

A man and a woman are shown in a snowy field, both performing a side-body stretch. The man, on the left, is wearing a grey hoodie and dark pants. The woman, on the right, is wearing a pink hoodie and black leggings. They are both smiling and looking towards the camera. The background is a snowy landscape with bare trees.

# NFPT

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# NFPT SELF - TEST

## DECEMBER 2024 EDITION

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**NOTE:** there are articles in this packet which contain links and/or references to resources and information only available online. Go to: [www.nfpt.com/blog/cec](http://www.nfpt.com/blog/cec) for these additional resources.

We thank you for your commitment to the fitness industry and to the NFPT organization of trainers. Please contact us at 800-729-6378 or at [info@nfpt.com](mailto:info@nfpt.com) with any questions, or to just be in touch. *We wish you continued success in your endeavors!*

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# Knee Anatomy, Common Injuries, and Exercise Programming Guidance

Knee pain and complaints are common among personal training clients. A clear understanding of the internal knee and its function supports the knowledge to program restorative knee exercises, progressions, and regressions (Hassebrock, et al., 2021).

This article examines the roles played by ligament and muscle anatomy in the knee for personal trainers. Additionally, common ligament and muscular injuries are discussed, as personal trainers will likely train clients who have experienced these injuries.

Since personal trainers are not qualified to treat knee pain directly, programming strategies will be discussed, emphasizing finding pain-free variations and modifications of exercises so that clients can continue to train. Six exercises for resilient and strong knees will also be covered that personal trainers can implement.

## Knee Kinesiology

The knee joint is the largest in the human body and allows complex movements. It includes the medial and lateral tibiofemoral and patellofemoral joints (Flandry & Hommel, 2010). Unlike ball-and-socket hip joint articulation, the femoral and tibial surfaces of the knee are not a close fit (Harput, 2020)).

The knee joint movements are mostly linked to the hip and ankle joint movements. The knee joint sustains high forces and moments and pivots between the human body's two longest bones (femur and tibia), making it susceptible to injury.

The arrangement of the knee ligaments and muscles that cross the joint provides the much-needed stability that counters the considerable biomechanical stress brought upon the joint (Kittl, et al., 2018). The hinge joint primarily allows movement in the sagittal plane through flexion and extension. It also allows slight medial rotation during flexion and the last stage of the knee's extension, as well as lateral rotation when "unlocking" the knee.

## Knee Anatomy

The knee is the junction of the femur, tibia, fibula, and patella bones. Ligaments, tendons, fascia, and muscles connect the joint and allow movement. Technically named a synovial joint, the knee is called a "hinge" joint for its linear and door-like movement patterns. When the knee is flexed, it can also perform internal and external rotation!

The knee joint has **four ligaments, including the menisci**, a type of hybrid cartilage/ligament that acts as a shock-absorbing barrier between the articular cartilage on the ends of the femur and tibia.

Three groups of muscles (popliteus, quadriceps, and hamstrings) allow movement and stability at the knee joint. Four muscles are in the anterior compartment of the thigh and are responsible for knee extension, and three are in the posterior compartment and are

responsible for knee flexion. The popliteus is located behind the knee joint and "unlocks" the knee by rotating the femur on the tibia, allowing knee flexion.

### *Ligaments*

#### **Lateral Collateral Ligament (LCL)**

The "fibular collateral ligament" is called the LCL because it connects the lateral femur and fibula. LCL limits the sideways motion of the knee. Any hyper or excessive movement in which the knee has to over-stabilize against a sudden change of direction that the surrounding musculature can't control could damage this ligament. Here are a few other important notes on the LCL:

- It is taut during full knee extension and slack during full knee flexion
- It protects the lateral knee from inside (varus) forces

#### **Medial Collateral Ligament (MCL)**

The MCL is called the "fibular collateral ligament" because its attachment sites connect the medial femur and tibia. Like the LCL, it limits the knee's sideways motion and is generally injured when the stress of quickly changing directions overpowers the force and stabilizing abilities of the surrounding musculature (Bates, et al., 2015). Here are a few other important notes on the MCL:

- It is taut during full knee extension and slack during full knee flexion
- It protects the medial knee from outside (valgus) forces

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#### **Anterior Cruciate Ligament (ACL)**

The word "cruciate" means crossing from one side to the other and one over the other. The ACL connects the femur to the tibia along the front center part of the knee. Specifically, one end connects to the anterior tibia along the medial side of the tibia's sagittal line. The other end connects to the deep portion (almost to the rear but not entirely) of the femur along the lateral side of the femur's sagittal line.

The ACL, one of the most common ligaments injured in sports, controls the following movements in the knee joint (Bates, et al., 2015):

1. Restricts anterior translation of the tibia
2. Prevents hyperextension of the knee
3. Secondary restraint to tibial internal rotation
4. Resists adduction and abduction in full extension
5. Guides "screw" mechanism of the knee joint as it approaches terminal extension

## Posterior Cruciate Ligament (PCL)

The PCL is the strongest ligament and primary stabilizer of the knee. It also connects the femur via the medial femur epicondyle to the tibia via the posterior intercondylar area. The PCL controls the following movements in the knee joint (Bowman & Sekiya, 2010):

1. Prevents posterior dislocation of the tibia while the femur is fixed
2. Prevents anterior dislocation of the femur while the tibia is fixed
3. Limits hyperextension of the knee
4. Controls stability of the knee during rotation

## Knee Cartilage

Cartilage, sometimes called “articular cartilage,” can be found at the end of the fibula, tibia, and femur and behind the patella. It is a connective tissue with no blood vessels or lymphatics, making it very slow to heal. It also has no nerves, so no pain can be felt. A significant function of knee cartilage is to absorb impact, reduce joint friction, cover the tibia and femur’s subchondral surfaces, and painlessly transfer forces.

The degeneration of cartilage causes [osteoarthritis](#), which leads to potential joint replacements, increased sedentary lifestyles, and mortality. Osteoarthritis is the most common form of arthritis in the United States, affecting 13.9% of the population or 26 million adults over 25 (Jacobs). 2014 Books of Discovery

In the knee, there are two types of cartilage:

1. **Hyaline** covers the end of the femur, tibia, and fibula.
2. **Menisci** is a specialized hybrid cartilage type that provides cushioning between the femur and tibia. Learn about [meniscus anatomy and injuries in this article](#).

## Composition of Knee Ligaments & Cartilage Structures

Ligaments, which connect one bone to another, are composed of approximately 70% water and 30% organic matrix, along with fibrocytes, the specific type of cells that make up tendons and ligaments.<sup>1,2</sup>

The organic matrix combines ground substance (a combination of protein and carbohydrate complexes forming a gel-like substance) and collagen. In ligaments and tendons, 90% of the Organic Substance is collagen. Collagen comprises 25 to 30% of the body’s protein.

Collagen production in the body can vary from individual to individual, with the aging process and genetics playing the most prominent role in the ability to make adequate amounts for tissue repair and maintenance.

Type 1 collagen fibers tend to be more rigid than Type 2. Hence, the ability to withstand the forces generated by movement and keep the bones they hold together without a daily injury.



Cartilage, which covers the end of all bones that touch each other, is different in composition compared to ligaments and tendons.

### Muscles of the Knee

The knee muscles are responsible for knee flexion and extension and work concentrically to control one movement and eccentrically to control the opposite movement. The **prime movers for knee extension** are the rectus femoris, vastus lateralis, vastus medialis, and vastus intermedius. They also function as antagonists for knee flexion. The **prime movers for knee flexion** are the biceps femoris, semitendinosus, and semimembranosus, assisted by the gracilis, gastrocnemius, and sartorius.

Here are some other functions and facts about some of the knee muscles besides their primary actions.

- Vastus intermedius
  - The most efficient knee extensor
- Vastus medialis
  - Assists the patella in tracking along the femoral condyles
- Vastus medialis oblique
  - Prevents lateral displacement of the patella and counters the force of the vastus lateralis
- Biceps femoris
  - Externally rotates the tibia relative to the femur
- Popliteus
  - Weak knee flexor and initiates extension of the knee when the knee is flexed

### Common injuries

#### LCL Sprain or Tear

LCL injuries are the complete opposite of MCL tears. They occur when the inside (medial part) of the knee is struck and pushed out or in sports with many quick stops and turns, such as soccer, basketball, and skiing. LCL injuries are also classified by severity, with classifications and symptoms similar to those of the MCL. However, the LCL does not heal as well as the MCL; in most cases, a Grade 3 injury will require surgery.

#### MCL Sprain or Tear

MCL injuries occur when the knee is struck on the body's lateral part (Outside). Since the MCL is located in the inside part (Medial) of the knee and resists widening of the inside of the knee joint when the knee is struck from the outside with a force that causes lateral buckling, it simultaneously separates and widens the medial portion of the knee joint causing the injury.

### **ACL Sprain or Tear**

An ACL tear is most often a sports-related injury but can also occur during rough play, auto accidents, falls, and work-related injuries. Most ACL injuries in sports happen when pivoting or landing from a jump. Like meniscus injuries, patients with ACL tears often feel a “pop,” the knee usually gives out underneath them. Subsequent pain and swelling are to be expected.

ACL tears do not necessarily require surgery. According to Doctor Jonathan Cluett, Board-Certified Orthopedic Surgeon in Massachusetts, your daily activities and demands should be considered before surgery.

For instance, do you regularly perform activities that require a normally functioning ACL? In addition, if the knee is stable, ACL surgery may not be necessary. Many patients with ACL injuries feel better within a few weeks. The only persistent problem may be instability.

### **PCL Sprain or Tear**

PCL injuries are commonly experienced when the knee is bent and an object forcefully strikes the shin backward. This type of injury can also occur in a car collision when the shin strikes the dashboard. Another mechanism of injuring the PCL is in sports when an athlete falls on the front of the knee.

PCL injury can also occur when the knee is hyperflexed and the foot points downward. Symptoms of PCL injuries are similar to those of ACL injuries. In the weeks following the injury, patients state that they can’t trust their knee or that it feels as if it is going to give out. Ligament and muscle tears are classified by their severity into three categories.

- **Grade 1** is a parietal tear. The tendon or ligament is still in continuity, with minimal symptoms. The symptoms are pain with minimal downtime, and most can return to their normal activities or sports within a few weeks.
- **Grade 2** is an incomplete grade two tear with more aggravated symptoms, such as more intense swelling, pain, and instability. At least three to four weeks of rest is usually necessary.
- **Grade 3** is a complete tear or separation of the ligament, tendon, or muscle. There is significant swelling and pain, and it is difficult to bend the knee. Instability or the knee giving out are common findings. Healing takes at least six weeks or longer. Having a knee brace with lateral and medial stabilizers is recommended. Due to good blood supply and the fact that it usually responds well to non-surgical treatments, it is rarely treated with surgery.

## Patellar Tendinitis

Chondromalacia Patella is the degeneration of the cartilage between your patella and femur. Your kneecap, which sits over the front of the knee joint, glides over the Femur as your knee bends or extends. Chondromalacia Patella (also called “Patellofemoral Syndrome”, “Runners Knee”, “Chondromalacia Patella” or “Jumpers Knee”) begins when the kneecap does not move properly and rubs against the lower part of the femur (Dan, et al., 2018).

Causes of chondromalacia patella:

- The kneecap is in an abnormal position(also called poor alignment of the Patellofemoral joint)
- Tightness or weakness of the muscles on the front or back of the thigh
- Flat feet
- Too much physical activity that places extra stress on the kneecap

Symptoms of Chondromalacia Patella are pain behind, below, or on the sides of the kneecap, being more noticeable while climbing up or down stairs, performing deep knee bends, standing for long periods, and running downhill (Nunes-Matinez & Hernandez-Guillan, 2022).

## Prepatellar Bursitis

Prepatellar Bursitis is the common cause of swelling and pain on top of the kneecap. The bursa are thin sacks filled with the body’s natural lubricating fluid. They are situated around our joints to prevent muscles, tendons, and skin from catching on bony surfaces throughout the body. When the knee is traumatized, subjected to repetitive use, or injured, the bursa can swell and fill with blood or fluid, which in turn causes pain and swelling (Rishor-Olney, et al., 2024). If the trauma is associated with a tear in the skin, the bursa can become infected; this is called infected bursitis.

Kneeling daily for extended periods of time or being sedentary increases the risk for prepatellar bursitis.

Symptoms of prepatellar bursitis are:

- Swelling over the kneecap
- Limited motion of the knee
- Painful movement of the knee

Bursitis of the knee can be treated by draining the bursa sac. In cases where infection is possible, an antibiotic is prescribed. In mild cases, resting the site with ice therapy and anti-inflammatory medication may work fine.



## Muscle Strains

A muscle strain is an injury that affects the muscle or the tendon. The severity can range from a mild stretch to a partial or complete muscle or tendon tear. These strains often occur where the muscle and tendon meet, known as the musculotendinous junction. Common areas for muscle strains in the hip and thigh include the hip flexors, groin, adductors, quadriceps, and hamstrings.

Hip and thigh muscle strains can result from a sudden, unanticipated movement or repetitive overuse over time. When the injury occurs, you may feel a “pop” or “tear.” The likelihood of reinjury is higher with a previous strain or injury, especially if it wasn’t fully healed (Opar, et al., 2012). Other factors that increase risk include tight muscles, poor motor control, and poor conditioning.

Symptoms of a muscle strain in the hip or thigh include pain, bruising, swelling, reduced mobility, weakness, and trouble walking. Hamstring strains are one of the most common muscles to be strained (Hickey, et al., 2022).

## How Personal Trainers Can Program For Knee Pain

Personal trainers cannot treat pain directly, but you can strengthen and lengthen the muscles supporting the joint. Rather than trying to pick exercises specifically “for knee pain,” **personal trainers should help their clients find pain-free exercises and modifications to painful exercises.** More often than not, a specific exercise is not to blame for the pain, but rather particular variables within the exercise, such as:

- Range of motion
- Load
- Volume
- Speed
- Stance or limb positioning

By avoiding painful movements or stimuli and training pain-free, positive performance adaptations can continue while simultaneously giving the knee time to rest and recover. When training specific muscles for knee pain, such as the vastus medialis oblique, research shows that training a specific muscle for knee pain is not more effective than a general approach.

Therefore, make sure that all of the muscles of the leg are being trained.

When modifying an exercise, here are some examples of regressions or progressions to find a pain-free variation.

These are just examples and won't necessarily hold in every case.

Variable	Squat	Lunge	Hip Hinge
Range of motion	Full squat -> box squat	Walking lunge -> short box step up	Full conventional deadlift -> Partial RDL
Foot position	Regular stance squat -> a stance that feels better than the pre-injury stance	Same as "squat" column or try different wedge setups to see if that different position helps	Same as "squat" and "lunge" column
Tempo	Emphasize a tempo (such as the eccentric portion) that is pain-free and minimize a tempo that provokes pain		
Load Position	Front squat -> low bar back squat	Goblet lunges -> open hex bar lunges	Barbell deadlift -> hex bar deadlift

## Six Strength Exercises for Resilient Knees

### Exercise 1 – Romanian deadlift

This is an excellent exercise for clients convinced they shouldn't bend their knees. The RDL is a very hip-dominant movement with little knee movement. It trains the posterior chain (glutes, hamstrings, spinal erectors), and many other muscles in the body. For more in-depth coaching on the deadlift, [check out this article](#).

1. Find a comfortable stance width
2. Hinge the hips back with a soft bend in the knees
3. Stop hinging right before the lumbar spine flexes
4. Drive the hips forward to move the body back to a standing position

You can use any modality: barbell, dumbbell, hex bar, etc. Remember the exercise variables and select pain-free ones. The single-leg variation of this exercise and other bilateral exercises in this list are other great options.

### Exercise 2 – Hip thrusts

Another excellent posterior chain exercise mainly targets the glutes and hamstrings, with some quadriceps activation. As a hip-dominant movement, this exercise will experience most of the load and movement in the hips rather than the knees, though the knees and quads will still experience some work.

Remember, these exercises aren't about avoiding a specific muscle or movement because of an assumption that they're bad for the knees. Still, they are modified in a pain-free way and train the muscles around the knees. For more in-depth coaching on the hip thrust, [check out this article](#).

1. Find a comfortable stance/foot position
2. Bring the hips and ribs to parallel with the abs
3. Drive the hips towards the ceiling by squeezing the glutes
4. Maintain the knees in alignment with the hips and feet

### Exercise 3 – Step down

Step-downs are the same as step-ups, but they are called step-downs to emphasize the eccentric portion of the exercise. This is a highly modifiable exercise, which makes finding a pain-free version especially doable. Here are some modifications:

- Decide which joint to emphasize movement in by leaning the torso forward for more hips or remaining more upright for more knees
  - Hold onto support or use an overhead band for stability and to reduce the load
  - Choose a suitable box height
1. Begin by standing up and removing the non-working leg from the box
  2. Slowly lower to the floor by maintaining tension in the lower body
    1. Touch the floor with the toes and then the heel
  3. Maintain the knee over the foot and decide if it ok for the knee to track past the toes or not, depending on the tolerance of the movement

If stepping up without assistance causes pain, the non-painful knee can step back up or assistance can be used.

### Exercise 4 – Sled pushes and pulls

Sleds are a great tool because they train the body in a gait pattern and many other patterns, such as crawling, walking backward, sideways, etc. The sled push and pull are about efficiently transferring power in the horizontal plane of motion. To learn more about sled exercises, [read this article](#).

### Exercise 5 – Calf and tib raises

It is essential to train the muscles below the knee. The gastrocnemius is a biarticular muscle that contributes to knee flexion. Find a foot stance and angle that is pain-free, and choose your preference for loading. Train the movement in a pain-free range of motion that allows for the biggest stretch possible.



Restricted ankle range of motion has been linked with a higher risk of injury (Taylor, et al., 2022). Calf and tib raises can help improve ankle range of motion if they are trained in a full range of motion or at least a long-length partial range of motion repetition. Tib raises are less known than calf raises, so here is how you can do them.

- Wall leaning tib raises- lean back into a wall and pull the toes to your nose by pivoting on the heels
- Use a tib raise device to add load and bring your toes to your nose in the seated position

#### Exercise 6 – Box squat

The box squat essentially does two unique things that a conventional full squat doesn't:

1. Limits the range of motion, which usually decreases knee flexion
2. This cues you to sit the hips back, placing the load on the hips and resulting in less forward movement of the knees in flexion and extension.

Usually, these two things have a better chance of providing a pain-free squatting opportunity. [Read this article](#) to learn more about squat cueing, techniques, and modifications.

# Mindfulness in Personal Training

Mindfulness as a practice has been exploding in popularity, making its way into professional sports, healthcare spaces, and school classrooms. The study of its effect on both the mind and body has increased in the research in recent years, showing promising benefits (Wang, et al., 2023). Mindfulness in personal training is one intersection that has profound potential to impact people. Understanding how to incorporate mindfulness into your training sessions is critical now more than ever.

**I want to give special thanks to Carissa Fish**, an expert mindfulness and wellness coach, who spoke with me as I prepared this article, provided me with background information about mindfulness basics, and suggested ways to apply it to personal training. In our conversation, we discussed:

1. The definition of mindfulness
2. Mindfulness in personal training
3. Application of mindfulness in personal training
4. Mind-body connection
5. Stress and recovery

By the end of this article, personal trainers will gain insight into adding a new layer of expertise to their sessions.

## Mindfulness Defined

Simply put, mindfulness is the opposite of being on “autopilot.” Some activities, such as brushing teeth or driving to work, are examples of how it is expected to be on autopilot. Some activities, however, are too easy to be on autopilot, often at our health’s expense, such as eating, exercising, and spending time at home. **Being mindful includes being present in the moment with kind and curious attention.**

Being present and putting our attention in the moment deserves it. This can be challenging, especially with phone notifications and the following duties. However, mindfulness does not mean pushing out any thought in our mind; instead, it means recognizing that it is there and balancing it with the moment we are presently in.

## Mindfulness in personal training

Many [personal trainers already use mindfulness](#) without realizing it. Recent research has explored how mindfulness may enhance athletic performance and mental health and reduce injury risk (Anderson, et al., 2021). one of the main reasons people look to personal trainers is to help them be aware of their bodies while exercising. Some examples of this are:

- Wanting to use the proper form
- Wanting to know how far to push themselves

- Wanting to get more consistent on their own

Mindfulness is critical to accomplishing all these goals, and personal trainers play a crucial role in helping clients achieve these goals. **Think about how a workout would go if you just scrolled through social media** or had an important phone call the entire time. You wouldn't be mindful of your form, pushing yourself the right way, or being consistent with the distractions. Here are some questions and pointers that experienced personal trainers often ask to help their clients grow in mindfulness during their sessions:

- How did you feel at the end of your set?
- How did your hip or shoulder feel with that movement and load?
- You should feel your hamstrings stretching under tension as you go down and your glutes squeezing as you come up.
- Grab the floor with your feet as you perform the exercise.

These questions and pointers are helping the client avoid autopilot and be present, paying curious attention to how their body feels specifically. If you aren't using these questions and pointers now, they are a great set to start with as you incorporate mindfulness into your sessions.

*How can personal trainers immediately apply mindfulness to their sessions?*

Clients often come to personal trainers believing they can't exercise well enough on their own, with self-criticism and judgment. Mindfulness can bring self-compassion to the training session, where the personal trainer helps the client believe in themselves and grow their self-compassion. **Too often, clients come to sessions comparing their bodies to someone else or their past selves.**

Personal trainers looking to [incorporate mindfulness](#) play a key role in helping clients accept themselves for where they are at that moment, not where they used to be. They can support their clients in this place by having them ask themselves: "What is here right now"? This question can help clients not push through pain or themselves too far, which we all tend to do if unchecked.

**As personal trainers, we have the opportunity to help our clients learn to accept where they are at during a training session.**

**The body scan is another quick tool that allows clients to slow down enough in their day to notice something about their bodies.** The body scan also allows the client to receive information about what their body is up to and not doing in that training session. Here is an example of how this dialogue can play out between a personal trainer and their client:

Trainer: "Before your warm-up, start with a body scan. I want you to take a moment to see if you can notice anything about how your body is feeling. Let's start with your feet and work up to your head. Do you feel any tightness, pain, tension, etc?"



Client: “Now that I think about it, I’ve been sitting all day, probably with my feet tucked under my chair with my knees bent. I felt some tightness in my hamstrings.”

Trainer: “Ok, that is great to know! Let’s start with extra hamstring stretching in your warm-up and add some single-leg leg RDLs for strength, which should help those hamstrings feel better.” The body scan can also be used as a post-set check-in, especially with new exercises or higher intensities, for clients to report sensations or feedback they observed. **The information gained from these regular check-ins is vital for building trust and a safe exercise environment between the trainer and the client.**

Here are key moments to check in with your client:

- First session after significant time off of training, such as after vacation or being sick
- After increasing the intensity of the exercise, such as by increasing the weight or complexity
- Before changing part of the routine
- If you observe any apprehensive body language in your client

### Mind-body connection

The mind-body connection is the opposite of the “autopilot” concept we discussed earlier. In autopilot, it is challenging to be acutely aware of the intricacies of how posture feels and where our limbs are in space. **The mind-body connection, instead, is an intentional choice to learn our body’s vocabulary for what feels good.**

Research indicates that teaching older adults who are taught techniques on relaxation, breathing, and yoga’s mind-body connection created a satisfying internal focus on bodily sensation (Gilchrist, et al., 2022). Improved focus, decreased fear of falling, and improved memory are other benefits that older adult clients may have from growing in their mind-body connection.

A non-exercise example of a mind-body connection (there are many types) is how we know when we are hungry. For some, it becomes difficult to form thoughts. For others, it is low energy. Just as it is essential to read our body’s signs of hunger, **it is also crucial to read our body’s signs of what it is physically feeling before, during, and after exercise.**

Think of a complex exercise such as a deadlift. To deadlift, one must grab the floor with their feet, create tension in the sides of the hips to keep the knees in line with the feet, hinge the hips backward, maintain a neutral spine, and keep tension in the shoulders. That is a lot to do simultaneously, and a solid mind-body connection is utilized. In other words, **the mind-body connection is an awareness of the checkpoints of your form in the exercise context.**

Support clients’ stress and recovery with mindfulness

**We don’t [heal or perform well](#) when stressed.** Mindfulness allows us to participate in rest and healing instead of checking out. Instead of checking out on the couch with social media at hand, mindfulness encourages us to prioritize proper restoration. That looks different from person to

person. It could be a walk outside without music or podcasts, time practicing an instrument, or anything else that allows us to escape the hamster wheel.

We are also at a higher risk of injury when we're stressed or not paying as close attention to our body as we should. Many studies have shown mindfulness's value in sports or lower injury risk (Erikson, et al., 2022). Even though your personal training clients aren't all competitive athletes, they still train with you to increase their performance. For clients already in pain, mindfulness may also help reduce their pain (Brandel, et al., 2022).

**One activity that can support stress and recovery is the five-senses activity.** Go through your five senses individually and see what you are sensing. What are you hearing, touching, smelling, seeing, and tasting? You may find a sense to hone in on during your recovery.

Recovery is just as necessary between the sets as after the workouts. We know that the cause of injuries while training is less about a specific exercise and more about exceeding the body's recovery threshold. Make sure that the rest between sets is fluid and regulated based on the client's feedback.

**Diaphragmatic breathing is an excellent activity that takes less than a minute and can lower blood pressure and heart rate, taking our body out of a sympathetic state.** When stressed, we usually breathe with our chest and accessory breathing muscles in the shoulders. This robs us of the benefits of increasing vagal tone, which calms our body. To breathe diaphragmatically, inhale through the nose by expanding the lower stomach and ribcage without lifting the chest or shoulders.

Breathing helps you be present because inhaling and exhaling require focus. Focused breathing practices also increase activity in the brain's part responsible for attention. To improve the focus during breathing, try counting breathing. **A basic exercise is the box breath**, where you inhale for 4 seconds, hold for 4 seconds, exhale for 4 seconds, and hold for 4 seconds. The time intervals can be adjusted.

## Conclusion

Incorporating mindfulness into personal training sessions offers an invaluable opportunity to enhance clients' physical and mental well-being. **By integrating mindfulness techniques, personal trainers can foster a deeper mind-body connection, improve client focus, and promote self-compassion, ultimately leading to more effective and fulfilling workouts.**

The strategies discussed, from body scans to mindful breathing exercises, provide practical tools for trainers to help clients stay present and attentive during their sessions. Embracing mindfulness in personal training supports physical fitness and nurtures a holistic approach to health and wellness.

# Giving DNA its Due: Designing a Genetically-Based Workout Program

*As personal trainers — and those aspiring to the field — surely know, every client with whom we interact deserves a personalized program in order to achieve results. The stepping stones on this path had previously included strength training, nutrition and exercises designed to increase endurance and flexibility. Today's science makes possible the opportunity to take such preparation a step further by considering one's genetic make-up. Read on to discover how an understanding of a client's DNA may help overcome sticking points and plateaus in training.*

## DNA and Fitness Abilities

Our genetic code makes up everything about us, from height and eye/hair color to food preferences. Research now indicates that DNA may hold the secrets to why some clients respond in certain ways to exercise and strength training.

The field of *DNA fitness* enables one to hone in on key aspects of physiology that personal trainers heretofore have not taken into consideration ~

- The body's energy utilization mechanisms
- Ease or challenge of weight loss
- Response to specific training regimens
- Recovery needs
- The body's potential for injury
- Power
- Endurance
- Flexibility
- Coordination

As we can see, having such knowledge would facilitate the design of a personalized training program, thereby helping to optimize a client's success in attaining his goals. This can certainly save a client time and money, since the trainer eliminates the all-too-common trial and error approach so commonly relied upon in the early stages of personal training.

## Fat-Burning Capability

Most of the readily-available home genetics tests reveal one's *genotype*, or how particular genes can influence such things as fat-burning abilities. We know that the majority of individuals we train can and probably will achieve some weight loss, especially when their exercise pairs with a clean eating plan. Genetic testing goes a step further, providing a glimpse into how quickly one's body accesses and utilizes fat as a fuel source when performing cardio. If a client receives a value in the "normal" range, we can infer that his body possesses a typical

mitochondrial adjustment/adaptation from aerobic exercises. Improvements in this aspect of fitness show slight variations from person to person.

Those individuals whose DNA test classifies their results as “enhanced” will find it far easier to utilize/mobilize stored fat during cardio. When we know this about a client, we can help them enhance their fat loss by prescribing a certain amount of cardio each week, designed to take advantage of their genetics in that realm.

### Harnessing Power

Genetic fitness testing can also reveal how easily a client responds to strength training and hence to building lean muscle tissue. Scoring in the “below average” range in this area would suggest a workout plan that includes lifting with a heavier weight load some days, and increased intensity on other days. Explaining this challenge to the client helps him understand that he must work “smarter” as opposed to “harder”. The distinction between these two words can make all the difference in a client’s motivation and attitude toward his training.

### Differences in Recovery Time

When one lifts weights with the intention of building muscle, each rep induces micro-tears in the muscle tissue which, upon rest and with prudent post-workout refueling, leads to stronger and larger muscles over time. We can think of these tears as a form of inflammation. DNA fitness testing addresses variations in one’s systemic inflammation – response to resistance training – and can help dictate what length of rest/recovery time a client will require. Scoring in the “well above average” range indicates that a client’s body requires a more extended rest time to allow for healing and recovery. For such individuals, trainers place more emphasis on such aspects as warm-up time, cool downs, and flexibility moves designed to enhance recovery. Some professionals build days into a weekly regimen when the client engages in foam rolling, yoga, flexibility/stretching, and/or lighter cardio. All of these movement types can work in synchronicity to help lower the body’s inflammatory response. Degree of injury risk closely aligns with this same category. For these clients, we can stress the importance of receiving adequate sleep each night as a further recovery tool.

### The Endurance Factor

Some of the more advanced genetic fitness tests include information regarding an individual’s VO2 max and stroke volume. Such information can prove very useful for clients who come to us with specific performance-related goals. Stroke volume reflects the quantity of blood that one’s heart pumps with each heartbeat; intensity of exercise will increase the stroke volume. We can help clients harness their genetic gifts of an “above average” reading, knowing that they will have greater improvements in VO2 max sooner rather than later. The more blood one can move through his body, the more efficiently he can perform.

Maximal O<sub>2</sub> uptake, the highest quantity of oxygen per unit of time that can get delivered to peripheral organs including skeletal muscle (vital to sustaining muscular contraction at peak exercise), ranks as the gold standard of cardiorespiratory fitness.

The consensus among scientists in this field leads us to believe that the genomic predictor score appears proficient in identifying the low and high responders to regular exercise. Someday soon we may see this value as a way to provide a solid foundation for the new biology of adaptation to exercise, and for the development of the exercise component of personalized preventive and therapeutic medicine. Much more research will reveal over time the specific direction in which such data will take us.

### DNA-based Nutrition

Often a detailed DNA test kit offers insight into one's food sensitivities, diet markers, response to metabolizing alcohol, and any vitamin/mineral/nutrient deficiencies that may contribute to one's training regimen success. If a trainer knows something as basic as how the client reacts to caffeine, for example, he can use this information when designing a tailor-made meal plan. The field known as *nutrigenomics* encompasses DNA testing specifically for weight loss. Research has shown that 2 clients on the same meal plan, and engaging in the same workouts, will vary in how much weight they can lose within a given time frame. Genetics dictates what weight-loss strategy works best for each individual; trainers who have the ability to formulate nutrition plans can thereby customize an entire lifestyle regimen for their clients.

### Genetics and Cellular Mechanisms

Variations in one's genetics accounts for the different functioning of enzymes, transporters, and receptors within the human body. These markers in turn have a profound effect on how each person digests, absorbs and metabolizes food, nutrients and supplements. Sometimes a client chooses to augment his training by enlisting the help of a registered dietitian, who can use genetic information to understand how one processes proteins, carbohydrates and fats. This enables such a professional to customize a meal plan specifically to facilitate the ease of weight loss.

### Dieting for DNA

One recent research study compared the effectiveness of weight loss groups with and without the aid of DNA testing. The group that underwent DNA testing showed a greater improvement in healthy food choices than their counterpart. Furthermore, the changes lasted through the first year of follow-up.

Adding DNA testing to dietitian consultations also demonstrated an increase in motivation (possibly through a more thorough understanding of diet advice given by the professional), reduced blood lipid panels, and improved blood sugar control.

### Disadvantages of the DNA-based Meal Plan

Although dietitians agree that no single diet will work for all clients, it remains challenging to determine whether or not to recommend the genetically-based meal plan route. Experts agree that the DNA diet fails to consider risks like obesity and eating disorders such as anorexia, two main concerns in regard to overall health. As such, a DNA-based meal plan does not take into

consideration one's complete clinical profile, which must include modifications for existing health conditions and any maintenance medications the client may take.

Often such diets favor the elimination of an entire food group from one's daily meals, which comes fraught with its own unique dangers. In addition, one's genes account for only 5% to 10% of diseases, such as type-2 diabetes and obesity. Consequently, diets based on DNA testing alone sometimes fail to offer the personalization that they espouse. Behaviors clients can modify, such as prudent meal plans and specific workout routines, will perform better in the long run with regard to sustaining overall health.

### From Fitness to Wellness

Simply defined, genomic medicine makes use of information from genomes (from humans and other organisms) and their derivatives (RNA, proteins, and metabolites) to guide medical decision making. Doctors and specialists in this area now have the ability to examine a person's entire genome (or at least a large fraction of it) and to make individualized risk predictions and treatment decisions, potentially including the aforementioned customized workout plans.

Health care that embraces personalized genomic medicine reflects an integrated, coordinated, evidence-based approach to individualizing patient care, using multidisciplinary allied medical teams to promote health and wellness. Personal trainers, too, can learn how to network with clients' physicians to further enhance overall well-being.

### Take-home Message

An in-depth understanding of a client's genetic predilection to respond in various specific ways to strength training, cardio and fat utilization can foster a higher degree of accuracy in program design. Today we truly can create individually customized exercise and nutrition lifestyle plans. If a client understands why he does a particular training program, he feels more in control of his results. Confidence and motivation follow, along with success for both of you!



# Trainers Can Go Beyond Exercise and Integrate the Pillars of Lifestyle Medicine into Client Workouts

*Lifestyle medicine, a branch of evidence-based healthcare emphasizing disease prevention over curative medicine, seems greatly underemphasized in today's Western medicine approach. Lifestyle medicine operates from a holistic health approach that works to treat root causes of health issues. Based upon the idea that the body can heal itself, such practices focus on treating the entire physical and mental systems in order to improve overall function and well-being, through lifestyle intervention.*

*Lifestyle medicine uses evidence-based methods to uncover the source of the problem, its root cause, and then can more easily address symptoms. For example, working to relieve stress in an effort to combat tension headaches, digestive issues or insomnia, would represent a lifestyle medicine practice. Exercise figures prominently in these scenarios, as we will see below. Learn how we can help our clients by coming at fitness from a whole-mind-and-body place!*

## The Pillars of Lifestyle Medicine

Although the principles of lifestyle medicine seem similar across most platforms, we do see minor differences among professed lifestyle specialists. For purposes of this article, we delve into the seven most commonly listed lifestyle medicine pillars: movement & fitness, healthful nutrition, restorative sleep, stress management, social engagement, gratitude & reflection, and cognitive enhancement.

### Movement and Exercise

As fitness professionals, we know that striving to include physical activity in daily life can improve health outcomes in just about everyone, regardless of age or gender. For this reason, consistent movement tops the list of effective interventions for optimizing overall health and well-being.

The 2018 *Physical Activity Guidelines Advisory Committee* reported current evidence on the relationship between active movement and health, specifically making note of benefits relating to physical activity:

- a decreased risk of chronic conditions such as heart disease, stroke, hypertension, and type 2 diabetes
- diminished risk of eight different types of cancer
- positive effect on brain function by reducing the risk of Alzheimer's disease
- improvements in anxiety, depression, sleep and cognitive function

The CDC reports that, sadly, only 50% of adults in this country achieve the necessary physical activity levels required to reduce and prevent chronic diseases. To further compound the problem, such lack of activity accounts for 10% of all premature deaths. Not only have adults

shown no significant uptick in regular aerobic activity over the past decade, but their sedentary behaviors have actually increased.

Tips that we can easily present to our adult clients to facilitate meeting suggested physical activity guidelines include:

1. **Move more/sit less throughout the day** ~ Adults who sit less and engage in *any amount* of moderate-to-vigorous physical activity experience health benefits.  
\*\*Suggest the following to sedentary clients:
  1. At least 150 to 300 minutes of moderate-intensity movement, spread throughout the week; **OR**
  2. 75 to 150 minutes a week of vigorous-intensity aerobic physical activity; **OR**
  3. Any combination of moderate- and vigorous-intensity aerobic activity.
2. **Muscle-strengthening activities** ~ Involve all major muscle groups 2 or more days per week.
3. **Find ways to add balance training** ~ This proves highly beneficial particularly for older adults.

### Healthful Nutrition

Studies conducted by the *True Health Initiative*, a global network of lifestyle medicine advocates, revealed some sobering statistics:

- 70% of all Americans fall into the overweight or obese categories
- over 100 million Americans likely will fall prey to diabetes by 2050
- over 40% of the population current live with some form of chronic disease(s)

Studies led by Dean Ornish, a Clinical Professor at UCSF and a pioneer in lifestyle medicine, have indicated that nutritional interventions remain a key contributor to reversing the progression of chronic diseases (severe coronary artery disease, type 2 diabetes, high cholesterol, and high blood pressure, among others). Experts have also linked dietary factors to the development of anxiety and depression.

As we continue to preach to our clients, even small and incremental nutritional changes can have major positive impacts on overall health in addition to one's fitness goals. Simply implementing a few healthy habits into one's weekly lifestyle can add years of longevity, especially when such choices replace consistently unhealthy foods. Healthy dietary guidelines advocate an eating pattern that includes of a variety of foods, to ensure that consumers receive as many vitamins and minerals as possible.

When speaking with clients, consider offering the following key points:

1. **Substitute nutrient-dense foods** in place of high-calorie foods with little to no nutritional benefits
2. **Be mindful of calories** by focusing on appropriate serving sizes
3. **Choose a rainbow diet** by consuming plenty of fresh fruits and vegetables
4. **Maintain a balanced ratio** of macronutrients ~
  1. **Unrefined carbohydrates**— whole grains, barley, brown rice and vegetables
  2. **Protein** – fish, fresh meat and poultry, egg whites, legumes (beans, peas), soy-based products (tofu, tempeh) and non-fat dairy
  3. **Healthy fats**— fish oils, flaxseed oils, nuts/seeds/nut butters
5. **Minimize/Eliminate processed foods** which contain added sugars, fats and salt
6. **Stay hydrated** with water or other unsweetened beverages

### Restorative Sleep

We do not often consider sleep health when working with fitness clients; yet this aspect of life does mesh with other health care agendas. According to experts, sleep affects a plethora of our tissues, muscles and major organs and organ systems. A well-rested body also encourages better intellectual performance, cognitive functioning and mood resilience, thereby affecting our overall well-being.

Scientific data show that insufficient sleep increases the risk of developing chronic conditions such as obesity, diabetes, and cardiovascular disease. Despite research emphasizing the negative health outcomes of poor sleep, the CDC determined that approximately 33% of our population who claim to achieve less than 7 hours of shut-eye per night often suffer problems with daily functioning.

Cultivating a regular sleep routine can prove challenging in our world of busy schedules and multitasking throughout the day. We can assist clients by suggesting ways in which they can help foster “signals” to let the body know when to wind down and ultimately calm the mind:

- **Sleep schedule** ~Try to go to bed and wake up at approximately the same times each day/night. This helps to regulate the body’s internal clock.
- **Ease into bedtime** ~Allocate sufficient time prior to getting into bed to allow your mind to clear and settle. Warm milk, calming tea, or soaking in a hot tub can work wonders. Avoid stimulating or stressful activities before bedtime.
- **Temperature** ~ Sleep experts suggest maintaining a temperature of 60-68 degrees Fahrenheit in the bedroom to achieve optimal restful slumber.

## Stress Management

Stress manifests itself in more ways than we consider. Our bodies may react with jitters, increased respiration/heart rate, or gastrointestinal troubles. Such occurrences reflect the cascade of internal triggers we often refer to as the “fight or flight” response. These internal mechanisms represent the convoluted interplay amongst our multiple organ systems. The result of this can either foster help under pressure – such as the proverbial stories of individuals lifting cars when a child gets somehow trapped underneath – or, in the case of chronic stress, can lead to serious health problems.

According to research published in the *American Journal of Lifestyle Medicine*, over 75% of doctor’s visits involve patients with stress-related symptoms/illnesses. As personal trainers, we know that clients often come to the gym to “work off stress”, or “take it out on the weight stack”. Both represent prudent stress management actions. However, sometimes we need to dig a bit deeper and address the underlying causes of chronic stress.

Learning appropriate responses to stress can offer significant health benefits. The following often remain outside our scope of practice, but still merit mentioning to clients struggling with an emotionally-charged situation:

- **Determine the cause/Recognize the signs**
- **Develop a stress management plan/Ask for help ~ This often involves discussions with a trained professional, who can assist with ideas for** mindfulness techniques individualized to fit one’s lifestyle
- **Choose a wise plan ~** Prudent nutrition, sleep, and exercise habits can help mitigate the negative repercussions of chronic stress

## Social Engagement

As something literally encoded within our neurobiology, humans have a deep-seated need for interpersonal connectedness. Emma Seppala, Director of [Stanford’s Center for Compassion and Altruism Research and Education \(CCARE\)](#), identifies social connection as an integral aspect of physical, mental and emotional health. She further suggests that the *number of social contacts* pales in importance when compared with *the quality of relationships*. Whether on the giving or receiving end, shared experiences and emotional bonds create a connection that remains vital to our overall health and even longevity.

Working in a gym or fitness center, we can see close relationships develop among individuals who take the same group exercise classes, help spot each other on the weight room floor, or even participate in small-group personal training. However, many adults, especially those in the 70-90+ age bracket, remain isolated and lonely, thereby encouraging potentially damaging health issues.

If a client comes to you and expresses a need for support beyond that which friends and family can provide, perhaps consider mentioning a support group. Connecting with others who

understand and can empathize with one's feelings, or perhaps who have undergone a similar life experience, often helps mitigate stress. Such groups also offer inspiration and hope by witnessing others coping better with their issues since attending the group sessions.

### Gratitude and Reflection

The act of practicing gratitude has been found to confer many positive effects on both physical and emotional health. Simply by “counting our blessings” and focusing upon all the good in our lives, experts tell us we can improve our immune system functions and might even extend our lives.

The simple act of gratitude meditation can directly and positively impact brain function. The region of our brain known as the *amygdala*—the control center for emotional processing – specifically demonstrates changes with regular meditative practice. After an 8-week gratitude meditation program, participants exhibited a lower activation of their amygdala and a faster return to baseline activation after exposure to depictions of negative emotional stimuli while in a non-meditative state. This tells us that implementing a regular gratitude meditation practice facilitates the managing of negative emotions, thereby raising levels of self-confidence and self-acceptance.

### Cognitive Enhancement

According to a study conducted by the *Global Council on Brain Health*, we can challenge our cognition by engaging in a variety of activities throughout our lifetimes, inviting improvements in a host of brain functions.

As a leader in healthy-aging research, the *National Institute on Aging* tells us that diverse lifestyle changes which specifically focus upon cognition may improve memory, concentration, information processing and motor function. Cognitive enhancement may even reduce symptoms associated with neurodegenerative brain disorders such as [Parkinson's Disease](#). Physical exercise stimulates the production of Brain- Derived Neurotrophic Factor (BDNF), a hormone that stimulates formation of synapses between neurons (the basis of memory). Regular exercise actually fosters changes in our genetic makeup to code for an increased production of BDNF; such positive alterations can last for the duration of a lifetime, as long as regular exercise continues to figure prominently in daily life. All of this points to the cultivation of a healthier brain as we age.

By implementing lifestyle changes that expose us to a variety of cognitively stimulating activities and ideas as well as regular physical activity, the human brain will respond with new connections and increased function. Personal trainers working with an older clientele have a prime opportunity to do just that, by taking clients through challenging but still age-appropriate exercise patterns. Changing up workouts with regular frequency keeps clients mentally engaged as well as physically fit.

## Powering Through Perimenopause With Strength Training

*Perimenopause, the transitional period before menopause, signals the lessening of estrogen levels in a female's body. During this phase of life, which in some women can last for years, menopause-like symptoms such as hot flashes or irregular periods start to appear and continue with increasing regularity. Sleep disruption and weight gain sometimes ensue. Exercise and nutrition become a priority to ensure a healthy body, yet many individuals fail to realize its importance. Read on to learn how personal trainers can help clients navigate perimenopause with confidence.*

### The Science of Perimenopause

Perimenopause and its physiological effects bring about a myriad of undesirable changes. In addition to altered sleep patterns and decreased levels of energy, the loss of lean muscle mass and the redistribution of fat mass in the abdominal region represent two of the most common complaints during this transitional period of life. For many women, the onset of perimenopause symptoms occurs in their late 30's, with menopause not setting in until 50 years of age. Since this unique time in a female's life can represent up to a decade in length, integrating regular strength training programs and cardiovascular exercise can help offset some of bodily changes. We already know that maintaining muscle mass remains even more critical for facilitating bone density, thereby reducing injury risks as we age. Research now indicates that exercise in general can help individuals face the aging process with greater success.

### Significant Health Changes

Personal trainers can better help clients work smarter through this phase of life by understanding exactly how perimenopause impacts the body on many levels ~

- Alterations in the musculoskeletal system as a result of lowered levels of circulating estrogen cause a reduction in muscle size as well as its ability to generate force (sarcopenia). This often progresses to the appearance of osteoporosis and/or osteoarthritis.
- Aging causes ligaments and muscle tendons to have reduced biomechanical function.
- Changes in the cardiovascular system, specifically a thickening and stiffening of the cardiac muscle and its accompanying vascular system, diminish blood flow and the exchange of oxygen and nutrients with tissues.
- The nervous system tends to lose neurons, leading to the slowing of nerve signal transmission. This can bring about a dip in cognitive function, and also impairs the ability of the nervous system to repair itself after injury.
- Loss of estrogen can potentially hasten the hallmarks of dementia.



- Low estrogen affects the genitourinary system, causing problems with the urethra, vulva, and vagina, reducing their resilience and exacerbating urinary and sexual symptoms/pelvic floor dysfunction.

### The Benefits of Exercise

Even for women unaccustomed to regularly working their bodies, a prudent exercise program during perimenopause typically includes cardiovascular activities, strength training and balance/flexibility practices (yoga, Pilates, T'ai Chi).

Experts suggest aiming for 2.5 hours of moderate aerobic activity per week, due to the following benefits ~

- By increasing cardiorespiratory function, exercise lessens the metabolic risks associated with declining estrogen.
- Exercise may bring about a reduced risk of high blood pressure, heart attack and stroke.
- By creating a calorie deficit, individuals can help counter or eliminate weight gain.
- Activities that cause an impact, such as walking or jogging, can build bone mass and help to offset the tendency toward osteoporosis.
- Exercise may help reduce low back pain and overall stress levels while elevating one's mood.

Finding a mode of exercise that a client enjoys guarantees she will remain consistent in her participation over time. Some general suggestions might include ~

- Swimming
- HIIT workouts
- Running
- Walking
- Cycling
- Elliptical machine
- Step machines
- Dancing, jumping rope, and team sports such as tennis, basketball or volleyball can work as safe options if a client has no presentation of osteoarthritis or severe osteoporosis.

Encourage clients to try out several of these activities to help alleviate boredom and ensure consistency while presenting new and fun ways to challenge their bodies.

Resistance Training During Perimenopause and Beyond

Sadly, at or around the tender age of 30, our bodies begin losing approximately 1% of their hard-earned muscle mass each year. Because metabolically active muscle tissue burns fat, the loss can cause fat-based weight gain.

Resistance training can help increase muscle power as well as bone density, and help improve hormone levels and metabolism.

The CDC recommends performing strength training at least 2x/week, ideally 3, targeting all of the major muscle groups in the body. Experts suggest not working the same muscle group(s) 2 days in a row. Lots of options exist for weightlifting, including some for which one need not have access to a fitness center ~

- Body weight exercises (squats, pull-ups and push-ups)
- Dumbbells/Barbells/Kettlebells
- Resistance bands
- Cables or weight machines
- Medicine balls
- Weighted household item, such as a water jug, a gallon of milk, or a full laundry detergent container

[Dr. Stacy Sims](#), a member of *Stanford Lifestyle Medicine*, suggests that women challenge themselves to lift weights heavy enough to near failure, 3-5 sets of 4-6 reps. “Overall, [we are] breaking the stigma that women need to prioritize long, endurance exercises and exclusively body weight work because they offer little benefits for body composition or lean mass during this time. Instead, lifting heavy (whatever that means to you) will help most during this transitional period,” says Stacy Sims, PhD, MSc, Exercise Physiologist.

### Sample Program

In addition to one’s cardiovascular activity of choice, perimenopausal females might consider starting weightlifting with a sample program that will hit all major muscle groups ~

- Squats performed on a Smith machine or with weights
- Lat pull downs
- Leg presses, either both legs together or unilaterally
- Dumbbell military presses
- Seated rows
- Back extensions

As strength increases, slowly and prudently increasing the amount of resistance used will help prevent a plateau.

### Research Strengthens this Position

One research study on resistance training included 31 women experiencing perimenopause. The aim was to observe the changes in fat-free body mass, lean muscle tissue and muscle

thickness following a regimen of regular weightlifting. At the conclusion of the study, all of the above increased significantly.

The *National Strength and Conditioning Association* (NSCA) advocates for higher intensity lifting for women past the age of 50: 2 to 3 sets of 1 or 2 multi-joint exercises for every major muscle group, at 70 to 85% of 1 RM. NSCA also suggests women include power exercises performed at higher velocities, with moderate intensities hovering around 40–60% of 1RM. Ample research suggests that a female can build hypertrophy using a variety of repetition ranges. Switching up an exercise routine every few weeks, at different intensities and rep ranges, helps alleviate boredom and generates a constant challenge for the body.

### Improving Bone Mineral Density

The bones in a human body represent a perfect example of the adage that “form follows function”. Bone density and bone remodeling occur at different rates. Approximately 80% of bone mass comes under the classification of *cortical*. The spongy trabecular bone boasts a higher surface- to -volume ratio than cortical bone. As we age, the cortex of a bone increases in its porous quality, gaining surface area but, unfortunately, losing strength. In the long bones, increased porosity near the periosteal surface leads to a greater loss of strength than increased porosity near the endocortical surface.

Both cortical and trabecular bone play important roles in bone strength. The spine and its vertebrae constitute the quintessential trabecular bone site; doctors consider vertebral compression fractures a strong indication of osteoporosis. However, the thin cortical shell also plays a key role.

The hip represents cortical bone, but both cortical and trabecular bone contribute to the strength of the femur. Interestingly, the contribution of the cortical bone takes on a larger role in femurs with lower trabecular bone density. In addition, cortical bone supports bending in the distal region of the femoral neck, while the trabecular bone supports the proximal load. The trabecular bone of the spine remodels more rapidly than the cortical bones of the hip and wrist. Under optimal conditions – in a young person, for example – bone remodeling can take anywhere from 4 to 6 months; any measurable effect that strength training may have on this process often takes years to show. In contrast, increases in bone density reveal themselves more rapidly in the presence of resistance training. Some studies show that bone density improvement can occur when a woman engages in five key resistance exercises: hip extension, knee extension, lateral pull-down, back extension, and abdominal flexion. If one performs these moves at 80% of 1RM, 3 sets of 8 reps per exercise, 2x/week over the course of a year, bone density will greatly improve.

Imagine a physician informing his perimenopausal patient that her bone density actually improved after engaging in a regular regimen of strength training. At this time of a woman’s life, when she feels her body changes represent a constant upward battle, such news could provide just the impetus she needs to keep moving forward with her new exercise regime!

## Perimenopause and Weight Gain

Women tend to blame abdominal weight gain, during both perimenopause and menopause, on hormonal shifts; however, this does not fully explain the reality. More often, such gains relate to the aging process itself as well as genetics and lifestyle.

As mentioned above, the loss of lean muscle mass decreases the rate at which the body burns calories (metabolic rate). Knowingly allowing this to occur makes maintaining a healthy weight for one's height even more of a challenge. If we consider a simple calories in/calories burned scenario, continuing to eat as much as one did prior to perimenopause, and in the absence of increasing activity levels will no doubt cause the number on the scale to nudge upward.

Sadly, especially in this country, the majority of individuals exercise less as they age. For those who remain active, genetics may dictate the distribution of weight around the midsection, providing yet another obstacle difficult to overcome. Losing interest in preparing healthy meals often occurs in older Americans, as does lack of proper sleep. When people fail to achieve a full night's rest, they tend toward excess snacking and more "mindless eating", leading to the consumption of excess calories.

At this stage of life, excess body fat comes at a cost: weight gain during perimenopause and menopause can seriously affect a woman's health. Many of the health issues commonly reported to doctors include breathing complications, heart disease, joint problems and type 2 diabetes. Several cancers pose increased risks associated with weight gain, including breast, colon and endometrial cancers.

Changes in one's lifestyle that include cardiovascular activity and weight-bearing exercises add up to an easier time maintaining weight, increasing metabolism, and thwarting many health problems.

## Protein Needs

Many a dietitian will recommend that adults aim to take in 0.8 grams/kilogram of body weight in lean protein each day. For a female weighing 120 pounds, this translates roughly to 43.5 grams of daily protein. For a sedentary individual this may suffice; but not for a female in the perimenopausal years who remains active and incorporating strength training into her regular lifestyle.

The 2023 *International Society of Sports Nutrition* recommends "Daily protein intake should fall within the mid-to-upper ranges of current sport nutrition guidelines (1.4–2.2 grams/kg body weight/day) for women, with protein doses evenly distributed every 3 to 4 hours across the day." This number far exceeds the previous standard, and highlights the need for active perimenopausal women to ingest sufficient high-quality lean protein to fuel the building of muscle mass.

## Exploring the Pro's and Cons of Creatine Use

The topic of whether to take over-the-counter supplements as a way of gaining an athletic edge often sparks debates on both sides of the fence. Creatine, a substance naturally produced in the human body, typically tops the list of supplements for bodybuilders as well as competitive athletes. In the United States, athletes spend close to \$14 million every year on creatine supplements. Here we discuss the efficacy, safety and potential health risks of consuming this product.

### What Drives the Popularity of Creatine?

Creatine monohydrate supplementation aims to deliver a greater and prolonged accrual of athletic gains. The attraction of creatine lies in its purported potential to increase lean muscle mass and enhance athletic performance, particularly during sports that demand short bursts of high intensity work (for example, high jumping, sprinting and weightlifting). Competitive athletes hope that such increases will ultimately play a vital role in maximizing workouts, thereby allowing for greater and ongoing sports-specific muscle adaptations.

### How Creatine Works

Creatine, produced by the human body in the liver, kidneys, and pancreas, gets converted into creatine phosphate or phosphocreatine. This compound resides within the muscles, where it serves as an energy source. During high-intensity, short-duration exercise, phosphocreatine gets called upon to help produce adenosine-triphosphate (ATP), the predominant carrier of energy throughout the human body.

As a result of such all-out high-intensity activities lasting 4-15 seconds in duration, ATP gets rapidly depleted; *however, it declines very little until stores of phosphorylated creatine get exhausted. Therefore, phosphorylated creatine, armed with its high-energy phosphoryl transfer potential, serves to maintain intracellular adenosine triphosphate (ATP) levels.* Creatine elevates anaerobic capacity considerably by raising the natural levels of the phosphorylated form of the compound, allowing intracellular concentrations of ATP to remain at higher levels for longer periods, permitting athletes to maintain greater training intensity and quality/quantity with each workout.

Creatine tends to increase the water content in muscle cells. This leads to the appearance of swollen muscle bellies, or the “pump” that so many weightlifters seek in the mirror at the gym. Such swelling may produce signals for muscle growth to occur, largely by increasing levels of the growth hormone IGF-1.

### Scientific Research Seems Positive

Volumes of data exist attesting to the success of creatine supplementation. Studies show that taking creatine in appropriate amounts delays fatigue by lessening the decreases in muscle pH

brought on by intense exercise, thereby allowing less reliance on the process of glycolysis. Diminished fatigue often goes hand-in-hand with improved complete recovery, a key aspect for any dedicated athlete. Supplementing with creatine may also foster the reduction of certain types of muscle damage resulting from high intensity resistance training and endurance exercise. Creatine increases the metabolic capacity of the target tissues, such as the capability of a muscle to contract more powerfully for a longer duration.

### Other Applications

In addition to potentially enhancing athletic abilities, research shows that creatine supplementation may foster better injury prevention, thermoregulation and “neuroprotection” in the case of concussion. This potentially opens the door for some clinical applications of creatine supplementation; studies have already looked at neurodegenerative diseases (e.g., muscular dystrophy, Parkinson’s and Huntington’s disease), diabetes, osteoarthritis, fibromyalgia, aging, brain and heart ischemia, and adolescent depression. Much more research will help shed light on more possible medicinal uses of creatine.

Some research studies indicate that creatine may play a role in preventing the severity of an athletic injury, even possibly enhancing the all-important rehabilitation process following an injury. Most likely this occurs as a result of the anti-inflammatory and anti-catabolic characteristics of creatine.

### Bone Strength

Personal trainers as well as physicians recognize that strength training can have a positive effect upon bone strength, attenuating bone loss that potentially leads to osteopenia and/or osteoporosis. Emerging research indicates that creatine supplementation may have favorable effects on measures of bone biology, caused largely by creatine’s ability to influence high-energy phosphate metabolism, growth factors, muscle protein kinetics, and the bone remodeling process.

In one study, creatine supplementation given to growing rats at 5 weeks of age over the course of 8 weeks significantly increased lumbar bone mineral density and distal femur bone strength when compared with a placebo. The authors speculate that creatine may have influenced the development of trabeculae during bone formation. Trabeculae, or the inside spongy part of bone, act like a network of supporting beams to provide strength and support to the bones.

### Heart Disease

Preliminary studies suggest that creatine supplements may help lower elevated levels of triglycerides (fats in the blood) in both men and women. In studies involving individuals with prior heart failure, those who took creatine in addition to their standard medical care increased the amount of exercise they could perform before fatigue set in, compared to those taking a placebo. Tiring easily ranks as a primary indication of heart disease. Another study of 20 subjects with heart failure found that short-term creatine supplementation in addition to standard medication helped to increase body weight and improve muscle strength. Creatine



also boasts the ability to lower circulating levels of homocysteine, a compound associated with heart disease, heart attack and stroke.

### Creatine for Women

A woman's body, and a female athlete's body in particular, reacts to creatine differently than what we see in men. Admittedly, the use of creatine among females has not received quite as much attention or research. Typically, women's bodies possess smaller amounts of creatine than their male counterparts; yet some emerging evidence indicates that taking creatine can increase strength, bone health and exercise performance, especially as women age. Some studies show promise for creatine supplementation as positively helping with mood and cognitive processing by elevating energy levels in the brain. The possibility exists that creatine may have even more benefit for women than for men. More study in the near future will reveal exactly how creatine works in women of different ages.

### Obtaining Creatine Through Food

Even though the human body itself produces creatine, some athletes turn to supplementation in a more holistic manner. Certain foods naturally contain higher levels of creatine, most notably those rich in protein ~

- Pork
- Beef
- Fish/Shellfish
- Animal milk, including cow, sheep, and goat

Whether or not one can derive levels of creatine from savvy food choices equivalent to that which over-the-counter supplementation offers remains up for debate.

### Types of Creatine Supplements

As with many other kinds of supplements, one can obtain creatine in any number of different chemical forms ~

- Creatine monohydrate – the most common type found in supplements. This form receives more research attention than any other.
- Creatine ethyl ester – studies suggest that it does not perform as well as creatine monohydrate.
- Creatine hydrochloride – dissolves in water better than creatine monohydrate, but lacks evidence that it works any better to build muscle.
- Creatine magnesium chelate – has not received much study.
- Buffered creatine monohydrate – one study considered whether a buffered form of creatine monohydrate would enter the muscle better to improve exercise capacity. Results failed to support this hypothesis.

- Liquid creatine – same as the powdered form only in a liquid.

The majority of large-scale research studies have looked at creatine monohydrate. Not much evidence exists to endorse other forms of the compound. As with any athletic supplement, consulting with a trusted medical expert prior to use always proves prudent.

### Side Effects of Creatine Use

Although the vast majority of competitive athletes who choose to utilize creatine supplementation experience little to no disturbing side effects, it can in fact have negative repercussions, especially when one exceeds suggested dosages. The following list outlines some of the more commonly reported side effects ~

- Weight gain
- Anxiety
- Breathing difficulty
- Fatigue
- Fever
- Headache/dizziness
- Nausea/vomiting/diarrhea
- Rash
- Muscle cramps
- Muscle strains/pulls
- Stomach upset
- High blood pressure
- Liver dysfunction
- Kidney damage

Ingesting caffeine and ephedra along with creatine can often heighten the risk of side effects.

### What Happens Upon Cessation of Creatine Supplements?

If an athlete has tried creatine for a short while and then decides not to continue its use, circulating levels will decrease over the course of a few weeks. The body will continue to manufacture it as always, albeit to a lesser extent at first; however, one may notice side effects as the body readjusts to having less creatine. These include ~

- Fatigue
- Muscle loss
- Weight loss

If one continues his regular weightlifting regimen, he may retain his strength, but may lack the ability to continue making great strides in strength gains.

### Safeguarding Kidney Function

Creatine use has the potential to exacerbate existing kidney disease. Always consult with a physician if a familial history of kidney problems might prove detrimental. If kidneys seem to function normally, most experts do deem it safe to go forward with creatine use. Studies show that consuming no more than 5 grams of creatine/day may confer some strength and overall health benefits.

### Frequently Asked Questions Regarding Creatine Supplementation

- **Does creatine increase testosterone?**

Studies have addressed this issue, but with mixed results. A study of rugby players found no change in testosterone among creatine users. However, levels of dihydrotestosterone did increase.

- **When should one ingest creatine?**

Some evidence suggests the supplement may work better following heavy exercise rather than before. A dearth of data exists on this point, so currently experts feel the timing may not make a significant difference.

### Additional Concerns

Since the human body does manufacture creatine, many individuals feel safe taking it as a supplement. However, “naturally occurring” does not necessarily mean “safe”. Since over-the-counter supplements do not need to conform to the same FDA standards as medications, it proves difficult to know exactly what goes into a product or in what quantities.

Taking creatine as a supplement to foster an edge in athletic prowess can potentially increase muscle creatine content by as much as 40% beyond its normal levels. Scientists continue to debate this result as safe or not.

Researchers still do not agree on the long-term effects of taking creatine supplements in individuals under the age of 19. Some supplements market directly and specifically to teens, claiming to help alter their body composition even in the absence of exercise. As a result, one survey conducted with college students found that teen athletes frequently exceed the recommended loading and maintenance doses of creatine.

For individuals living with liver disease or diabetes, creatine use sends up an immediate red flag. Children under the age of 18 as well as women who are pregnant/nursing should likewise avoid use. There are no data documenting the safety of creatine in children or adolescents. The *American Academy of Pediatrics* and the *American College of Sports Medicine* warn that teens should not use performance-enhancing supplements, including creatine, because of the possible health risks.

One might choose to consult with a pharmacist if he currently takes any medication or supplement that could affect blood sugar, because creatine may also affect blood sugar levels. Also, creatine use may exacerbate manic episodes in those individuals living with bipolar disorder.

### Key Factors to Consider Prior to Purchasing/Using Creatine for Strength Gains

Whether or not one chooses to pay attention to the aforementioned potential risks of creatine use, we suggest heeding the following ~

- Thoroughly examine product labels
- Learn about the source, purity, and potency of key ingredients
- Choose only products backed by scientific research
- Check for potential allergens contained in the supplement

### The Bottom Line

While it certainly may have its strengths, not all human studies show that creatine improves athletic performance, nor does every person seem to respond the same way to creatine supplements. Individuals who tend to have naturally high stores of creatine in their muscles do not seem to derive any energy-boosting effect from extra creatine. Creatine may improve strength, increase lean muscle mass, and help muscles recover more quickly following exercise. This muscular boost particularly helps athletes achieve bursts of speed and energy, especially during short bouts of high-intensity activities such as weightlifting or sprinting. However, scientific research on creatine continues to show mixed results. Although some studies show that it does help improve performance during short periods of athletic activity, no evidence proves that creatine helps with endurance sports like running longer distances. Do some research prior to making any definitive decisions...then, supplement wisely.

# Personal Trainers Can Positively Influence Public Health Initiatives

*Physical inactivity, and the health problems that follow in its wake, recently attained pandemic status. Addressing this problem falls under the category of a global public health priority. Many countries throughout the world have developed policies and guidelines for promoting/prescribing participation in physical activity as a successful means of intervention for chronic health conditions. We no longer need to rely solely upon endorsements by elite athletes to spread this message. Personal trainers and other exercise professionals who provide services to the general community can help influence public health initiatives. Read on to discover how trainers can get involved in the life-affirming realm of public health and policymaking.*

## Public Health Defined

How do we view health care within the United States? Do we conjure up images of physicians and hospitals, pharmacists dispensing medications, dentists performing routine cleaning, free clinics serving impoverished neighborhoods? While these ideals do reflect our current health care system, there exists an entirely separate sector of care that significantly and undeniably impacts the well-being of our community members: public health.

We can think of public health initiatives as those which seek to promote prevention, as opposed to providing care for and cures to illnesses. Professionals who work in this field take on the daunting responsibility of promoting and protecting the health and welfare of communities. We trust, and have come to rely upon, our clinicians for treating individuals living with various illnesses; just imagine a world in which we have public health professionals striving to prevent us from getting sick in the first place.

Physical inactivity, identified by the World Health Organization as the 4<sup>th</sup> highest risk factor for global mortality, profoundly affects the prevalence of disease and deteriorates the general health of populations. Decades of evidence indicates that adequate levels of physical activity, such as prescribed exercise, can serve not only as an effective intervention for prevention of many chronic health conditions; regular exercise works towards improvement of mental health and overall quality of life.

## Health Equity

All public health positions operate on some level towards the fulfillment of the three core functions of public health: *assessment, policy development, and assurance*. They have coined the term “health equity” to define these principles.

A task force of public health experts, medical professionals and employees from the *Centers for Disease Control and Prevention* (CDC) developed this framework to outline the public health activities all communities should undertake. Learning about this can help personal trainers commit to becoming more enmeshed in the quest to promote exercise within these parameters.

## Assessment

- Provides organizations with comprehensive information about a community's health status, needs, and challenges
- Develops community health improvement plans, determining how best to allocate potentially scarce resources
- Investigates, diagnoses, and addresses hazards affecting the population

## Policy Development

- Communicates effectively to inform and educate people about health, factors that influence it, and how to improve it
- Strengthens, supports, and mobilizes communities and partnerships to improve environmental health
- Creates and implements policies, plans, and laws that impact community health

Public policy serves as one of the most effective ways to improve the health of communities. Public health professionals, which include exercise instructors and personal trainers/coaches, play an important role in public policy development. By inserting themselves into a community and cultivating the proper relationships with medical teams, exercise professionals serve as assets in promoting and implementing healthy interventions.

## Assurance

This branch focuses on ensuring that the findings gathered through assessment and policy-related research get properly and effectively implemented.

- Utilizing legal and regulatory actions to improve/ protect the public's health
- Ensuring equitable access to the services and care needed for a healthy community
- Developing and supporting a diverse and skilled public health workforce
- Improving and innovating public health functions through ongoing evaluation, research, and continuous improvement
- Building/maintaining a strong organizational infrastructure for public health

## The Far-Reaching Potential of Exercise Professionals

The *American Public Health Association* offers many suggestions for health coaches and exercise professionals to consider. The potential exists for us to extend our skills outside of just gyms and fitness centers, thereby reaching so many more individuals, especially those in underserved areas of the community. The following statistics merely scratch the surface of the core health challenges we face in our country ~

- **Lacking support and feeling excluded within a social community can have a negative effect on mental and physical health**
- **While public health resources exist in a community, often physical, mental, financial, cultural and language barrier challenges stand in the way of easy access**
- **Fitness professionals must remain open to communities of color, LGBTQ+ individuals, and those living with disabilities. *Only by listening and responding appropriately can we ensure that public health remains fair and accessible for all members of society***

For fitness professionals, addressing these points hinges on finding creative ways to build a sense of community centered on physical activity and wellness. Local health fairs allow trainers to establish their names within a community while building trust among individuals, all of which contribute to making a positive impact on public health. As people become more active, they come to view their community and the role you play as a source of social support. Once you have helped people establish a physically active way of life, improved physical and mental health will follow.

### Overcoming Barriers

Helping clients and community members overcome barriers to accessing health resources represents a key area where health coaches and exercise professionals can make a difference. Very often members in your community lack the financial resources to join a gym. Sometimes the barrier rests on a lack of reliable transportation to and from a recreational facility. Perhaps physical or mental health conditions exist that limit one's ability to exercise in a traditional manner. In our country's "melting pot" of diversity, cultural and language barriers render some communities isolated.

By learning and possessing a willingness to *think outside the traditional box*, health coaches and exercise professionals can serve populations in creative ways. We might consider offering opportunities to improve people's health/wellness in churches, parks, municipal centers and even personal homes.

Ensuring equity, a significant public health concern within communities, involves taking into consideration how we might work to correct existing disparities. Are wheelchair ramps easily accessible where you plan to exercise? Do you speak a second language in addition to English that might prove useful should you wish to start a workout program in certain neighborhoods? Are there resources for the LGBTQ+ community that might be interested in adding physical activity to their list of offerings? When it comes to public health, *equity often means finding people where they currently gather and offering to work with them there.*



## Responsibility Rests in our Hands

As a society, we may acknowledge the problem of physical inactivity; but who bears the locus of responsibility? Professionals in the fitness industry can achieve status as a valuable public health resource as well as an essential component in the *delivery of policy recommendations*. Researchers, politicians, industry organizations, and policymakers support viewing fitness professionals as assets towards change. In the most recent edition of the *Fitness Professional's Handbook*, authors state that "Fitness professionals are at the cutting edge of health in much the same way that scientists discovering vaccines for major diseases were at the turn of the 20th century."

The former president of the *American College of Sports Medicine* (ACSM), Robert Sallis, recognizes that fitness experts can figure prominently in what he calls the "war" against inactivity. He goes on to add, "[W]e must begin to merge the fitness industry with the healthcare industry if we are going to improve world health.... With a wealth of evidence in hand, it is time for organized medicine to join with fitness professionals to ensure that patients around the world take their exercise pill. There is no better way to improve health and longevity."

For many years, researchers in the field of kinesiology discounted and/or failed to recognize fitness professionals as potential beacons of enlightenment. Given that for a majority of working adults, fitness professionals will serve as key points of contact for physical activity and exercise support, the need for research to move in this direction seems straightforward. In 2005, Hal Lawson, Professor in the Department of Educational Policy & Leadership at SUNY-Albany, spoke of the urgent need for sport, exercise, and physical education professionals to collaborate with other professions, "enabling the various programs and services to be connected and integrated as part of a growing international movement that promotes inter-professional collaboration." In some countries, schools have tried to introduce students to community fitness facilities and instructors as part of their curriculum. If a gap exists within a community regarding knowledge about fitness professionals and what we do, any attempts to offer a consistent approach to physical activity education and the ensuing health initiative improvements get undermined and often derailed.

## Which Comes First?

While empowered community development helps promote sports, exercise and physical education (SEPE) professionals, strategically designed SEPE practices, programs, and policies offer improvements to community development initiatives. This unique duality can empower trainers to get involved with groups that strive to build collaboration with those who do not possess the capacity or willingness to evolve into elite athletes.

We can remain open to collaboration with other professionals—especially social workers—who delve into empowerment and community development, such as those working in anti-poverty

arenas and community building. As SEPE professions develop this capacity to serve as leaders within a community, entirely new possibilities will pop up. We can contribute to sustainable, integrated social and economic development. When SEPE programs benefit development, local governments often view them as worthwhile investments for funding.

### Joint Collaboration

SEPE professionals can join a growing international movement that promotes “interprofessional collaboration”. This translates to professionals from different fields knowing they can depend on each other; therefore, they display a willingness to work and learn together. In many parts of the world where such a dynamic already exists, the inter-professional collaboration movement connects to university–school–community partnerships and to interprofessional education and training programs.

Empowerment-oriented and community-based SEPE programs and practices may contribute to sustainable development in five related areas:

- enhance human health and well-being across the lifespan
- reduce the harm brought about by poverty, social exclusion, social isolation, and inter-group conflict
- contribute to human capital development, especially among vulnerable youth
- develop collective identities, thereby facilitating collective action
- foster social networks and voluntary associations, which bring about strong democracies

Fitness professionals have so much to offer in these aforementioned arenas. We need to possess the confidence and willingness to leave the gym and enter yet one more area in which we know we can have a profound effect on public health nationwide.

SEPE professionals, practices, programs, and policies have the potential to strengthen both empowerment and community development initiatives, especially in high poverty areas who already experience social exclusion, social isolation, and inter-group hostility, unfortunately often on a daily basis. To the extent that SEPE professionals engage in such local endeavors, they can actually see themselves as contributing to national and international agendas for sustainable, integrated social and economic development.

### Bottom Line

Nationally certified professional exercise organizations (AFAA, ACE, NSCA, NACM, NFPT, to name a few) strive to deliver exercise-science and behavior-change education in ways that are engaging and compelling, recruiting more people to become exercise professionals and health coaches. Employees of such certifying bodies – and by extension, those among us who have sought out and hold these various certifications — drive innovation in the area of behavior-change programming, helping the public adopt and sustain healthier lifestyles. We can promote science-based programs and interventions and integrate them into aspects of public health.

If as personal trainers you find yourselves drawn to more than just the fitness center environs, you may consider branching out and dedicating your careers to promoting, protecting, restoring, and improving the health of your communities. Public Health professionals need exercise experts to foster one of the most important aspects of overall well-being.

# Mind-Body Interventions for Stress Reduction: A Comparative Analysis of Yoga, Meditation, and Tai Chi

In today's fast-paced world, stress has become an inevitable part of daily life, affecting both mental and physical well-being. The quest for effective stress-reduction techniques has led to the widespread adoption of mind-body interventions such as yoga, meditation, and Tai Chi. These practices are rooted in ancient traditions but have gained modern recognition for their scientifically validated benefits in managing stress. This article delves into the evidence-based research on the comparative effectiveness of yoga, meditation, and Tai Chi for stress reduction, exploring their unique approaches, mechanisms, and outcomes.

## The Growing Importance of Stress Reduction

Stress is a physiological response to perceived threats, triggering a cascade of reactions in the body that can have both short-term and long-term effects. Chronic stress has been linked to various health issues, including cardiovascular disease, weakened immune function, mental health disorders, and decreased quality of life. As traditional medical approaches often focus on symptom management, there has been a shift towards holistic methods that address the root causes of stress. Mind-body interventions like yoga, meditation, and Tai Chi are increasingly recognized for their ability to balance mental and physical states, promoting relaxation and resilience [against stress](#).

## Yoga: A Holistic Approach to Stress Management

[Yoga](#) is an ancient practice that originated in India and has evolved into various forms, each focusing on different aspects such as physical postures (asanas), breathing techniques (pranayama), and meditation. It is a comprehensive mind-body practice that integrates movement, breath control, and mindfulness to foster mental clarity and physical relaxation. Several studies highlight yoga's effectiveness in reducing stress. One such research, titled "Mind-body exercises for attention-deficit/hyperactivity disorder: A quantitative evidence of experimental studies," demonstrates the benefits of yoga in improving attention and reducing stress among individuals with ADHD ([PDF Link](#)). The physical postures combined with breath control create a calming effect on the nervous system, reducing the production of stress hormones such as cortisol. Yoga also promotes body awareness, which can help practitioners recognize and address stressors before they escalate into chronic conditions.

In addition to improving mental health, yoga has been shown to enhance immune function, as highlighted in a meta-analysis published in *PLOS ONE*. This study examined the effects of yoga, Tai Chi, and meditation on the immune system and found that these practices help regulate immune responses, reduce inflammation, and lower stress-induced immune suppression ([Full Text](#)). By calming the mind and body, yoga not only reduces stress but also strengthens the body's ability to cope with it.

## Meditation: Cultivating Mindfulness for Stress Relief

[Meditation](#), often regarded as the foundation of mindfulness practices, involves focusing attention and eliminating distractions to achieve mental clarity and emotional calm. There are many forms of meditation, including mindfulness meditation, loving-kindness meditation, and transcendental meditation, all of which aim to quiet the mind and reduce stress.

The practice of meditation has been widely studied for its effects on stress reduction, with compelling evidence supporting its role in promoting mental well-being. A study published in *Frontiers in Human Neuroscience* explores the neurobiological changes that occur with regular meditation practice. It found that a 12-week yoga and meditation lifestyle intervention led to significant increases in brain-derived neurotrophic factor (BDNF) and cortisol awakening response, both of which are linked to stress regulation and resilience ([Full Text](#)). These findings suggest that meditation can effectively rewire the brain's response to stress, making it a powerful tool for long-term stress management.

Another notable study compared different types of mind-body therapies, including meditation, Tai Chi, and yoga, in their applications for neurology. This research emphasized the use of meditation-based interventions in improving stress resilience among patients with neurological conditions, such as multiple sclerosis and epilepsy ([Full Text](#)). Meditation's ability to regulate the autonomic nervous system by shifting the balance from sympathetic (stress) dominance to parasympathetic (relaxation) dominance is a key factor in its stress-reducing effects.

In addition to its physiological benefits, meditation enhances emotional regulation. Regular practice has been shown to reduce anxiety, depression, and stress by increasing mindfulness and emotional awareness. By cultivating a non-judgmental awareness of the present moment, meditation helps practitioners detach from stress-inducing thoughts and emotions, leading to a more balanced and peaceful state of mind.

## Tai Chi: The Art of Gentle Movement and Stress Reduction

Tai Chi, a Chinese martial art that focuses on slow, deliberate movements and deep breathing, is another popular mind-body intervention for stress reduction. Often referred to as "meditation in motion," Tai Chi integrates physical movement with mental focus, promoting relaxation, balance, and mental clarity. Research has consistently shown that Tai Chi can significantly reduce stress and improve overall well-being. A systematic review of Tai Chi and Qigong, another mind-body practice, found that these practices were effective in improving mood and reducing stress levels ([PDF Link](#)). Tai Chi's emphasis on slow, flowing movements helps calm the mind and body, reducing the production of stress hormones and promoting a state of relaxation. A study comparing Tai Chi with other interventions, such as yoga and meditation, found that Tai Chi was particularly effective in reducing anxiety and depression among older adults. The gentle, low-impact nature of Tai Chi makes it accessible to people of all ages and fitness levels, and its benefits extend beyond stress reduction to include improvements in balance, flexibility, and cardiovascular health ([PDF Link](#)). Moreover, Tai Chi's focus on mindfulness and breath control allows practitioners to enter a meditative state while engaging in physical activity, making it a comprehensive mind-body practice for stress relief.

## Comparative Effectiveness of Yoga, Meditation, and Tai Chi

While each of these mind-body interventions offers unique approaches to stress reduction, they share common underlying mechanisms, such as breath control, mindfulness, and movement, which activate the body's relaxation response. However, there are distinct differences in how they achieve these outcomes.

- **Yoga:** Combines physical postures, breath control, and meditation to balance the body and mind. Its physical component sets it apart from other practices, offering the additional benefit of improving strength, flexibility, and balance. Yoga is particularly effective for individuals who prefer a more active approach to stress reduction.
- **Meditation:** Focuses primarily on cultivating mindfulness and mental clarity. It is an ideal practice for those seeking to manage stress through mental focus and emotional regulation. Meditation is also highly adaptable, as it can be practiced anywhere, without the need for specialized equipment or space.
- **Tai Chi:** Integrates slow, deliberate movements with breath control, offering a more dynamic form of meditation. Tai Chi is especially beneficial for older adults or individuals with mobility issues, as it provides gentle physical exercise while promoting mental relaxation.

A comprehensive review comparing these practices for stress reduction among healthcare workers found that all three interventions were effective in reducing occupational stress. However, the study suggested that yoga might have a slight edge in terms of physical benefits, while meditation and Tai Chi were more effective in improving emotional well-being ([PDF Link](#)).

## Conclusion

In the face of increasing stress levels in modern society, mind-body interventions such as yoga, meditation, and Tai Chi offer effective, accessible solutions for managing stress and improving overall well-being. While each practice has its unique strengths, they all share the ability to calm the mind, regulate the nervous system, and promote resilience against stress.

Yoga's combination of physical and mental practices makes it an excellent choice for those seeking to improve both mental and physical health. Meditation, with its focus on mindfulness and emotional regulation, is a powerful tool for cultivating mental clarity and reducing emotional stress. Tai Chi's gentle movements and meditative focus offer a dynamic approach to stress reduction, particularly for individuals seeking a low-impact exercise.

Ultimately, the choice between yoga, meditation, and Tai Chi depends on individual preferences and needs. Some may benefit from the physicality of yoga, while others may find peace through the stillness of meditation or the flowing movements of Tai Chi. Regardless of the chosen practice, incorporating these mind-body interventions into daily life can lead to profound improvements in mental and physical health, providing a natural and sustainable way to manage stress in today's demanding world.

## Thinking of Branching Out? Learn About BCAA Supplementation

*In September of 2024, we presented an article highlighting the pro's and cons of creatine use for serious bodybuilders. This month, we continue our series on sports supplementation with a detailed look at branched-chain amino acids, more commonly referred to as BCAAs. Read on to learn about their diverse and potent abilities to enhance any intense muscular or endurance workout.*

### Protein: The Anabolic Ally

When working with clients, trainers often encounter individuals seeking to “tone up” or “get in better shape”. These phrases most likely describe about 90% of gym members. Those who seek to cultivate a true bodybuilder’s physique, however, tend to proceed in a very different manner. Adding lean muscle mass properly requires dedication not only in the gym, but in the kitchen as well.

This author can speak from personal experience regarding the difficulties associated with consuming lean protein in the vast amounts required to successfully compete in bodybuilding. Even with a keen eye on meal preparation, many aspiring athletes find themselves falling short at the end of each day. In this case, supplementation can serve as a valuable tool.

Amino acids, known as the building blocks of protein, figure prominently when designing a mass-gaining regimen. Of the 20 amino acids required to build a complete protein source, scientists categorize only 9 of these as *essential*, meaning the human body lacks the ability to synthesize them; therefore, one must consume them through nutritional sources. They include *phenylalanine, valine, tryptophan, threonine, isoleucine, methionine, histidine, leucine, and lysine*. Of these 9, sports nutrition experts and scientists tend to hone in on only 3: leucine, isoleucine and valine, categorized as branched-chain amino acids (BCAAs).

### Definitive Structures and Metabolism

Branched-chain amino acids have amassed quite a bit of popularity during the last few decades, mostly due to their effects (and common use) within the bodybuilding community. We now know that BCAAs go far beyond simply serving as building blocks for muscle tissue; they can also affect muscle growth through some rather unique pathways in the body.

The name “branched-chain amino acids” comes from the structure of these compounds. Each one boasts a specific forked outcropping that resembles a branch. BCAAs comprise roughly a third of the total amount of amino acids found within muscle tissue.

The unique metabolic processes of BCAAs allow them to impact nearly every aspect of serious strength training. Countless studies designate them as powerful performance enhancers, and as previously mentioned, BCAAs themselves serve as wonderful energy sources for working muscles. While most amino acids face metabolism within the liver, muscle tissues primarily serve as the locations for BCAA metabolism. This allows for oxidation of the BCAAs to produce cellular energy in the form of adenosine triphosphate, or ATP. ATP serves as the human body’s primary source of energy for fueling muscle contractions.

Energy and the Sparing of Glycogen



BCAAs also shine as performance enhancers through their ability to spare glycogen during heavy training. Glycogen, which gets stored in the liver as a result of carbohydrate consumption, serves as a preferred fuel source for working muscles engaged in high-intensity exercise. When athletes head to the gym planning on a longer workout session than usual, glycogen availability and preservation will play a vital role in their energy stores. Studies have linked a significant increase in BCAA metabolism with prolonged exercise, since the body requires more energy during periods of stress brought on by intense training. For this specific reason, many athletes choose to supplement with BCAAs *during the peak performance point of their workouts*. Data have revealed that the ingestion of BCAAs before and during training can elicit and even boost the sparing of glycogen levels by 25%. Experts speculate that the ingestion of BCAAs leads to an increase in blood alanine levels; this substance, in turn, gets converted to glucose in the liver. At this juncture, the glycogen can henceforth return to working muscles and get utilized as fuel. This glycogen sparing effect of BCAAs will not only allow for prolonged and more intense training sessions, but also speeds up/enhances recovery time. A fully recovered body can promote a more successful workout the following day.

### BCAAs Also Compliment Endurance Training

Not only can BCAAs be used as energy themselves; they also enhance fat oxidation in athletes who may find themselves glycogen-depleted, as often occurs during a marathon. This allows individuals to train harder for longer without experience overwhelming fatigue brought on by the higher energy demands.

### The Duality of Leucine and Glutamine

The amino acids glutamine and leucine work together to offer a muscle tissue signaling effect on synthesis. Glutamine seems to direct the largest response; however, it often proves ineffective in the absence of sufficient quantities of circulating leucine in the body. Leucine acts directly upon stimulation of protein synthesis through the activation of insulin. Insulin plays the vital role of increasing the uptake of all amino acids into the body's cells. While BCAAs primarily serve muscle tissues for energy, the incorporation of BCAAs directly into muscle lies in the power of insulin-like growth factor, or IGF-1. IGF-1 stimulates muscle tissue synthesis, while insulin inhibits the breakdown of muscle and encourages the uptake of amino acids (including BCAAs).

### The Signaling of mTOR

Within recent years, scientists have found that BCAAs in general, and leucine in particular, send signals to the body that inform and facilitate the building of muscle. One of the ways leucine works to signal muscle growth comes via its unique interaction with *mammalian target of rapamycin*, or mTOR. Located directly within the cells and responsible for detecting an excess of amino acids, mTOR plays a key role in regulating hypertrophy, or muscle growth. Scientists continue to delve into the specifics of this process, but it seems as though the mTOR pathway shows extreme sensitivity to the amino acid leucine. Recent tests have shown that when

consumed orally, leucine activates mTOR which then jump-starts protein synthesis and hence muscular growth. In addition, this elicits an uptick in a cell's capacity to produce new proteins (muscle tissue).

### Dosage Suggestions

A colleague of mine dedicated his PhD research to the actions of the amino acid leucine, owing in large part to the manner in which this particular amino acid seems to dictate so much of what happens within muscle tissues. Athletes who take the time to do some research on BCAAs sometimes wonder why they should take all 3 BCAAs, if leucine seems to have exhibited the greatest potential for eliciting muscle growth. This reasonable proposition has a very good answer. Studies consistently demonstrate that more protein synthesis occurs when one consumes a 2:1:1 ratio of leucine, isoleucine, and valine. When taken alone, leucine may actually diminish the concentrations of the other two amino acids.

While BCAAs can certainly help to orchestrate and signal muscle growth, the body must contain a full spectrum of amino acids in order for the BCAAs to act as the substrate for muscle growth. This serves as a reminder to serious athletes to continue consuming adequate amounts of *whole lean protein* in addition to their supplementation. Lean beef, poultry, fish, low-fat dairy products, tofu and eggs serve as excellent protein sources to round out a bodybuilder's menu, of course in conjunction with fresh vegetables and whole grains.

### Holding Onto Muscle During a Leaning Phase

BCAAs can serve a very important supplemental role during any fat loss plan, due to their muscle-preserving abilities. Whenever a bodybuilder enters into any calorie-restricted phase of training, typically in the weeks leading up to a competition, the potential does exist for muscle tissue loss, a serious concern after months of hard work and dedication. All of the positive effects that BCAAs demonstrate on muscle growth will similarly serve to protect hard-earned muscle mass in periods of calorie restriction.

### Bottom Line

Some bodybuilders and athletes turn to dietary supplements in an attempt to improve their strength, muscle mass, and energy. However, these products do not necessarily come under FDA scrutiny, nor have firm standards been established. Some of them may contain ingredients that have not been proven effective or hold the potential to harm one's health. Here we offer a few key points to bear in mind regarding dietary supplements marketed for bodybuilding or performance enhancement ~

1. **Some bodybuilding products contain dangerous hidden ingredients.** As is the case with so many supplements on today's market, consumers may unknowingly take products laced with prescription drug ingredients, controlled substances, or other ingredients not listed on the label. Bodybuilding supplements may contain trace amounts of anabolic steroids—modified male hormones designed to increase muscle mass. Anabolic steroids

will not pass urine testing for those bodybuilders competing in a “natural” show, rendering the user disqualified from competition. While these substances can boost strength, the litany of potential long-term side effects contains some frightening facts, such as early heart attacks, strokes, liver tumors, kidney failure, and psychiatric problems. Stopping use too abruptly, and without properly tapering the dosage, can often lead to depression.

2. **Products containing stimulants such as *BMPEA* or *DMAA* can cause serious health problems.** Supplements containing the herb *Acacia rigidula* often contain  $\beta$ -methylphenylethylamine (BMPEA), which is not naturally occurring in the herb nor is it a regulated dietary ingredient. The dosage of the amphetamine isomer BMPEA may exceed that which falls under safety guidelines.
3. **Take charge of your health.** Prior to selecting/consuming any dietary supplement for athletic performance, always consult with a trained and knowledgeable health care provider. Together, you can make well-informed decisions.

## SELF-TEST

1. Which joint allows the knee to perform flexion and extension movements?
  - a. Ball-and-socket joint
  - b. Hinge joint
  - c. Saddle joint
  - d. Pivot joint
2. What is the primary function of the anterior cruciate ligament (ACL)
  - a. Prevent posterior translation of the tibia
  - b. Restrict anterior translation of the tibia
  - c. Stabilize the patella
  - d. Protect the knee from varus forces
3. Which muscle is primarily responsible for unlocking the knee during flexion?
  - a. Rectus femoris
  - b. Popliteus
  - c. Vastus medialis
  - d. Biceps femoris
4. What is the most common ligament injured in sports activities?
  - a. Lateral Collateral Ligament (LCL)
  - b. Posterior Cruciate Ligament (PCL)
  - c. Anterior Cruciate Ligament (ACL)
  - d. Medial Collateral Ligament (MCL)
5. Which of the following is a cause of chondromalacia patella?
  - a. Hyperextension of the knee
  - b. Poor alignment of the patellofemoral joint
  - c. Excessive lateral rotation of the tibia
  - d. Sprain of the medial collateral ligament
6. What is the primary role of mindfulness in personal training?
  - a. To help clients perform exercises with more intensity
  - b. To ensure clients are always thinking about their next workout
  - c. To encourage clients to stay present and attentive to their bodies during exercise
  - d. To push clients beyond their limits during each session

7. Which of the following is an example of a mindfulness technique that personal trainers can use?
  - a. High-intensity interval training
  - b. Body scans
  - c. Tracking calories burned
  - d. Listening to fast-paced music during workouts
8. How can mindfulness help clients who struggle with self-criticism during workouts?
  - a. By encouraging them to compare themselves to others
  - b. By pushing them to work harder despite pain
  - c. By fostering self-compassion and acceptance of their current state
  - d. By focusing solely on physical performance metrics
9. Which of the following best describes the relationship between stress, recovery, and mindfulness?
  - a. Stress is necessary for effective recovery
  - b. Mindfulness can support recovery by encouraging rest and reducing stress
  - c. Mindfulness increases stress and hinders recovery
  - d. Recovery should be ignored to focus on stress reduction
10. What is the purpose of diaphragmatic breathing in the context of mindfulness during personal training?
  - a. To increase heart rate for better cardio performance
  - b. To help clients focus on their breath and lower stress levels
  - c. To distract clients from difficult exercises
  - d. To enhance upper chest breathing for increased oxygen intake
11. Which aspect of fitness can genetic testing help optimize by understanding a client's DNA?
  - a. Training schedule
  - b. Dietary preferences
  - c. Energy utilization mechanisms
  - d. Sleep patterns
12. How can genetic testing influence a client's cardio regimen?
  - a. By determining the best time of day to exercise
  - b. By identifying the optimal heart rate zone
  - c. By assessing how quickly the body utilizes fat as a fuel source
  - d. By suggesting the ideal duration for each session

13. If a client's genetic test indicates a "below average" response to strength training, what adjustment might a trainer consider?
- Increasing the number of cardio sessions
  - Incorporating lighter weights with more repetitions
  - Implementing heavier weight loads and increased intensity
  - Extending rest periods between workouts
14. What does a "well above average" score in systemic inflammation from genetic testing suggest about a client's recovery needs?
- They require shorter rest periods between workouts
  - They can handle daily intense training sessions
  - They need extended rest times to allow for proper healing
  - They should avoid resistance training altogether
15. Why is understanding a client's genetic makeup beneficial for personal trainers?
- It allows for a standardized training program for all clients
  - It helps in creating personalized programs that optimize success
  - It eliminates the need for client assessments
  - It reduces the importance of nutrition in training
16. Which of the following is NOT listed as one of the seven pillars of lifestyle medicine?
- Movement & Fitness
  - Healthful Nutrition
  - Financial Planning
  - Restorative Sleep
17. What percentage of adults in the U.S. achieve the necessary physical activity levels to reduce and prevent chronic diseases?
- 25%
  - 50%
  - 75%
  - 90%
18. How many days per week should adults engage in muscle-strengthening activities involving all major muscle groups?
- At least 1 day
  - 2 or more days
  - 3 or more days
  - 5 or more days

19. Which of the following health benefits is not the result of regular physical activity?
- a. Reduced risk of certain cancers
  - b. Improved cognitive function
  - c. Enhanced vision
  - d. Better sleep quality
20. Which population would benefit the most from balance training?
- a. Athletes
  - b. Older adults
  - c. Pregnant women
21. What is perimenopause?
- a. The period after menopause
  - b. The transitional phase before menopause characterized by decreasing estrogen levels
  - c. A condition unrelated to menopause
  - d. A phase exclusive to women under 30
22. Which of the following is a common physiological change during perimenopause?
- a. Increased muscle mass
  - b. Enhanced cognitive function
  - c. Loss of lean muscle mass and redistribution of fat to the abdominal region
  - d. Improved cardiovascular health
23. How can strength training benefit women during perimenopause?
- a. By increasing estrogen levels
  - b. By reducing bone density
  - c. By maintaining muscle mass and facilitating bone density
  - d. By eliminating the need for cardiovascular exercise
24. What is the recommended frequency for strength training sessions per week during perimenopause?
- a. Once a week
  - b. 2 to 3 times a week
  - c. 4 to 5 times a week
  - d. 6 to 7 times a week



25. Which type of exercise is suggested to help build bone mass and offset osteoporosis during perimenopause?
- Swimming
  - Walking or jogging
  - Cycling
  - Yoga
26. What is the primary function of creatine in the body?
- To act as a neurotransmitter
  - To serve as an energy source during high-intensity, short-duration exercises
  - To regulate blood sugar levels
  - To aid in digestion
27. Which organ is NOT responsible for producing creatine in the human body?
- Heart
  - Liver
  - Pancreas
  - Kidneys
28. How does creatine supplementation potentially enhance athletic performance?
- By increasing fat storage
  - By elevating anaerobic capacity and maintaining higher ATP levels
  - By decreasing muscle mass
  - By reducing water content in muscle cells
29. What is a common effect of creatine on muscle cells?
- Dehydration
  - Increased water content leading to muscle swelling
  - Reduction in muscle size
  - Decreased protein synthesis
30. Beyond athletic performance, what is another potential benefit of creatine supplementation?
- Improved vision
  - Enhanced cognitive function
  - Neuroprotection in cases of concussion
  - Increased appetite

31. According to the World Health Organization, where does physical inactivity rank among global mortality risk factors?
- First
  - Second
  - Third
  - Fourth
32. Which of the following is NOT one of the three core functions of public health?
- Assessment
  - Policy Development
  - Assurance
  - Implementation
33. What term is used to define the principles of assessment, policy development, and assurance in public health?
- Health Equality
  - Health Equity
  - Health Parity
  - Health Justice
34. How can personal trainers contribute to public policy development?
- By prescribing medications
  - By cultivating relationships with medical teams and promoting healthy interventions
  - By conducting medical research
  - By providing financial assistance to clients
35. Which of the following is a suggested strategy for personal trainers to build a sense of community centered on physical activity?
- Offering online-only training sessions
  - Participating in local health fairs to establish trust and make a positive impact on public health
  - Focusing solely on elite athletes
  - Avoiding collaboration with other health professionals

36. Which of the following describes the primary focus of meditation as a mind-body intervention for stress reduction?
- a. Physical postures and breathing control
  - b. Slow, deliberate movements with breath control
  - c. Cultivating mindfulness and mental clarity
  - d. High-intensity movement and cardiovascular training
37. What specific physiological response is commonly activated by yoga, meditation, and Tai Chi that helps reduce stress?
- a. Parasympathetic nervous system
  - b. Sympathetic nervous system
  - c. Increased adrenaline production
  - d. Reduction in melatonin levels
38. Which of the following best describes Tai Chi in comparison to yoga and meditation for stress management?
- a. Primarily mental focus with no physical component
  - b. A combination of physical exercise and mental relaxation with low impact
  - c. High-impact physical exercise without a meditative aspect
  - d. A practice that involves deep breathing without movement
39. Which of the following mind-body interventions is described as integrating movement, breath control, and mindfulness to promote mental clarity and physical relaxation?
- a. Meditation
  - b. Tai Chi
  - c. Yoga
  - d. Qigong
40. Which practice is noted for its gentle, flowing movements that enhance balance, flexibility, and mental focus, making it particularly beneficial for stress reduction?
- a. Pilates
  - b. Tai Chi
  - c. Aerobics
  - d. Strength Training

41. What are the three branched-chain amino acids (BCAAs)?
- Leucine, Isoleucine, and Valine
  - Lysine, Methionine, and Threonine
  - Phenylalanine, Tryptophan, and Histidine
  - Glutamine, Arginine, and Proline
42. Why are BCAAs considered unique among amino acids in terms of metabolism?
- They are metabolized primarily in the liver.
  - They are metabolized primarily in muscle tissues.
  - They are not metabolized by the body.
  - They are metabolized equally in the liver and muscles.
43. How can BCAA supplementation affect glycogen levels during intense training?
- It depletes glycogen levels by 25%.
  - It has no effect on glycogen levels.
  - It can boost the sparing of glycogen levels by 25%.
  - It increases glycogen levels by 50%.
44. What role does alanine play in the glycogen-sparing effect of BCAAs?
- Alanine is converted to glucose in the liver, which then returns to muscles as fuel.
  - Alanine directly fuels muscle contractions.
  - Alanine inhibits glycogen breakdown in muscles.
  - Alanine reduces the need for carbohydrate intake.
45. What is a potential benefit of BCAA supplementation before and during training?
- It decreases muscle protein synthesis.
  - It enhances recovery time and allows for more intense training sessions.
  - It increases fat storage in the body.
  - It reduces the need for hydration during workouts.



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