

# Over-training

The term "over-training" means different things to different people. In running, most people in the sport define it in such a way as to relate to a running injury.

That's the common way people think of it. However, the more common manner in which it manifests itself is in suppressing one's body from gaining fitness, thus suppressing improvements in performance level.

## **There are --2-- separate consequences of "Over-training"**

1. The one where you incur a running injury

2. The one where your body enters into the physiological state where your anabolic system [a.k.a tissue building] is suppressed to some significant degree and thus your ability to acquire training adaptations and move forward in fitness level is suppressed. This can be referred to generally as "Physiological Over-training", or being in an "over-trained state".

**Physiological over-training, or being in an "over-trained state" is something one can measure. It often comes in the form of cortisol [stress hormone] production, which suppresses anabolic [tissue building] hormones and other hormone production [ie. testosterone, estrogen, growth hormone, thyroid hormone, and overall adrenal gland function], and competes with anabolic hormones for binding sites on tissues such as muscle. It reduces protein production, such as muscle protein, blood proteins [ie. Red Blood Cells, Immune system cells, etc]. This is a state where even though you are -not- injured, and even though you are training fully, your fitness level does -not- move forward, and may even reverse.**

Again, this is a measurable state. You can measure cortisol levels. You can measure red blood cell and EPO production ability. You can measure muscle protein synthesis. You can measure immune system activity. You can measure adrenal gland function. You can measure certain aspects of brain activity.

Regardless of what type of training program you believe in and follow [mileage oriented, or velocity oriented], its helpful if one's body can stay in an anabolic state such that it can adapt to one's training, thus moving forward in fitness, leading to increases in performance level.

That's major challenge and the major objective when designing any training program.

If your body can't adapt, you can't move forward in fitness level. If your body can't move forward in fitness level, it can't move forward in performance level.

Much of sport is about moving forward in performance.

# Over-training Embedded In The Design Of A Low Volume Training Program

If you grew up in the sport, you have been indoctrinated in the mileage oriented belief system. Even if/when you become a believer in velocity oriented training and attempt to make the shift away from mileage oriented training, the mileage oriented belief system isn't something that you can just press a button and delete all of its influence from your brain.

When you move to a velocity oriented belief system, the reality will be that you're a mileage oriented person trying to design a low mileage training program.

That may impact the design of your training program in that the shorter workouts will tempt you to think that you don't need much in the way of rest. You'll believe that programming in 2 or 3 days off between workouts will certainly be unnecessary and will result in loss of fitness. You'll believe this because you have been indoctrinated in the mileage oriented belief system and you're a mileage oriented person trying to design a low mileage training program.

**The reality is that the faster you train, the more rest you'll need.....regardless of how short the distance covered is in any given workout.**

The mileage oriented influence will have you trying to design a training program that crams as many workouts into a short period of time as possible. If you go down that path, over-training will be the result. Having grown up in the sport and thus been indoctrinated into the polar opposite mindset, it may take multiple extreme states of overtraining to force you into a different mindset.

The term "over-training" does -not- mean injury, but rather the physiological state where your anabolic system is suppressed to some significant degree and thus your ability to adapt to your training and move forward in fitness level and performance level is suppressed.

Once you choose [in your approach to designing a training structure] to focus less on the number of training days and more on the number of rest days, the body will work as it should, and your fitness level will move forward.

The faster your goal paces, the more rest days you'll need, even if your workouts are very short.

The slower you train, the fewer days you'll need off, which is likely why a mileage oriented runner is able to train every day running over 100 miles per week, not getting over-trained until he/she starts training faster.

## **Over-training.....Stay Anabolic**

As with any training program, its helpful if one's body can stay in an anabolic state such that it can adapt to one's training, thus moving forward in fitness, leading to increases in performance level.

In human physiology, the term "over-training" does -not- always refer to "injury", but rather the physiological state where your anabolic system is suppressed to some significant degree and thus your ability to adapt to your training and move forward in fitness level and performance level is suppressed.

The training program must be designed in a way that allows the runner's body to stay in an anabolic state over time.

"Exercise bouts that maximize anabolic hormonal response and/or minimize the catabolic hormonal response promote greater long-term adaptations....."

"Similarly, exercise bouts that limit the anabolic hormonal response and/or exacerbate the catabolic hormonal response suppress adaptations....."

**D.A.Judelson, et al**

**Effect of hydration state on resistance exercise-induced endocrine markers of anabolism, catabolism, and metabolism  
Journal Of Applied Physiology.....Volume 105 #3....September 2008....page 815 - 824**

## **Nutrition Medicine to aid in reversing the state of physiological over-training..... phosphatidylserine [supplement from soy]**

"An excessive cortisol response to exercise-induced stress has been linked to a negative training state, which could lead to overreaching or overtraining.

"Chronic overtraining often creates a disturbance in the anabolic-catabolic balance, which may express itself in decreased performance, injury, depressed immunity and psychological depression."

"Previous research has indicated that phosphatidylserine supplementation has the potential to attenuate the serum cortisol response to acute exercise stress. Equivocal findings suggest that this effect might be dose dependent. This study aimed to examine the influence of short-term supplementation with a moderate dose of PS (600 mg per day) on plasma concentrations of cortisol, lactate, growth hormone and testosterone before, during, and following moderate intensity exercise in healthy males."

"10 healthy male subjects participated in the study. Each subject was assigned to ingest 600 mg PS or placebo per day for 10 days using a double-blind, placebo-controlled, crossover design."

"Mean peak cortisol concentrations and area under the curve were lower following phosphatidylserine when compared to placebo."

"The findings suggest that phosphatidylserine is an effective supplement for combating exercise-induced stress and preventing the physiological deterioration that can accompany too much exercise. phosphatidylserine supplementation promotes a desired hormonal status for athletes by blunting increases in cortisol levels.

**Michael.Starks, et al**

**The effects of phosphatidylserine on endocrine response to moderate intensity exercise  
Journal of the International Society of Sports Nutrition....Volume 5 #11....July 2008**

"Phosphatidylserine is a naturally occurring phospholipid nutrient that is most concentrated in organs with high metabolic activity, such as the brain, lungs, heart, liver, and skeletal muscle. Phosphatidylserine is located mainly in the internal layer of the cell membrane and has a variety of unique regulatory and structural functions. Phosphatidylserine modulates the activity of receptors, ion channels, enzymes and signaling molecules and is involved in governing membrane fluidity. Traditionally, Phosphatidylserine supplements were derived from bovine [cow] cortex; however, due to the potential transfer of infectious diseases, soy-derived Phosphatidylserine has been established as a safe alternative.

"Phosphatidylserine has been shown to improve a variety of brain functions that tend to decline with age. In recent studies, Phosphatidylserine has been shown to enhance mood in a cohort of young people during mental stress and to improve accuracy during tee-off by increasing the golfer's stress resistance."

**Michael.Starks, et al**

**The effects of phosphatidylserine on endocrine response to moderate intensity exercise  
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"Phosphatidylserine has been reported to attenuate serum cortisol and adreno-cortico-tropic hormone (ACTH) responses to staged cycling exercise. 800 mg Phosphatidylserine supplementation lowered cortisol response by 30%, whereas 400 mg showed no significant results compared to placebo. Also, 800 mg Phosphatidylserine has been reported to reduce the cortisol response to intensive resistance training by 20%. Phosphatidylserine had no effect on testosterone levels. These finding suggest that Phosphatidylserine partly counteracts the stress-induced activation of the hypothalamo-pituitary-adrenal axis."

**Michael.Starks, et al**

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**As goes the immune system, so goes adaptations to training.**

**Nucleotides improve immune system function.**

**As goes the brain and nervous system, so goes adaptations to training.**

**Nucleotides improve brain and nervous system function**

**Ribose supplementation.....**

**Contrary to the hype about ribose supplementation, the major mechanism of action is unlikely to be the providing of cellular energy [a.k.a. ATP] to muscles.**

**Far more likely to simply provide the ribose needed for production of incredibly important things in our cells called nucleotides. Our cells use nucleotides to repair and regenerate themselves via production of mRNA, RNA, and regeneration and repair of DNA.**

**Nucleotides production improves immune system function.**

**The human body makes ribose. Like other things that the body makes, there are times of life when supplementation can be pretty important. During times of chronic stress, or for athletes in high intensity training.**

**Also important for aging populations.**

The study below shows that ribose supplementation improves the proliferation of a group of immune system cells, as well as improves their functioning ability.

"Ribose, a critical building block for nucleotides, plays an important role in.....transcription, translation.....".

"....we hypothesized that when cells are required to proliferate or differentiate, as in an immune response, the requirement for D-ribose may be greater than what could be supplied by the synthetic pathway."

"We hypothesized that providing an exogenous source of D-ribose during cell differentiation will enhance the process of differentiation."

"The expression of a cell surface marker representing maturity (CD11b) significantly increased and a cell surface marker indicative of immaturity (CD117) significantly decreased."

"Functionally, the cells had a greater oxidative burst function dependent on time and dose. The mechanism by which ribose enhances HL-60 cell differentiation is not known; however, as adenosine triphosphate levels did not change, adenosine triphosphate is not thought to be involved."

"We conclude that in this cell culture model, ribose supplementation enhanced cellular differentiation and function. Thus, ribose might be conditionally essential during time of higher need as in an immune response."

**M.Freeman, et. al**

**Ribose enhances retinoic acid-induced differentiation of HL-60 cells?**

**Nutrition Research..... Volume 28 #11.....page 775 - 782**

**by Dr. Mehmet Oz [a.k.a "Dr. Oz"]**

Ribose is a special sugar made in your body that doesn't come from food. Of all the things you can do to combat the effects of knee-dragging fatigue, taking daily a ribose supplement is the one that seems to really turbo-charge some people who have diseases with low energy associated with them. (The only side effect is that some people feel too much energy, if that's possible.) Ribose has also been shown to relieve fatigue, soreness, and stiffness after exercise, and some professional athletes have reported muscular benefits after taking ribose. However, the data are too weak to say it does or doesn't work well, since the studies just haven't been done.

And there is enough good research to recommend ribose for all of us. But if you want to give it a try, start with 500 milligrams three times a day for a week or so until you get used to the taste (or find a smoothie, coffee, or tea to put it in). Then go to 5 grams three times a day for three weeks to get a sense of the effect. Then you can scale back to 5 grams twice a day. By the way, since I know you're wondering: Each 5-gram scoop only contains 20 calories since ribose isn't metabolized as a sugar, so taking it won't increase your chances of becoming mistaken for a Sea World attraction. In fact, since it is a bit sweet, you might think of it as a sugar substitute.

**Training is all about using workouts to induce cell replication or production of stuff inside cells that allow them to function at a higher level. When cell replication is stressed too much, cells can't keep up with maintaining DNA integrity, and the things located at the end of DNA strands [telomeres] don't get maintained. When they were down, cell replication stops. A sign of overtraining. Outside of sport, is also a sign of accelerated aging.**

"Telomeres.....located at the end of chromosomes. The length of telomeres is an important measure of the replicative history of the cell and also an indicator of its proliferative potential, because in cell cultures chromosomal telomeres shorten with each round of cell division."

"The length of DNA telomeres is an important parameter of the proliferative potential of tissues. A recent study has reported abnormally short telomeres in skeletal muscle of athletes with exercise-associated fatigue."

"One reason for this shortening is the so-called end replication problem attributable to the inability of the DNA polymerase to completely replicate the ends of the linear molecules. However, recent in vivo studies suggest that cell replication is not the only factor accountable for the regulation of telomere length, and that external factors also can affect telomeres. In this respect, it has been shown that telomere shortening is stress dependent and that it occurs at higher rates in cells with low antioxidative defense."

"The fact that telomeres are influenced by external factors has recently been shown in a study on the effects of chronic stress on telomere length. Caregiving mothers (mothers of chronically ill children) with the highest levels of perceived stress have a significantly lower telomere length in peripheral blood mononuclear cells than do control mothers (mothers of healthy children). It has also been shown that mood disorders are associated with accelerated telomere shortening...."

"...and it is known that telomere shortening is not an irreversible process, because of the existence of telomerase, an enzyme capable of extending telomeres. Telomerase has been demonstrated in many tissues, including heart myocytes and skeletal muscle. Thus, it now seems likely that telomeres are subject to various regulations in many body systems to maintain tissue integrity."

"Skeletal muscle satellite cells.....are precursors able to....provide new myonuclei....generate new muscle fibers, or produce new satellite cells. Recent studies have demonstrated the important role played by satellite cells in the adaptation of skeletal muscle to strength training. Satellite cell proliferation can contribute to the acquisition of new myonuclei in hypertrophying muscle fibers and to the repair of segmental muscle injuries caused by excessive loading. It has also been shown that the proliferation of satellite cells in response to exercise allows the renewal of their own pool."

"....recent studies on the acute effects of strength training demonstrate the capacity of satellite cells to proliferate very rapidly in exercised muscle. Significant increases in the proportion of satellite cells have been detected in young men at 4 and 8 d after a single bout of maximal exercise, and a remarkable increase in satellite cell number (141% increase) has been observed as early as 24 h after 92 maximal eccentric contractions in young men."

"The significant recruitment of satellite cells in the adaptive process of skeletal muscle to exercise raises the important question of whether the regular practice of strength training affects skeletal muscle DNA telomere length."

".....skeletal muscle DNA telomere length in endurance athletes suffering from exercise-associated chronic fatigue, a condition labeled fatigued athlete myopathic syndrome. A severe reduction in skeletal muscle DNA telomere length has been shown in myopathic syndrome patients compared with a healthy, asymptomatic, age-matched control group."

**F.Kadi, et al**

**The Effects of Regular Strength Training on Telomere Length in Human Skeletal Muscle  
Medicine & Science in Sports & Exercise.....Volume 40 #1.....January 2008...page 82 - 87**

## **Ice Baths & Suppression Of Adaptations To Training**

Ice baths became popular around the late 1980's and early 1990's.

Some research during that time frame [presented at the International Olympic Committee's World Congress on Sport Science, which I attended in 1988] demonstrated that ice baths for 10 - 15 minutes in the area around 10 - 15 degrees C resulted in damage to the nervous system, or "nerve damage" to be specific.

Around that time, Ice baths were extensively used by the women's track team at the University of Texas, particularly by the women distance runners in the late 1980's. One of whom was one of my former high school athletes [she is now a medical doctor and an ETG club member (Gabrielle Patterson <http://www.judysbook.com/Patterson-Gabrielle-MD-Doctors-richardson-r21846454.htm>). At the time, her descriptions of it is what caused me to look for research on it, since it didn't seem like a good idea to me.

Since those days [late 1980's, early 1990's] I've always told people that its best to avoid using that modality given that in distance running the nervous system is the primary organ system one wants to train and develop, not damage. Thus based on published research, when I coached at the high school level in mid to late 1980's, as well as today in the ETG, we follow a protocol for Jacuzzi hot baths. Limited to about 10 minutes [100 - 105 degrees F] on the day following a workout.

To some significant degree, we know that this modality [Jacuzzi hot baths] is causing or contributing to an increase in a host of beneficial substances that aid training adaptations, such as nerve growth factor [NGF], Brain derived neurotrophic factor [BDNF], growth hormone, and improved immune system status. In short, I stopped being a fan of anything cold, including ice for an injury, back in the late 1980's. It didn't make sence to me to try to suppress the body's natural function. Swelling seems like a natural function. Having read a lot of research on it, I don't get the idea that as a species, we understand what purpose it serves, though we've gone out of our way to invent multiple ways to suppress it. My view is that if some part of the body is swelling, its doing that for a reason. I don't know that swelling//inflammation per se slows healing. I think there is a correlation, but no cause and effect, particularly after 1 or 2 days time. I think people have made an assumption that I don't know has been confirmed physiologically. I do know that there are lots of things going on in there involving the immune system not all of which should be suppressed.

There is a difference between workout recovery, as compared to adaptations to training [ie protein synthesis and tissue production]. The ice bath is a stressor to the body. One might look at cortisol [stress hormone] levels induced by an ice bath. Logically one can suspect that an ice bath would probably increase cortisol levels to a level that may suppress training adaptations to some degree.

Things that suppress the function of your immune system;

--- cryotherapy [a.k.a. ice baths]

--- NSAID's [a.k.a. anti-inflammatory drugs]

The Immune system is the end all and be all of adaptations to training. Don't do things that suppress the function of your immune system.....

"...the administration of nonsteroidal anti-inflammatory drugs or cryotherapy are common clinical practices to control the inflammatory process following connective tissue injury. However, there are contradictory conclusions on the potential of anti-inflammatory strategies to either prevent nonspecific damages or accelerate healing after acute tendon or ligament trauma."

"Cumulative evidences also show that, apart from releasing catabolic enzymes, inflammatory cells can ultimately favor tissue healing through different biological processes."

"Indeed, after the clearance of pathogens and other signals of danger, neutrophils will undergo apoptosis and be engulfed by phagocytic macrophages. Macrophages will then release growth factors that can stimulate fibroblast proliferation, collagen synthesis, and angiogenesis during the early phase of healing."

**Journal Of Applied Physiology.....Volume 102 #1.....January 2007.....page 11 - 17**

**D.Marsolais, et al**

**Inflammatory cells do not decrease the ultimate tensile strength of intact tendons in vivo and in vitro: protective role of mechanical loading**

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"The use of nonsteroidal anti-inflammatory drugs for the treatment of tendon inflammation might increase the levels of leukotriene B4 within the tendon, potentially contributing to the development of tendinopathy."

"This finding is of interest because NSAID's are routinely used in clinical practice for the symptomatic treatment of tendinopathy, such as inflammation and pain."

".the increased LTB4 level due to treatment with NSAID's could potentially exacerbate the situation by leading to neutrophilic infiltration and lymphocytic activation, paradoxically causing further inflammatory and degenerative changes in the tendon."

".the results of this study suggest that the routine use of COX inhibitors for the symptomatic relief of inflammatory tendon conditions might inadvertently worsen the processes responsible for the development of tendinopathy."

**Zhaozhu Li, et. al**

**Inflammatory Response Of Human Tendon Fibroblasts To Cyclic Mechanical Stretching**

**The American Journal Of Sports Medicine..Volume 32 #2....2004...page 435 - 439**

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"Macrophages are necessary for skeletal muscle regeneration after injury. Muscle recruits inflammatory monocytes/macrophages that switch toward an anti-inflammatory profile upon phagocytosis of debris."

"In vitro, proinflammatory macrophages stimulate myoblast proliferation, whereas anti-inflammatory macrophages stimulate their differentiation. Thus, macrophages are involved in both phases of skeletal muscle regeneration: first, inflammation and cleansing of necrosis, and then myogenic differentiation and tissue repair."

**Exercise & Sport Sciences Reviews....Volume 37 #1.....,January 2009.....page 18 - 22**

**B. Chazaud**

**Dual and Beneficial Roles of Macrophages During Skeletal Muscle Regeneration**

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[Anti-inflammatories, NSAID's, also known asCOX-2 inhibitors. It may be unwise to inhibit COX-2].....

"Restoration of normal muscle mass depends on myofiber growth, the regulation of which is incompletely understood. Cyclooxygenase (COX)-2 is one of two isoforms of COX...."

"Previously, we demonstrated that the COX-2 pathway regulates early stages of myofiber growth during muscle regeneration."

".....these data suggest that the COX-2 pathway plays a common regulatory role during various types of muscle growth via multiple mechanisms.

"Muscle regeneration involves the replacement of necrotic myofibers via de novo myofiber formation and involves a robust inflammatory response."

**American Journal Of Physiology.....Volume 290 #5.....May 2006.....page C1651-C1659**

**B.A.Bondesen**

**The COX-2 pathway regulates growth of atrophied muscle via multiple mechanisms**

# Blood Chemistry Profile

It is possible to use blood tests to periodically monitor various aspects of train-ability, mainly in the area of attempting to make sur over-training. The measures listed below may prove helpful in that area;

## **Plasma Glutamine -----**

- shows level amino acid glutamine in the blood, an indirect indicator of immune status
- compare to levels during Training Preparation period, and other early periods
- levels significantly below early period levels may indicate immuno-suppression. and reduced ability to adapt to further training

## **Lymphocyte to Neutrophil Ratio -----**

- measure of immune function
- looking for levels between .75-.80
- low ratio may indicate over stressed immune systems and reduced ability adapt to further training

## **Blood Urea -----**

- indirect measure of glycogen depleted status
- looking for levels between 25-30mg% (women), 36-42% (men)
- take morning following the day of the workout, and again 24 hours later
- high levels may indicate protein breakdown for energy production due to muscle and liver glycogen depletion

## **Serrum Ferritin -----**

- shows level of iron stored in the body
- looking for levels above 50ng/ml
- levels below 12ng/ml indicate near full depletion

## **Transferin Saturation Percentage -----**

- transferin is the protein which transports iron in the blood
- looking for saturation levels around 35%
- levels below 16% indicate bone marrow iron stores near full depletion

## **Hemoglobin -----**

- measure of hemoglobin in red blood cells
- looking for levels above 12g/dl

## **Free Erythrocyte Protoporphyrin (FEP) -----**

- Protoporphyrin. is the precursor of hemoglobin
- looking for levels around 30ug/dl
- levels above 100ug/dl may indicate reduction in hemoglobin production

## **Mean Corpuscular Volume (MCV) -----**

- measure of the average size of red blood cells
- looking for levels between 85fl - 95fl
- levels above 95fl may indicate destruction of smaller/older cells via foot strike hemolysis