# Aquatic Cross Training for Athletes: Part I

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Column Editor

## SUMMARY

THE CURRENT ROUNDTABLE IS THE FIRST PART OF A 2-PART SERIES THAT IS DESIGNED TO EXAMINE THE USE OF AQUATIC EXERCISE TRAINING, SUCH AS DEEP-WATER RUNNING. SEVERAL EXPERTS IN THE FIELD OF AQUATIC EXERCISE HAVE BEEN BROUGHT TOGETHER TO DISCUSS ISSUES RELATED TO THE USE OF AQUATIC EXERCISE IN THE TRAINING PROGRAMS OF ATHLETES AND VARIOUS OTHER POPULATIONS.

## INTRODUCTION

A growing interest in the effects of performing exercise in aquatic environments has resulted in an increase in the occurrence of scientific inquiry on the topic (2,3,5,9). Several studies have focused on the short-term (4) and long-term (8) effects of exercising in aquatic environments on both young and older women and men. Research in this area has focused on the effects of training in aquatic environments on cardiovascular (2,3,8) and muscular adaptations (6,7,9).

Several researchers and practitioners have suggested that aquatic cross-training may be a useful tool for athletes. In particular, deep-water running has received a lot of attention as it offers a unique training stimulus that has the ability to maintain aerobic performance as well as decreasing the stress of the training environment (1). Interestingly, the use of deep-water running appears to supply an effective cardiovascular training stimulus with both healthy and injured individuals (1). When individuals are restricted from land-based exercise, the use of aquatic-based cross-training with modalities such as deep-water running appears to offer an alternative exercise method that has the ability to translate to running performance.

The current roundtable is designed to explore the concept of aquatic cross-training and how it might be useful to the strength and conditioning professional.

## QUESTION 1: DOES THE LITERATURE SUPPORT AQUATIC CROSS-TRAINING IN ATHLETES?

*Becker*: While there is not a massive body of literature that speaks directly to this question, there is literature that supports the potential value of aquatic exercise as a cross-training mode (17). Aquatic cross-training has been used extensively in a variety of sports, but particularly with track and field athletes, because aqua-running is simple to train and the potential value has been more extensively researched (7,12,20). While aquatic cross-training can present a very significant aerobic challenge to the athlete, there are differences in motor activity, muscle recruitment, and cardiovascular performance (6).

*Lindle-Chewning*: Many professional athletes including boxers, ice skaters, tennis players, baseball players, and runners have cross-trained in the water. Although these athletes have reported success with aquatic cross-training, there is little scientific evidence to support these athletes' claims for the majority of these sports. In the 1990s, there was a flurry of scientific research investigating the viability of deep-water running/jogging as a cross-training modality (1–3,6,11,12). In general, the majority of these studies suggest that adding deep-water running to an athlete's training regimen has the potential to increase fitness and ultimately improve performance.

*Huff*: Several research studies suggest that aquatic exercise may be valuable as a mode of cross-training for certain athletes (7,9). These studies suggest that technique is a factor in the effectiveness aquatic exercise as a cross-training modality (4). The actual benefits of aquatic cross-training might be limited by the athletes' experience with water exercise. Athletes that are encouraged to use aquatic cross-training must first be taught the proper technique and form. Additionally it may also be necessary to use an intensity that is similar to that used during land-based training in order for aquatic modalities to be effective (1). The difficulty is that there are many factors that influence the intensity of water exercise. One way to account for this is to educate the athlete about specific aquatic techniques that can alter the intensity of exercises in the water.

*Sherlock and Sherlock*: The aquatic field has little supporting research to validate testimonials provided by clinicians, patients, and/or athletes promoting aquatic rehabilitation and/or cross-training. The most abundantly discussed research topic in the aquatic realm is the

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modality known as deep-water running (2–7,10–12,14,16). Supplementing training programs with deep-water running for distance runners has been successful in maintaining and, in some instances, increasing fitness levels and performance (2–7,10,14,16). An article by Martel et al. (12) provides evidence that increases in vertical jump can occur with the use of jump training in an aquatic environment. It was suggested that aquatic jump training programs provided the same performance benefits as land-based plyometric programs with considerably less muscle soreness. Based on these findings, the use of aquatic jump training programs may be warranted when working with athletes.

*Stolt*: Much research has been done supporting the role of training in the aquatic environment for postoperative and rehabilitative, surrounding diseases and conditions associated with aging and special medical groups. For the most part, this work supports aquatic cross-training. Overall improvements in strength, $\dot{V}O_2max$, and cardiovascular endurance are demonstrated (1,2,6,8).

The research focuses primarily on runners and/or using the aquatic arena as another medium for running. The athletes are trained in both shallow and deep water. In deep water, the athlete may or may not use a belt that provides flotation. In shallow water, the individual may run freely through the water or may use equipment such as treadmills or cycles. Focus has been on cardiovascular fitness and response, including heart rate, stroke volume, blood pressure, $\dot{V}O_2max$, perceived exertion, and blood lactate. Both land and water temperature as well as water depth affects performance and training (3,5,7,11–13).

Beyond running, there is little research available that addresses cross-training for athletes. For example, does running through shallow water at various depths from ankle to chest promote greater core stability response and in turn transfer to performance in a football game. These are areas that research could clearly demonstrate how potentially vital aquatic cross-training can be. This information is anecdotal at best and makes inferences through observation. I have observed physiological changes as well as modification of injury risk through water exercise in a variety of athletes. More research needs to be done to examine how training can benefit populations of other athletes.

### QUESTION 2: DOES AQUATIC CROSS-TRAINING SUCCESSFULLY MAINTAIN AEROBIC FITNESS IN ATHLETES?

*Becker*: There is a significant metabolic demand from an aquatic training program that compares favorably to land-based training. While there are some significant differences in cardiovascular function, the overall cardiac demand appears to be, at the least, equivalent (15,16). In an older study, cross-country athletes with high entry level fitness were tested over a 3-week period, comparing conventional training to aquatic exercise, finding no significant difference between the aquatic and conventional groups (8). Based on these studies, it is reasonable to conclude that a structured aquatic cross-training program can maintain fitness in already fit individuals. Bushman and co-workers (4) demonstrated that competitive distance runners could successfully maintain running performance, $\dot{V}O_2max$, maximum heart rate, and lactate threshold following a 4-week program of an aquatic-only training program. There seems to be quite compelling evidence that an aquatic cross-training program can successfully maintain aerobic fitness and may be used to augment a training program for many athletes.

*Lindle-Chewning*: Although there are variations in training programs, testing procedures, and study lengths, there is favorable evidence that deep-water running training is successful in the maintenance of aerobic performance in subjects who are already endurance trained (2–4,10,12).

Several studies suggest that including or replacing a portion of the land-based aerobic training plan with deep-water running has the potential to affect aerobic performance in trained athletes who are not injured. Hertler et al. (4) compared the effects of 8 weeks land-based training ($n = 7$) to 4 weeks of land-based training followed by 4 weeks of deep-water running ($n = 6$) on maximal oxygen consumption ($\dot{V}O_2max$) and leg strength in trained runners. After the completion of the 8 weeks of training, there were no differences in $\dot{V}O_2max$ or isometric leg strength between 2 training groups. The authors concluded that deep-water running has the potential to supply enough stimuli for the maintenance of aerobic performance in trained runners.

Additionally, Tartaruga et al. (11) examined the effects of including deep-water running in a training program for elite runners. One group continued training on land and the second group replaced 30% of their training volume with deep-water running training. After 8 weeks of training, the researchers found no difference between the training modes for training-induced changes in maximal oxygen uptake, ventilatory threshold, maximal expiratory volume, running economy, maximal heart rate, stride frequency, stride length, relative stride length, stride time, support time, nonsupport time, and horizontal velocity.

Even though deep-water running is mechanically different from land-based running (5), both Wilber et al. (12) and Bushman et al. (3) concluded that long-term deep-water training has the potential to stimulate the physiological adaptations needed to maintain running economy. Based on these data, it appears that uninjured athletes can benefit from including deep-water running in their overall training plan (3,9).

It has also been suggested that deep-water running is a useful tool that can allow injured athletes to maintain cardiovascular fitness and ultimately running performance (2). Over a 22 month period, Burns and Lauder (2) examined the effects of deep-water running on 181 active-duty army soldiers with injuries that precluded them from their regular weight-bearing physical fitness activities. They suggest that $\dot{V}O_2max$ and running performance can be maintained while soldiers are restricted from weight-bearing aerobic training.

Finally, Tartaruga et al. (10) report that water running is now being included in the training regimens of noninjured runners. This practice has gained popularity with coaches because of the ability of deep-water running to maintain aerobic capacity when incorporated in the overall training plan.

In conclusion, it appears that deep-water running has the potential to maintain $\dot{V}O_2max$ and running performance in injured and noninjured individuals, thus suggesting that deep-water running may be an important training tool for endurance athletes.

*Huff*: Several research studies have concluded that aquatic cross-training will maintain aerobic fitness in athletes (1,2,5). Wilber et al. (10) report that trained runners who undergo deep-water running training are able to maintain $\dot{V}O_2max$. The runners substituted their normal program with deep-water running. The training program consisted of training at 90–100% of their $\dot{V}O_2max$ for 30 minutes and 70–75% for 60 minutes on alternate days. The researchers concluded that after 6 weeks of deep-water running, $\dot{V}O_2max$ remained the same (10). It is important to note that the participants in this study were trained runners and were able to maintain exercise intensities in the water that were comparable to those achieved on land.

Athletes who are familiar with aquatic exercise will be able to use proper technique and therefore be able to maintain greater intensities than those that are not familiar with the techniques of water exercise. This contention is supported by a study that compares the $\dot{V}O_2max$ of experienced deep-water runners to that of inexperienced deep-water runners, resulting in differences between the two groups (4). The $\dot{V}O_2max$ values of the experienced runners while running in the water were within 3.8 $mL \cdot kg^{-1} \cdot min^{-1}$ of those measured while running on land. The $\dot{V}O_2max$ values of the inexperienced deep-water runners resulted in a 10.3 $mL \cdot kg^{-1} \cdot min^{-1}$ difference than those measured on land. The researchers concluded that the differences were due to inappropriate body position in the water.

Although the research does support aquatic cross-training, the experience of the athletes, their ability to maintain proper form and technique, their understanding of the properties of the water, and the program design will all influence the effectiveness of the training session.

*Sherlock and Sherlock*: Though few studies have been completed concerning aerobic maintenance with the use of aquatic cross-training, there are supportive findings. A study by DeMaere et al. (5) tested trained cross-country runners measuring oxygen consumption, ventilation, rate of perceived exertion, respiratory exchange ratio, and fat and carbohydrate oxidation and found evidence to support that deep-water running is comparable to treadmill running at submaximal exercising levels. This study concludes that deep-water running could be incorporated into a training program as an enhancement tool or even a substitution (5). Proper running form during deep-water running is best achieved without the aid of a buoyancy device (2,4,6).

*Stolt*: During training in the water, the body demonstrates physiological responses differently from what we would expect for the same intensity and workload of a land-based activity. Eckerson and Anderson (1) found that healthy collegiate females performing shallow-water exercise elicited a heart rate and oxygen uptake response corresponding to 82% and 48% of the maximal values on a treadmill, respectively. The results found here should be noted because the physiological response for these participants (high heart rate, low $\dot{V}O_2$) is different from that of other aquatic exercise, which demonstrates a low heart rate for a given $\dot{V}O_2$. This is a concern because it is difficult to give reasons for such marked differences in this group of athletes as compared to other participants (1,2,5,6,8,12,13). Perhaps the difference is due to the starting fitness level of the participants involved. Regardless of the reason for this difference, it is important to note that shallow-water running elicited responses comparable to land running (12).

In deep-water, the parameters of these responses are different from those in shallow water, mainly suggested by the increased hydrostatic pressure relative to the person's height. It is much different to run in waist or chest depth water than to be suspended and immersed from the shoulders down. In the same study, it was found that deep-water running required a higher energy output to elicit the same physiological response. Other research demonstrates a higher stroke volume, an unchanged or higher heart rate at intense but not moderate workloads, unchanged systolic blood pressure, with a higher breathing frequency but lower tidal volume (2,3,5–7,8,11,13). Additionally, it has been shown that perceived exertion is higher in deep-water running relative to $\dot{V}O_2$ and heart rate. It is suggested that the external hydrostatic pressure and an altered running technique in supported submaximal water running may add to an increased anaerobic metabolism, with changes in respiratory exchange ratio and perceived exertion, but not in total ventilation (11).

## QUESTION 3: IS AQUATIC CROSS-TRAINING AN EFFECTIVE MEANS TO INCREASE AEROBIC ENDURANCE IN ATHLETES?

*Becker*: Less research has been done in this area. Ritchie and Hopkins (13) demonstrated the ability to present a sufficient training stimulus to increase aerobic power. Gehring and co-workers (9) demonstrated that competitive runners could achieve training intensities similar to land-based running, as measured through oxygen consumption, heart rates, and rate of perceived exertion. In a recently completed study pending publication, we assessed 101 college-age individuals, half in an aquatic aerobic training program and half in a conventional land-based exercise program (1). Students were trained for 50 minutes 3 times per week for 15 weeks. Most of the students were already athletically active, but the groups all showed improvement in aerobic fitness levels. The aquatic-trained individuals showed statistically greater improvements in respiratory function and endurance than the land-based exercisers. Aerobic endurance is a function of both peripheral muscular endurance and cardiorespiratory endurance, and thus it is reasonable to postulate that improvements in respiratory muscle endurance may lead to improvements in overall aerobic endurance.

*Lindle-Chewning*: Many different modalities of aquatic training are effective for improving aerobic endurance in untrained subjects, including deep-water running, deep-water exercise, and shallow-water exercise (5). There is little scientific evidence investigating the use of aquatic exercise to improve cardiorespiratory fitness in trained athletes.

*Huff*: It is important that an overload stimulus be applied in order to achieve gains in aerobic performance. Therefore, exercising in the water at an intensity that is greater than that to which the body is accustomed should result in an improvement in aerobic endurance (6). Kravitz and Mayo (6) report that 7–11 weeks of shallow-water running training has the potential to increase $\dot{V}O_2$ by 5.6 to 18.9% in untrained individuals. Conversely, 4–6 weeks of deep-water running training resulted in no change or a small increase when trained individuals were examined.

It is possible to experience gains in aerobic endurance when working with untrained or detrained individuals when using deep-water or shallow-water running training (6). There is limited research exploring the use of aquatic running training with trained individuals, but current literature suggests that aquatic training offers minimal gains. Factors that may influence the effectiveness of the aquatic training regimen may include the athletes' experience with water exercise and their ability to maintain proper form. Additionally, it is important to note that in order to induce physiological changes, the athlete must be able to achieve an exercise intensity that is greater than that seen with untrained individuals. Finally, the magnitude of the aquatic running training induced improvement will also be based on intensity, duration, and frequency of training.

*Sherlock and Sherlock*: As in any exercise program, land, water, or otherwise, if enough stimulus is provided to elicit a training response, adaptation will occur. Aquatic exercise places new physiological demands on the person immersed. Training the respiratory system (primarily the inspiratory muscles) changes in the cardiovascular response (increases in cardiac output, enhanced diastolic filling, decreased peripheral vascular volume, depressed sympathetic activity, and increased stroke volume), fuel utilization (preference of carbohydrate to fat even during submaximal activity), and shifts in musculoskeletal patterns all demonstrate the possibilities of aquatic stimulus to elicit a training response for aerobic endurance training (1,3,5,7,8,11,12,14,20).

*Stolt*: As discussed in question 2, physiological responses demonstrate cardiovascular changes occur during exercise as well as to develop and maintain aerobic fitness. Aerobic endurance can be trained through aquatic cross-training. As we would train an athlete as a runner for aerobic endurance through fluctuations in intensity, frequency, and duration on land, the same is held true in aquatic running.

## QUESTION 4: CAN STRENGTH GAINS BE ACHIEVED THROUGH AQUATIC CROSS-TRAINING?

*Becker*: The aquatic environment may be used to provide a workload sufficient to create fatigue and produce strength gains in both deconditioned adults and athletes (18). Fatigue mechanisms are not well understood and are composed of both central and peripheral processes, but are important factors in the process of strength development. The work of movement against the resistance of the water may be varied through altering surface area (fins and paddles), altering buoyancy (foam barbells), and adding turbulent flow (working against jets) and is proportional to the speed of movement. The resistance presented by the viscosity of water is a complex velocity-driven equation (2). Aquatic techniques have evolved for most common strength-building needs. Recently, Martel and co-workers (11) demonstrated the ability to increase vertical jump in female volleyball players using specific aquatic plyometric training. Robinson and co-workers (14) demonstrated that these improvements could be accomplished with less muscle pain as well. Obviously, the skills of a trained aquatic therapist are helpful in creating programs for specific strengthening needs.

*Lindle-Chewning*: Hertler et al. (4) measured leg strength in experienced female athletes after 4 weeks of land-based training followed by a deep-water running training program. Isokinetic testing showed no difference in leg strength between the deep-water running and land-based running groups.

Strength increases are documented in research for untrained subjects in several water training formats with and without the use of aquatic exercise equipment (5). Poyhonen et al. (7) investigated a 10-week aquatic resistance training program for healthy women and measured improvements in knee flexion and extension torques and muscle mass. Significant improvements in all parameters were noted after the training program. Takeshima et al. (9) found significant improvements in older women in leg flexion, leg extension, chest press, chest pull, shoulder press, shoulder pull, and back extension following a 12-week supervised program.

Although strength gains in the aquatic environment for trained athletes has not been studied, with proper training techniques, it may be possible. One challenge faced by aquatic investigators is controlling progressive overload. Techniques such as progressively increasing the surface area of drag resistance, progressively increasing the size and density of foam for buoyant resistance, progressively increasing the speed of movement through the full range of motion, or progressively increasing the number of repetitions through the full range of motion at the same time are being used to quantify resistance used in the aquatic environment. As these methods of measuring and controlling intensity become more prevalent, research on strength gains for trained athletes may surface.

*Huff*: Although aquatic exercise offers several methods for increasing exercise intensity, it may be difficult to achieve an intensity great enough to result in gains in muscular strength.

Intensity can be increased by applying more force to the movement, using buoyancy equipment, increasing the drag and surface area with equipment or body position, using weighted equipment, and increasing the speed and velocity of movements. However, athletes would have to possess a very good understanding of the techniques involved in manipulating the forces of water to increase the intensity enough to elicit gains in strength. They would also experience the challenge of maintaining proper form while applying that much force against the water. Therefore, significant gains in strength might be limited.

In one study, Poyhonen et al. (8) suggest that possible gains in strength in response to 10 weeks of progressive aquatic resistance training are related to neurological adaptations (8). Significant improvement in the muscle torque of the knee extensors and flexors and improvement in neural activation of both muscle groups were noted in this study. Improvements in neurological activation may partially explain the gains in strength in response to aquatic resistance training.

Land-based resistance training programs typically incorporate a combination of eccentric and concentric muscle actions. Conversely, most movements against the force of water result in concentric-only muscle action. However, resistance training in the water using buoyancy equipment provides an additional overload stimulus during the eccentric phase of the movement. For example, adding buoyancy equipment to a lateral raise would result in overloading the latissimus dorsi eccentrically during abduction and concentrically during adduction. The opportunity to train both concentrically and eccentrically could possibly optimize gains in strength.

The opportunity to increase strength through aquatic cross-training will be limited by the athletes' experience with resistance training in water, experience with the equipment used, and the ability to maintain proper form and technique during the exercise.

*Sherlock and Sherlock*: If appropriate stimuli are provided, strength gains can be achieved. The water is a very interesting medium where styrofoam, surface area, turbulence, and other unique equipment can provide a more challenging exercise session. With this equipment and the distinctive ability of water to support a body in a variety of positions, strength gains can be achieved. The ability of an untrained individual to increase strength in an aquatic environment is well documented (1,2,11,12). There is little documentation of strength gains through aquatic training within the athletic population. Post-injury, water provides an ideal environment to begin a program focused on strength, muscular endurance, range of motion, and cardiovascular training. The density of water allows muscular endurance and, in some instances, strength to be targeted with every movement.

*Stolt*: This is a challenging question to answer. Much research supports this in gerontology, special populations, and in postrehabilitative protocols of nonathletes. The research to support this is using relatively untrained individuals who would likely show gains regardless of what they are doing (1,2,5–7). The question, however, is centered on the athletes who have no special needs. These athletes are conditioned and trained individuals who may have completed the strength gains necessary for the sport. The athlete may be in pre- or post-season. Does the use of this arena assist in strength gains for this individual? Research is lacking regarding strength development in athletes. My evidence is anecdotal and observational.

There are definite strength gains for the athlete who is returning from an injury. In the aquatic environment, this athlete can relearn movement against resistance in a completely supported environment. By training in the water, the athlete not only works in a medium that has a greater viscosity than air, he or she needs to learn to balance differently because of proprioceptive changes in the environment. Movement becomes more exaggerated, and, if moving against the flow of the water, the athlete needs more strength to balance and generate movement. When the athlete returns to the environment in which he or she trains, strength gains may be apparent due to the awareness that the athlete gained from the movement in the water.

## QUESTION 5: WHAT TYPES OF AQUATIC CROSS-TRAINING ARE RECOMMENDED FOR ATHLETES?

*Becker*: Certainly the most frequent and most studied technique is aqua-running (3,5,8–10,12,16,19). This may be varied with cross-country skiing movements and a wide variety of upper body activity. Core strengthening may be very successfully achieved in the pool. Flexibility exercises are a useful component of any aquatic cross-training program. In general, we have tried to approximate the normal land-based athletic activity for a significant component of the training interval. Aqua-running is kinesthetically different from running on land, and mechanics must be monitored.

*Lindle-Chewning*: Deep-water running is widely accepted as a form of cross-training that will maintain aerobic conditioning as well as leg strength in endurance-trained athletes. For athletes, specificity remains important. The 3-dimensional resistance provided by the water offers a training stimulus not offered by other training modalities. Multiplanar movements can specifically be performed in the aquatic environment and resisted through a full range of motion.

One option for cross-training in the aquatic environment identified through research is plyometric training. Robinson et al. (8) investigated identical plyometric jump programs performed in water and on land. Using 32 college-age women in an 8-week program, they found "aquatic plyometrics provided the same performance enhancement benefits as land plyometrics with significantly less muscle soreness."

*Huff*: Aquatic cross-training is generally recommended for runners. The aquatic environment offers a medium for training that will elicit a similar physiological response to running on land, while decreasing the impact experienced by the body. Several studies have been conducted comparing the physiological responses of running in shallow water, deep-water running, and running on land (3,9,10).

Aquatic cross-training in which jumping exercises are conducted in an aquatic environment may also be beneficial in the development of power. Martel et al. (5) measured the vertical jump of female volleyball players before and after 6 weeks of jump training in an aquatic environment. It was determined that the jump program resulted in an 11% improvement in jumping performance on land. The athletes performed power skips, spike approaches, single and double leg bounds, continuous jumps for height, squat jumps, and depth jumps in the aquatic environment (7). These results suggest that aquatic movements have the potential to be similar to those performed on land.

Aquatic cross-training may also be beneficial in the development or improvement of sport-specific movements such as swinging a baseball bat or tennis racket or developing stride length and foot placement for sprinting. Aquatic cross-training programs can be designed to focus on teaching the body to move properly against the forces of the water.

Aquatic cross-training is also a valuable tool in the development of core stabilization. The torso muscles are required to support the body as the limbs move against the forces of the water. This is very similar to the recruitment of the torso muscles during some types of athletic performance where efficiency is based on the athlete's ability to transfer the energy from the legs to the arms.

*Sherlock and Sherlock*: Aquatic cross-training has unlimited variations for postures, movements, and foci. The type of cross-training should be related to the sports movements, bioenergetics, and overall needs of the athlete. With this in mind, creating a program that suits the needs of the specific athletes using buoyancy, surface area, turbulence, levers, and surface tension is the optimal choice. Deep-water running is well supported for cross-training in runners (2–7,10–12,14,16). Aquatic plyometrics has been disputed as an alternative to land plyometrics for increasing vertical jump in volleyball players and would have a positive effect on any athlete competing in a sport requiring power and speed (9,13). The Burdenko method is a well-established, sport-specific program that many athletes use; however, no research exists to date to support the effectiveness of the program. Warm-water flexibility training, range-of-motion exercises, Tai Chi relaxation exercises, and visualization exercises would also be assistive for most athletes. Range of motion and flexibility have been noted to demonstrate great improvements when performed in warm water (15).

*Stolt*: Many references are made to deep-water running for aquatic cross-training; however, the training can mimic the game that the athlete will play. Footwork drills including jumps, hops, shuffles, sprints, and change of direction can be introduced. The dynamics of performing these drills in the aquatic arena is different from land drills and should not be solely relied on. The differences are due to the buoyancy and viscosity of the water. It is recommended that the athletes who are performing a higher impact type of activity in shallow water wear shoes. Water shoes or sneakers used for aquatic training are available from several companies.

Use of drag equipment such as paddles and aqua fins increases the surface area that the athlete has to move and creates greater resistance. A kickboard can be used for the same purpose with the athlete moving the board through the water. Examine the population of athletes you have, the number of athletes who are participating in a session, and the pool space you have available. This will determine what you can do safely. Most importantly have fun and be creative. Your imagination is the limiting factor here (4,9,10). ■

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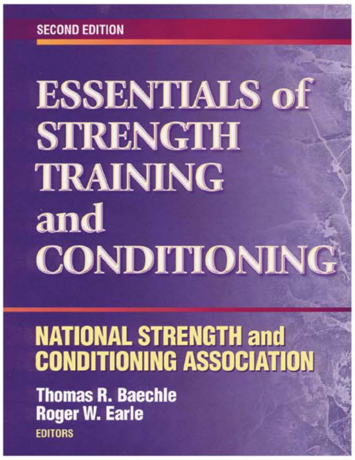


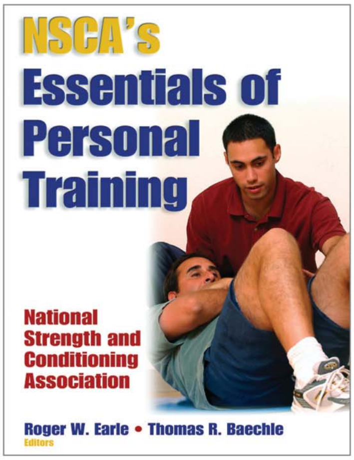


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