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Core Training

Features

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Matthew Kutz, PhD ATC, CSCS

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about this PUBLICATION

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Resistance Training Performed on Unstable Surfaces Does Not Increase the Activation of Muscles Contained in the Core.

In recent years, it has become in vogue to target the development of the lumbopelvic and abdominal regions of the body with the use of training activities performed on unstable surfaces. Since there is a paucity of data examining the efficacy of this type of training, researchers from Eastern Illinois University recently examined the muscle activation during resistance exercises performed on stable and unstable surfaces. A total of twelve trained men were recruited to be subjects in a quasi-experimental crossover study where each subject performed four different exercises on either a stable or unstable surface with various intensities. Prior to initiation of the study, all subjects underwent a 5-week familiarization period in which the subjects were familiarized with each condition. The exercises employed in this investigation included the dead lift, back squat, overhead press, and curl. Three different intensities were examined: 50% of one repetition maximum (1-RM) performed on stable ground (50S), 50% of (1-RM) performed on an unstable surface (50US), and 75% of (1-RM) performed on stable ground (75S). Electromyographic (EMG) techniques were utilized to determine the amount of activation for the rectus abdominis, external obliques, transverse abdominis/internal obliques, and erector spinae. There were no differences between the 50S and 50US condition for any muscles assessed. Additionally, there were no differences between the 75S and 50US when examining the external obliques and erector spinae across all lifts examined. The 75S condition resulted in a significantly greater activation of the rectus abdominus and the transverse abdominis/internal obliques during the overhead press when compared to the 50US condition. As a whole, this study revealed that training on an unstable surface offers no core training benefit beyond what is accomplished while training on stable surfaces. This suggests that the use of stable surface training with appropriate loading schemes allows for the training of core musculature without adding unstable surfaces to the training plan. Therefore, it may be recommended to not use unstable surfaces as part of the overall athlete development plan.

Willardson, JM, Fontana, FE, and Bressel, E. Effect of surface stability on core muscle activity for dynamic resistance exercises. *Int J Sports Physiol Perform* 4:97 – 109. 2009.

Does Accumulate Fatigue Result in Alterations in Sprinting Performance that Effect Hamstring Injury Risk in Soccer Players?

Recently, there appears to be an increased occurrence of hamstring injuries in soccer. It appears that these injuries occur during spring movements when fatigue begins to manifest itself. It is postulated that there are changes in running mechanics which occur because of fatigue which increases the risk of hamstring injuries. It appears that this fatigue-induced increase in hamstring injury risk is partially related to a decrease in hamstring eccentric strength. Much of the research examining this phenomenon has not used a fatiguing protocol which is indicative of actual soccer match play. Therefore, the purpose of this investigation was to examine the occurrence of movement mechanics alterations which have been previously linked to increased hamstring injury potential with the use of the SAFT90 protocol. The SAFT90 is a protocol which has been designed to model the types of movements and physiological strain encountered by soccer players during a 90-minute game. Briefly, the SAFT90 incorporates 1,269 changes in speed and 1,350 changes in direction which are accomplished by running backwards, side-stepping, and sprinting forward. Changes in speed are also stimulated via audio feedback. In order to evaluate the effects of fatigue on running mechanics, nine semi-professional soccer players were recruited for this investigation. All subjects performed a standardized warm-up which included five minutes of cycling, five minutes of static stretching, and five minutes of jogging. The SAFT90 protocol was divided into two 45-minute bouts separated by a 15-minute rest period in order to better model a soccer game. Maximal 10-meter sprints were performed at 0, 15, 30, 45, 46, 60, 75 and 90 minutes during the SAFT90. Kinematic data was collected on one complete stride for the dominant leg during all of the sprints. Results of the study suggest that maximum knee extension angle decreases as fatigue increases, which may be indicative of the ham-

string not being able to limit forward motion as it becomes fatigued. This effect may be magnified by an increase in lower limb segment velocity which occurred toward the end of each half of the SAFT90 protocol. Taken collectively these two occurrences could partially explain an increased occurrence of hamstring injuries when fatigue accumulates. From a performance perspective, as fatigue accumulated, sprinting performance was also impaired. Overall, this study begins to explain some of the reasons for hamstring injuries that occur during soccer matches. This information highlights the importance of properly strengthening the hamstring muscles with exercise that apply an eccentric load, and the need for soccer-specific conditioning which models the change of speed and directions typically seen in a game.

Small, K, McNaughton, LR, Greig, M, Lohkamp, M and Lovell, R. Soccer Fatigue, Sprinting and Hamstring Injury Risk. *Int J Sports Med* 30:573 – 578. 2009.

The Partial Curl-up and Sit-up Produce the Highest or Equal Abdominal Muscle Activation.

The development of the trunk and spine muscles appears to be important for the reduction of lower back pain and the improvement of athletic performance. There are numerous exercise recommendations that are used to train these muscles. Generally, these exercises are modifications of the sit-up or curl-up exercises. For example, during the sit-up, the feet can be fixed or unfixed and the knee angle used during the exercise can range between full extension and a bent 90° knee angle. Little data exists to differentiate which modifications to these exercises results in the highest muscle activation. Therefore, the purpose of this investigation was to explore the electromyographic (EMG) activity of variations of trunk flexion positions (sit-up or curl-up) including the protocol used by the Canadian Society of Exercise Physiology Health and Fitness Program. EMG data was collected from the upper rectus abdominis (URA), lower rectus abdominis (LRA), external obliques (EO), lower abdominal stabilizers (LAS), rectus femoris (RF), and the biceps femoris (BF) of 14 subjects. Three different sit-up positions were randomly ordered via three variables: the distance the hand traveled along the floor (5, 10, 15 cm), bent or extended knee, and fixed or unfixed feet. When examining the distance that the hands moved, it was determined that 10cm resulted in the greatest activation of the LRA, while 5cm displacement resulted in the lowest RF activation. Additionally, the 15cm distance resulted in the lowest activation of the URA. When examining the knee position it was determined that there were no differences in EMG activation of the muscles evaluated during the bent-knee and extended leg sit-up. Fixing the foot was determined to result in lower overall EMG activation for all of the muscles analyzed in the present study. Overall, it was determined that the highest EMG activity was determined for the partial curl-up and the sit-up. This data is important as it gives insight into the effects of slight changes to the curl-up and sit-up exercises on muscle activation patterns.

Parfrey, KC, Docherty, D, Workman, RC, and Behm, DG. The effects of different sit-up and curl-up positions on activation of abdominal and hip flexor musculature. *Appl Physiol Nutr Metab* 33:888 – 895. 2008.

Strength Training Combined with Plyometric Training Improves Kicking Performance in Soccer

The ability to kick the ball effectively is an important contributor for success in soccer. It is well established that resistance training results in an increased ability to generate force. Several studies have examined the effects of a resistance training regimen on kicking performance in soccer. All of these studies suggest that resistance training has the potential to improve kicking performance which should contribute to an overall improvement in match play. The present study expanded upon these findings by combining resistance training and plyometric training. Thirty-eight subjects were divided into two groups: a control group (CG n = 21) and the training group (TG n= 16). The 6-week resistance training program required subjects to train three days per week (Monday, Wednesday, and Friday). Resistance training consisted of the bilateral inclined leg press, leg extension, half squat, and leg curl. The intensity and volume was altered throughout the training plan. This group also performed plyometric training which consisted of depth jumps and hurdle hops on these training days. After the six weeks of training, muscular strength was significantly increased in all of the exercises trained (+15.9 – 61.4%). Vertical jump performance, as indicated by vertical displacement, instantaneous vertical velocity and maximal power output, was significantly increased in response to the training intervention. Kicking performance was also improved in response to the training intervention. Based upon these findings, it was concluded that the combination of resistance and plyometric training results in improvements in markers of kicking performance as well as other performance characteristics associated with success in soccer. ■

Perez-Gomez, J, Olmedillas, H, S Delgado-Guerra, S, Ara, I, Vicente-Rodriguez, G, Ortiz, RA, Chavarren, J and Calbet, JA. Effects of weight lifting training combined with plyometric exercises on physical fitness, body composition, and knee extension velocity during kicking in football. *Appl Physiol Nutr Metab* 33:501 – 510. 2008.

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Touch Your Core With Light Load/High Velocity Resistance Training

One of the hottest fitness trends in the last decade has been core stability training. Unfortunately, this trend has led many athletes, as well as personal trainers, to move away from training major muscle groups and instead design entire workout programs around core training. Yet, as new research suggests, core strength does not significantly contribute to overall strength and power and shouldn't be the main focus of a workout program (1). Many bodybuilders do not even do isolation movements for their core as they are aware of the fact that in nearly every standing resistance training exercise, the core must stabilize. Yet, while developing a strong core is important for increasing athletic performance, reducing likelihood of injury, and reducing existing pain levels, a strong core can be developed by stabilizing while simultaneously training your major muscle groups. A unique way to torch your core is with light load/high velocity resistance training, as you are able to train with high intensity at a sprinter's pace.

A core stability exercise can be defined as "any exercise that channels motor patterns to ensure a stable spine through repetition" (2). Therefore, for example, squats, pull-ups, and standing overhead presses are all core stability exercises as they all require the core to stabilize. If your goal is to develop core strength and power while training major muscle groups, training at a high velocity can challenge your core. These explosive movements are very fast-paced, intense, high-energy, anaerobic movements that require a lot of muscle groups to fire simultaneously. This type of training allows the athlete to rapidly accelerate and achieve maximum velocity on every repetition. Moreover, the power output in a short amount of time is astounding. For example, if an athlete is able to do 25 repetitions with 40lbs cable presses in each hand (80 pounds total) in 20 seconds, that is 2,000lbs of power output in 20 seconds.

Rather than focus on how many repetitions to perform, instead focus on completing the maximum number of repetitions within a given time frame with high intensity and proper form. I cannot stress enough the importance of maintaining proper biomechanics while training at high velocity, as it will not only prevent injury, it will also effectively engage the proper muscles and lead to a more challenging workout. Too many times athletes, as well as trainers, sacrifice proper form for speed.

To increase core activation, perform these exercises in a less stable environment. Marshall and Murphy compared muscle activity in the rectus abdominis, transversus/internal oblique abdominis, external oblique abdominis, and erector spinae when push-ups were performed on a Swiss ball versus a stable floor. The results demonstrated that at the top portion of the push-up, with the hands positioned on a Swiss ball, there was significantly greater activity in the rectus abdominis (35% vs. 9% of maximal activity) and transversus/internal oblique abdominis (33% vs. 13% of maximal activity) (3). ■

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Table 1. Sample Low Resistance/High Velocity Workout

Movement	Sets	Time
Alternating Power lunges into cable standing chest fly	3	30 seconds
Squat Rows	3	30 seconds
Medicine Ball Squat Presses	3	30 seconds
Cable Standing Punches Staggered stance	3	30 seconds
Cable Squats into Curls	3	30 seconds
Medicine Ball Overhead Throws	3	30 seconds
Resistance Ball Cable Chest Press	3	30 seconds

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Watch Your Bodymechanics

Greg Frounfelter, DPT, SCS, LAT, CSCS

As a student, I can remember sitting in a kinesiology class where we were learning about the facet joints of the spine. The instructor made a comment about how these were not designed to be weight-bearing joints, but rather they were designed to allow motion between the different individual vertebral levels. He went on to say how they were often used to bear weight in "chronic lifters" and often became arthritic and painful. The term "chronic lifter" is the phrase that really struck me. What is a chronic lifter? Is it a competitive lifter, a laborer, or is it a recreational fitness individual/athlete? The answer is a resounding, yes. Regardless of your activity, proper mechanical loading of the body's tissues can help prevent injury.

Look to industrial medicine and ergonomics to see how they attempt to use proper body segment positioning to minimize strain on the body and thus prevent injury (1 – 3); such injuries are often called cumulative trauma injuries (1 – 3). This is also true with weight training. Anyone in the strength and conditioning industry knows that if you exercise with faulty mechanical loading, a.k.a. bad technique, it is only a matter of time before you get injured. However, injury does not only occur while performing training lifts/exercises, it occurs as a result of twisting and reaching to pick up a water bottle, loading a plate onto a bar/weight racks, or any number of other mechanisms. It is important to use good body mechanics in the gym when carrying plates and loading/unloading them to and from bars and racks, not just while performing the training lifts themselves. This adoption of proper body alignment is an important life skill that will serve you well long after your athletic career is over. My own experience of transitioning from a competitive lifter to physical therapist is a perfect example of how these skills can transfer over to other parts of our lives. I may not do deadlifts or squats, as I did as a competitive powerlifter, but the techniques for these lifts promote proper body mechanics that I need to use when I transfer and work with patients as a physical therapist.

In regard to ergonomics (or the study of how the human body fits and functions within its environment), there are several risk factors for injury, of which one should be aware. They are excessive forces, awkward positions, static postures, contact stress, vibration, and cold temperatures (1,4). This is a pretty exhaustive list, but in terms of body mechanics in the training facility, we will consider forces and awkward positions.

Force: In terms of injury prevention, the weight of objects lifted is often used synonymously with force. This can be for one or multiple repetitions. In either event, excessive force exertion can increase one's risk of injury.

Awkward Positions: Positions that place the body in extreme ranges of motion, especially when coupled with excessive forces, such as stooping forward and bending at the lower back can be a recipe for disaster.

Let us look at some common examples. I can think of power cages in a facility that have weight storage racks that are too close together and require you to bend and twist around adjacent racks in order to load and unload weights to and from the bar. This leads to a significant amount of awkward, unbalanced reaching that can potentially harm joints and muscles. I have also seen similar circumstances around the bench press areas and dumbbell racks.

Certain plate-loaded machines also have these problems by forcing you to load and unload weights by reaching into and out of the machines. Classic examples of this are certain 45 degree leg press machines and vertically-loaded lat bar machines. These scenarios demonstrate faulty body mechanics that can cause injury, and that is before you even get to the issues of proper exercise technique. I cringe at how many times I have seen young lifters doing deadlifts and cleans with proper technique, only to see them bend forward at the waist while they load and unload the bars. If only they would transfer the mechanics they learned in their lifting technique, to more common tasks.

Often facility design and equipment arrangement can help us promote better body mechanics, but use of body mechanics to prevent injury is a personal choice. Here is

list of personal protection strategies to prevent injuries (1,2,5):

- Test how heavy something is prior to lifting it; ask for help if you think you need it.
- Use a good lifting stance with firm footing.
- Bend your knees and hip hinge.
- Brace your midsection and use your legs as the prime movers, not your back.
- Keep the load close to your body.
- Stay upright, not slouched.
- Keep your arms short and squat at the legs.
- Avoid end-range positions, especially with your wrists, shoulders, and back.

The first two items are fairly self-explanatory. The third point of bend your knees and hip hinge relates to squatting properly, such as when picking up a weight off of the ground or another low position. A basic coaching point is to "stick out your butt as you go down; the knees will take care of themselves." The forth point brings out the idea of using your midsection to keep the spine in proper lifting position. It also lends to the 6th item, stay upright, not slouched. A common coaching point to this is "show off the chest" to keep the lumbar spine in a neutral position. This is not only an advantage in squatting but also in loading plates on a bar, or lifting them in general, at various heights.

The points of keep the load close to your body and keep your arms short and squat helps prevent loading ourselves in a way that produces long lever arms and increased torque on our bodies (2, 5). "Keep the bar close to you as you pull," and "carry the load close to you" are often heard reminders. This not only is for protecting the back, but saving the shoulders as well as when you grab and place various weights at different heights. For example, by keeping your elbows close to you as you load or unload weights, you will experience less torque in terms of the rotator cuff being loaded. By "keeping your arms short" you can increase the mechanical advantage of your spine and shoulders (3) as you perform the needed preparatory activities that surround exercises of your workout such as loading/unloading bars or machines, or carrying weights to and from storage racks (3). Also, avoiding end-range positions is a critical task. If you load a joint in an extreme end-range position, such as behind your back, increased torque and load on that joint can result in injury (3). Our bodies, in terms of our joints, are strongest at the mid-range positions (3). Using this helps reduce injury.

We train to meet our goals. Becoming injured is not one of them. Mechanical strain can and does cause injury. This phenomenon is a consequence of repeated mechanical loading patterns that occur over thousands of repetitions. This is not limited to performing training exercises, but also the set up and tearing down for these same exercises such as loading and unloading weight equipment. By utilizing proper body mechanics at all times, during training in the facility or in all other aspects of our lives for that matter, one can control risk factors for injury and maintain musculoskeletal health. ■

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Evidence for Core Training: What Works and for Who?

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Core training comes in all shapes, sizes and ranges from the traditional sit-up, to the insane and eccentric. Much of core training has evolved into what has been called stability training or functional training. Some have claimed that much of what core training has evolved into falls short of "functional." That is, if functional is intended to mimic or simulate sport/competition-like conditions. For example, there are not many athletes who complete or practice on surfaces that are round and unstable. On the other hand, it is as equally unfair to relegate "functional" to mean only those activities which mimic the exact conditions of a given sport. That being said, core (including functional or stability) training is an integral piece to all performance enhancement programs. The purpose of this article is twofold; 1) review and critique the evidence for core training, and 2) raise thought-provoking questions for future research on core training.

Master builders have long proclaimed that, "form follows function." This is also true when building athletes. When "building" athletes it is important to keep this axiom in the forefront of our minds by asking, "what demands are being placed on my athletes?" When considering this question, the idea of functional can be extrapolated to be more than just mimicking the mechanics of a movement or skill. Although that is an aspect of function, mechanical movements and skills are only one aspect of function. Function can have many meanings within the context of sport performance—enter the concept of core training. Core training is closely related to functional training (although not synonymous) and a strong core is fundamental to function. An athlete who has core strength, or stability, can change directions more efficiently, has a greater capacity to accelerate and decelerate, has less "disruptions" in the transfer or dissipation of power through the kinetic chain, and among other things, can better manage stress to the lower back.

Just about every activity in our "non-athletic" daily routines requires core strength and stability in some form—and I am sure that every sport, activity or performance requires core strength. However, that is not to say that to be successful in sports, every athlete should be able to do 1,000 hanging crunches while squeezing a medicine ball between their knees or balance squat on a stability ball. In other words, core training is not exempt from thoughtful critique. When taking an evidence-based approach to core training, it is important to ask, "is there a threshold? Or, at what point is sufficient core strength achieved?" In other words, if core strength is a prerequisite for high performance is there an "extra" benefit for an athlete who can do 1,001 perfect crunches compared to an athlete who can only do 1,000? However, is core strength even a prerequisite to high performance? Maybe we should ask Babe Ruth.

Core training has become a fixture in performance and fitness programming. First popularized in the 1980s by the San Francisco Spine Institute (3), core training has evolved to be a cure-all for all manners of performance and health deficits. Reports have been made that core training has had a positive performance impact on just about anything that can be associated with activity or sports, from a golfer's club head speed to 40-yard dash times. These claims (not all unfounded) have spurred a lot of interest in core training and even more in core training gadgets. Core training has been adopted by a very diverse population of users ranging from elite athletes to out-of-shape and overweight couch potatoes (3). Ironically, much of the "evidence" used to promote core training was performed on a non-athletic population (7). This can be a serious threat to external validity. Much of what is being touted as benefits of core training has not been validated for elite athletes. One should not assume that core training with a stability ball will have the same, or even similar, outcome for an elite athlete as it would on a part-time recreational one. For example, Stanton et al. (5) did not find a greater or more significant improvement in running economy or

running posture of a stability ball-trained group over that of the control group. Furthermore, core stability has yet to be directly correlated with higher performance. That is to say, no one knows for sure if there is a linear correlation with improved core strength to sports performance (or even more relevant if core strength is correlated to more "W's" in the win column). Several studies have been conducted that have not shown a significant difference in performance as a result of core training as compared to other forms and types of training in competitive athletes (7). However, core training does appear to contribute to improvements in performance measures of sedentary or recreational athletes (1,2,6,8) and has been shown to increase lactate clearance following intense exercise in a mixed population (4).

In hindsight, these findings (and others like them) should be expected. Non-elite, or recreational athletes, have historically responded better to any training intervention, given that they are further away from the performance ideal. Well-trained athletes are very near, or even often transcend that ideal and therefore have less of a margin for improvement. This phenomenon seems to be the case with core training as well. The cursory review of the evidence seems to be that core training does not have as dramatic an impact on the trained athlete's performance when compared to recreational athlete's improvements, as a result of core training.

None of this is to say that core training is not valuable. On the contrary, it is, as I already stated, "integral to responsible training." However, it is important to ask, "how are we measuring core training and what standards are we using?" If the only benefits (or most significant benefits) are primarily shown in sedentary populations, are we even asking the right questions? Furthermore, are the performance measurements we use to justify core training correlated to measures of sports success (i.e., greater salaries, longer contracts, less injuries, more wins, more scholarship offers, etc.)? Food for thought.

When critiquing the evidence, it is important to operationally define and differentiate core training from its close relatives. In essence, core training focuses on the muscles of the core (Table 1) and can be isolated or trained as groups; as opposed to functional training, which tends to focus on movement and movement patterns, regardless of the specific muscles involved. That being said, it is still difficult to differentiate core and function.

Core training has taken on many forms throughout its evolution. Just about any activity that utilizes core muscles in isolation, or in groups, can be considered core training (although it is certainly more "functional" to create ways to use them in groups). Equally as diverse is the equipment used for core training which includes medicine balls, kettlebells, stability balls, balance boards, wobble boards, dumbbells, or no equipment at all—this is by no means an exhaustive list. Core training can also be performed in any number of positions, from inverted hanging to prone quadruped. In essence core training is only limited to the imagination of the fitness professional designing the program. Basically, anything that calls for the simultaneous or sequential activation of core muscles, preferably at sport-specific velocities, can be core training, even it if does not come close to replicating a specific sport's typical movement patterns.

When it is all said and done, it is important to ask the right questions and to responsibly critique the evidence and substantiate claims being made without stifling creativity. Patients, clients and athletes require greater core strength for a variety of different reasons. Those reasons include rehabilitation for daily functions (i.e., ADL's), rehabilitation for return to competitive sports, fitness training for balance and posture, strength training for competitive advantage, and needing something to do during a cool down. Whatever the reason, it is important to ask the right questions for why we are doing something.

When beginning a core training program, I recommend considering the following questions:

- How much core strength is enough?
- What is the most efficient (and safest) way to integrate core strength and function?
- How will these exercises promote the goal of the participant?
- Are new or experimental core exercises warranted? (if so why)
- Is the goal to reach a predetermined standard of participation or function (i.e., in rehabilitation, reconditioning, for proper ADL's) or is it to gain a competitive advantage?
- What is the outcome that is hoped for and how will I measure it?

Core training can be adapted to meet the needs of all these individuals but it is important to evaluate the evidence before wholesale adaptation. The reality is core strength (and not core "training") is a significant contributor to function, coordination, balance, and injury prevention. The best way to achieve core strength will vary between the population as well as the reasons for needing core strength. ■

Table 1.

Common Core Muscles	Action
Rectus Abdominis	Flexes the spine (lumbar vertebrae)
Transversus abdominis	Compress the ribs and viscera, providing thoracic and pelvic stability
Quadratus lumborum	Unilateral: lateral flexion of vertebral column; Bilateral: depression of thoracic rib cage
Gluteus maximus	Powerful extensor of hip; laterally rotates thigh; upper fibers aid in abduction of thigh; fibers of IT band stabilize at knee extension
Gluteus medius	Anterior and lateral fibers abduct and medially rotate the thigh; posterior fibers laterally rotate thigh; stabilizes the pelvis and prevents free limb from sagging during gait
Illiopsoas	powerful hip flexion; lateral rotation
Erector Spinae group	Bilateral: extension of vertebral column; maintenance of erect posture; stabilization of vertebral column during flexion, acting in contrast to abdominal muscles and the action of gravity. Unilateral: lateral bend to same side; rotation to same side; opposite muscles contract eccentrically for stabilization
Multifidus	Bilateral: extends vertebral column; controls lateral flexion to side opposite contraction (eccentric for stability); Unilateral: rotates vertebral column to opposite side
Piriformis	Lateral rotation of extended thigh; abducts a flexed thigh
Tensor fascia lata	Hip flexion; medially rotate and abduct a flexed thigh; tenses IT band to support femur on the tibia during standing
Rectus femoris	Extends knee; flexes hip
Pectineus	Flexes hip; adducts thigh; medially rotates thigh
Sartorius	Flexes hip and knee; laterally rotates thigh when flexed at the hip

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Sugar and Athletes

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While Americans typically fear the word sugar, most athletes have come to terms with the fact that sugar is another word for "glucose" and thus understand that this is what fuels their workouts. In direct contrast, we know that most Americans take in too much sugar on a daily basis which can contribute to obesity and being overweight. So what does the healthy athlete need to know and do in order to stay healthy while maximizing performance?

The Acceptable Macronutrient Distribution Range (AMDR) for carbohydrates is 45 to 65 percent of total calories (3). As you know, carbohydrates exist in both complex and simple forms. Sugar, a simple form of carbohydrates can be found naturally in foods (such as the fructose in fruit or the lactose in milk) or added to the food. Added sugars, also known as caloric sweeteners, are sugars and syrups that are added to foods at the table or during processing or preparation (such as high-fructose corn syrup in sweetened beverages and baked products). See table 1 for ways to identify added sugars on your food label. The body's response to sugars does not depend on whether they are naturally present or added to the food—added sugars supply calories, but few or no nutrients (6).

According to the Dietary Reference Intake (DRI) Report from the Institute of Medicine (IOM), "the maximal intake of added sugars (should) be limited to providing no more than 25% of total energy (2)." That is 500 calories (30 teaspoons or 10 tablespoons) for someone on a 2,000 calorie diet and 1,000 (60 teaspoons or 20 tablespoons) calories for an athlete on a 4,000 calorie plan. You do not need to be a registered dietitian to know that one quarter of your intake adds up to a lot of sugar.

Other organizations are taking notice and agree with this assessment. A recent report from the American Heart Association suggests that individuals follow a prudent upper limit of intake of half of the discretionary calorie allowance (4). See table 2 for a definition of discretionary calorie allowance. Basically, the new guidelines recommend that women should eat no more than 100 calories of added processed sugar per day, or six teaspoons (25 grams), while most men should keep it to just 150 calories, or nine teaspoons (37.5 grams).

Americans need to cut back dramatically on sugar consumption, the AHA stated. Their new guidelines are far below the 22 teaspoons (90 grams) or 355 calories of added sugar consumed by the average American each day, according to a 2004 government survey (4).

How Does This Fit Into Athletes' Guidelines?

Research on performance shows that an athlete likely needs carbohydrates to compose 55 – 65% of their total calorie intake (1). Taking into account these newer limits on simple sugars, an athlete should continue to consume adequate carbohydrate calories during exercise as the guidelines recommend 0.8 – 1.0 grams of carbohydrates per minute, or approximately 25 – 30 grams every half hour (5) and be sure the rest of your training diet contains limited amounts of added sugars.

Locating Sugars On Labels

Reading the ingredient label on processed foods can help to identify added sugars. Names for added sugars on food labels include:

agave	honey
brown sugar	invert sugar
corn sweetener	lactose
corn syrup	maltose
dextrose	malt syrup
fructose	molasses
fruit juice concentrates	raw sugar
glucose	sucrose
high-fructose corn syrup	sugar
	syrup

Adapted from http://www.mypyramid.gov/pyramid/discretionary_calories_sugars_print.html, accessed 9/15/09.

Discretionary Calorie Allowance

Each person has an allowance for some discretionary calories. But, many people have used up this allowance before lunchtime. Most discretionary calorie allowances are very small, between 100 and 300 calories, especially for those who are not physically active. For many people, the discretionary calorie allowance is totally used by the foods they choose in each food group, such as meats with higher fat content, cheeses, whole milk, or sweetened bakery products.

Source: http://www.mypyramid.gov/pyramid/discretionary_calories.html, accessed 9/15/09. ■

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Exercise to Reduce the Risk of a Groin Strain Injury

about the **AUTHOR**

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A groin strain may cause an athlete significant pain and disability, possibly requiring a lengthy course of rehabilitation (1). The incidence of groin strains is high in sports like ice hockey, swimming, American football, Australian Rules football, and soccer (2 – 4,6). The primary muscles involved in a groin strain are the "adductors", a collection of six muscles in the inner thigh (table 1). They function to adduct the leg (move the leg toward or across the midline of the body) in positions that are not weight-bearing and decelerate the leg during movements that are weight-bearing.

The Adductor Muscle Group

- Adductor Longus
- Adductor Brevis
- Adductor Magnus
- Pectineus
- Gracilis
- Obturator Externus

Risk Factors

Poor flexibility, dysfunctional hip strength, and/or a previous history of an adductor muscle strain have been reported as potential risk factors for athletes who experience a hip adductor muscle strain (4,6,7). An adductor strain occurs when the tension generated in the adductors exceeds the failure tolerance of the tissues. Pushing off or attempting to accelerate during ice skating are examples of an adductor strain injury mechanism. A swimmer may strain the adductors due to the repetitive adduction that is performed during the terminal portion of the breaststroke leg kick (2).

Preventing Hip Adductor Strain Injuries

Sports medicine professionals have successfully reduced the risk of injury in professional hockey players by having them perform specific exercises to strengthen the adductors (8). If one competes in one of the high risk sports, the following exercises should be added into his/her training program.

Side-lying Hip Adduction

The side-lying hip adduction is a good starting point for most individuals. Position oneself in a side-lying position with the top leg situated behind the body (figure 1). Adduct (lift) the lower leg 5 – 6 inches off of the surface. Hold for a count followed by returning the leg to the resting position. Perform 2 – 3 sets of 20 – 25 repetitions. Add ankles weights as tolerated over time.

Sumo Squat

To perform the sumo squat, externally rotate one's legs assuming the "sumo" position (figure 2). Perform 2 – 3 sets of 8 – 12 repetitions. Increase the challenge of this exercise by holding dumbbells.

Sagittal Plane Hip Extension Using a Slider Board or Fitter

Stand with one leg positioned on either a slider board (figure 3) or on a fitter (figure 4). Position yourself so that you can extend your leg backwards at a 45 degree angle. Using the slide board, or the fitter, will reproduce the functional movement pattern that has been associated with injury. Perform 3 sets of 15 – 25 repetitions bilaterally. ■

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Figure 1. Side-lying Hip Adduction

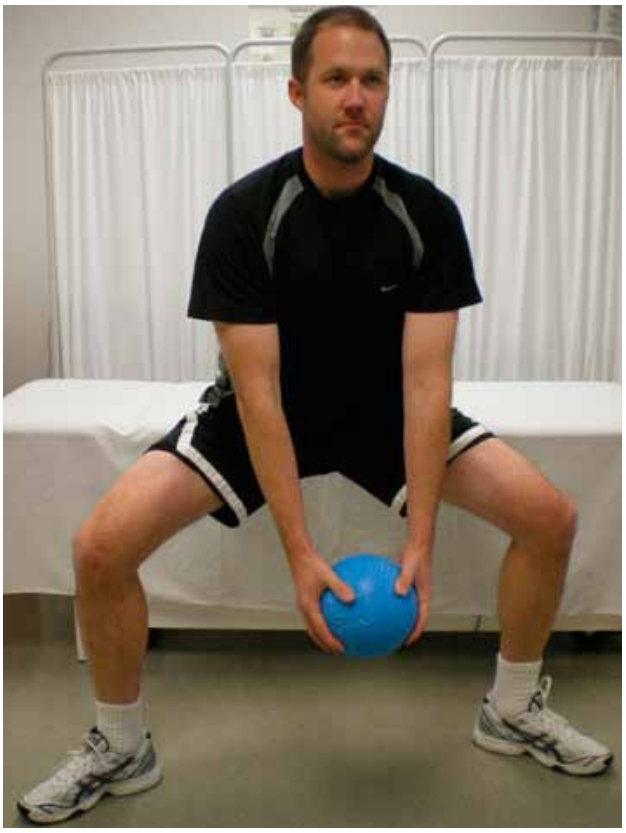

Figure 2. Sumo Squat

Figure 3. Sagittal Plane Hip Extension with a Slider Board

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Suzie Tuffey Riewald, PhD, NSCA-CPT

"Help—I'm Nervous"

about the AUTHOR

Suzie Tuffey Riewald received her degrees in Sport Psychology/ Exercise Science from the University of North Carolina —Greensboro. She has worked for USA Swimming as the Sport Psychology and Sport Science Director, and most recently as the Associate Director of Coaching with the USOC where she worked with various sport national governing bodies (NGBs) to develop and enhance coaching education and training. Suzie currently works as a sport psychology consultant to several NGBs.

"Setting goals, imagery, and concentration are all mental skills that have been discussed in the most recent Mind Games columns. These have all been beneficial skills, and I have been using them to manage and enhance my practice and competition performance. But, when are we going to learn about nervousness? Sometimes, I get so anxious at a competition that it gets in the way of my performing well. Please help me."

These reflections may sound familiar to many of you. Feelings of nervousness—things like sweaty palms, racing heart, jitteriness, tight muscles (somatic or bodily anxiety symptoms), doubts, worry and difficulty concentrating (cognitive anxiety symptoms)—are a common experiences for many athletes, especially before and during competition. Furthermore, at times (and I want to be sure to emphasize this), this nervousness can have an adverse effect on performance. What are you to do?

Change Your Perspective (Interpretation)

When anxiety was discussed above, it was emphasized that at times, anxiety can hurt performance, but not all the time. Unfortunately, it is often the case that when an athlete experiences anxiety, or nervousness before a competition, he or she automatically thinks, "oh no, I am nervous—this isn't good. Things are going to end badly." Being nervous should not necessarily be an "oh no experience" as anxiety does not always hurt performance. In fact, various theories put forth to help us understand the relationship between anxiety and performance suggest that anxiety can actually help performance—up to a point. Think about it from a practical perspective. Have you not found that sometimes a little worry or jitteriness gets you primed to compete? Of course you have. For example, the increased arousal before competition can elevate your heart rate and raise your body temperature, helping prime the body's physiological systems. So, be cautious of mentally "tagging" any nervousness you experience as detrimental and something you need to get rid of. Instead, be aware of what you are experiencing and change your perspective regarding anxiety and its role on performance. See anxiety as something that can help performance, but take appropriate steps to keep it in check.

Determine Optimal Anxiety Levels For You

If some anxiety seems to facilitate performance, but experience (and research) tells us too much anxiety hurts performance, what are you supposed to do? How much nervousness is right? The answer depends on you. That is, optimal anxiety tends to be individualized; some athletes perform best with low anxiety, others with moderate anxiety and still others with higher anxiety levels. Think back on past competitive experiences to begin to sort out what is best for you. Prior to your better performances, how nervous or anxious were you? What specifically were you thinking and feeling? Reflect back on poorer performances to give you a means of comparison. Most athletes will see a pattern emerge that links certain levels of nervousness to better performances. Now, think about trying to attain this identified level of anxiety as opposed to thinking "oh no" when experiencing pre-competition anxiety.

Learn, practice and implement anxiety management skills. Note that the skills to manage anxiety can be basic and easy to understand, but they are hard to implement effectively when needed most. That is why we still witness elite-level athletes tensing up and double faulting on critical points in tennis, or missing free throws and making critical errors during a basketball game. If you are more plagued by the physical (somatic) manifestations of anxiety, your pre-competition goals should focus on calming your body using such skills as stretching, moving around, so as not to get tight, light massage or deep, controlled breathing. When mental (cognitive) anxiety tends to be excessive, your goal should be to calm the mind—effective skills include using positive self-talk, focusing on process goals (as opposed to outcome goals), distracting oneself so as not to think about being worried and reminding oneself of past successes to build confidence. Another important note is that these skills must be practiced. Practice them during training sessions by setting up situations that will

elevate your anxiety and present an opportunity to practice your anxiety management skills.

Understanding Underlying Causes of Excessive Anxiety

While it is important to have skills to manage anxiety (increase or decrease as needed), it is equally important to identify the "whys" behind anxiety. Why are you more nervous today than you were before the game last week? Research indicates that the greater the importance you place on an event, the more elevated your anxiety will become. That is why you will typically feel greater anxiety before the state championship meet than you will before a seemingly meaningless inter-squad competition. Additionally, the greater the uncertainty surrounding the event, the more elevated your anxiety will be. You are probably thinking, "of course there is uncertainty. Isn't that the nature of competition— that there is uncertainty about who is going to win?" Yes, but you might be able to moderate this uncertainty. You need to recognize that while the outcome of an event is uncertain, is it also, to a large extent, typically out of your control. So, having a sole focus on the outcome (i.e., winning), as opposed to focusing on the things you can do to perform at your best, is probably going to increase anxiety. Therefore, to manage pre-competition anxiety, it may be beneficial to focus on the controllable aspects of performance—that is, to focus on what you need to do to perform well. For example, a tennis player preparing for a quarterfinals match would focus on good footwork, playing aggressively and hitting deep into his opponent's backhand, instead of focusing on reaching the semifinals. This player is more focused on controlling of his own ability—moving well, being aggressive and hitting deep balls—than on who will win.

Now, do your best to keep your nerves in perspective and under control. ■