



# GETTING THE ANSWERS TO YOUR CORE QUESTIONS

RESEARCH FROM THE SCIENTIFIC ADVISORY PANEL

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Core training, which focuses on strengthening the anterior abdominal muscles as well as multiple muscles from the shoulders to the hips, is essential for improving overall stability and mobility for people of every age. Core exercises are also commonly implemented in both sport and rehabilitation programs to maximize strength, improve endurance and reduce injury.

The core is involved in every movement, either by initiating or transferring force. As such, the U.S. Department of Health & Human Services recommends that healthy adults under 65 years of age complete a strength-training routine that includes core exercises twice a week, specifically advocating core training as a means to improve stability and maintain mobility.

Health and fitness professionals have a wide range of options when developing core-strengthening programs for their clients, including popular workout programs such as Pilates, yoga and TRX. Additionally, numerous core exercises can be completed without equipment and with minimal space requirements. Whereas isolation core exercises elicit activation of the proximal trunk muscles (abdominal, oblique and lumbar), integration exercises that require activation of the shoulder and hip musculature are more effective for maximizing strength, improving endurance, enhancing stability, reducing injury and maintaining mobility.



*Core exercises are also commonly implemented in both sport and rehabilitation programs in order to maximize strength, improve endurance and reduce injury.*

## KEY POINTS

- The core is made up of not only the anterior abdominal muscles, but also includes multiple muscles from the shoulders to the hips.
- The core muscles are continually active in simple activities of daily living such as sitting, standing, walking and reaching.
- Core training will help exercisers build strength, improve stability, maintain mobility, breathe deeply and reduce injury.
- There are numerous core exercises that can be completed without equipment and with minimal space requirements.
- Isolation exercises are simple, single-joint movements that primarily elicit activity from a single muscle.
- Integration exercises are complex, multi-joint movements that elicit greater activity from a broad range of muscle groups.

## CORE RECOMMENDATIONS

The U.S. Department of Health & Human Services recommends that healthy adults under 65 years of age complete a strength-training routine that includes core exercises twice a week, specifically advocating core training as a means to improve stability and maintain mobility.<sup>1</sup> Core exercises are also commonly implemented in both sport and rehabilitation programs in order to maximize strength, improve endurance and reduce injury.

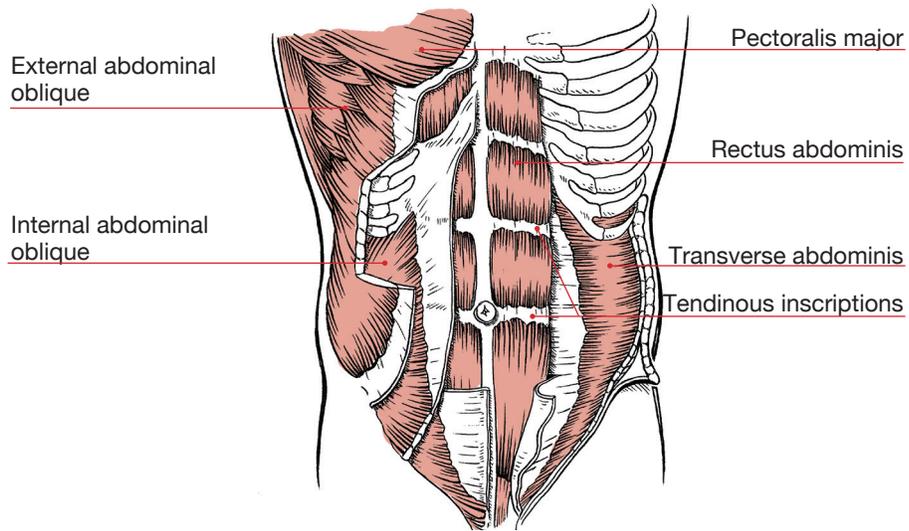
## CORE QUESTIONS

### *What is the core?*

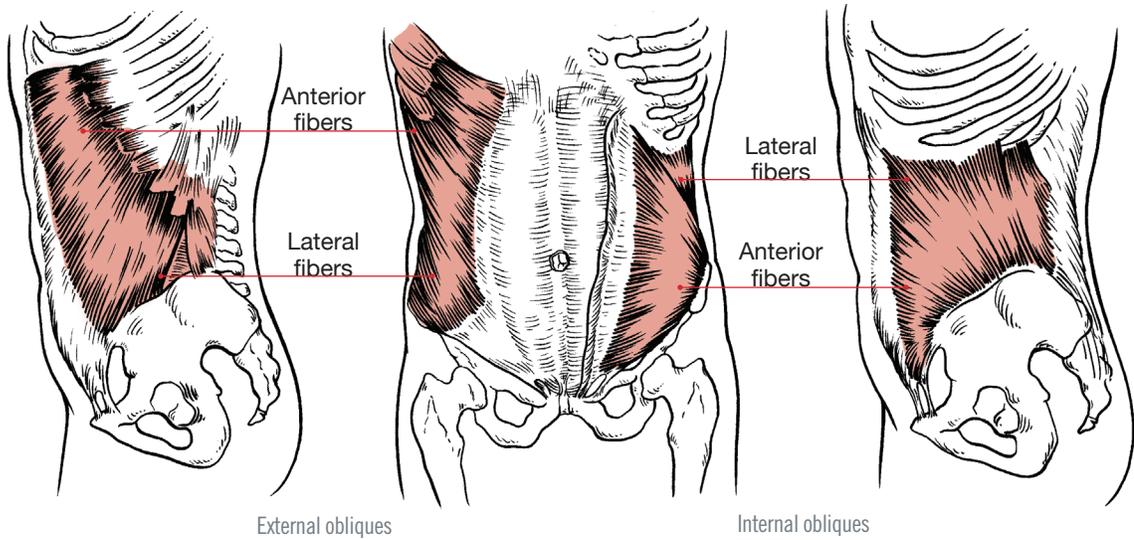
The definition of the anatomical core can be simplified as the muscles, bones, cartilage and ligaments involved in movement of the trunk, or the area from the shoulders to the hips.

Table 1		
Primary Core Muscles		
Muscle	Description	Action
Rectus abdominis (Figure 1)	Flat muscle of the anterior abdomen	Forward trunk flexion
Obliques (Figure 2)	Diagonal, flat muscles of the lateral abdomen	Lateral trunk flexion
Erector spinae (Figure 3)	Vertical bundle of muscles on the back	Backward trunk extension
Transversus abdominis (see Figure 1)	Deep muscle layer below the obliques	Compress ribs and internal organs
Multifidi (Figure 4)	Thin, long muscles of the back	Spine stabilization
Quadratus lumborum (see Figure 4)	Deep muscle layer of the back	Lateral trunk flexion
Latissimus dorsi (Figure 5)	Broad, flat muscle of the back	Trunk rotation
Psoas (Figure 6)	Long muscle from lumbar spine to anterior hip	Hip flexion
Gluteus maximus (Figure 7)	Large, thick muscle of the back hip	Hip extension

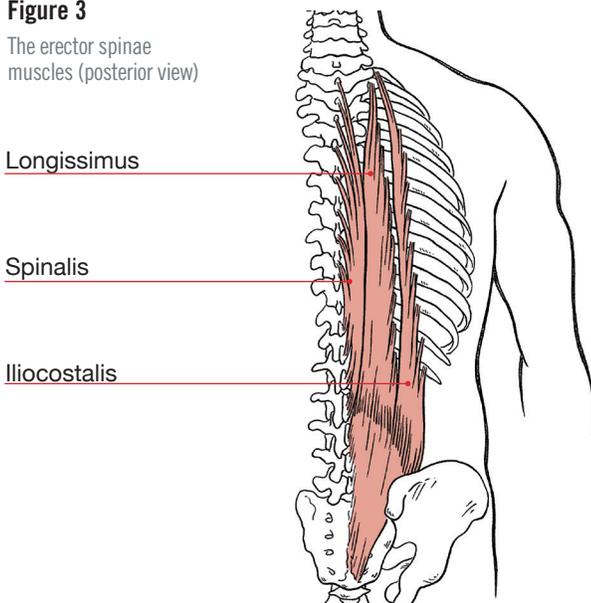
**Figure 1**  
Muscles of the abdominal wall



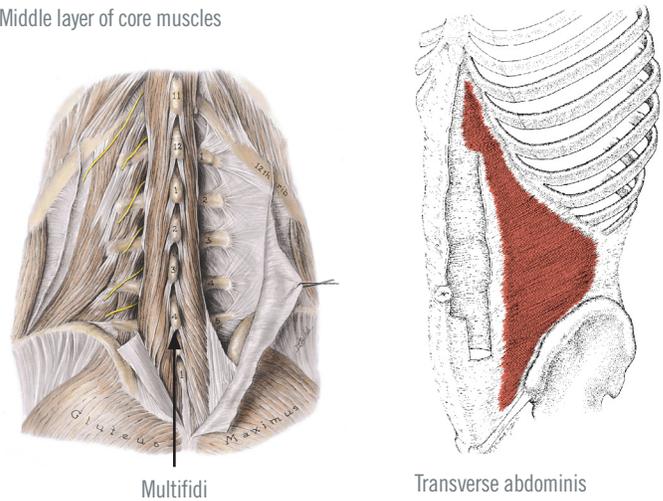
**Figure 2**  
External and internal obliques



**Figure 3**  
The erector spinae muscles (posterior view)



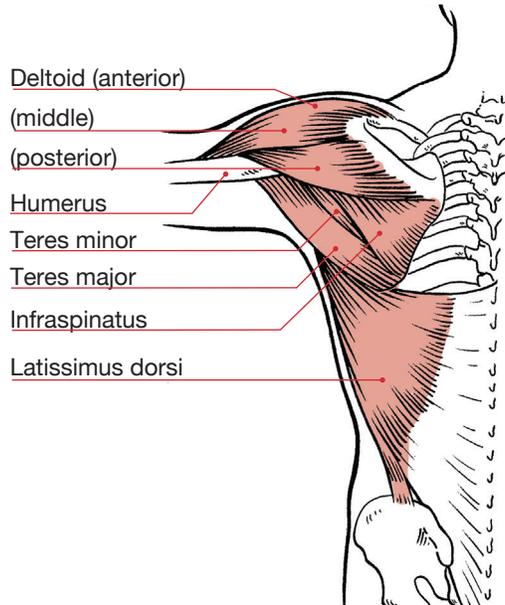
**Figure 4**  
Middle layer of core muscles



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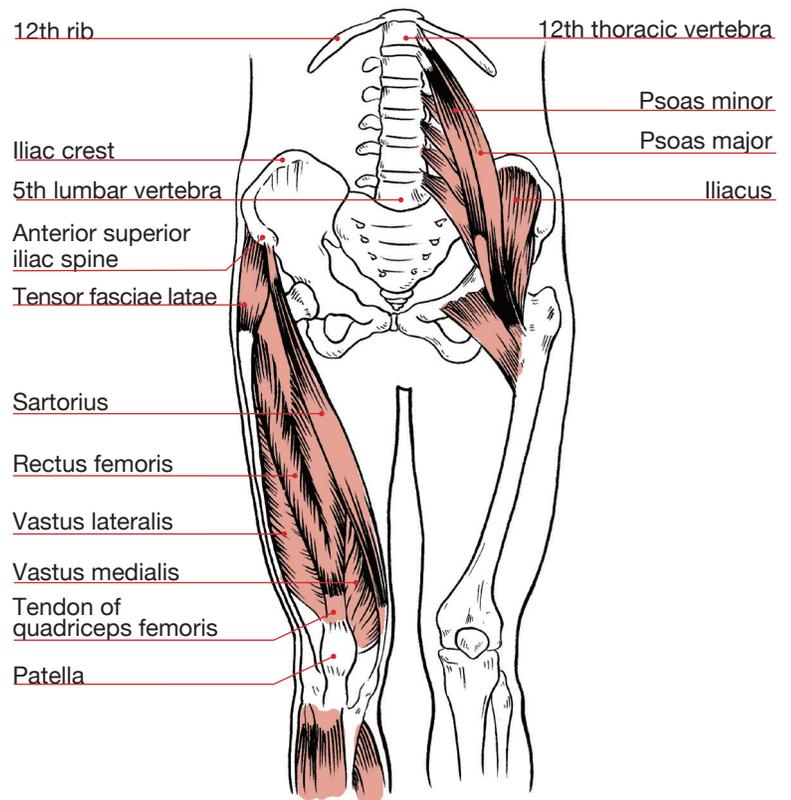
**Figure 5**

Superficial musculature of the superior and inferior shoulder joint, prime movers for shoulder abduction (deltoid) and adduction (latissimus dorsi and teres major)



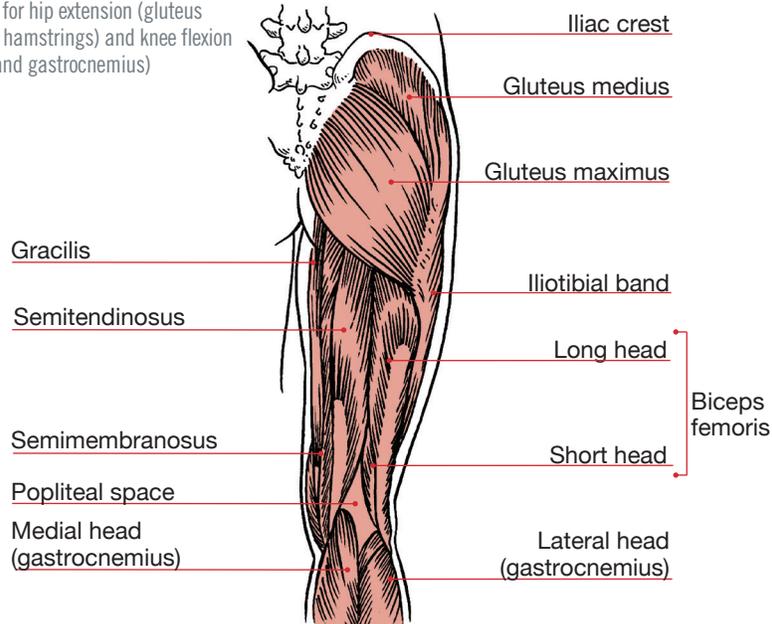
**Figure 6**

Anterior musculature of the hip and knee, prime movers for hip flexion (iliacus, psoas major and minor) and knee extension



**Figure 7**

Posterior musculature of the hip and knee, prime movers for hip extension (gluteus maximus and hamstrings) and knee flexion (hamstrings and gastrocnemius)





In addition to these muscles, the core includes skeletal components, such as the bones that comprise the pelvic girdle (hip and sacrum), and the vertebral column (cervical, thoracic and lumbar). Together, these components are the central connection between the upper and lower body, including the independent limbs (arms and legs).

### ***What is functional core training?***

Functional core training is a popular phrase in the fitness industry referring to the link between an exercise and physical performance in daily life. Therefore, one goal of functional training is to assist individuals with varying lifestyles to perform their regular tasks, at work and home, with efficiency and without pain. For example, functional training will prepare the body to lift heavy objects, climb stairs without pain and react to environmental conditions. These simple everyday movements are actually complex with respect to how the muscles work together for stability and support.

The complexity is due to the movements occurring in three different planes: sagittal, frontal and transverse. Movement in the sagittal plane is most common. People move in the sagittal plane when traveling forward and backward, including flexion and extension of the spine. Movement in the frontal plane incorporates movement of the spine from side to side, while movement in the transverse plane utilizes rotation about the spine. Ideally, core training involves exercises in all three planes.

Core training can also refer to integration exercises that elicit activity from multiple primary muscles of the trunk (front, back and side) in three dimensions. Integration core exercises require activation of the distal trunk muscles (shoulder and hip), as well as activation of the proximal trunk muscles (abdominal, oblique and lumbar), as opposed to isolation core exercises that only require activation of the proximal trunk muscles. Understanding the difference between these two core-training strategies will enable personal trainers, sport coaches and medical providers to suggest the optimal type of exercises during a strengthening routine.

Based upon muscle activity, integration exercises that require activation of the shoulder as well as hip musculature are potentially ideal in terms of maximizing strength, improving endurance, enhancing stability, reducing injury and maintaining mobility. These integration exercises elicit the overall greatest muscle activity while also challenging coordination and balance.

***... functional training will prepare the body to lift heavy objects, climb stairs without pain and react to environmental conditions.***

### ***Who needs core training?***

Almost everyone would benefit from core training. The core muscles are active during simple activities of daily living such as sitting, standing, walking and reaching. Any movement that involves lifting, twisting or balancing relies on core activation. A healthy core will also help power athletic activities such as swimming, cycling, running, throwing, hitting, catching and rowing. However, if a person is recovering from an injury or surgery, it is always wise to consult a physician before beginning a core-training program.

### ***Why is core training important?***

The core is involved in every movement people make, either by initiating or transferring force. Core training will help build strength, improve stability, maintain mobility, breathe deeply and reduce injury. Core strength allows an individual to generate and maintain force. Stability is critical for any weight-bearing activity and will reduce low-back pain by enabling better posture. Mobility allows a person to remain independent by performing daily tasks that require coordination of various body parts. Finally, it will also promote efficient breathing and lung capacity. The core muscles are connected to the diaphragm, which allows a person to inhale and exhale at his or her maximum capacity to assist in overall task performance.

One of the most compelling reasons to complete a core-strengthening program as an aging adult, recreational athlete or sports professional is to reduce the chance of injury. Leeton et al.<sup>2</sup> reported that injured athletes had significantly less strength in the core musculature, especially



the hip abductors. Multiple studies have been conducted with a focus on the connection between neuromuscular trunk training and knee injury which concluded that non-contact knee injuries were less frequent in the group of participants that completed a core-training program.<sup>3,4</sup>

#### ***When should a person complete core training?***

At a minimum, core-training exercises should be completed twice per week after a warm-up lasting at least five minutes. However, it is feasible to perform a few exercises during or after every workout session. Ideally, begin the core routine with flexibility stretches, progress to strength and stability exercises and add advanced options when appropriate. Balance the exercises between the three dimensions of the core: abdominal, oblique and lumbar.

#### ***What are the options and benefits for advanced core training?***

The degree of difficulty during a core workout can be enhanced with minimal equipment by adding external resistance or a balance challenge. When completing exercises with the trunk off the ground, such as a hover, plank or bridge, an arm or leg could be lifted to increase core activity. Arokoski et al.<sup>5</sup> compared abdominal and low-back activity during exercises with and without a balance component. The participants completed a bridge exercise with both feet on the ground as well as with one leg lifted. The average muscle activity was at least 20 percent greater in the rectus abdominis and multifidi and 200 percent greater in the external oblique muscles when one leg was lifted. A personal trainer or rehabilitation specialist could

begin the program with simple isolation exercises, and, as the individual gains strength, progress to more integrated, complex variations.

## **POPULAR CORE WORKOUTS**

### ***Pilates***

Pilates is a method of core training that can be performed with or without equipment and consists of low-impact flexibility, strength and endurance movements. The exercises target activity in the abdominal, back, hip and thigh muscles with 25 to 50 exercises in a single routine. Pilates coordinates these core muscle activities with breath control as well as continual fluid movements. Pilates training increases abdominal, hip and low-back strength as well as flexibility.<sup>6,7</sup>

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### ***Yoga***

Yoga is a full-body workout that combines stretching and strengthening exercises with thoughtful breathing and meditation. There are more than 100 different forms of yoga, varying from relaxed to intense. Yoga poses can be modified for every age and fitness level, providing low-impact strength training with core benefits. Research has shown significant activity of the three-dimensional core muscles during 11 common yoga poses.<sup>8</sup>

### ***TRX®***

TRX is a form of suspension training using ropes and webbing. This format leverages gravity and body weight to develop core strength, stability and flexibility. TRX exercises can also be modified for varying fitness levels by adjusting the distance from the anchor point. McGill et al.<sup>9</sup> compared core muscle activity during exercises on a stable surface to activities performed with the suspension system and concluded that the instability of the TRX elicited greater torso muscle activation.

## TESTING CORE ENDURANCE AND STABILITY

The following sections present two simple exercises to evaluate core health. The hover test evaluates core endurance, while the spine stabilization test assesses core stability.

### **Hover Test**

Have the client lie down on the stomach with the shoulders above the elbows, forearms flat on the floor, shoulders and hips at an even height and feet wider than the hips. Time how long the client can maintain this position without the hips rising above or dropping below shoulder height.

- 0–30 seconds = below average
- 30–60 seconds = average
- 60–90 seconds = above average
- 90–120 seconds = excellent

### **Spine Stabilization Test**

Have the client lie down on his or her back with the legs straight above the hips, perpendicular to the ground. He or she should place the hands under the low back and apply pressure to them by rotating the hips up slightly while engaging the lower abdominals. Have the client slowly lower the legs and note the angle between the legs and the ground when he or she can no longer maintain the pressure from the low back to the hands.

- 90 degrees = needs immediate attention
- 75 degrees = poor
- 60 degrees = below average
- 45 degrees = average
- 30 degrees = above average
- 15 degrees = great
- 0 degrees = excellent

## CORE EXERCISES

Isolation core exercises elicit activation of the proximal trunk muscles (abdominal, oblique and lumbar), while integration core exercises require activation of the distal trunk muscles (shoulder and hip) in addition to activation of the proximal trunk muscles. Based upon muscle activity, integration exercises that require activation of the shoulder as well as hip musculature are potentially ideal in terms of maximizing strength, improving endurance, enhancing stability,

reducing injury and maintaining mobility when completing the core-strengthening guidelines. These integration exercises elicit the overall greatest muscle activity while also challenging coordination and balance.

### **Isolation Exercise: Crunch**

Lie down with the fingers at the temples, pull the shoulder blades together, bend the knees and rest the feet lightly on the floor. Lift the shoulder blades off the floor and lower them back to the floor with control.

### **Integration Exercise: Hover**

Lie face down with the shoulders above the elbows, forearms flat on the floor, shoulders and hips at an even height from the floor and feet wider than the hips. Try to hold this position for periods of 10 seconds, eventually building up to a hold of one to two minutes. As an advanced option (shown here), move one hand diagonally away from the start position across the floor and then move back to the start position.

### **Integration Exercise: Balance mountain climber plank**

Start with the shoulders, elbows and wrists aligned and the feet hip-width apart. Bring one knee to the opposite elbow while maintaining a flat upper body and twisting the lower body.

### **Isolation Exercise: Oblique crunch**

Lie down with the fingers at the temples, pull the shoulder blades together, bend the knees and rest the feet lightly on the floor. Lift a single shoulder blade off the floor, twisting toward the opposite knee and sliding the top of the hand across the lateral thigh. Then, lower the shoulder blade back to the floor.

### **Integration Exercise: Side hover**

Start in a side-lying position with the shoulders directly above the elbow, the supporting forearm flat on the floor and the feet stacked. Hold the other hand above the head for 20 seconds.

### **Isolation Exercise: Extension**

Lie face down with arms above the head. Lift and lower the chest off the floor by contracting the gluteal muscles.

### **Integration Exercise: Pointer**

Start in a quadruped position with both hands and knees flat on the floor. Lift one leg and the opposite arm to the height of the shoulders. Repeat on the other side.

## SUMMARY

Core training helps to build strength, improve stability, maintain mobility, breathe deeply and reduce injury. The core is made up of not only the anterior abdominal muscles, but also includes multiple muscles from the shoulders to the hips. These muscles are continually active in simple activities of daily living such as sitting, standing, walking and reaching. There are numerous core exercises that can be completed without equipment and with minimal space requirements. Isolation exercises are simple, single-joint movements that primarily elicit activity from a single muscle. Integration exercises are complex, multijoint movements that elicit greater activity from a broad range of muscle groups. Both types of core training are important for a range of populations; from the aging adult to maintain independence to the sports professional to reduce the chance of injury.



## **ABOUT THE AUTHOR**

Jinger S. Gottschall, Ph.D., earned her doctorate degree in integrative physiology from the University of Colorado at Boulder and furthered her academic career as a postdoctoral fellow in neurophysiology at the Emory School of Medicine. She is currently an associate professor at The Pennsylvania State University, with a research focus on the effectiveness of various exercise regimens. Gottschall is a passionate advocate for physical activity and has dedicated her career to finding programs that promote balanced, healthy lifestyle choices while delivering the results they promise. She is also the co-owner and founder of FITOLOGY, a Les Mills™ group fitness and cycling studio in State College, Pennsylvania, and a consultant for Les Mills International.

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