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how to effectively train fitness clients

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National Federation of Professional Trainers

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Ergothioneine: The Mushroom's Mighty Amino Acid

Mushrooms, members of the general class of edible fungi, enjoy popularity in global cuisine. From the exotic truffle to the ordinary white caps, mushrooms now also figure prominently in scientific research as one of the top nutritional sources of the amino acid *ergothioneine* (ERG). Read on to learn about the health benefits packed into these tiny powerhouses, including potential medicinal uses, enhanced aerobic capacity, and extending life expectancy.

Mushroom-Driven Amino Acid Supply

Nature does not supply an abundance of the amino acid ergothioneine, except for some fungi and other microbes. As such, humans need to consume ergothioneine through a variety of food sources. Mushrooms rank as the leading dietary source of ERG. *More and more, the evidence for ERG as a potential antioxidant and anti-inflammatory source is mounting*. Its ability to prevent or mitigate many of the ailments we associate with the aging process has led some scientists to the nickname "longevity vitamin."

Evolution and ERG

Circulating levels of ERG seem to peak sometime during young adulthood. A naturally occurring transport protein known as OCTN1 latches onto ERG and distributes it to the rest of the body. While this transport protein also takes other compounds around the human system, it seems to favor ERG, carrying it 100X more efficiently than any other ingested nutrient.

Perhaps carrying out some evolutionary protective purpose, ERG tends to settle in high concentrations within those cells/tissues at greatest risk for inflammation and/or oxidative stress, including the ERG-dense mitochondria. As the years go by, however, the body somehow loses much of its earlier ability to access and accumulate ERG. Cells lacking in OCTN1 transport protein clearly become vulnerable to oxidative stress, resulting in increased DNA damage.

Putting Mushrooms on the Menu

Limited intake of ERG in the typical American diet may affect one's long-term health and life expectancy. Mushrooms do not figure prominently in most American meal plans, especially in comparison to other countries. Italy's inhabitants traditionally have a decidedly longer life expectancy than Americans. Apparently, their typical menus include a plethora of mushrooms; consequently, Italians boast a 4-fold greater amount of ERG than most Americans. Similar findings exist for those who live in Finland, France, and Ireland.

In the spring of 2021, scientists published the data from a study spanning 20 years. Researchers followed the dietary habits of 15,000 American participants. The control group did not include mushrooms in any of their meals during the length of the study. In comparison, those individuals who consumed even small amounts of mushrooms presented with a 16% lower mortality rate. When some of the subjects swapped mushrooms for red meat or processed meat products *just once daily* when preparing recipes, they exhibited a 35% reduction in mortality from any cause.

Penn State researchers found that among the most commonly consumed mushrooms, portabellas and criminis contain the highest levels of ergothioneine, followed closely by the more ubiquitous white button variety. A standard 3-ounce USDA serving of these mushrooms supplies up to 5 mg of ERG. The exotic mushrooms contain even more ergothioneine. The same 3-ounce serving of shiitake, oyster, king oyster, or maitake mushrooms can contain up to 13mg ERG. Even after cooking mushrooms, their levels of ergothioneine do not diminish.

Insights Into Serious Health Conditions

A longitudinal study conducted in Sweden involved over 3,200 adult men and women who adhered to clean, healthy diets. Researchers followed/tested the participants over the course of 21 years. Out of the 112 metabolites measured, data revealed that higher plasma ergothioneine levels most strongly aligned with a decreased risk of cardiovascular-related diseases and a reduced mortality rate. Another study found a strong correlation between low levels of circulating ERG and increased frailty as well as cognitive disorders and Parkinson's disease. New research suggests that individuals who include an abundance of mushrooms in their regular weekly menus suffer less from bipolar disorder, depression, and schizophrenia. Most likely the high levels of antioxidant-promoting ergothioneine found in many mushroom varieties once again function as a protective mechanism against cell and tissue damage.

Dr. Bruce Ames recently included ERG in his "Triage Theory". Dr. Ames feels that the human body utilizes certain micronutrients as if in a triage situation, with priority given to functions that support reproduction and survival. If an insufficient amount of ERG exists, long-term health potentially moves to the bottom of the list, leading to reduced life expectancy.

ERG and the Gut Microbiome

The relationships between depression and <u>gut microbiota</u>, particularly those involving the immune system, have garnered much focus recently. Scientists found a direct correlation between the presence of the gut bacteria *L. reuteri* in rats and high levels of circulating ergothioneine. They took this one step further, giving the rats prophylactic doses of oral ergothioneine, only to discover improvements in REM sleep abnormalities as well as diminished signs of deleterious social behaviors.

Can ERG Fight Depression?

Numerous animal studies have shown that inflammatory mechanisms can underlie stressinduced depression, frequently accompanied by social avoidance. Such mood disturbances seem to increase central and/or peripheral inflammation; thus, perhaps the antiinflammatory aspects of ergothioneine help explain its positive anti-depressant functions.

Eliminating Exercise-Induced Stress Complications

Stress occurs as a result of other factors besides just emotional triggers. Intense repetitive bouts of exercise can elicit a high level of stress, along with oxidative damage and

inflammation. Antioxidants alone cannot always manage such situations; but *secondary antioxidants* can activate a cellular pathway known as NRF2, which potentially ameliorates the problem. Ergothioneine falls into this category and may actually improve aerobic exercise performance, extending time to exhaustion and reducing accompanying exercise-related stress.

It's Own Food Group

Given all of the unusual potential exhibited by fungi, mushrooms in particular, some professionals support the idea of making mushrooms their own "kingdom" within the current USDA Food Groups. At the very least, proposals to recognize mushrooms when providing nutritional guidance will flourish as more clinical trials occur.

Avoiding Lifting Injuries

As fitness professionals, we accept the premise that most serious strength-training athletes and bodybuilders will experience injuries at some point in time. Within a 1-year period of regular strenuous workouts, almost 50% of bodybuilders report suffering from some sort of injury. Understanding the mechanics of such issues can help avoid potential problems as well as teach us the best manner of dealing with injuries, if and when they occur.

Why Do Injuries Occur?

Resistance training, from the point of view of one's muscle tissue, practically invites injuries. The act of challenging muscles past their comfort zone, which involves placing significant loads upon fairly small areas, creates micro-tears in the muscle fibers. Time, repetition, rest, and proper nutrition then work in consort to repair these tears, culminating in hypertrophy and strength gains.

What exactly contributes to the onset of injury? Most often, injuries happen during weight training, yet typically these do not hamper an athlete's ability to continue with his workouts. As we would expect, using gym equipment improperly, or for any purpose other than that which the manufacturer intended, leads to the majority of bodybuilding injuries.

Those individuals who train more often will statistically suffer a greater percentage of injuries. Other contributing factors include attempting to top a former personal best in bench pressing or a deadlift; incorrect use of straps; training while under the influence of alcohol; and surprisingly, dietary issues/proper nutrition.

Injury Sites by the Numbers

The United States Olympic Training Center regularly sees injuries resulting from a variety of athletic endeavors. Specific weightlifting-related injuries over a 6-year period yielded very interesting data. Over 64% of reported injuries involved the lower back, knees, and/or shoulders. Most of the back injuries consisted of pulled muscles or strains, similar to shoulder complaints. Tendinitis, however, accounted for 85% of all knee injuries.

Once identified and properly treated, the rate of acute/recurring injuries proved very low, accounting for a mere 3.3 injuries per every 1,000 hours of resistance training.

Nerve Impingement

Many strength training moves require an athlete to place a joint in a challenging position, one that may compromise its very integrity. Improper execution of even the most basic of weightlifting exercises may lead to pinched nerves. Nerve damage, a far more complex and serious condition, may also occur in cases of poor alignment or improper machine utilization.

Nerve damage can arise from compression, or from an individual's overzealous choice of a weight load unfamiliar to him or outside of his abilities.

Commonly reported lower back pain often stems from a herniated spinal disk, which in turn compresses a nerve root. Nerve pressure generated from years of poor posture/arthritis can eventually lead to irreversible weakness and/or permanent nerve damage.

Overuse and <u>overtraining</u> injuries often fall into this category. Therefore, trainers must remain vigilant in continuously charting a client's progress, to ensure that the client does not move too rapidly into any high-intensity training without first assessing the readiness of his body. Even for elite athletes/weightlifters, typical injuries arise predominantly from overuse.

Nerve Damage versus Soft Tissue Injuries

When dealing with the aftermath of any sports-related injury, distinguishing one involving potential nerve damage from the much more commonplace soft tissue tears can make a significant difference in how these issues get addressed, treated and resolved. If a physician or coach cannot definitively pinpoint the specific injury site, nerve conduction tests can prove helpful. This knowledge can then illustrate an exact location, should the course of treatment include a nerve block or steroid injection.

The nerve injury known as carpal tunnel syndrome, or median nerve entrapment at the wrist, presents with a tingling sensation/numbness, eventually leading to significant and often debilitating pain. Experts believe this arises over time from chronic, repeated mechanical compression, originating from improper/overused wrist flexion as well as repetitive activity of the hand and wrist.

Improper grip of barbells often leads to this carpal tunnel syndrome. However, ulnar neuropathy occurs most often at the elbow joint. Similar to the problems associated with medial nerve damage, compression of the ulnar nerve from progressive bicep isolation exercises leaves an athlete vulnerable to numbness and tingling in the hand, with potential ensuing cachexia and weakness. Bodybuilders often report that excessive hypertrophy of the muscles located in the triceps' medial head cause compressive ulnar neuropathy.

Ulnar neuropathy at the wrist can arise from direct compression on Guyon's canal, also known as the ulnar tunnel. Guyon's Canal Syndrome refers to the collection of symptoms resulting from compression of the ulnar nerve. Bicyclists often find themselves dealing with this situation, known within elite cycling circles as handlebar palsy.

Can Proper Nutrition Thwart Injuries?

Evidence shows that disordered eating behaviors may increase the risk of musculoskeletal injuries. A common mistake made by many serious strength training athletes involves the drastic altering of caloric intake following a bodybuilding injury. Many bodybuilders believe that working out less while continuing with their normal caloric intake may lead to weight gain.

Contrary to this line of reasoning, research shows that in a state of injury repair, metabolism actually kicks into high gear. Hence, when rehabbing an injury, trainers ought

to remind clients to consume sufficient calories, especially lean protein, to fuel the recovery process. Optimal nutrition can play a key role in controlling inflammation, providing the best fuel for rebuilding injured tissue, minimizing muscle wasting, and maintaining strength gains. Selecting the perfect nutritional foods can actually help accelerate rehabilitation. While striking an appropriate omega-6 to omega-3 balance makes sense for overall health, a short-term excess of omega-3 fatty acids during injury repair lowers inflammation, mitigates pain, and tends to shorten recovery time.

Fish with a higher <u>Omega-3 fat</u> content, such as tuna and salmon, along with nuts and plant-based oils, serve as ideal fuel sources during this time. Trainers might consider suggesting to injured clients that consuming protein every three hours during the day, after rehabilitation sessions, and before bed will go a long way toward facilitating injury repair.

Charting a Course for Injury-Free Workouts

Armed with the aforementioned information, trainers can continue to guide clients toward successfully meeting their goals while also sidestepping potential injury-inciting land mines. When proper form/alignment, appropriate rest intervals, and prudent weight loads converge, clients will find themselves spending more time "in the game", and less if any time sidelined while rehabbing injuries

Soda Addiction: How to Break the Cycle

When working with fitness clients, personal trainers are likely to come up against lifestyle habits that need to change, one of which is very problematic and difficult to quit: Soft drink consumption. Those clients who may drink a six-pack of Coca-Cola daily or admit to running to the grocery store at midnight upon realizing the soda reserves are empty may very well suffer from a *soda addiction*. What might we suggest to clients looking to "kick the habit"?

Discerning a Developing Addiction

Addiction, a mental and physiological disorder, involves the continued use of a substance, regardless of the individual acknowledging its negative effects. Soda addiction doesn't have an official "category", and not enough evidence exists to proclaim it a *true disorder*; however, the problem exists for many Americans of all ages. The combination of sugar and usually caffeine serves as a double-whammy with regard to physiological dependence: dopamine release is affected and surges of caffeinated energy are provided.

Dependence on soda can start slowly or come on with expediency. Any personal or familial history with prior addictions, as well as one's unique brain wiring, determine how exactly the addiction will progress, and hence, how the challenging tapering/quitting process will unfold.

The Science of Addiction

As is the case with any caffeinated beverage or high-sugar content item, consumption elicits the release of the neurotransmitter *dopamine* from the brain. Dopamine induces pleasurable feelings, the outcome of which may lead to additional dopamine-seeking by drinking more and then, to addiction in some individuals.

For some, soda addiction bears a great likeness to caffeine addiction or alcoholism: while two drinks used to cause the desired sensation of a relaxed and mellow state of mind, over time, the brain gets accustomed to the cycle of regular alcohol consumption. Soon, it takes 4 or 5 drinks to induce the same pleasurable feelings; this is how a physiological addiction develops.

The more one consumes soda, the less one derives pleasure from the dopamine response. This leaves the individual craving more. Continuing in this mode, chasing the satisfying dopamine sensation despite knowing the craving cannot be sated, leads one to develop a dependence.

Soda, Calories, and Poor Health Outcomes

According to a study published in the *American Journal of Preventive Medicine*, in this country alone, calories from beverages comprise 21% of the total daily intake by individuals over the age of 2. *The associated health risks with such a statistic do not seem to vary whether the soda contains sugar or not.*

Scientists have linked frequent soda consumption with an increased risk of developing type 2 diabetes. Just consuming one diet soda a day led to a 36% increased risk of metabolic syndrome and diabetes, reported by a research team at the University of Minnesota. Studies out of Columbia University and University of Miami report that indulging in a daily diet soda may elevate one's risk of a heart attack, stroke, or other vascular complications.

Phosphoric acid, another component found in large supply in <u>carbonated beverages</u>, will over time lead to a disruption in the body's delicate calcium/phosphorous ratio. This causes calcium to leach out of the bones. Excess soda consumption can result in osteopenia and/or osteoporosis, thereby increasing the incidence of fractures and broken bones.

As the body senses a lack of calcium, it begins pulling magnesium from its largest storage bank, the muscles. This in turn sets off a cascade of muscle pain, cramps, and fatigue.

Breaking the Cycle

Anyone who has ever attempted to break a long-standing habit – whether this involves excess shopping, smoking cigarettes, or late-night television – knows the difficulty

associated with the process. The mindset must demand a firm commitment, notes Michael Jacobson, Executive Director of the advocacy group *Center for Science in the Public Interest* (CSPI). Having patience with oneself goes a long way as well. "It takes a few weeks to truly forget the craving," says Barry Popkin, PhD, Director of the Interdisciplinary Obesity Program at the University of North Carolina.

Kicking the soda addiction by "going cold turkey" does not work for everyone. While it definitely shortens the period of acclimation, this method comes with a host of withdrawal symptoms which may include irritability, fatigue, headaches, and/or mild depression. Some severe "soda junkies" report a thirst that never gets satisfied with any other beverage.

Slow and Steady

Tapering one's soda consumption can succeed as well, although the process takes a bit more time. Most individuals do not experience withdrawal symptoms nearly to the extent of those attempting "cold turkey" abstinence. One method that yields great success involves drinking soda from a glass instead of the bottle or can. This allows the consumer to add ice cubes to the glass along with the soda, thereby diluting the beverage as the ice melts. It also forces one to drink much more slowly than gulping or guzzling directly. Over time, adding more ice and less soda eases the quitting process, while still allowing the brain and taste buds a little pleasure. Drinking from a straw, too, slows down the consumption rate.

Another idea that works requires the purchase of a large bottle of carbonated water, without sugar if possible. As the level of the ice cubes/soda in the glass goes down, add a commensurate volume of carbonated water. Over time, shifting to a mix of ³/₄ carbonated water to ¹/₄ soda helps the palate readjust itself.

Enhancing the Flavor of Water

For another creative alternative to soda, try adding fresh fruit, herbs, raw veggies, and spices in any combination to a pitcher of water. You might also consider purchasing a

specific water bottle designed with an inner vessel where the fruit, etc. goes. This inner part contains holes so that the flavor can seep into the water but not the fruit itself. Regardless of your chosen method, allow the vessel to infuse in the refrigerator overnight. For more potent flavors, allow an additional day to "marinate".

Some popular combinations which might tempt one's palate include the following \sim

- lemon + mint/cilantro
- lemon + ginger
- cucumber + lemon + lime + mint/basil
- cucumber + grapefruit
- cucumber + watermelon + mint
- carrots + apple + lemon + ginger
- carrots + pomegranate + sage
- blackberries + raspberries + strawberries + mint
- Grapefruit/mint/basil

Always choose from seasonal favorites, when the stores and farmer's markets offer an abundance of the freshest produce.

If carbonation and the sensation of bubbles satisfy as much as the flavor, adding club soda or other mildly-flavored soda water to any of these combinations works perfectly well.

The Final Word

If you have a client attempting to quit his soda addiction, remind them that this process might require days, weeks, or even months to fully accomplish. Remind him how the body needs to adjust its tastes, just as the mind needs time to realign its expectations. He may initially miss the sugar/caffeine "high", but gently remind them that the end result will feel like sweet success.

Understanding Tempo: Can Specific Eccentric Cadence Can Boost Hypertrophy and Strength?

Understanding lifting tempo is complicated enough for trainers, and most likely completely escaping your clients' attention. Science reveals different outcomes for how we apply such cadences in our lifting, specifically with regard to hypertrophy and strength gains.

Comparing and Contrasting Contractions

Bodybuilders and other resistance-training enthusiasts often extoll the virtues of slowly executed eccentric actions. They base such reasoning on the hypothesis that slower eccentric tempos induce a greater magnitude of muscle-damage and endocrine responses, and thus a greater consequent hypertrophic response. Indeed, the literature suggests that the greater <u>time under tension</u> promoted by slow eccentric phase increases the degree of microdamage following resistance training. Given that muscle tissue microtears/damage enhance hypertrophy, we can understand how a longer eccentric phase may optimize the growth response.

When comparing different forms of muscle contractions, eccentric training often proves superior in promoting both strength and hypertrophy, when compared to concentric or isometric muscle loading. Scientists attribute this to the higher force generated during eccentric contractions, resulting in a stronger loading stimulus. Eccentric moves lead to a more pronounced disruption of muscle sarcomeres, increase in satellite cell activation, and ultimately more muscle protein synthesis, which easily explains the greater hypertrophy observed with consistent eccentric exercise.

Defining Slow Eccentric Contractions

Coaches, trainers, and bodybuilders denote the duration, or tempo, of a repetition using a 4-digit number, such as 1-0-2-0. The first numeral represents the eccentric phase, the second numeral identifies the isometric transition at the top of the movement, the third denotes the concentric phase, while the fourth numeral represents the transition at the

bottom of the movement. The sequence of 1-0-2-0 would mean that the eccentric phase lasted for 1 second and the concentric phase took 2 seconds, with no measurable transition period between actions.

Sometimes you may see only three digits, 1-0-2, as the transition (the last digit) is presumed to be 0. And if you see only two digits, that also presumes that the concentric phase should be carried out quickly as possible.

Does Speed Matter?

Currently, experts differ on whether manipulation of movement velocity during resistance exercise has an effect on hypertrophy of specific muscles. However, several experiments set out to determine just that.

Some research indicates that muscle hypertrophy after eccentric training interventions seems velocity-independent, when time under tension, load magnitude, and range of motion remain consistent. However, given the fact that controlled movement plays a major role in joint loads, slower velocities allow for superior motion control/fewer fluctuations of acceleration observed during eccentric contractions. These aspects support the advantage of such training in special populations such as older clients with frailty issues and/or those with neurological/musculoskeletal challenges. In addition, the extended time under tension during a single repetition in slow eccentric training may provide a superior stimulus for tendon adaptation, compared to fast eccentric movements.

The Physiology of the Tempo

One study aimed to understand the physiological responses between slow 6-0-2-0 (slow) and moderate 2-0-2-0 (regular) eccentric cadences. Subjects executed five sets of bench press to failure, using 70% of 1RM. Data revealed that the participants performed more repetitions during each set using a regular cadence, but experienced a greater total time under tension during slow cadence moves. In addition, the post-exercise levels of lactate, creatine kinase, and testosterone all rose after a 6-0-2-0 pattern of movement.

Another similar study compared the impact of varying different eccentric tempos on hypertrophy and strength during an isolation exercise. Thirteen participants, whose 1RM for a squat averaged approximately 2x their body weight, performed unilateral leg extensions. One leg moved in a faster eccentric tempo of 1-0-1-0 while the other leg engaged in a slower eccentric cadence of 3-0-1-0. Over the course of the 8-week experiment, total workload and intensity remained constant.

The data showed that whatever the chosen tempo, both legs gained strength during this exercise. The hypertrophy gains were similar, with the 1-0-1-0 showing a slight edge over the slower cadence. When questioned about their rates of perceived exertion, the participants reported that the slower eccentric contractions definitely seemed more difficult.

Blood Supply, Tissue Type, and Speed Variables

An even more in-depth, muscle-specific study looked at the effects of altering the duration of the eccentric phase in isotonic contractions on hypertrophy and strength of the quadriceps femoris. The term *quadriceps femoris* muscle means "four-headed muscle", hailing from the Latin term encompassing the four individual muscles: <u>rectus</u> <u>femoris</u>, vastus medialis, vastus lateralis, and vastus intermedius. Out of all of these, only the rectus femoris crosses both the knee and the hip joints.

In this study, ten healthy young adults performed unilateral isotonic knee extension exercises, with each leg assigned to an eccentric move lasting either two or four seconds. Each of the subjects' legs performed five sets using 70% of 1 RM until muscle failure, with three minutes of rest between sets. The study lasted for eight weeks.

While all muscles increased in size over the duration of the experiment, only the *vastus medialis* seemed to favor the 4-second eccentric move, leaving researchers with the question of whether different types of muscle tissue might favor a different contraction cadence for optimal hypertrophy, *a phenomenon referred to as "nonuniform hypertrophy"*.

Another aspect of interest, although not pursued or presented in the aforementioned studies, involves the origin of the blood supply to the various quad muscles. The rectus femoris receives blood from the femoral artery, lateral femoral circumflex, and superficial circumflex iliac arteries. The *vastus medialis* gets fed by the femoral, deep femoral, and descending genicular arteries. Blood to the *vastus lateralis* comes from the lateral circumflex femoral and deep femoral arteries.

Utilizing the Force-Velocity Relationship

Strength and conditioning coaches often employ a strategy of lowering loads slowly and under control in the eccentric (lengthening) phase of normal training. Understandably, an athlete displays greater strength when lowering a weight eccentrically than when engaging in a concentric lift, to the tune of 30-50%.

Some strength coaches also endorse the occasional <u>eccentric-only workouts</u>. They recommend choosing a weight that exceeds the individual's unassisted lifting capability. The athlete spends several seconds lowering the weight, while a training partner or the coach himself aids in the concentric lift. A common problem with such training stems from the "human nature" aspect of choosing a lighter weight, such that the eccentric phase does not prove quite so daunting. A heavyweight really will provide the greatest long-term growth effect, so an athlete must ensure that his lifting partner feels up to the challenge.

Takeaway Tempo Theory

From a practical point of view, the differences elicited by slow versus fast eccentric contractions seem to prove statistically very small with the currently available data. Still, this minute advantage could benefit very advanced bodybuilders and high-level athletes, or perhaps, breaking plateaus.

Understanding the Vastus Muscles

The *quadriceps femoris* muscles (quads) are the most voluminous muscles in the body the quad muscles together contain more mass than any other muscle group— the general population knows where their quads are: on the front of the thigh between the hip and knee joints. What may not be as familiar are the names and functions of each individual quad muscle. As the name suggests (*quad* is the Latin word for *four*), we have four quadriceps muscles— <u>rectus femoris</u> and three vastus muscles.

Though we may understand the quads as a unit, understanding each of the vastus muscles gives us greater insight into how to train and protect this powerful muscle group.

Quadriceps Function

As a whole, the primary purposes of the quads are hip flexion and knee extension. We use them when we run, walk, kick, and jump (and squat and



lunge!). These thigh muscles support us not only in sports, but are essential for daily activities like climbing the stairs and getting up from a chair.

However, when we look at the individual muscles that make up the quads, we see that *rectus femoris* is the only muscle of the four which crosses both the hip and knee joints, and thus, the only one to be *primarily* involved in hip flexion. The vastus muscles, then, all play a primary role in the quads' other main function— knee extension.

Vastus medialis

Vastus medialis is the smallest of the group, and is positioned medially on the femur. It extends the entire length of the thigh, originating at the medial side of the femur and

inserting into the quadriceps tendon. Its function is to extend the knee, to stabilize the patella, and to help correct patellar tracking.

Vastus lateralis

Vastus lateralis, found laterally on the thigh, is the largest of the quad group. It originates from several sites on the femur– the intertrochanteric line, the greater trochanter, gluteal tuberosity, and linea aspera– and attaches to the outer border of the patella. Its function is to extend the lower leg and to support the body in rising up from a squat position.

Vastus intermedius

Vastus intermedius is the deepest of the four quadriceps muscles, located in the middle of the thigh, beneath *rectus femoris* and in between *vastus lateralis* and *vastus medialis*. It originates at the anterior and lateral surface of the femur and inserts in the quadriceps tendon. Its primary purpose, like the others, is knee extension. Because of its location, of all the quad muscles, *vastus intermedius* is the most challenging to stretch and to massage (without being limited by the other quad muscles).

In recent years, a slanted muscle was discovered between *vastus lateralis* and *vastus intermedius*. Because of its location, this fifth quad muscle has been called the *tensor of vastus intermedius*, but its specific function is still being studied.

Training Considerations

The quads handle a lot of strain from the hip and knee joints, which makes them vulnerable to injury. In addition to their primary functions, the quads also absorb force when the foot strikes the ground and help to regulate gait. Strength training the quads can help to protect them and the joints they support.

Knowing that the vastus muscles are primarily involved in knee extension and stabilization, we can also understand that exercises including these actions are important for strengthening them. Stability exercises and performing leg extensions can help to prepare the quads for higher impact movements like running, jumping, and kicking. In athletes like runners, who tend to have <u>hamstring dominance</u> and underdeveloped quads, strengthening these muscles is especially important to correct imbalances that could result in injury.

While understanding the quads as a muscle group is often sufficient, understanding each individual muscle and each of their specific functions and locations can help with more focused training and intentional programming.

Hyponatremia: The Dangers of Excessive Fluid Consumption

For peak performance every day, athletically and otherwise, the human body requires water. Our cells, bones, organs, and muscles count on sufficient hydration to function properly. However, *overloading* the body with fluids can cause water intoxication, or *hyponatremia*, leading to serious health consequences.

The Delicate Fluid Balance

Safe levels of human body hydration normally hover between 1% hyperhydration and 3% hypohydration. Exercise-associated hyponatremia, a potentially dangerous malady, develops when an individual consumes more water than his kidneys can eliminate. The water excretion rate of a healthy adult approximates 20 L/day, or roughly 800-1,000 mL/hour. In order to keep the body in safe homeostasis, the maximum amount of water intake for an individual with healthy renal function need not exceed 1 liter each hour. Even when accounting for losses from <u>sweat</u> and other physiological principles, more volume than this can rapidly bring on hyponatremia complications.

Vague But Serious Symptoms

Signs and symptoms of hyponatremia typically consist of dizziness, irritability, generalized weakness, nausea, muscle tremors and/or cramps, diarrhea, and decreased urine output. More severe cases can result in excess thirst, general malaise, fatigue, headache, and vomiting. If left unchecked, hyponatremia can cause cerebral edema, seizures, coma, and even death.

The Dangers of Long-Distance Running

In an effort to better understand the mechanism of water intoxication, scientists studied close to 800 runners who participated in the 2002 Boston Marathon. Prior to the event, subjects completed a survey regarding personal demographics and training history. After the race, runners provided a blood sample and completed a questionnaire detailing their fluid consumption and urine output during the race.

Of 766 runners who signed up for the study, 488 provided a usable blood sample at the finish line. Of these, 13% had hyponatremia (a serum sodium concentration of 135 mmol/liter or less); 0.6% showed signs of critical hyponatremia (120 mmol/ liter or less).

The Role of Sodium

Sodium plays a vital role in fostering normal blood pressure, nerve and muscle function, and of course the body's fluid balance. When hyponatremia hits an athlete, particularly when sodium levels drop precipitously (below 135 mmol/liter) as a result of being diluted by excess circulating fluid, the low osmolarity of his body's extracellular space relative to the higher intracellular level causes fluid to move from one to the other. This occurs as the body strives to maintain homeostasis. When the amount of intracellular water increases, cellular edema develops. Such an occurrence in the brain — confined within the skull and having no place to expand — can rapidly turn life-threatening.

Health Hazards for Soldiers

Not only elite athletes run the risk of water intoxication. Records culled from the U.S. Army Inpatient Data System helped to identify all hospitalizations for hyponatremia among new military recruits between 1996 and 1997. Seventeen medical records met the criteria; subsequently, researchers analyzed the events leading to these soldiers' hospitalizations.

77% of the hyponatremia cases occurred during the first four weeks of basic training. Nine of the patients had consumed water in excess of 2 quarts every hour. Three deaths occurred as a result of overhydration, cerebral edema having resulted from a water intake of over 5 L (usually 10-20 L) of water during a period of a few hours.

It seems evident that hyponatremia resulted from far too aggressive fluid replacement practices for soldiers training out-of-doors in extreme weather conditions. Following the incidents from 1996 -1997, the Army revised their fluid replacement policy, giving close consideration given to both heat stress and physical output.

Fluid Overload versus Sodium Depletion

The pathogenesis of hyponatremia often proves difficult to pinpoint. Typical causes include over-consumption of hypotonic fluids, inappropriate release of antidiuretic hormone, impaired kidney function, and/or the leaking of fluid into intestinal and other cellular regions.

Since 1985, when exercise-induced hyponatremia first came to the attention of the medical and athletic communities, two theories somewhat at odds with each other have attempted to describe the etiology/pathology of this syndrome. One camp favors the theory that hyponatremia only surfaces in athletes who lose water and sodium concurrently during prolonged exercise, and fail to adequately replace this key electrolyte. The second theory claims that symptoms appear when an athlete generates a total body overhydration situation over the course of a long event.

Perhaps the fault lies with coaches and trainers, who have historically urged athletes to remain well-hydrated during extended bouts of exercise, particularly in high temperatures. A series of case studies reported over two years' time have established that in fact whole-body fluid overload incites the severe symptoms of hyponatremia, and perhaps reduces the blame placed upon sodium losses. However, some experts still hold fast to the notion that electrolyte-infused fluids might very well prevent the chance of sodium spilling over into other areas of the body, thereby disrupting the osmoregulation which the body tries so hard to maintain.

The Key to Protecting Kidneys

The average percentage of water in a person's body at any given point in time varies, from about 45% to as much as 75%. Properly functioning kidneys can remove 20-28 liters of fluid from the body over the course of 24 hours; however, their capabilities peak at excreting a liter per hour, as referenced above. Since the kidneys themselves contain between 80 and 85% water (second only to the brain), we begin to see the precarious balance and how easily the scales can tip dangerously.

Safeguarding Our Athletes

Personal trainers and coaches bear the responsibility of educating clients on the importance of fluid intake, not only during training/practice, but also when participating in competitive events. Stressing the potential risks of both hypohydration and hyperhydration on athletic performance helps paint a more complete picture. A key take-home point should focus on consuming no more than 1 liter of fluid per hour, thereby enabling the kidneys to safely eliminate excess water. Discussion of electrolyte supplementation can help facilitate a prudent pre-workout meal, as well as addressing the athlete's needs both during and immediately following an endurance event.

Ketone Applications: Moving Beyond Fat-Burning and Towards Healing

Accumulating evidence suggests that any athletically-inclined individual can benefit from a shift of energy metabolism toward the utilization of ketone bodies. However, the good news does not end there. Clinical research evidence on exogenous and physiological ketones suggests they particularly helpful for patients/clients living with Type-2 diabetes, congestive heart disease, depression, IBS, and many other ailments. Read on to find out the numerous ketone applications that may improve health conditions.

What Is Ketosis?

Data on both human and rodent experimentation have identified an individual's average serum ketone body concentration as lying between 0.1 to 0.5 mM; thus, *a true state of ketosis reflects serum concentrations above 0.5 mM.* Conditions that result in carbohydrate deprivation/low glucose availability, such as intermittent fasting or adopting a ketogenic diet, typically pair with such elevated serum ketone numbers.

The Heart on Ketones

Owing in large part to the enormous requirement for continual replenishment of energy stores, our organs — the heart in particular — possess an uncanny ability to utilize *any available carbon-based substrate*. To this end, they can metabolize exogenous fatty acids, glucose, lactate, amino acids, and ketone bodies to produce energy.

During the progression of congestive heart failure, the ailing heart can actually reduce glucose oxidation, shifting to increasing ketone metabolism. Although previously considered to be a relatively minor substrate, *ketone body oxidation* contributes up to 20% towards cardiac energy metabolism. Research suggests that *the normal healthy heart generates approximately 60-80% of its energy requirements from fatty acids, with approximately 10-20% from glucose*. The beneficial ketone applications for heart failure are certainly worth mentioning to clients with heart issues.

Navigating the Ketogenic Highway

In order for the body to utilize fat as an energy source, referred to as *entering ketosis*, it must significantly deplete existing glycogen stores. Such a *ketotic state* evolves through severe restriction of dietary carbohydrates; some individuals following a strict ketogenic meal plan seek to consume less than 5% of their daily calories from carbohydrates. Without readily available glycogen, the body seeks alternate forms of energy.

Certain unique metabolic pathways within the body that access fatty acids (typically from adipose tissue) lead to their breakdown into ketone bodies. Through this *beta-oxidation process*, the ketone bodies enter the Krebs cycle and ultimately produce adenosine triphosphate (ATP), the body's energy units. Utilized in this manner, ketones serve as an efficient fuel for the entire body, including the brain.

In Consideration of Ketone Supplements

<u>Exogenous ketone</u> supplementation can offer the serious athlete many benefits, including improved performance, efficient weight loss, cognitive improvement, and a lessening of sports-induced inflammation. Ketones tend to spare lean muscle mass, as the body instead begins to use fat stores for energy.

As trainers, our focus typically revolves around those individuals with a keen interest in performance and athleticism. However, even for the general public, supplementation of exogenous ketones shows promise in other arenas. Studies show that cancer cells cannot make effective use of ketone bodies, unlike most other tissues in the body. In fact, *dietary ketone supplementation increases the survival rates of cancer-riddled mice by as much as 70%.*

Exogenous ketone supplementation also causes a significant dip in circulating blood glucose levels, brought about by a *sharp increase in insulin sensitivity*. Scientists in this field of research have started to consider exogenous ketones as a potential therapy for Type-2

diabetics. Additional work in this area will most likely reveal more answers as time goes on.

MCTs: Chains of 6-10 Carbon Molecules

When embarking upon a true <u>ketogenic meal plan</u>, individuals replace the bulk of their carbohydrate calories with those derived from healthy fats. Dietitians who work with clients interested in a ketogenic lifestyle suggest a daily macronutrient breakdown of 70-80% fats, 5-10% carbohydrates and 10-20% protein. For a 2000-calorie diet, this translates to approximately 165 grams fat, 40 grams carbohydrate, and 75 grams protein.

Such narrow parameters prove challenging for many, especially since the body typically utilizes carbohydrates (in the form of glucose) for energy. During the transition, many individuals experience what some refer to as "keto flu": fatigue, lethargy, general malaise. This, too, deters many people. However, after about 7-10 days, the body rebounds and adapts to utilizing fats as its primary energy source.

Caprylic acid, a medium-chain triglyceride (MCT), rapidly breaks down from its 8-carbon fatty acid chain configuration into ketone bodies, especially when an individual fasts or rigorously depletes calories/carbs. In 2017, studies revealed that caprylic acid possesses the highest net ketogenic effect of any medium-chain triglycerides. In short, MCTs represent fats that burn like carbohydrates, particularly effective when an athlete seeks to restrict carbs prior to an event favoring a very lean physique (i.e., bodybuilding competitions).

MCTs and Health Benefits

Caprylic acid has also demonstrated the ability to maintain "good" (HDL) cholesterol levels while improving the clearance of the so-called "bad" LDLs in mice fed a high-cholesterol diet. A 2008 study published in the journal *Lipids* also identified caprylic acid as a modulator to plasma cholesterol levels. The same anti-inflammatory properties attributed to medium-chain triglycerides may also help support the gut microbiome. Individuals who make caprylic acid and other MCTs an integral part of their nutrition program have reported benefits in addressing several digestive disorders, including irritable bowel syndrome (IBS), gastric emptying, and lipid malabsorption. To date, little research has been done to uncover and explain the mechanisms behind these effects. However, some evidence does suggest that caprylic acid can target Interleukin 8 (IL-8), an inflammation-promoting glycoprotein frequently associated with Crohn's disease.

Guiding Clients Toward Appropriate Ketone Applications

Our clients with comorbidities or health concerns may inquire about ketogenic diets or ketone applications for their health issues. Numerous studies suggest that the administration of exogenous ketone supplements and the metabolic changes they bring on might pave the way for potential therapeutic treatment of central nervous system disorders, oxidative stress, and cardiac complications, as previously mentioned.

For the many individuals who find the stringent regulations of a ketogenic diet challenging to maintain, such exogenous supplementation can offer a gentler way to reap the benefits of ketosis.

If you have clients seeking to embark upon the ketogenic lifestyle, even temporarily, you can now shed some light on the process involved, the highly coveted benefits, and the long-term manifestations in improved health.

Varicose Veins: How the Vein Strain Can Happen To Anyone

Even the fittest athletes can develop varicose veins. So, if your clients complain about them, they're certainly not alone. Nor are these veins an indication of <u>their sessions</u> not working. Varicose veins can affect anyone, and what's more, they can negatively affect athletic performance, too.

Why Varicose Veins Occur

Varicose veins are inflamed blood vessels that form just under the top layer of the skin's surface.

Often red, blue, or purplish in coloration, varicose veins typically occur on the lower half of the body, most particularly behind the legs, ankles, and feet. When vein walls weaken and your blood valves aren't functioning properly, it causes blood to build up in the vein—this is a varicose vein.

These unsightly blood vessels are sometimes accompanied by swelling, <u>itching</u>, aching, or a sense of heaviness around the affected area. Some of the main causes of varicose veins include:

- Aging Over time, our valves and veins become weaker, causing poor circulation.
- Excess weight The more weight you carry, the more pressure on your veins.
- Pregnancy A pregnant woman's body produces extra blood to support the fetus, which can start to collect at the valves and cause build-up.
- Immobility Standing or sitting for extensive periods of time slows down blood flow and promotes the development of varicose veins.
- Genetics Some people are simply more prone to varicose veins than others. Women tend to be more susceptible to them than men.

While varicose veins are often a sign that blood circulation needs improving, they are not necessarily a sign that your health is in danger. Contrary to popular belief, there are no links between varicose veins and heart disease.

The Symptoms and Recognizing Early Stages

Varicose veins can be recognized in a number of different ways. Affected veins often appear to bulge in twisty, rope-like patterns. They are usually purple or blue in coloration, and are visibly raised above the skin. Spider veins are the smaller blood vessels closer to the surface of the skin that become visible, but usually are not raised. Both are signs of <u>veinous insufficiency</u>.

Some of the early stages of varicose veins look like:

- Aching or painful legs
- Swollen feet
- Red or purple spots under the skin
- Unusual pink or red skin pigmentation

Why Athletes May Suffer From Varicose Veins, Too

Even though immobility is often one of the reasons behind varicose veins, you can still develop them if you are very active. Athletes, even professionals, and even fitness enthusiasts can and do still get them just like everyone else. But why?

Athletes who rely on their legs to support their own or additional weight over long periods of time (such as <u>weight-lifting</u>, running, hiking, skiing, or cycling) put a lot of pressure on their veins, which may become vulnerable to the build-up which triggers varicosity.

Whether you're sitting at a desk all day or spending hours working out or training, blood can still start to pool inside the veins of your lower body and cause internal pressure.

How Unhealthy Veins Can Affect Athletic Performance

Varicose veins can negatively impact physical and athletic performance by decreasing stamina, cause localized pain or itchiness, aggravating leg exhaustion, and causing inflammation. If an athlete (or just a very active person) develops varicose veins, they're likely to see a difference in the way they cope with their regular exercise routine. The more intense and repetitive an athlete's exercise routine is, the more severe their veins may be.

Can They Be Prevented?

While there is no way to 100% guarantee that someone won't develop varicose veins in the future, there are some simple things anyone can do to reduce the probability. Some of them include:

- Stretching By increasing mobility and flexibility, one can <u>facilitate better</u> <u>blood flow</u> in the legs and prevent pooling to occur inside veins.
- Cardio Used in conjunction with stretching, cardio is great for promoting better circulation throughout the body and keeping blood pressure in a balanced place.
- Weight loss The less weight once carries, the less pressure placed on the veins in your lower body. Committing to some long-term weight loss habits can reduce the likelihood of developing varicose veins.
- Adequate rest For very active clients, rest might be what they need to slow down the development of varicose veins. After heavy exertion, legs need time to fully recover before going at it again.
- High fiber intake A high fiber diet means a healthy, regular digestive system. Strain on blood vessels can be reduced by eating foods rich in natural, nutrient-dense fibers. For anyone who may not get enough fiber in their diet, they can consider growing trend of taking supplements and vitamins to improve health and well-being.

How To Self-Treat Varicose Veins

Although there is no cure-all for varicose veins, there are a number of different treatment methods that can help to subdue this kind of affliction, many of which are accessible at home.

Wearing compression stockings is one easy option as the increased pressure improves blood flow and alleviates swelling. Regular swimming is another, as it increases blood circulation throughout your body. Some people also use plant extracts such as horse chestnut, as it has a toning effect on veins and promotes blood flow.

There are also some treatments that you need to avoid, as although they may offer temporary relief, they can make varicose veins worse in the long run. For example, <u>myofascial release</u> may alleviate the pressure surrounding the veins and stimulate a better flow of blood in the legs. However, as your veins are delicate, the pressure of massage may cause more damage and even cause a vein to burst. *Never* foam roll over a raised, varicose vein, and make sure your clients know this.

This doesn't mean that you cannot have a massage, it just means that only very light pressure should be applied, and never directly on the veins themselves.

If your veins are causing irritation, negatively affecting your performance, or are detrimental to your health you can have them removed. There are various options for removal such as laser treatment, sclerotherapy, vein stripping, or ambulatory phlebectomy, all of which are performed by a medical professional.

If your clients (or you!) suffer from varicose or spider veins, maintaining a healthy weight and balancing physical activity and rest are by far the most reliable ways to prevent them from developing. Although they're something everyone can suffer from, you can do your best to limit them and reduce the impact they have on athletic performance.

Hunger Hormones: Ghrelin, Leptin And The Satiety Balance

Research shows that a significant percentage of dieters regain *most*, if not all, of the weight they shed within a year's time. Increased appetite/loss of willpower top of the list of common reasons. Another variable to consider is the impact of hunger hormones. The hormone *ghrelin*, might actually encourage one's body to regain lost weight as fat. To help clients who face this dilemma after months of successful weight loss, read on and learn about the hormones responsible for hunger and satiety, and how they can easily turn against a serious dieter.

Duality of Satiety Hormones

The control of energy balance within the human body largely rests on two key hormones, *leptin* and *ghrelin*. Leptin, produced by adipose tissue, mediates satiety/appetite and long-term regulation of energy balance. This hunger hormone works to *suppress* food intake, letting the body know enough fuel has been ingested, and to begin the fat-burning creation of energy. This in turn kickstarts the weight loss process.



Ghrelin and leptin – hormones regulating appetite. Leptin the satiety hormone. Ghrelin the hunger hormone. When ghrelin levels are high, we feel hungry. After we eat, ghrelin levels fall and we feel satisfied. Ghrelin, a faster-acting hunger hormone released by an empty stomach, plays a role in meal initiation/short-term food intake. It measures the highest right before

consumption, and dips maximally within 60 minutes following a meal.

"In a perfectly working body, ghrelin tells us to eat so we don't die of starvation, and leptin tells us when to stop," says Dr. Michelle Sands, hormone, metabolism, and epigenetics expert, and author of Hormone Harmony over 35. Unfortunately, hormones sometimes find that perfect balance elusive.

"Leptin is a bigger player than ghrelin when it comes to weight gain and energy balance," Dr. Sands says. "It's closely tied to your thyroid and brain. When leptin is working well, we have a better metabolic rate, mood regulation, memory, brain function, and mental sharpness. When it's not, it can play a role in obesity, mood swings, and brain fog." In addition, Dr. Sands says that "Some people are genetically predisposed to release more ghrelin, and they get hungry faster as a result."

Anorexia and Hunger Hormone Dysregulation

Research highlights how <u>eating disorder</u> sufferers have problems regulating feelings of hunger and satiety; whether this hails from an emotional or physiological place, such circumstances may perpetuate and/or contribute to the onset of anorexia.

Given that leptin directly affects appetite/body weight regulation, scientists set out to determine whether leptin played any role in eating disorders. Researchers measured leptin levels in 67 women: 21 anorexics, 32 bulimics, and 14 binge eaters. They compared/contrasted these values to those of 25 healthy women. Not surprisingly, the anorexic subjects displayed much lower leptin levels.

As anorexia proceeds to a more serious level, ghrelin levels go up, as expected with someone hovering near starvation. Upon the refeeding that accompanies intense therapy, the level of ghrelin plummets, which may explain why many people with anorexia struggle to put on weight. After long-term bouts of the disease, normal hunger signals frequently fail to function. It requires time and a tremendous caloric load to <u>add weight safely</u>.

Why Extremely Low-Calorie Diets Fail

The physiological status of an anorexic patient differs vastly from that of an average dieter; therefore, where these individuals seem to have found a way – albeit dangerous – to drop significant weight and keep it off, those results do not necessarily apply across the board.

Researchers at Rockefeller University discovered the leptin gene almost 20 years ago. We have now come to understand how leptin functions as one of many reasons why diets don't work. As body fat stores go down, so too do circulating leptin levels. Lower leptin levels throw off the body's satiety response; now the body takes longer to register the feeling of fullness following a meal. Over time, this scenario serves to bring the body back to its original weight, often with a higher percentage of fat tissue than before the loss.

Pleasure Reward of Food

The function of ghrelin first gained notice as a stomach-derived hormone involved in energy balance, hunger, and food consumption. Recent work now highlights its role in reward-driven behavior via activation of the so-called "cholinergic-dopaminergic reward link".

According to research published in the journal Addiction Biology, ghrelin not only reduces fat utilization but also plays a key role in the food reward cascade controlled by the brain's pleasure-reward system. Ghrelin levels are negatively correlated with weight, so dieting (especially severe calorie restriction) tends to increase ghrelin output.

Paradoxical Effects of Dieting

Individuals who embark upon severe caloric restriction in an effort to reduce weight often find the diet cannot be sustained long-term, due to an eventual lack of willpower, increased hunger, and a reduction in their metabolic rate. The human body interprets such a situation as "famine" and reacts appropriately for survival. As metabolism slows, in an effort to conserve energy, dieters very often experience a surprising regaining of weight. Leptin levels fall rapidly in response to fasting/severe caloric restriction, thereby bringing about profound hormonal changes. Low leptin levels can lead to overfeeding and suppressed thyroid activity.

Stress-Eating, Hunger Hormones, and Fat Levels

In addition to increasing appetite, ghrelin may also encourage the build-up of abdominal fat. Increased ghrelin syncs directly with stressful situations, as evidenced by the multitude of individuals who tend to mindlessly eat when stressed. Ghrelin contributes to weight gain by maintaining these stress levels (rather than allowing the body to return to homeostasis); the cascade culminates in strong urges to randomly snack or overeat.

On The Horizon

Several molecules and signaling pathways associated with leptin and ghrelin receptors have been identified as potential targets for pharmaceutical treatment, with the goal of overriding resistance to these hormones. Developing such medications could someday mean more effective treatments for individuals living with obesity.

Until then, we can help foster healthier lifestyles for our clients by steering them away from fad diets, and more towards prudent eating habits. Balancing macronutrients and exercise, trainers and dietitians can help clients conquer the mysteries of leptin and ghrelin and thereby gain better control over their physiques.

Exercise and Autism: A Positive Impact on Behavior

<u>Autism</u> refers to the complexity of neurobiological development disorders. Affecting 1% of the population within this continent, many experts consider it among the most serious of all mental health conditions. Recent studies indicate that physical exercise can confer short-term benefits for young autistic patients. As trainers, working with these children and teens can make a profound difference in their quality of life and that of their family members. *How prepared are you for such a challenge?*

Stereotypical Behaviors

The diagnostic display of characteristics used to identify an individual as "on the autism spectrum" may include a lack of social/interpersonal skills, delayed verbal abilities, and especially repetitive movements (also referred to as self-stimulation). The most common stereotypical behaviors — rocking motion of the hands, nodding, rocking the body forward/backward, and the need for repeated manipulation of objects – *all occur in an involuntary manner*. As we can easily understand, such behavior can cause significant interference/disruption in social and/or learning interactions, both of which play a critical role during childhood.

The exclusive function of the aforementioned movements involves physical and sensory self-regulation. The earliest support for exercise as an autism intervention came from anecdotal evidence highlighting how movement can serve as a technique for controlling self-stimulatory behaviors. Special education teachers reported that students appeared more attentive and cooperative after P.E. classes, field trips, or other outdoor excursions. This early interest caught the attention of scientists studying autism characteristics and behaviors, most notably the effect of exercise on self-stimulatory movements. Overall, these studies have proven promising.

The Reasoning Behind Typical Autism Movements

Autism experts have posited two theories with regard to physical activity and selfstimulatory movements. One states that engaging in vigorous physical activity produces physiological arousal similar enough to self-stimulation, thereby mitigating the need for the inappropriate behavior, if only temporarily. Another theory claims that physical exercise can indeed provide sensory feedback similar to self-stimulation, but in a more acceptable framework.

Reasonable logic stands strong behind these theories. Self-stimulating behavior provides a bit more sensory input when the individual feels the need. Conversely, using the movements for self-soothing can help block out too much input from the surroundings. Experts also point to the movements as a means of reducing pain, as they elicit moodenhancing beta-endorphins throughout the body.

Effects of Exercise on Stereotypic Autism Movement

A fairly comprehensive study set out to examine the relationship, if any, between moderate physical activity and self-stimulatory behavior. The sole subject, a 12-year-old male, initially refused to run on a treadmill for the 15-minute time frame requested by the scientists. The experiment shifted to cater to the boy's desire/ability to run between 5 and 8 minutes.

The treadmill progressed at 4.5 miles per hour, enough to induce effects concomitant with a mildly strenuous activity level (increased respiratory rate) but nothing more. Verbal praise and support, offered every 60 seconds, helped to encourage the child as he ran.

Even running for fewer than 15 minutes per session, the participant still displayed a considerable decrease in self-stimulatory behaviors. The researchers suggested that any form of moderate exercise might easily fit into a school/learning curriculum, for example, or other organized gatherings. Blended classrooms of children both with and without autism (mainstream education) often face unique teaching/learning issues; self-stimulation and other uncontrollable characteristics associated with autistic children can disrupt the flow of lessons and distract some classmates. If frequent exercise breaks can help with this, it seems worthy of consideration.

Varying Intensity Yields Different Results

Within the scientific community, questions arose regarding what level of exercise intensity could add the most benefit to an autistic person. It appears as though 15 minutes of mild exercise, such as engaging in a game of throw-and-catch with a partner, or taking a brisk walk, had little if any effect on the manifestation of self-soothing behaviors. However, 15 minutes of continuous and vigorous exercises like running or jogging always induced a reduction in autism-stereotyped behaviors.

The mean reduction of behaviors – 17.5% — measured prior to and after jogging, only lasted temporarily; the self-soothing movements returned to pre-exercise levels within 90 minutes, and often within just 10 minutes following the exercise. Still, educators and parents alike can use this data to find the proper amount of exercise to add to their child's school day, making learning as well as teaching more successful.

Success Across the Ages

A compilation of studies looked at exercise methods of 64 autistic volunteers, ranging from age 3 up to age 41. As data reflected above, scientists observed a lessening not only of selfsoothing movements but also in levels of aggression and "off-task" behavior following the exercise. These studies also sought to rule out post-exercise fatigue as a possible cause of diminished self-soothing movements. As hypothesized, on-task behavior and appropriate motor behavior, both of which require energy, actually increased following physical exercise.

Powerful Anecdotal Evidence

In any community of adults living with autism, people often share success stories as a means of motivating others. An interesting post by a blogger calling herself *Cerys the Chameleon* describes how the gym, and weightlifting in particular, evolved into a safe space for her. Upon reading her descriptions of how bodybuilding worked as a tool for managing her symptoms, it seems that any personal trainer could confidently advocate for young people to get involved in this passion.

Here you can read an excerpt of Cerys' story:

"What I didn't ever consider when I began the gym was how good weight lifting is for selfregulation. When the barbell is on my shoulders, it almost has the effects of a weighted blanket – it feels really comforting and grounding. The feeling of my muscles contracting is a nice sensation, a reminder that I'm alive. The sound the barbell makes when the plates hit the floor after a lift soothes me, plus the feeling of achieving that lift is euphoric.

When I began the gym and I was highly anxious, I would incorporate mindfulness into it. Every push I made I was pushing something away that I no longer wanted in my mind, anxiety, past memories, hurt. Every pull, I was pulling something I wanted, more confidence, independence, health.

It's also helped me massively to have a structure and routine. To set goals to work towards and feel a bit more control. Being autistic I often feel out of control due to the sensory overwhelm and difficulties keeping up with daily life."

We Can Change Lives

The positive effects outlined here, resulting from the introduction of exercise in the autistic population, highlight the need to reach out to and encourage this demographic to embrace all that we offer in a gym/fitness center setting. If we can succeed in helping these individuals reduce aggressive behavior, improve muscle tone/decrease body fat, lessen distracting bodily movements and increase academic skills, we can impact life not only for the person living on the autism spectrum but also for their friends/family members. As personal trainers, our omnipresent goal of changing people's lives calls upon us to do so in the autism community.

Wind Sprints: How to Effectively Train Fitness Clients

Wind sprints have secured a prominent place among today's vast array of training options. Consisting of a series of top-speed running spurts, followed by "recovery" walking, wind sprints offer a multitude of benefits. Changing particular variables of the exercise can help tailor it to any athletic discipline. Learn how and when to incorporate wind sprints into your clients' workout sessions.

Putting the Wind Sprints to Work

Ideally, trainers compose workouts with <u>a purpose or goal</u> in mind. If the design of the specific conditioning aligns with the client's sport-specific needs, the trainer propels his client forward, improving speed/endurance/power accordingly. The versatility of a wind sprint makes it a common option.

If we consider the mechanics of a heavy lift (bench press, for example), we know it requires a short burst of powerful energy to enact the concentric portion of the move. Such a dynamic parallels what one experiences during a wind sprint: short bursts of all-out power, followed by a brief respite (the eccentric half of the bench press). This author included wind sprints when training for competitive bodybuilding, and found it highly successful!

Basic Mechanics

A properly executed wind sprint finds the well-conditioned athlete reaching close to 90% of maximum effort, over a set distance or time. The first phase of the wind sprint should reach an aerobic heart rate range (50-80% of max); the runner will reach an anaerobic level by the end of the sprint. During recovery, the heart's bpm should return to around 50% of max heart rate before engaging in the next sprint.

*It's important to note that one should not attempt maximum intensity when beginning a sprinting routine, but instead, should step up intensity over the course of the training program.

Sprinting can tax the body significantly more than other modes of training. As such, adequate rest intervals play a key role in the success of this type of workout. For this reason, most athletes choose to perform wind sprints on days planned for resting or strength training, as opposed to cardio days.

By definition, wind sprints do not add significant time to one's current training. As an example, one can sprint for 15 seconds, then walk for 45 seconds. After four such sets and a rest period, the athlete then sprints for 30 seconds followed by 30 seconds of walking recovery. Once again, after completing four sets and a brief rest, the last two sets in this particular protocol call for a 60-second sprint followed by an equally long recovery. This training amounts to less than 20 minutes.

Proper Warm-Up

A study published in the *International Journal of Sports Physical Therapy* described an experiment where researchers separated 25 recreational runners into four groups. Each group engaged in various stretches prior to sprinting: ballistic, dynamic, static, and a control group that sprinted without any prior stretching.

Data showed a significant and perhaps unanticipated correlation between stretching and sprint times. The control group, who did not stretch at all, demonstrated the greatest sprinting improvement. While stretching post-exercise remains valid and essential, a few minutes of a simple walk or jog should prove sufficient as a warm-up prior to wind sprint training.

Building Muscle and Power

As sprinting puts an athlete temporarily into an anaerobic phase, it facilitates anabolism in much the same way as weight training. However, while weight training hones in on one body part at a time, sprinting requires the combined simultaneous effort of multiple muscles, making it a favorite in terms of complete muscle training exercises.

Studies have proven that sprinting can enhance protein synthesis pathways, particularly those that facilitate protein breakdown, by as much as 230%. With proper nutrition and recovery, sprinting can actually promote lean muscle mass. Sprinting also boosts the body's production of human growth hormone and improves insulin sensitivity.

The act of wind sprinting increases the proportion of type II "fast twitch" muscle fibers in the legs; these typically align with increased muscle mass and strength in the <u>glutes</u> and <u>hamstrings</u>. For the majority of runners, power hinges on these two muscles.

To HIIT or Not To HIIT?

Nicholas Rizzo, a fitness researcher for RunRepeat, analyzed over 70 scientific studies in an effort to compare the effects of conventional <u>high-intensity interval training (HIIT</u>), sprint interval training (SIT), and moderate-intensity continuous training (MICT). Despite spending 60% less time exercising, SIT participants experienced a 39.6% higher reduction in body fat percentage than participants who performed conventional HIIT. Likewise, in comparison to MICT, SIT resulted in a 91.8% higher reduction in body fat percentage while requiring 71.1% less time exercising. Perhaps this knowledge will enable trainers to safely encourage clients obsessed with HIIT training to try SIT as a complement to their current workout regimen.

Variations on a Theme

To help alleviate the repetitive tedium of regularly performing wind sprints, consider the inclusion of exercises that focus on improving form. In this manner, the trainer can add a modicum of variety to the sprint.

Consider adding the following when designing a sprint-based workout protocol:

- High Knees Sprint: Improves the knee drive component of the leg cycle.
- Straight Leg Striking Sprint: Focuses on key speed mechanics during the pulling/cycling pattern of foot strike.
- Butt Kick Sprint: Improves speed by shortening the lever arm of the leg.

- Power Skips Sprint: Focuses on the pre-loading and unloading phases of the knee drive.
- Forward Bounding Sprint: Ideal for foot strike power production, and also forces up to 3x the average extension while accelerating.
- Downhill Sprints: Classified as "overspeed training", sprinting downhill builds the ability for faster and more expedient leg cycling. Over time, as the athlete experiences a faster turnover/stride frequency, he also cultivates power and speed.

Using Wind Sprints with Clients

Whether a client seeks to improve speed, agility, power, or overall strength, sprint intervals can add a unique dimension to any training program. Requiring a small-to-moderate time commitment, the payoff speaks for itself. With so much variety from which to choose, wind sprints may become a personal trainer's new favorite tool for taking clients to the next level of athleticism.

Training Load, Injury, and Athletic Performance: Mastering the Trifecta

When training an athlete toward peak/competitive performance whether postrehabilitation or from current ability, training load must exceed capacity. With carefully planned increases in load, *t*he athlete's capacity tolerance improves. However, if the applied training load *greatly* exceeds capacity, or bumps it up *too quickly*, such a challenge to tissues invites the risk of injury. Read on for the answers to the following key issues:

- How can practitioners determine the definition of "too much training"?
- Following injury, how soon should training loads progress?

Identifying the 3 Key Concepts

When developing rehabilitation or performance programs, personal trainers must take into account *three* key parameters:

- the "floor"
- the "ceiling"
- time

The floor represents an athlete's current capacity; the ceiling represents the workload needed for the athlete to move toward and execute sport-specific activities. Perhaps the biggest, most challenging variable in this equation hinges upon the time it may take to progress from current abilities to those required for excelling in performance.

If coaches impose unreasonable training loads, or progress the workload too aggressively, athletes often find themselves at increased risk of <u>injury</u> and underperformance. Since we know that different physical capacities will adapt at different rates, most trainers agree that gradual and measured increases in training load allow athletes to safely progress, thereby reducing injury risk and enhancing performance. Keeping this in mind, trainers, coaches, and physical therapists must carefully consider allocating sufficient time to transition from the "floor" (rehabilitation) to the "ceiling" (return to performance).

Knowing The Specifics of the Population

Personal trainers and/or coaches who work with a younger athletic demographic (under the age of 18) must consider the following when developing training programs:

- (1) the effect of sport specialization on athletic development and injury
- (2) biological maturity
- (3) motor/coordination deficits in adolescents with special needs
- (4) responses to workload progressions

Historically, prudent training programs designed for younger athletes have emphasized *multisport participation* rather than sport specialization, in order to optimize motor skill acquisition while minimizing injury risk. We can think of this as basic crosstraining–skills that benefit the athlete across a wide range of endeavors. Sports medicine professionals, too, advocate progressive, gradual increases in workloads, citing this as the most optimal route toward fostering resilience to the demands of high-level competition.

Still, some training models prefer to emphasize the accumulation of sport- and skill-specific hours as they strive to turn out elite-level athletes. Despite recommendations against sport specialization, many eager budding athletes/coaches still choose this route, often neglecting to focus on basic training skills.

Does Excessive Training Help or Hinder?

Two schools of thought regarding training intensity often find themselves at odds when it comes to coaches and competitive athletics: does a higher training load *exacerbate injury rates*, or does training *confer a protective effect against injury*? Furthermore, does *under-training* elicit an uptick in injury risks?

In one study, athletes who engaged in 18+ weeks of training before the initial onset of an injury saw a reduced risk of subsequent problems. However, those with high chronic intense training protocols seemed to present with an even smaller risk of injury.

Regardless of the sport, coaches seem able to draw a direct relationship between wellhoned skills and injury reduction. In order to cultivate the physical qualities needed to provide this protective effect, however, athletes must engage in rigorous training. This forms the basis of what professionals call The Paradox of Training and <u>Injury Prevention</u>, a concept with which trainers and coaches constantly struggle.

Can The Paradox Work Favorably?

The paradox forms its basis on evidence that injuries are not caused by overtraining but more likely by an inappropriate training program. Coaches often witness a phenomenon whereby athletes accustomed to high training loads suffer *fewer* injuries than athletes training at lower workloads. They note that excessive and rapid increases in training loads typically cause the majority of soft-tissue injuries.

As an important determinant of injury, assessing training loads carefully and frequently (measured up to twice daily and over periods of weeks and months, or throughout a sports season) makes prudent sense. Training protocols aside, coaches would do well to fully understand the limitations of the younger athletes with whom they work. Loadsensitive athletes – those with multiple risk factors – benefit most from frequent monitoring, and a program designed to restore local tissue strength for sport-specific capacity.

Load-*naive* athletes – younger adolescents with potentially weaker or "immature" bone structures – develop best with monitoring as well as a cautionary eye on competitive events. Load-*tolerant* athletes may only need occasional monitoring, and can handle a somewhat swifter progression to optimum loads.

Final Thoughts

The appropriately graded prescription of high training loads should theoretically improve an athlete's overall level of fitness, which in turn may confer *protection against injury*. Over time, this may ultimately lead to greater physical resilience in competition.

The first important step, developing the training program, requires the practitioner to cultivate a strategy based on available evidence, professional knowledge, and experience. For decades, exercise strategies have been based on the fundamental training principles of overload and progression. Training-load monitoring allows the practitioner to determine whether athletes have completed training as planned, and how they have coped with the physical stress.

Some professionals discount training load as a means of quantitatively indicating whether particular load progressions will increase or decrease the injury risk. They argue that insufficient evidence exists to support the use of training load data to manipulate future training with the purpose of preventing injury. If we choose to accept this point of view, have we heretofore relied upon too simplistic of a solution? Need we embrace the risks and uncertainty inherent in any training protocol, and accept the inevitable appearance of athletic injuries?

These issues demand our attention, regardless of the age demographic we train. Careful consideration, planning and strategic execution of training programs will reveal the most appropriate paths for our clients.

Supporting Senior Clients: Cultivating a Sense of Belonging

As fitness professionals, supporting senior clients with the skills and tools at our disposal is an important obligation. It is vital that we help our senior clients exercise safely and also offer a number of ways to provide them with nutritional guidance in order to provide the greatest opportunities for improved health outcomes. Cultivating a sense of belonging amongst older clients appears to be the best way to do just that.

Aging Population

With the aging population of the United States comes a number of potential health issues including the prevalence of cognitive and mental health problems like dementia and depression. According to the CDC (Aug 2022) life expectancy as of 2022... lower than the previous two years, is approximately 77 years old. Compared to the life expectancy of approximately 57 years old in 1923, and combined with the massive growth of overall population in the past 100 years, this poses a potential crisis in the health span of our clients, family, and community at large.

An estimated 6.5 million Americans age 65 and older are living with <u>Alzheimer's</u> or some other form of dementia (Alzheimers Association, 2022). The Alzheimer's Association also predicts that the number of persons with some form of dementia will continue to grow as our population ages. The evidence suggests that more should be done to help improve the continued health, fitness, and subjective well-being of older adults.

A Sense of Belonging

Perhaps as an additional consideration when designing fitness and wellness programming for clients over 65, fitness professionals can incorporate the value of community, socializing, and purpose in life. A sense of belonging has been shown to provide better health outcomes and longevity for older persons. The Blue Zones Theory of health and longevity was proposed by Dan Buettner in his 2008 book conveniently titled *Blue Zones.* Buettner uses demographic data to highlight a number of regions throughout the world that contain the most long-living individuals. These longlived individuals appear to have a number of variables in common including various nutritional and exercise aspects and a *sense of purpose*. For some of these folks, such purpose was realized via duty to the family, like helping to raise grandkids or volunteering for the community.

More empirical research was done by Okuzono et al. in 2022. Okuzono measured health differences in subjects who exhibited the Japanese concept of *ikigai*. Ikigai. loosely translated as *a reason for being* is similar to a sense of purpose, and data from the study showed a 36% decrease in instances of dementia in those subjects with ikigai.

Another study, by Inoue et al., showed that older adults had higher reported subjective well-being scores when they felt a sense of belonging. In this particular study, subjects were given the opportunity to support some local sports teams. The simple relationship with other team supporters was enough to give the subjects a healthy sense of community.

Teamwork Makes the Dreamwork

Fitness professionals can be valuable coaches for more than just workout programming, providing holistic guidance on all aspects of wellness. Opportunities abound for senior networking, camaraderie, and social connection. Sharing the love of a local baseball team, even if an individual never goes to an actual game, can develop a sense of belonging. Joining a local gym can provide an outlet for meeting like-minded people; joining a fitness class has a built-in team. The sense of purpose that comes from belonging to a community of likeminded people seems to be a major factor in the health span of older adults.

Fitpros can make such suggestions and encourage their older clients to fold into the community or, we can provide more direct sources of forging relationships by leading

senior fitness classes or even just holding "lunch and learn" classes at your local community center. At the very least, you can partner up two or more of your senior clients for mutual support and accountability for their health and wellness endeavors, perhaps even assigning "support tasks" to help the other reach their goals in order to cultivate a sense of purpose.

Ultimately, we need to acknowledge the <u>importance of community</u>, connectedness, and sense of purpose when supporting senior clients, and our responsibility to these clients to provide such opportunities.

SELF – TEST

- 1. Mushrooms rank as the leading dietary source of which amino acid?
 - a. Ergothioneine
 - b. Threonine
 - c. Isoleucine
 - d. Tryptophan
- 2. Research suggests that individuals who include an abundance of mushrooms in their regular weekly diet suffer less from:
 - a. Bipolar disorder
 - b. Depression
 - c. Schizophrenia
 - d. All of these
- - a. Primary antioxidants
 - b. Secondary antioxidants
 - c. Essential amino acids
 - d. Non-essential amino acids
- 4. Which of the following is a contributing factor to training injuries?
 - a. attempts to top a personal best
 - b. incorrect use of straps
 - c. training while under the influence of alcohol
 - d. all of these will increase the likelihood of injury
- 5. What kind of test can prove helpful to distinguish the difference between nerve damage and a soft tissue tear?
 - a. Nerve conduction test
 - b. Flexibility testing
 - c. X-ray testing
 - d. DEXA scan
- 6. Research shows that in a state of injury repair, metabolism will
 - a. Increase
 - b. Decrease
 - c. Stay the same

- 7. While rehabbing an injury, an increase in ______ serves as an ideal fuel source.
 - a. Vitamin D
 - b. Omega-3s
 - c. Calcium
 - d. Carbohydrates
- 8. It is not possible to be addicted to soda.
 - a. True
 - b. False
- 9. Which of the following neurotransmitter induces pleasurable feelings?
 - a. Melatonin
 - b. Gamma-aminobutyric acid
 - c. Dopamine
 - d. Histamine
- 10. Over time, increased consumption of phosphoric acid will lead to a disruption in the /phosphorous ratio.
 - a. Magnesium
 - b. Histamine
 - c. Lipton
 - d. Calcium
- 11. A ______ eccentric tempo induces a greater hypertrophic response.
 - a. Slower
 - b. Faster
- 12. A tempo sequence of 1-0-2-0 would mean:
 - a. The eccentric phase lasted for 1 second and the concentric phase lasted for 2 seconds, with no measurable transition period between actions.
 - b. The concentric phase lasted for 1 second and the eccentric phase lasted for 2 seconds, with a short pause in between actions.
 - c. The isometric phase lasted for 1 second and the isotonic phase lasted for 2 seconds, with no measurable transition period between actions.
 - d. The isotonic phase lasted **for** 1 second and the isometric phase lasted for 2 seconds, with a short pause in between actions.
- 13. Research studies indicate that different types of muscle tissue likely favor a different contraction cadence for optimal respective hypertrophy.
 - a. True
 - b. False

- 14. Together, these muscles contain more mass than any other in the body.
 - a. Abdominals
 - b. Quadriceps
 - c. Forearms
 - d. Latissimus
- 15. As a whole, the primary purposes of the quads are:
 - a. Hip extension and knee flexion
 - b. Knee extension and hip flexion
 - c. Lower back rotation and gastrocnemius supination
 - d. Gastrocnemius rotation and lower back supination
- 16. This muscle crosses both the hip and knee joints.
 - a. Vastus medialis
 - b. Vastus femoris
 - c. Rectus femoris
 - d. Intermedius rectus
- 17. As a trainer, why is it important to understand each of the individual vastus muscles? Because:
 - a. knowing their location will make training more purposeful
 - b. understanding each of their functions helps when creating exercise programs that are specific to fitness training goals
 - c. in order to represent the personal trainer distinction with an educated professionalism, it is important to be well versed in anatomical muscle structure and function
 - d. all of these are important reasons that a personal fitness trainer understands this, and other, muscle groups
- 18. Overloading the body with fluids can cause 'water intoxication', also known as:
 - a. Hyponatremia
 - b. Hypernatremia
 - c. Hydroxication
 - d. None of these as 'water intoxication' is not possible
- 19. When the body enters ketosis, it must significantly ______ existing glycogen stores in order to utilize ______ as an energy source.
 - a. generate; fat
 - b. deplete; fat
 - c. generate; glucose
 - d. deplete; glucose

- 20. Ketotic state evolves through severe restriction of dietary ______.
 - a. Fats
 - b. Carbohydrates
 - c. Proteins
 - d. Ketones
- 21. A true state of ketosis reflects serum concentrations at:
 - a. Above 0.5 mM
 - b. Below 0.5 mM
 - c. Above 10 mg
 - d. Below 10 mg
- 22. Varicose veins will not affect athletes because of their constant movement and training.
 - a. True
 - b. False
- 23. Varicose veins are inflamed _______ that form just under the top layer of the skin's surface.
 - a. Arterial walls
 - b. Skin cells
 - c. Muscle tissue fibers
 - d. Blood vessels
- 24. Despite popular belief, there is no link between varicose veins and heart disease.
 - a. True
 - b. False
- 25. The control of energy balance within the human body largely rests on two key hormones:
 - a. Adrenaline and histamine
 - b. Growth hormone and prolactin
 - c. Leptin and ghrelin
 - d. Dopamine and endorphins
- 26. In a functioning body, _____ tells the body when it's hungry and _____ tells the body when to stop eating.
 - a. Ghrelin; leptin
 - b. Leptin; ghrelin
 - c. GH; prolactin
 - d. Prolactin; GH

- 27. The most common stereotypical behaviors of autism include:
 - a. rocking motion of the hands
 - b. rocking the body and nodding
 - c. repeated manipulation of objects
 - d. all of these are typically reserved with autism
- 28. 15 minutes of continuous and vigorous exercises, like running or jogging, always induced a reduction in autism-stereotyped behaviors.
 - a. True
 - b. False
- 29. Consisting of a series of top-speed running spurts, followed by "recovery" walking, is more commonly known as:
 - a. Short sprinting
 - b. Wind sprints
 - c. Quick run
 - d. Road run
- 30. In an effective wind sprint, the runner will reach an _____ level by the end of the sprint.
 - a. aerobic
 - b. anaerobic
- 31. During recovery, the heart's bpm should return to around _____ of max heart rate before engaging in the next sprint.
 - a. 10%
 - b. 20%
 - c. 50%
 - d. 80%
- 32. When training an athlete toward peak/competitive performance, training capacity must exceed training load.
 - a. True
 - b. False
- 33. When developing rehabilitation or performance programs, personal trainers must take into account what 3 key parameters?
 - a. Time, tempo and temperature
 - b. Foundation, space, tempo
 - c. Feet, midway, endpoint
 - d. Floor, ceiling, time

- 34. Coaches often note that soft tissue injuries are most typically caused by:
 - a. rapid increases in training loads
 - b. gradual increases in training loads
 - c. passive lifting at slow tempo
 - d. all of these will cause injury
- 35. According to the CDC, life expectancy is ______ than previous two years with an approximate life expectant average age of ____ years old.
 - a. Higher; 92
 - b. Lower; 77
- 36. The most long-lived individuals appear to have which variable/s/ in common?
 - a. Nutritional aspects
 - b. Purposeful exercise/movement
 - c. Sense of purpose
 - d. All of these contribute to longer life expectancy

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