HORMONAL AND METABOLIC CHANGES DURING PROGRESSIVE OVERLOAD TRAINING–A REVIEW

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CROSSFIT ROOTS

This article is dedicated to the early CrossFit warriors Greg Amundson, Jim Baker, Eva Twardokens, Jason Highbarger, Ed Conover, Dave Leys, Garth Taylor, Matt Mast, Thomas Crubaugh, Brent Edwards, Ross Burke, Phil Mancini, and Mike Weaver. I hope I haven't missed anyone.

After Coach Greg Glassman and Lauren were booted from Spa Fitness after Eva dumped a loaded bar, these were the ones who threw their lot in with him and worked out in a small space set aside at Claudio's Brazilian Jiu Jitsu gym using a new and contrarian approach to training, called "CrossFit". They were introduced to short intense workouts with the startling addition of plenty of variety—major lifts, gymnastic basics, rowing, running—mixed—hard and fast—short and intense—no routines.[1] As intense, varied, fast and loaded as those workouts were, a couple of years later when the early CrossFitters moved with Greg and Lauren into the first CrossFit box (our HQ), they were stronger, more powerful, faster and more flexible. All of which was accomplished without one athlete having been overtrained.

In the first CrossFit Journals from September 2002 until October 2004, Greg was writing every single word. He put all of his considerable mental strength into making those Journal beginnings a reflection of what CrossFit stands for. There are many gems--brilliant and captivating--special. They deserve rereading–like a good book does.

At the end of 2004, Greg began to relinquish some of the writing to other specialists--Olympic lifts, barbell training, running, recovery, regeneration, gymnastics, nutrition and much more. These new contributors were and are successful men and women with **a specific** talent and a depth of knowledge that comes from hard study and experience. Their special contributions have enriched us all and continue to do so.

CrossFit was never meant to stand still and Greg's hold was not "the chokin' kind." anyone can see that by the way he allowed the CrossFit Journal to develop and expand in the hands of other coaches, trainers and scientists. CrossFit was meant to grow, not only physically, but abreast of information from scientific exercise studies, some of which actually track biological and inflammatory processes relative to performance—never mind if the programs involved aren't exactly like CF. We can still profit from them.

Josh Everett has reminded me--and rightly so, that CrossFit is more intense and the workouts more varied than any other training protocol. So that "even if a training program has a consistent workout routine pushing the limits of volume and intensity it will not have the same effect as that of CrossFit because of the stress involved in the constantly varied stimuli" unique to CrossFit. And that varied stimuli is exactly why controlled studies are probably not possible for CrossFit workouts. Knowing that, I was still drawn to a 2010 study out of Australia because the training had as much variety as possible while remaining controlled; plus it gave us a peek at hormonal and metabolic changes during progressive overload compared to normal training.

THE AUSTRALIAN STUDY

Rugby league is a high contact, dynamic sport in which athletes require a combination of strength, power, speed, agility, aerobic and anaerobic endurance, and attributes specific to elite rugby athletes.[2] The 2010 Australian study by Aaron Coutts Ph.D, Peter Reaburn, et al[3] is of interest because it is a controlled scientific study backed by an impressive battery of tests across 6 weeks of overload compared to "normal" training that involved 5-7 sessions per week and included rugby league training, endurance development, resistance training, speed and agility.

This study gives us an insight into the hormonal and metabolic changes in elite athletes who take on a progressive overload training program to be compared with the same age and number of athletes in a normal training program. Biochemical, immunological, physiological and psychological markers for overloading or overtraining and adaptation were measured in the two before, three times during the 6-weeks of training and after the one-week tapering period. **Progressive physical training sessions (5-7 per week for 6 weeks)** included field-based specific rugby league training, endurance development, speed, agility and resistance training. **Progressive training loads** across the 6-weeks were significantly greater (21.6%) for the overload training group than for the normal training group. **Training duration** was progressively increased for each week for both groups, however the overload training group spent more time training than the normal training group. Capping it all off , they combined both groups for a week of tapering off before assessing all data again. **Other measurements** included the Multistage Fitness Test (p. 4), 10-s cycle sprint, VO_2max, peak aerobic running velocity, maximal heart rate, vertical jump and body mass.

Physiological Performance in the Progressive Overload Training Group

- **Multistage Fitness Test.** Over the 6-week testing period performance decreased by 9.2%, whereas the normal training group increased performance by 3.3%.
- **VO_2max.** Over the testing period there was a significantly lower VO_2max compared to the normal training group.
- **Peak aerobic running velocity (Vmax), heart rate, body mass, and peak cycling power.** At completion of the testing period there was a significant reduction in all of these measurements compared to the normal training group.
- **Vertical jump, mean power output, and mean relative anaerobic capacity measured during a 10 s sprint.** There were no significant changes.

Of interest, in the progressive overload training group, this training model resulted in supercompensation in the Multistage Fitness Test, vertical jumps, and VO_2max, along with a reduction in muscle damage and a return to a more anabolic hormonal environment after the tapering period.

Hormonal Changes

Testosterone (T) Concentration.

- At two weeks into training both groups had an increase in testosterone concentration, the overload group more than the normal training group.
- At four weeks both groups had a decrease in testosterone levels--below baseline for the progressive overload group and slightly above baseline for the normal training group.
- Post-training levels were significantly lower than baseline for both groups, but much more so for the progressive overload training group.
- During the tapering down week, there was an increase in T for both groups, but not back to baseline. The increase was more significant for the overload group.

Cortisol levels. In this study, cortisol levels were elevated across the 7-weeks. It has been noted by Mastorakos et al[4] that athletes at this level of competition may exhibit a chronic mild hypercortisolism at baseline that may be an adaptive change to chronic exercise. Other studies that measured cortisol levels after international rugby competition, speed skaters, and weightlifters all had elevated cortisol levels after a single competition.

Testosterone/Cortisol (T/C) Ratio. Except for the second week of training when the ratio rose slightly, it declined for both groups (i.e testosterone low/cortisol high)--but more so for the progressive overload training group. During taper the plasma T/C ratio significantly increased in both groups. Other studies--describe later--also reported a decline in the T/C ratio during stress such as after an international rugby competition;[5] in speed skaters during an eight-month season;[6] because of a mental challenge during exercise;[7] and in national level male weightlifters. [8]

Hematology

Creatine Phosphokinase (CK). Elevations of this enzyme are seen clinically in myocardial infarction and rhabdomyolysis and other conditions of muscle damage--even intramuscular injections or strenuous exercise. Rugby league training demanded high intensity sprints, body contacts, jumps, resistance training, all of which may elevate CK levels. Although the CK levels were elevated in both groups 2 weeks into training, they were significantly elevated in the progressive overload training group until the mean levels were more than three times the upper limit of normal after tapering-down training. I am told by Skip Hanson, a man with lots of CrossFit and 15 years of rugby that "people assume because there are no pads that athletes slow down before impact. I can assure you they don't."

Glutamine/glutamate ratio. In this study the glutamine/glutamate ratio and the Multistage Fitness Test were found to be the only two tests useful for tracking tolerance to training in team sport athletes. The glutamine/glutamate ratio was significantly lower at the end of the training period for the overload training group but not the NT group. During the taper week, the Glutamine/Glutamate ratio was significantly increased, i.e. glutamine increased and glutamate reduced.

MULTISTAGE FITNESS TEST

The multistage fitness test (MSFT) is also know as "the beep test". Its objective is to monitor the development of the athlete's maximum oxygen uptake. It requires no fancy equipment and, in the Australian study was found to be one of only two tests useful in determining an athlete's progress. This one has the advantage of not requiring tests involving blood, urine, or sputum. It has already been tried thanks to two visiting Swedish CrossFit athletes; thanks Erick and Chris. It's tough and fun. To conduct the test you'll need two people plus:

- A flat, non slippery surface at least 20 metres in length
- 30 meter tape measure
- Marking cones
- The Multi-Stage Fitness Test audio tape or CD (about $15)
- Tape recorder or CD Player and a note book to record the result
- Find more information on www.brianmac.co.uk/beep.htm or with a search of GOOGLE.

TESTOSTERONE-CORTISOL CONNECTION

The testosterone to cortisol ratio reflects the balance between the processes that build muscle tissue (anabolic) and those that break them down (catabolic).[9] [10] Higher levels of testosterone are linked to performance in strength and power tasks, whereas diminished levels of testosterone and increased levels of cortisol have been linked to overtraining and reduced performance.[11] [12] David Smith Ph.D. (Calgary) states that "testosterone gives an

excellent picture of athlete status." He has been measuring it in his athletes for 20 years.[13]

Cortisol. Cortisol was discovered by Kendall and Reichstein in 1937 and is the most abundant and the major stress hormone. In Fig. 1 you can see the effects of the stresses of the day on the cortisol levels.

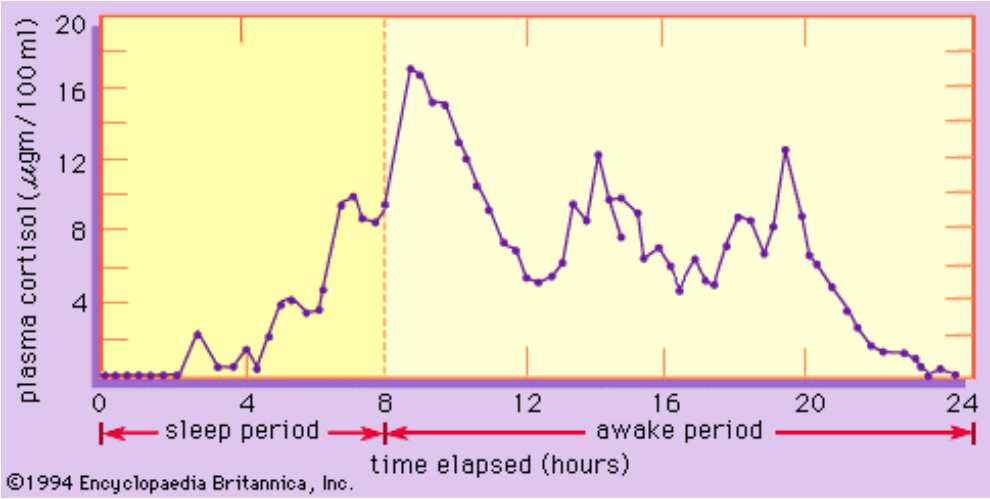

Fig. 1. Cortisol levels in response to the random episodes of stresses and anxieties in the waking day and their decline when stress levels are low as we drift off into sleep. *(Originally published by Weitzman ED: Twenty-four-hour patterns of episodic secretion of cortisol in normal subjects, J of Clinical Endocrinology & Metabolism, 33:13-22, 1971.)*

Cortisol is a catabolic hormone (breaks down proteins) and is balanced by anabolic hormones (builds up tissues). Its production is controlled by the hypothalmus and the pituitary gland peptide, adrenocorticotropic hormone (ACTH). Its primary function is to supply an immediate increase of sugar into the blood to deal with the presence of stress--physical and emotional. At the same time it causes the synthesis of glycogen in the liver for later use.

Cortisol also has direct suppressive effect on the process of testosterone genesis so that there is a potential for inhibition of that important anabolic hormone during exercise and recovery.[14] [15] This is why maintaining at least a balanced testosterone:cortisol ratio is so important to the athlete.

The potent anti-inflammatory effect of adrenal cortical hormones is well known. What may not be as well known is that they also depress the body's immune responses by negatively impacting the function of white blood cells--this is, after all, their anti-inflammatory action. Steroids used clinically are cortisone, hydrocortisone, and their pharmaceutical derivatives, prednisone and dexamethasone, among others.

Testosterone/Cortisol Ratio after an International Rugby Competition

A group of scientists in the UK confirmed the well known fact that intense exercise causes a temporary decrease in immune protection. Additionally, after an international rugby game and up to 14 hours later, there was a large decrease in the serum testosterone/cortisol ratio (testosterone decrease; cortisol increase). Thirty-eight hours into recovery that ratio rebounded *above the pre-game level*. This rebound was thought to represent a *physiological requirement for recovery* following intense tissue damage resulting from game collisions, [16] and was probably a reflection of their elite athletic status.[17]

Testosterone/Cortisol Ratio in Speed Skaters

Free testosterone/cortisol ratio was used in eight elite speed skaters (five males, three females) during an eight-month season to study its effectiveness as a marker for overstrain and/or incomplete recovery. It was confirmed that a decrease of 30% or more in the testosterone/cortisol ratio is a reliable indication of temporary incomplete recovery from progressive overload training and residual weariness and, consequently, of reduced effectiveness for competitive purposes.[18]

Facing Hostile Environments

For those who face hostile environments and threats to their life and the lives of others, the attempt to actually control the normal "fight-flight" response takes intense special training and discipline. The combination of physical and psychological stress endured by military personnel, law-enforcement officers, firefighters, and rescue workers is profound[19] and results in mortality rates related to cardiovascular disease and cerebrovascular accidents greater than others of the same age and sex.[20 21 22]

Twice a Day?

Ten nationally competitive male weightlifters were randomly assigned to train either once or twice daily for 3 weeks. A small group granted, but of interest was a satellite finding of a decreased testosterone:cortisol ratio of -10.5% in the twice a day group and an increase of that ratio by +1.3% in the once a day group. Regarding the purpose of the study, it was concluded that there were no additional benefits from increased daily training frequency in national-level male weightlifters. There was however an increase in isometric knee-extension strength (+5.1% vs +3.2%) and neuromuscular activation (+20.3% vs +9.1%) for the twice-daily group. It was thought that this might provide some rationale for dividing training load in an attempt to reduce the risk of overtraining.[23]

Female Testosterone

You guys don't have a monopoly on testosterone--that androgen that fires up the gym. Women have it too--but only about 1/10 that of men. The amount is small, but important to our well being, good mood, strength, sex drive, bone mass, muscle growth,

maintenance and repair. The published studies on the effects of exercise on cortisol and testosterone in women have differing results. In one study, significant increases in testosterone concentration in young female athletes have been recorded immediately after exercise, to be returned to preexercise levels ninety minutes after completion. Aizawa et al[24] demonstrated that competitive stress in female soccer players affected hormonal status in female athletes with levels of cortisol increasing significantly and testosterone remaining unchanged. Banfi et al[25] confirmed the reliability of a 30% decrease in the free testosterone/cortisol ratio as an indication of overstrain and/or incomplete recovery in both male and female elite speed skaters.

GLUTAMINE/GLUTAMATE CONNECTION

Glutamine and glutamate are amino acids critical to life and metabolic functions. In athletes an imbalance between the two is being used to determine training status with glutamine less than glutamate being a sign of overtraining.[26 27]

Glutamines are building blocks of proteins; some are synthesized and others are provided by the food we eat, which include beef, chicken, fish, eggs, milk, dairy products, wheat, cabbage, beets, beans, spinach, and parsley. Glutamine plays a role in a variety of biochemical functions including protein synthesis, acid-base balance and cellular energy. It also provides nitrogen for anabolic processes and carbon for the citric acid cycle (Krebs cycle).

A study in Austria has found glutamine depletion in skeletal muscle of severely ill patients to be an outstanding metabolic marker related to acute skeletal muscle wasting.[28] In catabolic states of injury and illness, glutamine becomes conditionally-essential (requiring intake from food or supplements). Glutamine has been studied extensively over the past 10–.15 years and has been shown to be useful in treatment of serious illnesses, injury, trauma, burns, and treatment-related side-effects of cancer as well as in wound healing for postoperative patients.

In another study, Smith and Norris[29] looked at the possible link between overtraining and lower plasma glutamine, something that had been observed in other studies.[30 31] They found that with increased training load, the glutamine plasma levels decreased and the glutamate levels increased and therefore proposed that training status can be represented by the glutamine/glutamate ratio (glutamine level divided by glutamate level). Furthermore, based on the changes in glutamine and glutamate concentrations during the study's different training conditions, the authors proposed that glutamine concentrations reflect tolerance to volume, glutamate to intensity and the ratio between the two to overall tolerance to training. Of the five overtrained athletes in this study, the glutamine concentrations declined significantly with heavy training and the glutamate concentration was significantly higher than all the other athletes in the study, i.e. decreased glutamine/glutamate ratio.

Low glutamine levels in 1992 Olympic athletes. This is an interesting study. The 1992 Olympic athletes were offered a medical screening service during both intense and light

training periods. Participation was voluntary. The athletes were divided into three groups relative to their amino acid profile.

1) Twenty one track and field athletes had no lasting fatigue and a *normal amino acid pattern.*
2) Twelve judo competitors reported heavy fatigue at night, but recovered overnight to continue training. One in this group presented with infection and *all 12 had decreased plasma glutamine levels.*
3) Eighteen track and field athletes and one rower had chronic fatigue and had been unable to train normally for at least several weeks. Ten athletes in this group presented with infection, *all 18 had decreased plasma glutamine levels* (< 450 micromol/L).

The findings were that an inadequate protein intake appeared to be a factor in those with chronic fatigue, infection and a persistent decrease in plasma amino acids, mainly glutamine.[32] It was perhaps not understood at the time, but these highly trained, well nourished elite Olympic athletes with low glutamine levels, fatigue and chronic illness were showing all the signs of nonfunctional overloading/overtraining.

HEART RATE VARIABILITY

In addition to glutamine/glutamate ratio and total testosterone levels to indicate physical status of his athletes, David J. Smith Ph.D, Professor of Kinesiology, University of Calgary, also monitors heart rate variability (HRV) to track their progress,[33] as do others in the U.S., Brazil, Europe and Russia.[34] [35] [36] [37] [38] In 2008, a group in Montreal, Quebec, Canada reviewed the literature and concluded that correct interpretation of HRV during the training process requires the comparison with other signs and symptoms of over-reaching to be meaningful.[39]

Heart rate variability (HRV) refers to the different durations of individual normal cardiac cycles. Clinically, it is a tool for assessing risk and cardiac autonomic nervous system status; its absence is an ominous sign in patients with myocardial infarction and helpful in the early diagnosis of diabetic neuropathy.

If you take your child's pulse, you would probably find that it is irregular. HRV is normally very marked in the child, with the beat-to-beat intervals slowing with expiration, accelerating with inspiration as the parasympathetic and sympathetic nervous systems trade dominance. That is basically its mechanism. In the athlete it can be used to evaluate stress with workouts and pre-competition. In a stressed athlete the sympathetic nervous system would dominate, eliminating the possibility of HRV.

STRESSFUL EXERCISE AND THE FEMALE ATHLETE

The athletic triad. The benefits of exercise are undisputed. We are healthier being fit and strong, benefits we hope will mean a long life of physical independence. This being true, it is also true that for woman there is a unique set of risks known as "the athletic

triad" when all three appear together. They are amenorrhea, reduced bone mineral density, and eating disorders. Other problems are infertility and abnormalities in thyroid hormone levels in the absence of thyroid disease. Thus, for women, well-structured workouts and well balanced meals are mandatory.[40 41 42 43]

The mechanism of exercise-related female reproductive dysfunction is not yet completely clarified, the difficulties being the diversity of sports and exercise programs, overtraining, a balanced diet, and exogenous steroids for birth control or post menopausal supplement. De Crée[44] demonstrated that the outcome of the many studies is controversial and contains flaws related to methodology.

It is important to make some sense out of this "athletic triad" because a decrease in estrogens in the female body causes infertility and may also have long-term effects, such as premature osteoporosis and impaired skeletal structure.[45] We await more studies linking older and newer findings.

Little ballerinas. It's common knowledge that girls who start serious ballet training or gynastics before they begin menstruating delay the onset of puberty. The more they dance per week the more puberty is delayed and the more prone they are to the effects of low estrogen levels described above. [46]

CHRONIC ILLNESS AND OVERTRAINING

For many years there has been a single stressor approach to overtraining--that of a failed balance between training load and recovery, resulting in stagnating performance. This approach ignores the role of nonexercise-related factors. On the other hand, the multistressor approach includes all relevant factors--physical, emotional, psychological, social and family pressures as role players in an athlete's overtraining syndrome.

One of the signs of overtraining is increased vulnerability to common, non-critical infection leading to recurrent infections. Other signs of course are chronic fatigue and underperformance. However, your workouts are not the only culprit in the overtraining syndrome. We tend to look solely at the load-recovery imbalance in our training to define overtraining. But some scientists are looking at the multistressor approach. In addition to the workout programming there are stresses on various levels of our lives. The role players are physical, emotional, psychological and social.

Your physical strength and fierce will to excel may overcome any tendency for your loads and times to have suffered, but all of life's stressors combined are eating away at your immune system. It is impossible to live stress-free in our society...it's always one or three things or something else out there jabbing at us. But it is imperative for your health to find some peace in your busy over-taxed world. Sliding into chronic illness--one upper respiratory infection after another for example---is a warning sign.[47 48 49]

In 1998, Carl Foster Ph.D, [50] at the Milwaukee Health Institute published a paper on overtraining suggesting four days/week for "hard" training days, two "easy" days and one

"off" day. This of course, may not work for CrossFit because of the stress involved in a variety of modalities. However, it worked for Dr. Foster's group and can be adapted. His studies found that this approach was more successful in reaching athletic goals than the six days/week with lighter loads and one day off.

SYSTEMIC INFLAMMATORY STRESS

In 2009 and 2010 Main et al[51] [52] provided data that implicated cytokines in the inflammatory responses to training. Of interest, in 2007 Napoleão et al[53] also named cytokines as markers and role players in the inflammatory processes involved in plaque formation and acute myocardial infarction (heart attack), as well as in the recovery and healing processes.*

Cytokines are small secreted proteins which mediate and regulate immunity, inflammation, and the development of blood cells (hematopoiesis). Relative to the symptoms of inflammatory stress resulting from nonfunctional overload training, they have significant effects on the central nervous system resulting in typical symptoms of nonfunctional overload training such as fatigue, lethargy, loss of appetite, and mood disturbances. Future research is bound to reveal more information about cytokines and their receptors. [54]

TREATMENT FOR OVERTRAINIG

Mark Rippetoe tells us that "the treatment for overtraining is reduced workloads and time for recovery. This will not of course result in improvement or even maintenance, but it is better than complete layoff, which results some degree of detraining. Your best bet is prevention with an understanding that the more advanced the athlete, the more complex the programming."

Of importance:

- The most available, subjective, and reliable guide for nonfunctional overloading is what it always has been--a decrease in performance.
- Functional overloading may lead to improved performance when recovery or taper periods follows, but without adequate recovery or taper, overtraining may require weeks or months to restore performance capacity.[55] [56]
- The symptoms for nonfunctional overreaching (overloading) and the more serious overtraining are the same. It is therefore, a huge challenge for coaches and athletes to recognize when adaptation is not occurring.[57]
- The glutamine/glutamate ratio and the Multi-Stage Fitness Test (MSFT p. 4) may be useful measures for monitoring athletes' progress.

* Formation of plaques is explained in "Understanding Chest Pain" posted in Conover's Corner www.crossfitsantacruz.com.

YOUR BEST BETS

"Regardless of the type of cycle used to prepare for competition, the final two to four weeks prior to the event must include a reduction in both volume and intensity." [58]

Tapering. In the Australian study, at the end of the 6th week, testosterone levels were at their lowest for both groups (overloaded and normal). This, the beginning of the 7th week, is the point at which tapering began. At the end of the tapering week, the T levels had not yet returned even to baseline for either group. I should mention here that at the end of the tapering week there was a significantly larger increase in testosterone for the progressively overloaded training group as opposed to the normal training group and those increases were repeated in the increments across the 6 weeks as well--the results of "functional overloading." Dr. Coutts (Australian study) reported that none of his players became overtrained. "One player showed worrying signs during the overreaching [overloading] phase. However, he had a very functional response following the taper. He rebounded nicely and had the season of his life! There are some that have shown the rebound in the taper is related to the reduction before the taper."[59]

Start tapering. Rippetoe and Kilgore, advise to start tapering two to four weeks before competing by reducing volume (number of reps) and intensity (percentage of max load you've used in training). They also recommend only one to three heavy lifts once or twice/week during this time.[60]

Peter Raeburn Ph.D, Central Queensland University, Australia, has commented that "most research suggests maintaining intensity right up to the event. Thus, dropping volume gradually is the way to go (i.e. reps and sets)."[61]

Bosquet et al proposed that "a two-week taper during which training volume is exponentially reduced by 41-60 % seems to be the most efficient strategy to maximize performance gains." [62]

The last tapering workout before competition. In the Australian study the testosterone levels had dropped below baseline by the end of the 6th week and one week later had begun to increase, but were not yet up to baseline and were far from the elevated level two weeks into the overload training.

In the Cunniffe[63] study, the rebound in the testosterone levels in international rugby players was thought to represent a *physiological requirement for recovery* following intense tissue damage resulting from game collisions.

The "rule of thumb" laid out by Rippetoe/Kilgore[64] is that the last tapering workout before competition should be two days before competing.

Focus! A mental challenge during any workout, never mind competition has been shown to depress the testosterone level and augment the sympathetic and adrenal systems

beyond what may be tolerable--increasing cortisol, heart rate, respirations, and norepinephrine.[65]

Motivation. Motivation substantially enhances performance and leads to an increased peak oxygen uptake. Competitive conditions also augment the cortisol response to exercise, suggesting that a combined adrenal and sympathetic nervous system (adrenalin) activation may be one of the key "driving forces" to performance improvement. [66]

What Else? Here's where the devil's in the details. Recovery is more than setting limits on overload and the timely reduction in weight and reps. There are other things that hold as much importance because they are the scaffolding within which properly programmed training yields the best results. They are simple things like "good" sleep, balanced nourishment, and hydration.

Hydration. Don't forget adequate hydration--be good to your kidneys and your cellular milieu--all of those electrolytes need something to float around in. An elegant study out of The Netherlands has found that dehydration causes a delay in the emptying of the stomach. This in turn may result in exercise-induced nausea.[67] It's not a good idea to arrive for our workout in a dehydrated or NEVER an over-hydrated state, a dangerous condition that can cause a wash out of vital electrolytes. A very brilliant physician once told me: "Let thirst be your guide and pay attention to its prompts."

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Peter Reaburn Ph.D., Associate Professor, Central Queensland University, Australia, has generously given of his time to review this article for me. I am grateful to him for his

incisive and helpful comments. He is one of the authors of *"Monitoring for overreaching in rugby league players"*. Dr. Reaburn is also author of a new book, ***"The Masters Athlete".*** His biography and a complete table of contents of his book can be seen on: www.mastersathlete.com.au.

Big thanks to **Eva Twardokens** for her review of the several iterations of this article. Eva does everything in her life with honesty, strength and a great smile. She is not only an 11 year CrossFit veteran, but a 2X Olympian in Alpine Skiing, a 12 year veteran of the U.S. Ski Team and has won 6 National Championships, a world Championship Bronze Medal, is a World Technical Skiing Champion and to top it all off--she is a 2007 National Weightlifting Champion.

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