in the fitness world.

Throughout Underwater Treadmill Running, you will find a number of resources and ideas. Please use them to help reach your goals, regardless of what those goals may be. Perhaps you just want to lose weight; maybe you want to run a triathlon; or it could be that you wish to climb a mountain and need to cross-train comfortably. No matter what your dream, underwater treadmill running can help you get there.

Even if you have had to restrict or limit land-based running in the past because of joint discomfort from ground impact forces, you can use the underwater treadmill. It's welcome relief for former joggers or runners who thought they wouldn't ever run again; best of all, it's a fitness method that's pain-free.

Who says you can't have it all? I can't wait to see you cross your "finish line" with the assistance of an underwater treadmill.

Dr. Dennis Dolny
Head of Human Performance Lab, Utah State University

Part I

Why Water?

Water.

It makes up approximately 70 percent of the earth and two-thirds of the human body. It's essential for life. And its natural properties can be harnessed for rehabilitative and health-enhancing purposes.

Today, aquatic exercise has increased up to 33 percent throughout the world in only a few decades. Truly, it's common for water aerobics classes to be standard at any fitness facility with a pool. Additionally, underwater cycling has entered into the scene. [American Sports Data, 2004]

Yet perhaps one of the most widely-discussed types of water-based workouts is running while submerged on an underwater treadmill.

Underwater Treadmills: Ideal for *Any* Body, Thanks to the properties of H2O

When it's said that "anybody" can use a submersible underwater treadmill to walk, jog, run or sprint, *it's true.*

Underwater treadmill running has been shown to work for persons of all ages and abilities because it taps into the science behind the natural properties of water:

1. Water provides low-impact, low-weight bearing exercise, minimizing the risk of injury or undue stress. It reduces the foot-striking forces that so often "jar" muscles, ligaments, tendons and bones. This lessens the long-term burden on runners' bodies. During underwater running, the weight of a human body is reduced up to 90 percent depending upon the depth of the water. This means a 150-pound runner carries as little as 15 pounds when submerged. Typically, such an experience facilitates longer-than-typical runs for exercisers with reduced risk of overuse injuries.
2. Because of water's hydrostatic effect of increasing thoracic pressure, underwater treadmill runners can benefit from superior cardiovascular conditioning. Additionally, runners will not suffer from muscle soreness as the venous return process is "supercharged" to clear metabolic waste during exercise in water.
3. Water enables different muscle recruitment patterns to occur between underwater running and land-based running. Thus, many runners find that their underwater treadmill runs produce a renewed sense of strength in their legs, abdomens and upper bodies.
4. In a pool with a variable-speed underwater treadmill, water can be pumped using directional water jets to add resistance to the running routine. This type of frontal resistance engages the upper body and core and forces the exerciser to focus on his or her posture as ambulation occurs. Studies have even demonstrated that using a water jet setting at 50 percent creates an added metabolic requirement equivalent equal to running about one mile per hour faster. At a 75 percent water jet setting, the amount doubles to two miles per hour faster.

Estimated METS for Hydroworx Walking and Running Speeds with Jet Resistances- ***

Treadmill Speed			JET Resistances (% of 100% Capacity)							
(miles/hour)	0%	20%	30%	40%	50%	60%	70%	80%	90%	100%
1.5	2	2.25	2.7	2.9	3.3	3.5	4.2	5	5.8	
2	2.5	2.75	3.2	3.4	3.8	4	4.7	5.5	6.3	
2.5	3.4	3.65	4.1	4.3	4.7	4.9	5.6	6.4	7.3	
3	4.4	4.65	5.1	5.3	5.7	5.9	6.6	7.4	8.3	
3.5	5.2	5.45	5.9	6.1	6.5	6.7	7.4	8.2	9	
4	5.75	6	6.45	6.7	7.1	7.3	8	8.8	9.6	
Switch to Running Speeds										
5	8	8	8.4	9	9.65	10.25	10.9	11.5		
5.5	8.5	8.5	8.9	9.5	10.15	10.75	11.45	12		
6	9.3	9.3	9.7	10.2	10.95	11.55	12.05	12.8		
6.5	9.75	9.75	10.15	10.65	11.4	12	12.5	13.3		
7	10.25	10.25	10.65	11.15	12	12.6	13.1	13.9		
7.5	10.85	10.85	11.25	11.85	12.5	13.1	13.8	14.6		
8	11.65	11.65	12.05	12.65	13.1	13.7	14.3	15.1		
8.5	12.4	12.4	12.8	13.4	13.75	14.25	14.75	15.5		

***- METS refer to metabolic equivalents where 1.0 MET is the resting metabolic equivalent average for humans. SO a MET value of 5 means the individual is exercising at 5 times their resting metabolic level. If subjects are greater than 30 Body Mass Index (BMI) one can assume the MET value is about 1 unit lower than the value in the Table.

How Warm Is Too Warm?

Of course, the temperature of the water when working out on an underwater treadmill is an essential consideration for trainer and runner.

The more tepid the water, the easier it is for runners to continue for longer and longer periods without feeling an undue sense of exhaustion or achiness post-exercise. (Obviously, the water cannot be too warm, or workouts will become unduly difficult. Up to about 86 degrees Fahrenheit is a good rule of thumb.)

A rise in the temperature will typically correlate to a rise in heart rate, so this should be factored into any underwater run. Interestingly, it has been observed that females have slightly lower heart rates than do their male counterparts; this may be related to their generally-higher body fat levels than are found in men.

Given the facts about H2O and its helpfulness when it comes to exercise, sports and training, it is little wonder that in the past two decades, innovations such as submersible treadmills with variable speeds and resistance jets (not to mention the therapy pools with built-in treadmill floors) have become widely available to the public via health clubs, hospitals and rehab centers, physical training clinics, high schools, colleges, and professional athletic facilities.

From the east to west coasts of America, to cities and towns across Europe and Asia, underwater treadmills are setting the standard for a new wave of fitness enthusiasts and professional athletes who aspire to challenge themselves to a new way of working out.

Did you know that HydroWorx, the leader in underwater treadmills, was inspired to manufacture its underwater treadmills after seeing how they were used to help horses recover from severe injuries?

Part II

Underwater Treadmill Workouts for Weight Control and Health Improvement

Beyond the gains outlined in Part I, coaches, physical therapists, fitness leaders and researchers are promoting the value of underwater treadmill running because it enables athletes and non-athletes to keep up with numerous suggested guidelines.

In terms of the American Heart Association, Centers for Disease Control and Prevention and American College of Sports Medicine guidelines, first issued in 1995 and continuously updated, underwater treadmill workouts can be incredibly beneficial.

As these guidelines explain, they have been established…

> *"…to promote and maintain health, all healthy adults aged 18 to 65 years need moderate-intensity aerobic (endurance) physical activity for a minimum of 30 minutes five days each week or vigorous-intensity aerobic physical activity for a minimum of 20 minutes three days each week."*

Additionally, this book would be remiss if it did not add that, according to the Centers for Disease Control and Prevention, as of 2008, almost 34 percent of all Americans over the age of 20 could be described as clini-

cally obese. This shocking figure has elicited a host of recommendations from entities such as the U.S. Department of Health & Human Services, which suggests all individuals:

> "…maintain their weight by doing 150 to 300 minutes (2 ½ to 5 hours) a week of moderate-intensity activity such as brisk walking…"

Yet for the third of the population categorized as "obese", moderate-intensity activity on land can lead to strains, sprains and other physical issues. And for those persons who are injured or cannot handle land-based activities, it can be tremendously difficult to follow this advice.

Fortunately, any individual – including those with extreme physical limitations, such as those who are obese or fighting against other conditions (e.g., paraplegics, quadriplegics) – can work out in a pool with an underwater treadmill, making it an extremely attractive alternative to simply "giving up" or "accepting the inevitable".

Underwater Treadmill Advantages – Measurable Outcomes, Comprehensive Gains for Persons with Physical Limitations

For individuals who are injured or have difficulty exercising on land, regular runs in an underwater treadmill eliminate the "de-training" (as well as the concurrent weight gain, muscle loss and fat increase) that can occur during rehab periods.

Moreover, these runs provide cross-training stimulus; consequently, an individual's rehabilitative period can be used to actually improve his or her health and fitness level rather than merely enabling him or her to avoid losing the "status quo" level of conditioning.

The outcomes of regular underwater treadmill running have been observed and recorded for the past decade. Data from those outcomes points to the overall advantages and demonstrates that those advantages

are physiological *and*, just as importantly, psychological.

Measurable physiological responses to underwater running on a submergible treadmill include:

- A similar exercise intensity to land treadmill training as the underwater treadmill velocity increases. (The higher the velocity, the closer the runner can find him- or herself reaching physiological responses typical of land-based run ning.)
- Lowered resting heart rates and workout soreness post-exercising.
- Marked gains in overall body flexibility.
- Reduced repetitive strains joint stress.

Underwater Treadmill Exercising Improves Psychological State

Two recent case studies demonstrate the psychological gains that can be made with underwater treadmills: one from the University of Idaho and another from Texas A&M.

In the University of Idaho study, entitled "Peak Cardiorespiratory Responses during Aquatic and Land Treadmill Exercise", researcher compared underwater and land-based treadmill running outcomes. Their conclusions indicated that underwater treadmills elicited similar peak cardiorespiratory responses compared with those of land treadmill running during maximal-exertion testing.

At Texas A&M, lean body mass increases were noted on test participants who ran in an underwater treadmill for prescribed periods over a series of weeks. In this study, the findings pointed to increases, mainly in the muscles of the legs.

Psychological responses to underwater running on a submersible underwater treadmill are more difficult to scientifically prove, but anecdotal

evidence indicates and infers their importance:

- For injured athletes, being able to keep up with their fitness levels can provide a marked measure of relief. Those who are accustomed to working out at least once a day can feel confident that runs on an underwater treadmill with resistance jets will only help them maintain and possibly increase their fitness levels. This makes them more assured that when they return to prime health, they will not have "lost ground".
- For athletes who are not injured, but who have reached a plateau in their fitness levels, underwater treadmill running can assist in breaking their psychological barriers. Not only is the experience of running in a warm water environment invigorating, but it adds another dimension to their predictable routines.
- For athletes and ex-athletes who struggle with weight and/or ability issues due to injuries or medical conditions, underwater running on a treadmill with variable speeds can contribute to their getting back to a healthy emotional and physical state.

Without a doubt, the underwater treadmill running phenomenon is spreading across the world.

From Olympic athletes like Mo Farah and Galen Rupp to the everyday exercisers at the Randolph YMCA in West Morris, New Jersey, people are clamoring to obtain the benefits that working out on an underwater treadmill can and will provide. They are safely getting fitter and making a dent in the problem of obesity that has spread across the United States in the past few generations.

That's why the next section of this book focuses on working out safely and effectively in a manner that makes the most of this technologically-advanced type of equipment.

Part III

Underwater Treadmill Running Tips

"For some of my friends who have bad knees or sensitive joints, they didn't know that they'd be able run again and recapture their youth. And for a few of my fellow health and wellness enthusiasts, we didn't know that a whole new world of high intensity low-impact workouts were about to be added to our fitness routine."
– Marcello, Randolph YMCA HydroWorx X80 boot camp member

As a supplemental cross-training tool to land workouts and a phenomenal way to burn calories, an underwater treadmill provides incredible pain-free, low impact opportunities for recreational and elite athletes.

However, it's extremely important that any person who wishes to engage in these types of workouts and get the most benefit from them prepare accordingly. Otherwise, the cross-training modalities of an underwater treadmill walk/run/sprint may be negated by poor form.

Below are four areas which must be considered when getting ready to add an underwater treadmill to any individual's regular regimen.

Posture

The way one holds his or her body in water while trying to run against the pressures of the water (which are much stronger than the pressures of the air) tends to become "sloppy" if posture is not consistently considered. Adapting to an aquatic environment while keeping the body "in line" is critical to maximizing the calories burned and cardiovascular response returned during a run on an underwater treadmill.

A good rule of thumb is to ensure that the body follows a "plumb" line. That is, if a line were drawn from the ear to the hip to the ankle (when the runner is in profile), the line would be straight. If the body is bent forward, adjustments must be made as soon as possible.

To ensure that this type of posture is followed throughout the exercise, it can be helpful to make use of an underwater video camera attached to a television or computer monitor. Thus, the runner and his or her trainer can make physical corrections throughout the workout.

Gait & Stride Length

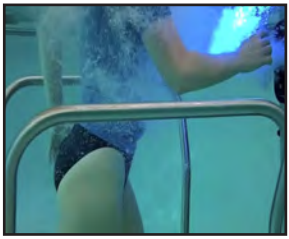
As with posture, a runner's gait in water is very different than on land. Legs are being propelled through a relatively dense material (when compared to air), so the gait must be modified accordingly.

For most runners, the gait they use when on the underwater treadmill will need to be perfected to their body type and preferred style. Some choose to run with very "high knees" in an up-and-down movement. Though this can be beneficial, it can also lead to "bouncing", which is to be avoided. Others choose to run on their toes with their legs reaching an extension.

Again, while there's no "one way" to run on an underwater treadmill, it's

important to find the proper gait that will enable the runner to get a low-impact, challenging workout while maintaining excellent posture and not allowing his or her body to "bob" in the water.

Arm Swing/Movement



Arms play an important role while running on an underwater treadmill. On land, they are used to help propel the body; in an aquatic environment, they can actually slow a runner if they are positioned in a "sloppy" manner.

The best way to ensure that arms are moving in a fashion that will be beneficial is to look for the amount of splashing being created by the hands and elbows. Ideally, the splashing should be minimal, as the arms must be moving as efficiently as possible.

This isn't to suggest that the arms will not be working. On the contrary, as in the case of swimmers, the arms of the underwater treadmill user will get an extraordinary amount of toning thanks to the water's density.

Foot Strike

Finally, any underwater treadmill runner must be prepared to use proper "foot strike" techniques.

Like gait patterns, foot strikes will vary depending upon the athlete. Some choose to run similarly to the way they run on land (e.g., a heel-toe motion); others feel more comfortable running on the balls of their feet (e.g., in a modified "tiptoe").

Each type of foot strike will produce a variety of muscular and cardiovascular responses, as different parts of the lower body will be affected depending upon the motion.

To Shoe or Not to Shoe?

There has been an enormous debate between underwater treadmill enthusiasts as to whether or not it's better to run with or without shoes.

Generally speaking, it's more of an individual preference. Many runners prefer the feel of barefoot underwater treadmill running because it allows them to feel their foot strike. Yet other runners like the way specially-designed underwater treadmill shoes hug their feet.

If you're interested in underwater treadmill running, why not try both methods and see which works better for you?

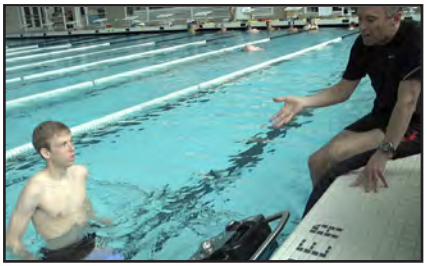
Part IV

For the Track, Running or Fitness Coach of Underwater Treadmill Runners and Exercisers: Expectations

Being the track or running coach of an underwater treadmill runner can be a challenge for aquatic running novices. Therefore, it's essential that coaches prep themselves by studying the mechanics, reading books such as this one and, ultimately, getting in the water themselves. (Being able to understand firsthand what an athlete is experiencing can make all the difference.)

There are several benefits that coaches of underwater treadmill runners have over coaches who only train in land-based environments.

Advantages for Underwater Treadmill Running for Track Coaches



1. The ability to coach from the sidelines – Because the coach can stand alongside the runner in the pool while he or she is running, it can be much easier to make adjustments and suggestions during a workout. And, when possible, a coach can even run on another underwater treadmill situated next to his

or her runner, providing the opportunity for competitive trainings. Though this type of training can occur on a land treadmill as well, the underwater environment offers a safer, more advantageous (see number 2, below) venue for both coach and athlete.

2. The technology available to coaches who work with underwater treadmill runners enables them to be able to monitor the athlete's biomechanics, including gait patterns and stride, via submerged cameras attached to land monitors. Additionally, coaches can see what's occurring in the runner's body and make modifications immediately. This helps avoid the development of bad habits.

3. An underwater treadmill with an easily-adjusted speed dial and optional resistance jets gives control to a coach who wishes to increase his or her athlete's intensity. When running on land, runners may be tempted to slack off on their intensities, which can lead to subpar performance. In the water, the coach can ensure this does not occur. Plus, the coach may use the resistance jets to mimic the physiological responses of walking, jogging or running uphill.
4. Coaches whose athletes are healing from an injury can ensure that their athletes do not miss a day of training despite their conditions. (This occurred with elite, Olympic-level runners Galen Rupp and Kara Goucher in 2010; neither missed a training day despite both needing "time off" from land-based running.) Because it takes very little time for the body to "decondition" itself if fitness levels are not maintained, this translates to a boon for coaches of athletes. It also enables athletes to restore and recover from intense workouts (whether on land or not) without having to suspend training.
5. When the option presents itself, being able to adjust the depth of the pool water can alter the bodily responses to the underwater treadmill run workout. Not sure what level will work best? Most scientists studying the phenomena of VO2 changes and muscular responses to underwater treadmill running start with water at the xiphoid, then move up or down 10 centimeters (about 4 inches.) The xiphoid water level typically provides a balance in the amount of buoyancy so a runner can benefit from reduce ground impacts and not experience too much "float". See bouncing below.

The Coach's Perspective: What to Watch For

As a final note to coaches, it's important to understand the nuances of what to watch for when coaching runners on an underwater treadmill. In addition to land-based running issues (such as biomechanics, speed, breathing, etc.), there are a few additional considerations that will help both coach and athlete have a better outcome:

- The arms of the runner should "break" the water rather than being forced backwards by the water's density.
- The feet of the runner should come down in a straight line from the hip to the ankle, maintaining a correct form.
- The runner should not rely on the buoyancy of the water to propel him or her upward (in a bouncing motion), as this will negate some of the beneficial aspects of underwater treadmill running.

Part V

For the Underwater Treadmill Runner or Exerciser: Expectations

Just as it's essential for underwater treadmill running trainers to understand their roles in an aquatic environment, it's equally important for underwater treadmill runners to understand their expectations as well.

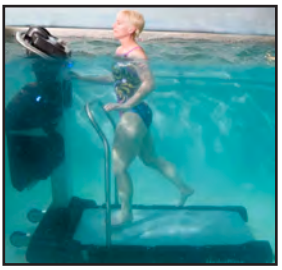
Many athletes are surprised at how challenging underwater treadmill running can be, especially when resistance jets are incorporated into a workout; thus, they may be unprepared to succeed at their newfound training method. However, it's imperative that they move forward and embrace this type of cross-training modality, as long-distance runners can successfully log up to 25-33 percent of their weekly mileage on an underwater treadmill without losing any conditioning.

Some of the unexpected (and perhaps unconsidered) elements that must be deliberated by the underwater treadmill runner before embarking on this kind of innovative training include:

- The intensity of the upper body workout due to the force of the water. In the air, the runner's arms can "pump" relatively freely; in the

water, it's more difficult and requires muscular strength and agility.

- The change in gait pattern, foot strikes and strides from land-based running. As discussed previously in this book, water running on underwater treadmills necessitates a new way of propelling oneself. Some first-time users report shin tightness due to the greater recruitment of the tibialis anterior muscle to flex the foot during the forward swing of the leg against the drag forces of water. However, this feeling soon goes away after the runner becomes comfortable with underwater treadmill usage.



- The drag forces of the water, which will engage muscles differently than during land-based running.
- The trainer, who may wish to coach from the water, the side of the pool or even an underwater treadmill situated next to the runner. This creates a more personalized type of training environment, but can feel unusual to runners unaccustomed to this kind of one-to-one training.

So how can underwater treadmill exercisers (whether walkers, joggers or runners) maximize their water workouts?

With a technologically-advanced, state-of-the-art underwater treadmill equipped with resistance jets, there are a number of possibilities:

1. Resistance jets can be turned on and added for a greater challenge. Running against the force of the jets has been shown to increase metabolic rates without increasing the orthopedic stressors of running at faster velocities.
2. The incorporation of flotation and/or resistance devices around the waist, feet and/or hands can add more "drag", forcing the body to work harder.
3. Because an advanced underwater treadmill has adjustable speed options, it's possible to do "fartlek" or interval trainings,

whereby the runner can move from a walk to a jog, to a light run, to a sprint, and then repeat as desired. On land, these types of intervals have been shown to increase endurance, speed and flexibility; in an underwater setting, they can be expected to do likewise, but without risk of overuse or "explosive speed" injury.

4. In a special therapy pool with underwater treadmill floor, runners also have the option of selecting the water depth they prefer. In fact, during a University of Idaho case study, it was determined that having control over the water depth could vary the intensity of exercising noticeably for participants. This not only helps from a fitness and conditioning standpoint, but can avoid workout "burnout". (Adjustable water depth can also be utilized with the submergible underwater treadmills depending upon the pool into which it is submerged.)
5. Upon finishing underwater treadmill workouts, the underwater jets can be hooked up to a massage hose, enabling runners to enjoy a massage. Such water-based, high-powered massages have been shown to reduce post-workout soreness.

At this point, it's time to begin looking at a few of the exercises that can be undertaken by athletes and trainers who wish to employ the advantages of underwater treadmill running.

Part III of this book gives ideas for underwater treadmill training methods based on those that have been successfully used by athletes of all ages and abilities.

Part VI

Aquatic Treadmill Studies from the Lab

It's not simply anecdotal evidence that has driven professional athletes and "weekend warriors" to take on the challenge of an underwater treadmill workout. Numerous research studies have proven that underwater treadmill exercise can be a fantastic complement to any fitness routine.

At the **University of Idaho**, researchers from the Department of Health, Physical Education, Recreation and Dance compared the metabolic-cost of submaximal land and aquatic treadmill exercise. Using male and female participants who were college-aged track and field athletes, researchers were able to track the energy expenditures during proscribed underwater treadmill and land-based treadmill sessions.

The result of this University of Idaho case study was a finding of a stride rate that was about 1/3 less in water versus land yet a similar energy expenditure was observed during underwater treadmill running and land-based treadmill running.

Another study, conducted by researchers at **Brigham Young University** (BYU), examined the water treadmill parameters needed to obtain land treadmill intensities in runners. The study, which included subjects who were athletic, showed that participants took 22 fewer strides per minute

during the underwater treadmill workout than during the land-based treadmill workout, supporting the Idaho study. They also noted heart rates at comparable metabolic levels were approximately 7 beats per minute lower in water compared to land.

Overall, the researchers at BYU concluded that, to mimic comparable underwater treadmill training sessions, athletes should select water treadmill speeds eliciting a heart rate response that is seven beats per minute less than typical training heart rates on land.

Given these facts, individuals running on underwater treadmills (and their coaches or trainers with whom they work) can fine-tune their workouts utilizing both the empirical "feel" of their runs as well as the raw numbers that studies such as the two abovementioned provide.

At this point, readers should be well-prepared for the physical considerations and proven science of underwater treadmill running. Now, it's time to consider the expectations that are realistic for trainers and athletes when implementing an underwater treadmill training program for enhanced performance, diversity in working out, general enjoyment, weight loss, rehabilitation of injury, and more.

Underwater Treadmill Running 101

Water running is generally categorized into two types: deep-water running (DWR) and shallow-water running (SWR). Both have been shown to provide benefits to individuals who need or want an alternative to land-based running or jogging. However, research has demonstrated DWR and SWR produces lower peak oxygen consumption (commonly abbreviated as VO2max or VO2peak) and reduced heart rates than those observed when similar maximal effort land-based running exercises are tracked. Additionally, SWR traditionally required running along a shallow pool, where the force required to "push" water through a pool creates a very unnatural running form and may form bad habits when one moves back to land running. And DWR does not provide a ground contact phase of support so it's transfer to land running is suspect.

Hence, this is part of the reasoning behind the movement toward a new form of SWR*- running in a stationary position on an underwater treadmill whose depth level can be adjusted as needed.

**Used in this capacity, "shallow" can mean any depth up to the point where the individual can no longer touch the floor of the pool or body of water into which he or she is submerged.

The water treadmill provides the ground support, but unlike land running there is a significant reduction of impact forces on lower extremities. Combined with the resistive forces created while moving against water creates increased work of the muscles in the core and upper body result in a challenging experience overall.

As an added bonus to those who are considering running in a pool, researchers have shown that runners who engage in underwater treadmill running as part of their fitness regimens actually build more lean muscle than do those who simply run on land.

For many people around the world, underwater treadmill running doesn't produce a "Why?"; it produces a "When can I join?"

2011 Japanese Study Suggests Water Triggers Human Movement Patterns in Brain

In what may be a landmark research study, in 2011, Japanese scientists discovered that simply immersing people in water may promote brain activity associated with movement. Healthy adult males were seated in an oversized, reclining bathtub and hooked the participants to a device called a functional near-infrared spectroscopy (fNIRS) system.

This fNIRS system detects subtle changes in the subjects' metabolic rates throughout portions of the brain and represents increased brain activity. Though the subjects were doing nothing more than sitting motionless, as the water was being poured into the tub and while sitting in hip deep water, their brains were exhibiting increased metabolic activity similar to movement.

Over time, the scientists noted that there was a significant increase in the parts of the brain called the somatosensory area, supplementary motor area and primary motor areas, portions of the brain responsible for initiating movement.

Excited over their findings, the Japanese researchers released their findings to the world in late 2011.

Perhaps this insight into what's happening in the brain when the body is submerged will give new hope to those who are reacquiring motor learning patterns and/or acquiring motor skills because of an accident or congenital condition.

Quadriplegic Exercises in Water

Sometimes, an action as simple as holding oneself upright in a chair or feeling the pressure of a parent's hug can be deemed miraculous. It certainly has been for Brian Keefer, 23, a patient of the International Center for Spinal Cord Injury at Kennedy Krieger Institute in Baltimore, who is rallying from a life-altering accident with poise, grace and the help of experts.

Keefer suffered a devastating spinal cord injury in 2008 during a gymnastics accident. In a moment, he went from being an athletic college student to a quadriplegic; however, he never lost his zest for living life to the fullest. It was that attitude that drove him to begin rehabilitation at Kennedy Krieger, a facility renowned for its expertise in helping patients with neurological conditions regain as much mobility as possible. In Keefer's case, physical, occupational and aquatic therapists focused their attention on helping the young man regain movement and function through cutting-edge techniques that include aquatic therapy in a HydroWorx pool.

"With our HydroWorx pools, the options are virtually limitless when it comes to developing treatment plans for patients," said Christy Sachs, Manager, Aquatic Therapy Center at Kennedy Krieger Institute. "We're able to create completely individualized aquatic therapy sessions because of the flexibility to adjust the water depth, temperature, treadmill speed, and jet output in the pools."

In June 2011, the Extreme Makeover: Home Edition team completely renovated the Keefer's Etters, Pa., family home. By adding technological advances like a donated $40,000 HydroWorx T-series unit, Keefer has been given more freedom and independence. He can also work out anytime in an aquatic environment, which he loves. "In the pool, I'm free," Keefer told reporters.

Part VII

Three Underwater Treadmill Running Workouts

Workout 1: Interval 'pyramid' training techniques

DESCRIPTION: The interval or "pyramid" training technique takes underwater treadmill runners through an intense, but fast, workout. Runners are required to challenge themselves in short bursts, ultimately burning calories and strengthening muscles.

EXERCISE	TIME	TREADMILL SPEED
Warm-Up Walk	1 minute	3 mph
Light Run	30 seconds	5 mph
Walk	30 seconds	3 mph
Faster Run	30 seconds	5.5 mph
Walk	30 seconds	3 mph
Faster Run	30 seconds	6 mph
Walk	30 seconds	3 mph
Fast, Intense run	30 seconds	6 mph, 50% resistance jets
Recovery Walking	30 seconds	3 mph

* This 5-minute, fat-slashing exercise can be repeated as desired. Additionally, underwater treadmill speed and resistance jets can be changed to continuously challenge athletes.

Workout 2: HydroWorx X80 Bootcamp Workout

DESCRIPTION: The HydroWorx X80 Bootcamp Workout utilizes the natural properties of water and the underwater treadmill jet machine to create a balanced workout for the whole body. The Bootcamp was designed by Murphy Grant, Director of Sports Medicine at the University of Kansas.

The workout is a high speed interval program with a variety of rest periods, upper body exercises, and lower extremity workouts.

Below is an approximately 25-minute portion of the Bootcamp:

EXERCISE	TIME	TREADMILL SPEED
Warm-Up Walk	1.5 minutes	5 mph
Warm-Up Skip	1.5 minutes	5 mph
Warm-Up Jog	2 minutes	5 mph
Interval Run	2.25 minutes	5.2 mph, 60% resistance jets
Interval Jog	2 minutes	3.5 mph, 45% resistance jets
Interval Run	4 minutes	5.5 mph, 65% resistance jets
Interval Jog	2 minutes	3 mph, 45% resistance jets
Interval Run	5 minutes	6 mph, 75% resistance jets
Cool-Down Walk	5 minutes	comfortable speed

Workout 3: Ironman Triathlon Training

DESCRIPTION: The following 33- to 35-minute exercise has been adapted based on that used to help an Ironman triathlon who was injured return to racing.

EXERCISE	TIME	TREADMILL SPEED
Warm-Up Walk	1-2 minutes	comfortable speed
Run	5 minutes	7 mph, 35% resistance jets
Run	5 minutes	7.7 mph, 40% resistance jets
Run	9 minutes	8.2 mph, 50% resistance jets
Run	12 minutes	8.5 mph, 60% resistance jets
Cool-Down Walk	1-2 minutes	1-2 minutes, comfortable walk

Part VIII

Underwater Treadmill Stories of Achievement

As a final wrap-up to Underwater Treadmill Running, the following athletes have agreed to share their stories of achievement. Each has traveled far personally and career-wise, and underwater treadmill running has helped in one way or another to ensure they consistently exceeded their fitness expectations.

Success Story #1: *Galen Rupp, Oregon Project elite runner*

I have been coached by Alberto Salazar for so long that it's difficult to imagine a time that he wasn't introducing me to the most proven up-to-date methods of training.

When he first suggested that I run in an aquatic environment on a treadmill, I have to admit I was a bit dubious. Certainly, I trusted his judgment, but I didn't think I could get as much out of underwater treadmill runs as he assured me I would.

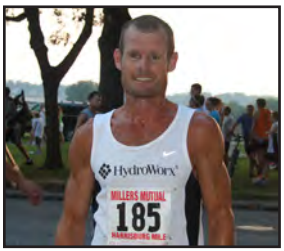
I was very, very mistaken… and he was very, very accurate.

Now, I log dozens of miles every week on an underwater treadmill as part of my overall training plan. Even if I'm sore or injured from running outdoors, I can jump in the pool and run without an issue. Underwater treadmill running has transformed me as an elite athlete. There's no doubt about that.

As Alberto is fond of explaining, though, you don't have to run for a living to work out on an underwater treadmill. When my career as a runner comes to an end, I can see myself still running underwater for the rest of my life; that's how passionate I am about the underwater treadmill.

You just have to give it a shot… and believe me, once you've tried it, you'll be hooked!

Success Story #2: *Nick Berra, masters runner*



I was fortunate to have discovered the HydroWorx treadmill just as I was turning 40 and embarking on a second running career as a Masters-level athlete. After taking almost two decades off from competitive running, I began to train harder and log more miles than I had done in years. My times were dropping and I was becoming very competitive, but the pounding from the road and track work was taking its toll on my body, which wasn't 23 years old anymore.

Once I was introduced to the underwater treadmill, I was not only able to log a bunch of my weekly miles in the pool and reduce the wear and tear on my legs, but I also began running a large percentage of my interval workouts in the pool as well. The recovery time after these workouts was almost zero (as opposed to days when running similar workouts on the track), and the resistance of the water was improving both my endurance and strength. It was like discovering the fountain of youth – I was able to do more work while actually feeling better afterwards: the best of both worlds!

Now, 3+ years later, HydroWorx plays an even larger role in my training than ever before. As I have aged, I have not backed down my training at all, just shifted larger portions of my miles and workouts to the treadmill. I still feel great, and continue to push myself to new levels. Without the pool I don't think there is any way I would have stayed this injury-free or attained to performance levels I have been able to achieve. I'm counting on it to continue to keep me fit and at the front of the pack for years to come.

For more information on underwater treadmill running, please visit
www.hydroworx.com

When Olympic athletes need to supplement their weekly mileage…

When recreational runners want a low-impact, injury-free way to stay in the game…

When physical fitness enthusiasts want an innovative, fun way to lose weight and stay healthy…

…They all turn to underwater treadmill running!

You don't have to be an Olympian to use an underwater treadmill. In fact, they are successfully used by individuals across all segments of the population for various reasons. Just because someone isn't out to win a gold medal doesn't mean he or she isn't interested in physical, emotional and psychological self-improvement through innovative exercise.

Alberto Salazar
from the Letters to Enthusiasts in ***Underwater Treadmill Running***

If you're searching for a pain-free, phenomenal, exciting exercise you can enjoy for the rest of your life, look no further than running on an underwater treadmill.

Let authors Alberto Salazar and Dr. Dennis Dolny show you why water workouts work wonders, and how you can harness water's natural properties to get in incredible shape.

Underwater treadmill running: It's just your speed, it's as intense as you need it to be, and it's spreading across the globe!

Catch the wave! Read ***Underwater Treadmill Running*** today.

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