### Speed, Agility, and Quickness training

Speed, agility, and quickness (SAQ) training is a useful and effective method of fitness training that stimulates muscular, neurological, connective tissue, and even cardiovascular fitness adaptations. SAQ exercises present the body with numerous scenarios requiring coordinated movements, reaction to various stimuli, and quick bursts of speed. These challenges can promote improvements in physical performance and sustain youthful movement throughout life. When clients are properly prepared, and SAQ training is done appropriately, it can be a valuable addition to any fitness-training regimen.

The term speed, as it is used throughout this text, refers to straight-ahead velocity and is measured as distance covered, then divided by time (distance ÷ time). Agility requires the ability to sprint in multiple directions (running and cutting) while maintaining postural control and oftentimes requires reacting to a stimulus. Quickness refers to the ability to react to a stimulus (i.e., reaction time) and appropriately change the motion of the body in response to that stimulus (such as hitting a baseball).

SAQ training improves a client’s ability to accelerate, decelerate, and dynamically stabilize the entire body during high-velocity movements in all planes of motion (such as running and cutting). In addition, SAQ training stimulates the nervous system to respond more efficiently to demands placed on it and enhances muscular recruitment and coordination when performed with correct mechanics.

It is important to note that agility and change of direction (COD) are separate, although both of these related concepts fit underneath the umbrella of agility training. Agility involves reacting to a signal, or stimulus and then changing the body’s sprinting direction in response to that stimulus. A good example of this concept is of a coach instructing an athlete to run in various directions (e.g., shuffle left, shuffle right, forward, backward) in no discernible order, by pointing in various directions. This requires the athlete to react to the coach’s cues and respond accordingly. Conversely, COD does not involve reacting to a signal, but it still requires an individual to accelerate, decelerate, and change directions, such as an athlete running through a predetermined obstacle course. This differentiation is important as fitness professionals design agility drills, which should involve a response to a signal versus only working on COD.

HELPFUL HINT

Change of direction (COD) requires a client or athlete to run in all directions at maximum speeds. As such, it requires optimal body control and coordination. Examples of COD include running through an obstacle course or performing predetermined cone drills.

Agility combines COD with unpredictability. In other words, it requires a client or athlete to react to a stimulus and sprint accordingly in the proper direction. An example would be a group of school children playing a game of tag.

**Speed**

Speed is the ability to move the body in one direction as fast as possible. It is the product of stride rate and stride length. Stride rate is the number of strides taken in a given amount of time (or distance). Stride length is the distance covered in one stride, during running. Although certain aspects of speed are dependent on genetic factors, it is a skill that can be learned through an integrated training program. Not every client needs to run as fast as an elite athlete, but speed improvements among athletic and nonathletic clients can have both performance and health-related advantages. Speed-specific exercises (i.e., sprinting drills) stimulate muscle tissue and nerves in ways that other training methods do not and thus can stimulate health and performance adaptations that will be missed if it is not included in a fitness training program.

**Proper sprint mechanics**

Proper running mechanics enable the client to maximize force generation through biomechanical efficiency, allowing maximal movement velocity to be achieved in the shortest time possible. Two important aspects of sprint technique are frontside and backside mechanics. Frontside mechanics involve *triple flexion*, which includes the synchronized movement of ankle dorsiflexion, knee flexion, and hip flexion. Improved frontside mechanics are associated with better stability, less braking force, and increased forward driving force. Proper frontside mechanics align the lead leg to optimally apply force into the ground to help propel the body forward. Backside mechanics involve *triple extension*, which includes the synchronized movement of ankle plantar flexion, knee extension, and hip extension.

Improved backside mechanics are associated with a stronger push phase, including hip-knee extension, gluteal contraction, and backside arm drive. Frontside and backside mechanics work in synchrony to apply force to the ground, recover from a stride cycle, and propel the body forward effectively. When executing either frontside or backside mechanics drills, it is essential to keep the pelvis in a neutral position to facilitate proper range of motion and force production .

HELPFUL HINT

Triple flexion includes ankle dorsiflexion, knee flexion, and hip flexion; the lead leg while sprinting. Triple extension includes ankle plantar flexion, knee extension, and hip extension; the rear leg while sprinting.

| **Body Position** | **Comments** |
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| Foot/ankle complex | While sprinting forward, the foot and ankle should be pointing straight ahead in a dorsiflexed position when it hits the ground. Slight deviations (e.g., foot external rotation) are expected during multidirectional running and lateral shuffles. |
| Excessive flattening or external rotation of the foot will create abnormal stress throughout the rest of the body and decrease overall performance. |
| Knee complex | The knees must remain straight ahead. Avoid excessive knee valgus (i.e., knock knees). |
| If the athlete demonstrates excessive adduction and internal rotation of the femur during the stance phase, it decreases force production and may lead to overuse injuries. |

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| Lumbo-pelvic-hip complex (LPHC) | The body should have a slight forward torso lean during acceleration. |
| During maximal velocity, the LPHC should be fairly neutral, without excessive extension or flexion, unless to reach for an object. |
| Head | The head should remain in line with the LPHC, and the LPHC should be in line with the legs. |
| The head should not compensate and jut excessively forward, unless necessary to track an object (such as a ball), as this can affect the position of the LPHC (known as the pelvo-ocular reflex). |

**Agility**

Agility necessitates the ability to start (or accelerate), stop (or decelerate and stabilize), and change direction while maintaining postural control. Agility requires high levels of coordination to be able to maintain one’s centre of gravity over their base of support while changing directions at various speeds. Agility training can enhance deceleration capabilities, dynamic flexibility, postural control, core strength, and proprioception. Proper agility training can also help reduce the risk of injury by enhancing the body’s ability to effectively control eccentric (deceleration) forces in all planes of motion as well as by improving the structural integrity of connective tissue (e.g., tendons and ligaments) during uncontrolled and reactive situations.

**Quickness**

Quickness is the ability to react and change body position with maximal rate of force production, in all planes of motion and from all body positions, during dynamic activities. Quickness involves the ability to assess visual, auditory, or kinesthetic stimuli and to provide the appropriate physical response as fast as possible (such as hitting a baseball, returning a tennis serve, or swerving to avoid a car accident).

HELPFUL HINT

Agility often requires an individual or athlete to react to a stimulus and respond accordingly, such as a basketball player running in various directions to avoid a defender.

Quickness also requires an individual to react to a stimulus; however, the response does not require ambulation (e.g., running or sprinting). An example of this would be a hockey goalkeeper defending against a penalty shot.

**Speed, Agility, and Quickness for nonathletic populations**

Although speed, agility, and quickness training is a widely used and accepted improvement method for sports performance in athletes, components of an SAQ program can also significantly improve the physical health profile of apparently healthy sedentary adults and those with medical or health limitations. Many recreational activities, such as softball, golf, tennis, hiking, running, skiing, and water sports, require a combination of coordination, power, reaction time, and agility. These activities may become more challenging with age or sedentary living, preventing some from enjoying these activities throughout life. By contrast, the increased physical demands of SAQ training can improve athleticism and movement proficiency and aid in injury prevention when applied safely and effectively. In addition, individuals from a variety of populations find SAQ training fun and invigorating while increasing exercise compliance, adherence, and effectiveness.

Unlike the more common steady-state, moderate-intensity cardiovascular forms of exercise (such as treadmill walking) often prescribed for nonathletic populations, SAQ drills require greater integration with a variety of the body’s biologic systems. An individual must be able to accelerate, decelerate, and change direction in response to a variety of both predictable and unpredictable stimuli at a relatively high rate of speed. Thus, SAQ training provides a unique challenge to the biologic systems of nonathletic individuals, facilitating constant responses and adaptation. Such rapid adaptation to SAQ training is critical in the development, maintenance, and improvement of physical function from childhood through a person’s senior years.

Because of the elevated intensity of SAQ protocols, it is essential that fitness professionals perform extensive client assessments examining exercise experience, movement quality, health history, and injury profile before beginning an SAQ training program. Moreover, SAQ training should always follow a comprehensive warm-up protocol. Prior to beginning SAQ training, clients should have a good base of fitness that incorporates flexibility (including mobility in the ankles, hips, and thoracic spine), muscular endurance, cardiovascular endurance, and strength. Establishing a solid base of fitness in these components can help nonathletic populations avoid injury when SAQ training is introduced. Once introduced, SAQ drills should progress from slow and simple to fast and complex over an extended period of time. The initial focus during these exercises should be technique rather than speed to ensure that exercises are performed properly and that a client is adequately prepared for these demands before progressing to speed-focused performance.

**SAQ training programs for youth**

From birth, children are programmed to develop progressively higher neuromuscular capabilities in line with their physical and mental maturation. Much of this development is innate at very early stages; for example, crawling progresses to standing, standing progresses to walking, and walking progresses to running. Once a child has developed basic ambulation, the rate and magnitude at which they progress beyond that point often depend on an external interaction with the environment (Drabik, 1996). To continue developing effectively, the environment must challenge children’s biologic systems; in other words, they must learn how to adapt and apply appropriate movement patterns through external measures.

SAQ training for youth is an effective way of providing a variety of exposures to various physiologic, neuromuscular, and biomechanical demands, resulting in the further development of physical ability. The majority of youth today spend little time, if any, performing generalized, unstructured physical activity (play time) that facilitates the development of SAQ skills. Subsequently, fitness professionals can use play-style activities as a form of SAQ training. SAQ programs for youth have been found to decrease the likelihood of athletic injury, increase the likelihood of exercise participation later in life, and improve physical fitness.

Based on several research studies, young athletes can perform SAQ training one to three times per week with four to eight drills per workout; one to four sets of each drill, with three to five repetitions and 15–60 seconds of rest is appropriate for most younger athletes. Training should start at the lower end of these ranges with a primary focus on exercise technique; over many months, there should be a gradual progression to greater amounts of work with a focus on speed and technique. As with any fitness program, the quantity, frequency, and intensity of SAQ exercises should be appropriate and adjusted accordingly, based on the child’s physical fitness capabilities and maturity level.

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| Frequency/Week | No. of Drills | Sets | Repetitions | Rest Periods |
| 1–3 | 4–8 | 1–4 | 3–5 | 15–60 seconds |

TRAINING TIP

In the beginning stages of training, children should be taught proper exercise technique and be allowed to practice SAQ drills. Once they become accustomed to completing four to five simple exercises once or twice per week, progression to more exercises accomplished two to three times per week can be incorporated over a few months. Shorter rest periods can be included as the child’s fitness improves, if speed and technique are maintained.

Example SAQ drills for youth populations

Red Light, Green Light

1. Participants line up shoulder to shoulder along the base of a designated field, 20 yards (18 meters) long or longer.
2. One participant is chosen as the “stop light” and begins at the opposite end of the field.
3. The stop light turns their back to the other participants and calls “Green light.”
4. On calling green light, the participants all move as quickly as possible toward the stop light.
5. Still with their back to the group, the stop light yells “Red light!” and then immediately turns around.
6. On hearing “red light,” the participants are to stop movement and remain motionless, freezing with perfect stature, form, and control.
7. If the stop light sees anyone move, they call them to start over at the base of the field.
8. This is repeated at arbitrary intervals until a participant is able to reach and touch the stop light.
9. This participant then becomes the new stop light.

Follow the Snake

1. The instructor lays 5 to 10 jump ropes (or one long rope) on the ground in a random S-type pattern.
2. Participants line up on one side of the ropes; keeping a foot on each side of the rope, they follow the pattern of the rope first forward to the end, then backward to the beginning.
3. Participants can be timed to create a competition.

**SAQ training for weight loss**

Interval training in which participants exhibit short, repeated bouts of high-intensity activity has been found to be highly effective in improving a variety of health-related factors. High-intensity, short-duration programs have been found to match (and sometimes surpass) results for functional capacity, muscular power, fat and weight loss, and other metabolic adaptations when compared with moderate-intensity, long-duration exercise protocols, such as jogging. The high-intensity, short bouts of SAQ drills make them a valid choice for interval training modalities with appropriate nonathletic populations. The variety of exercises provided through the incorporation of SAQ training can increase participants’ adherence by making a program fun and engaging. Although athletes use these drills to improve their sport-specific abilities, weight-loss clients can also benefit from the increased exercise intensity and variety of movements, as long as the client is capable of performing the exercise safely and at a high enough intensity throughout an extended workout. This can be done by creating a small circuit of appropriately challenging SAQ exercises.

STRETCH YOUR KNOWLEDGE

High-intensity interval training can burn more subcutaneous fat than long-duration, low- to moderate-intensity endurance training (Trembley et al., 1994; Viana et al., 2019).

When designing SAQ programs for weight loss, the primary focus of the program is to keep heart and respiration rates appropriately elevated to increase caloric expenditure. It is critically important to administer a thorough fitness assessment before beginning an SAQ protocol with a weight-loss client and to maintain appropriate levels of exercise intensities based on the client’s abilities and fitness level. Fitness professionals should gradually introduce SAQ training to avoid excessive impact, muscle soreness, and joint stress, with SAQ exercises included in one to two workouts per week. Technique must be mastered in each exercise used, allowing clients to perform each exercise at a comfortable speed. Gradually, the quantity of exercises can be increased as a client’s fitness improves.

TRAINING TIP

As a weight-loss client’s fitness improves, the volume of SAQ exercises can increase. One strategy is to include SAQ exercises in two to three workouts per week, doing three to four sets of three to five repetitions, and 15 to 60 seconds of rest between repetitions. To maintain or increase a high metabolic demand, less rest is given between repetitions, but use caution to avoid improper execution of an exercise.

**SAQ circuits for weight-loss populations**

Circuit 1

1. Jump rope: 30 seconds (using various foot patterns)
2. Rest for 20 to 60 seconds depending on the client’s ability to maintain intensity.
3. Cone Shuffles: 30 seconds

* Place eight cones in a line about 75 centimetres apart.
* The client lines up facing the line of cones.
* The client lowers their centre of gravity and side shuffles in and out of the cones without hitting them.
* The client first performs this facing forward and then facing backward.
* This is repeated for the duration of the station.
* Other foot patterns can be used as well, such as forward, backward, and stepping over the cones.

1. Rest 20 seconds.
2. Any three ladder drills: 30 seconds (see Agility Ladder Drills)

Circuit 2

1. 5-10-5 Drill: 30 seconds (see 5-10-5 Drill)
2. Rest 20 seconds.
3. Modified Box Drill: 30 seconds (see Modified Box Drill)
4. Rest 20 seconds.
5. Partner Mirror Drill: 30 seconds

* Place two cones 10 yards apart.
* Two clients stand in between the cones, facing one another.
* One partner is designated the leader; the other is designated the mirror.
* Staying in between the cones, the leader moves in a variety of patterns, shuffling, jumping, dropping to the ground, turning around, and so forth.
* The mirror mimics the motion of the leader without falling behind.
* The leader and the mirror switch each time the drill is done.

**SAQ training for older adults**

SAQ training for seniors may help prevent age-related decreases in bone density, coordinative ability, and muscular power. This aids in the prevention of injury and an increase in quality of life. Although some loss of physical function is an inevitability of the aging process, recent research has determined that these losses can be minimized by appropriate exercise interventions. Osteopenia, or loss of bone density and a precursor to osteoporosis, is often related to the aging process, particularly in women. This increases the likelihood for bone fractures and other acute and chronic skeletal disorders, such as osteoporosis. Research has determined that properly administered programs requiring an elevated degree of load on the skeletal system (e.g., weight-bearing exercise), such as those found in SAQ protocols, are safe and effective in slowing and potentially reversing osteopenia in older adults.

STRETCH YOUR KNOWLEDGE

A 10% loss of bone density at the hip can result in a 2.5 times greater risk for hip fracture.

The confidence and ability to sit, stand, bend, twist, and walk are essential in older adult populations to aid in the prevention of falls and maintain daily life activities. The abilities required for safe, effective movement often decline with age primarily because they are underused. To maintain and improve these abilities, it is essential that older populations practice coordinative skills on a regular basis. SAQ-based programs have been found to improve coordination and movement confidence, decreasing the likelihood of falling or other movement-related injuries.

Sarcopenia, or age-related loss of skeletal muscle mass, can be detrimental to maintaining functional capacity in older adults. Resistance training as well as SAQ-based interventions has been found to help slow and reverse this process. Slowing and reversing sarcopenia has particular relevance with interventions requiring increased speed of movement and rate of force production, similar to those found in SAQ protocols.

When designing an SAQ program for older adults, the fitness professional must take special care when ensuring safety for participants. Drills should focus around activities the individuals will need for daily life, such as standing up from a chair and navigating ground obstacles. Fitness professionals should consider the clients’ readiness for SAQ exercise before beginning these drills. Prior to beginning SAQ drills, fitness professionals must ensure that older clients are able to perform common activities of daily living, such as rising from a chair, maintaining balance while walking and maneuvering, comfortably moving up and down stairs, squatting, lunging, and bending. As adults age, visual tracking and vestibular (balance) performance also decrease, increasing the risk of missteps and falls.

While SAQ training can have positive impacts, the risk of falls must be considered prior to introducing SAQ training. A foundation of strength and flexibility is very important to ensure that older clients can safely perform SAQ exercises and gain the value offered by these exercises. A gradual progression over several months, from simple to more complex exercises, is important to allow clients plenty of time to learn different exercises at an appropriately challenging level.

TRAINING TIP

Initially, low volume (i.e., one to two sets of one to two drills) is sufficient to improve fitness among older adults, and progression to more volume should occur slowly, avoiding large increases in volume from one week to the next.

**SAQ drills for seniors**

Varied Size Cone/Hurdle Step-Overs

1. In a line 10 to 15 metres long, place various size cones, hurdles, and other objects about 60 centimetres apart.
2. The client lines up, facing sideways to the line of objects; as they step over each object, they move down the line and then back to the start.
3. The client can be timed.

Stand-Up

1. The client begins seated in a chair.
2. Two cones are placed directly in front of the chair, with the first placed 10 to 15 feet (3 to 4.5 meters) away; the second is placed 20 to 25 feet (6 to 7.6 meters) away, directly behind it.
3. On the instructor’s command, the client stands up from the chair as quickly as possible.
4. As quickly as possible, they move to the left of the first cone, then to the right of the second cone while turning around, to come back to the chair to complete a “figure 8” around the cones.
5. The client then repeats the figure 8 in the opposite direction and finishes by sitting in the chair.
6. The client is timed.

**SAQ drills and programming strategies**

SAQ exercises should be integrated carefully into a client’s overall training program. It should be emphasized that the programming guidelines are only meant to be suggestions and should be gauged on the total volume of training for all components (cardio, core, balance, plyometric, and resistance) in a workout. As the demands for movement speed and reactivity increase, so do the risks of injury. The safety and success of an SAQ program is dependent on the physical capabilities and fitness level of the client. The better a fitness professional can match drills appropriate to a client’s capabilities, the safer and more effective the program will be. All exercises should be performed with precise technique to minimize risk of injury.

| **Client Experience Level** | **SAQ Exercise** | **Sets** | **Reps** | **Rest** |
| --- | --- | --- | --- | --- |
| Beginner | 4–6 drills with limited inertia and unpredictability, such as Cone Shuffles and Agility Ladder Drills | 1–2 | 2–3 | 15–60 seconds |
| Intermediate | 6–8 drills allowing greater horizontal inertia but limited unpredictability, such as 5-10-5, T-Drill, Box Drill, and Stand-Up | 3–4 | 3–5 | 0–60 seconds |
| Advanced | 6–10 drills allowing maximal inertia and unpredictability, such as Modified Box Drill, Partner Mirror Drill, and timed drills | 3–5 | 3–5 | 0–90 seconds |

Modified Box Drill

For this drill, the client begins at the middle cone. The fitness professional then calls out a cone number. The client moves to the appropriate cone and returns to the middle to wait for the fitness professional to call another number.