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OLYMPIC COACH

SUMMER 2003 • VOLUME 15 • NUMBER 3

Message from the **DIRECTOR OF COACHING** and **SPORT SCIENCES**

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UNDERRECOVERY and **OVERTRAINING:** Different Concepts—Similar Impacts?

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COVER PHOTO BY GETTY IMAGES. Triathlete Barb Lindquist

Message from the USOC's DIRECTOR OF COACHING and SPORT SCIENCES

by

PETER DAVIS, Ph.D.

At the Olympic Training Centers, we provide service to elite athletes and coaches on a daily basis. We spend a lot of time trying to figure out how to optimize performance. Over the years I have seen a lot of athletes train and compete—and have successes and disappointments. I can't remember where I first heard the following quote, but after coaching and watching many, many athletes I have come to the belief—"that it's not always how hard you train that makes a difference—it's how well you recover."

At the USOC Division of Coaching and Sport Sciences, we believe that recovery/regeneration is a critical element of performance so we decided to focus our attention on this important area in this edition of Olympic Coach.

Dr. Michael Kellman is a well known and much published author in this area and is presenting some of the topics from his excellent book "Enhancing Recovery" (Human Kinetics). If you would like to further explore this area I recommend that you pick up a copy of the book—details are provided in his article.

Angie Calder, previously from the Australian Institute of Sport, but now with the University of Canberra can always be relied on to give coaches and athletes practical solutions to enhance recovery. She hasn't let us down for this edition and gives some very useful modalities that can be incorporated into your training and recovery program.

Dr. Mike Stone and Meg Stone along with Dr. Peterson from the USOC Division of Coaching and Sport Sciences are providing us an interesting perspective of how training and over-training, and recovery and under-recovery fit together. Both of these articles emphasize common themes (also mentioned by Angie Calder.) Athletes need to track their training—how can you know what to change if you don't know what you did?

Dr. Peterson raises some interesting points that are worth repeating. Talk to your athletes, observe (and ask them) "How are you doing?" *…and actually listen to their response!* There are lot's of complex scientific tools out there that we think indicate over-training and under-recovery—but sometimes simple questions and insightful observation can tell us so much more.

Dr. Peterson also points out that recovery strategies should be built into workout schedules up front—not as an afterthought when things start to go wrong. Most coaches are really expert at writing complex workouts that fit into all sorts of micro-cycles and macro-cycles (see the article by Mike and Meg Stone)—but not many write a schedule that describes the workout to be accomplished and the recovery strategy to be followed afterwards. This should be common practice.

At the USOC we are actively pursuing this concept and are working on guidelines to assist coaches in this area in the future.

We hope you get as much out of this edition of Olympic Coach as we did putting it together. Remember the benefits of any training session don't always occur during the session—they start to occur after it has stopped. What you do between each training session determines how well you can train and/or compete in the next session(s). This goes for your physical, mental, nutritional and spiritual capacities.

UNDERRECOVERY and OVERTRAINING: DIFFERENT CONCEPTS—SIMILAR IMPACT?

by MICHAEL KELLMANN *(Ruhr-University of Bochum, Germany)*

This article is a condensed version of the book chapter M. Kellmann, 2002, "Underrecovery and overtraining: Different concepts—similar impact?" in Enhancing recovery: Preventing underperformance in athletes, edited by M. Kellmann (Champaign, IL: Human Kinetics), 3-24. Modified and reprinted with permission.

The approach of the book *Enhancing Recovery: Preventing Underperformance in Athletes* addresses recovery as a key factor of performance. The main assumption is that a constant lack of recovery or disturbed recovery turns into overtraining. Even being only slightly underrecovered over an extended period of time results in underperformance in athletes and non-athletes alike.

In sports, the connection between the current recovery-stress state and performance in competition or training achievement is obvious (Kellmann, 2002). To avoid overtraining and to optimize performance in sports, physiological and psychological recovery should be programmed as an integral component of training (Hooper & Mackinnon, 1995). Moreover, athletes need sufficient recovery during phases of intensive training to prevent overtraining. Underrecovery is not due only to a frequency of competitions that leaves no room for adequate recovery. It can also occur as a result of training mistakes such as:

1. Monotonous training programs,
2. More than three hours of training per day,
3. More than a 30 percent increase in training load each week,
4. Ignoring the training principle of alternating hard and easy training days or by following two hard days with an easy day,
5. No training periodization and respective regeneration microcycles after two or three weeks of training, or
6. No rest days (Norris & Smith, 2002).

> To avoid overtraining and to optimize performance in sports, physiological and psychological recovery should be programmed as an integral component of training.
>
> *Hooper & Mackinnon, 1995*

THE PROBLEM OF UNDERRECOVERY

An oversimplified description of underrecovery is the failure to fulfill current recovery demands. Underrecovery can be the result of excessively prolonged and/or intense exercise, stressful competition, or other stressors. However, being underrecovered over a longer period may not necessarily lead to overtraining, although it will lead to progressive fatigue and underperformance (Budgett, 1998). Optimal performance is only achievable if athletes recover after competition and optimally balance training stress and adequate recovery.

A clear and sufficient definition of recovery can rarely be found in the literature. Authors discussing overtraining, especially in the field of sports medicine, often refer to recovery but do not provide detailed information on what physiological and psychological recovery is about. Mostly, recovery is defined as the compensation of deficit states of an organism (e.g., fatigue or decrease in performance) and according to the homeostatic principle, a re-establishment of the initial state.

These definitions are all quite general and consider recovery as a counterpart to the disturbance in an initial state or a deficit condition of the organism that enables the individual to perform. Kellmann and Kallus (1999) stated that recovery encompasses active processes of re-establishing psychological and physiological resources and states that allow the individual to tax these resources again. Kellmann and Kallus (2001) developed a more precise definition to describe the complex issue: "Recovery is an inter-individual and intra-individual multi-level (e.g., psychological, physiological, social) process in time for the re-establishment of performance abilities. Recovery includes an action-oriented component, and those self-initiated activities (proactive recovery) can be systematically used to optimize situational conditions and to build-up and refill personal resources and buffers." (p. 22).

OVERTRAINING

Gould and Dieffenbach (2002) pointed out the relevance of overtraining in high performance sports and the importance as a performance-influencing factor, which was recently identified in several studies of high-performance athletes. In a study by Gould et al. (1998) 84 (28%) of 298 U.S. Atlanta Olympic athletes reported that they had overtrained for the Games and this overtraining had a negative impact on performance. Similarly, in open-ended responses 35 of the athletes said that they identified overtraining/not getting enough rest as the number one coaching action that hurt their performance. In the 1998 Nagano Winter Olympics, ten percent of the U.S. athletes from 13 different sports reported that they were overtrained and that this had negative effects on their performance. Also in open-ended responses from these same Olympians it was identified that the need to taper, rest, not to overtrain, travel less, and stay healthy were changes that they would employ if they could prepare again for the Olympics.

In general, overtraining is described as *an imbalance between training and recovery* (Kuipers & Keizer, 1988). However, according to Lehmann and colleagues (Lehmann et al., 1999), overtraining is due to *an imbalance between stress and recovery*, that is, too much stress combined with too little regeneration. Both descriptions sound similar, but the definition by Lehmann and colleagues explicitly asserts that stress includes all training, competition, and additional *non-training stress factors*. Social, educational, occupational, economical, nutritional, and travel factors; time stress; and the monotony of training act to increase the risk of developing an overtraining syndrome.

Lehmann et al. (1999) distinguished between *short-term overtraining*, which lasts less than three weeks, and *long-term overtraining*, which lasts at least three weeks or more. The authors also point out that short-term overtraining (also called overreaching or supercompensation training) is a common part of athletic training, which leads to a state of overreaching in affected athletes. This state of overreaching is characterized by a transient underperformance, which is reversible within a short-term recovery period of one to two weeks and can be rewarded by a state of supercompensation (an increase in performance ability following one to two weeks of regeneration after a short-term phase of overtraining). Therefore, short-term overtraining or overreaching (terms that can be used synonymously) is a regular part of athletic training. Nevertheless, when overreaching is too profound or is extended for too long, *short-term overtraining turns into long-term overtraining*. This occurs "if a necessary regeneration period is inappropriately short or recovery therefore remains incomplete and is additionally associated with too many competitions and non-training stress factors. The athlete clearly runs the risk of a resulting overtraining syndrome" (Lehmann et al., 1999, p. 2). With this approach Lehmann et al. (1999) consider overreaching (and short-term overtraining) as an integral and necessary aspect of training.

ACCUMULATION AND INTERACTION OF TRAINING AND NON-TRAINING STRESSORS

How complex the fine-tuning of a training process is can be highlighted by the accumulation and interaction of training and non-training stressors. Performance abilities are influenced by many factors such as *training* (e.g., stress/recovery relationship, training volume, intensity, methods, technique training, frequency of competitions), *lifestyle* (e.g., sleep, daily schedule, nutrition, alcohol consumption, smoking, housing conditions, leisure activities), *state of health* (e.g., cold, fever, gastric and intestinal diseases, infections), and *environment* (e.g., family, roommates, teammates, social contacts, job/school, coach).

As hard as it may be for coaches to accept, athletes do have a life outside of sports. Emotional stress or fighting inside and outside of the training environment (e.g., illness, fights with friends or partners, parents' divorce) can affect them strongly. Problems and obligations at school, difficulties with time management (practice/school/friends), and other responsibilities can be pictured as a single package load. Often, individuals can easily handle those situations, but when heavy training load is added to an already high "personal package load," the total impact on the systems simply gets too high. Although all components could easily be handled by themselves, the combination is overwhelming.

STRESS-STATES AND RECOVERY DEMANDS

Kellmann proposed a model describing the interrelations of stress-states and recovery demands. The basic assumption is that with increasing stress, increased recovery is necessary. Limited resources (e.g., time) initiate a vicious cycle: under increased stress and unable to meet increased recovery demands, the athlete experiences more stress. People may be stressed to the point that they fail to find or make time to recover adequately, or to consider better ways of coping with the situation.

The model of stress-states and recovery demands may explain how overtraining can develop (see figure 1).

The axis of the stress-states can be seen as a continuum of an increasing training load, which can be labeled at the end points "no training" and "overtraining" (similar to Kreider et al., 1998). With an extended training load the organismic recovery demands increase proportionally. A short-term planned sacrifice of recovery enhances long-term performance effects (e.g., supercompensation). If the training load and intensity increase over a longer time "without adequate recovery" or with merely "inappropriate recovery," the individual experiences long-term

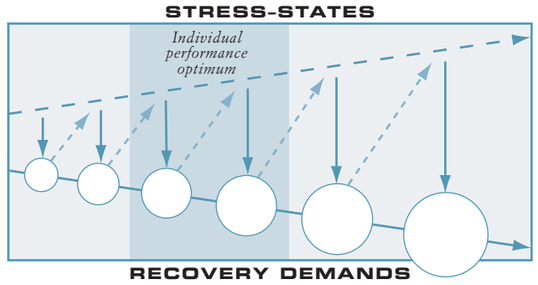

FIGURE 1. The "scissors-model" and the increasing stress-states. Reprinted, by permission, from M. Kellmann, 2002, Underrecovery and overtraining: Different concepts—Similar impact? In Enhancing recovery: Preventing underperformance in athletes, edited by M. Kellmann (Champaign, IL: Human Kinetics), 17.

underrecovery, which may result in the overtraining syndrome. To reach the optimal recovery-stress-state, athletes have to increase their self-initiated activities to fulfill their recovery demands. At each state of the model, recovery can work as a regulation mechanism, which is caused by an increasing distance between the two axes into a higher recovery debt (days to weeks). The higher a person is on the stress-states or the more extensive the overtraining syndrome that occurs, the more recovery efforts are needed in order to reach the individual optimal recovery-stress-state.

> Practice is important to improve performance, but the focus should be on the quality rather than on the quantity of training.

INDIVIDUAL DIFFERENCES

Athletes in general are likely to not only differ from the general population but also show a broad range of inter- and intra-individual differences. This also applies to the training load. "Thus a particular training schedule may improve the performance of one individual, be insufficient for another, and be damaging for a third" (Raglin, 1993, p. 842). The different effects of the same training stimulus may be explained by the individual *recovery-stress state*. The recovery-stress-state represents the extent to which someone is physically and/or mentally stressed as well as whether the person is capable of using individual strategies for recovery and which strategies are used. The recovery-stress-state can be changed positively either by stress reduction, or more important, by self-initiated recovery activities.

To compare athletes, for example, with norm data of psychological or physiological tests may be misleading. Inter-individual differences in recovery potential, exercise capacity, non-training stressors, and stress tolerance may explain the different degrees of vulnerability experienced by athletes under identical training conditions (Lehmann et al., 1993). The key is to evaluate athletes individually, monitoring them regularly and comparing the obtained data longitudinally. Stress and recovery should be monitored during the training process to prevent overtraining. Recognizing that different athletes have different thresholds for overtraining, Hooper and Mackinnon (1995) recommended that training be individualized. When working with teams or a group of athletes, coaches may find individualization of training difficult. But especially in weight and strength training sessions, this can easily be achieved. Reductions or increases of rounds and sets during weight and strength training, and specific instructions regarding exercise intensity, can serve to individualize training. However, when training is individualized, it should be clearly communicated to the athletes that it is done to achieve individual optimal training results. If the individual training is not explained, the situation for athletes with the lower training volume may become awkward.

SOMETIMES LESS IS MORE

The concept that sometimes "less is more" is often ignored in the daily training regime. Even in leisure sports the "no-excuse, feel-the-burn, more-is-better" theory of working out is rampant. However, the focus should be on the quality instead of the quantity of training. When performance plateaus occur, athletes often increase their effort and enhance the training load, which initiates a vicious cycle and after continuation, can turn into a heavy overtraining syndrome. Consequently, overtraining can be prevented but it is frequently overlooked as a result of the lack of understanding on the part of coaches and athletes. Coaches may have to enforce rest because some athletes are unwilling to reduce training for fear of becoming detrained. Similarly, coaches may need to prevent athletes from trying to get back into shape too quickly after a break. Overtraining can be effectively treated by rest or prevented outright by not training hard, but these obviously are not desirable options for the competitive athlete.

In the real training world the concept of less is more seems to be hard to sell. Most coaches feel that coaching is their job, and it is the duty of their athletes to follow their regimes. In addition, when coaches back off too much, performance may decrease. This shows that there is a careful balance between practice and recovery. Practice is important to improve performance, but the *focus should be on the quality rather than on the quantity of training*. During long and hard training sessions athletes tend to take "hidden rests," for example, by going at a slower pace during the exercises. A thoughtful variation of the training exercises includes a recovering element. An increase of the overall quality of training occurs when the standard regular training routine is modified, when new exercises are introduced, or simply when different types of training are applied.

SUMMARY

Underrecovery and overtraining: Different concepts—similar impact? This question can clearly be answered with a yes and a no. Yes, they have the same impact—performance declines; No, they are not similar—*underrecovery is the precursor/cause of overtraining*. Consequently, the key to prevent overtraining is an active and proactive enhancement of recovery. Coaches and athletes need to be educated about the importance of optimal recovery and its impact on performance. When athletes understand that a weekend without training is part of the planned training schedule, which implies that they should not train on their own or go for a heavy bike ride with friends, they take a huge step toward adequate recovery. In addition, the multilevel concept of stress and recovery emphasizes that physical training is just one part of athletes' lives. Emotional worries outside of the training environment may disturb the recovery process as well. Consequently, athletes' self-initiated activities and coaches' knowledge about individual preferences for recovery strategies are important elements to avoid overtraining and subsequent underperformance.

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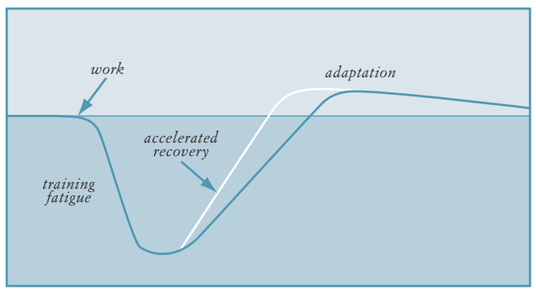

FIGURE 1. The principle of recovery

"If there was one single factor that helped this team to perform to the level they did at Atlanta, it was the recovery program that was put in place…and monitored throughout our 1996 program."—*Barry Barnes Head Coach, Australian Men's Basketball, 1996 Atlanta Olympic Report.*

Athletes work hard to prepare and perform successfully throughout a competitive season or for major events. Unfortunately, many ignore or forget the performance benefits gained through including recovery strategies within their daily training programs. Indeed there is a tendency for many athletes to limit the use of recovery techniques to times when they are ill or injured. Yet recovery strategies have far more benefits for athletes than merely as tools to assist with rehabilitation or recuperation.

Recovery is one of the basic principles of training methodology (Rushall & Pyke, 1990) and it has two primary roles: The first concerns monitoring the athlete's adaptation to training and stress so that appropriate recovery strategies can be determined. The second relates to the selection of specific recovery techniques and strategies to minimize any residual fatigue from training and competing. (Figure1).

RECOVERY STRATEGIES: MONITORING ADAPTIVE RESPONSES

WHAT ARE THE VARIABLES COACHES SHOULD MONITOR?

Each coach has a wealth of observational information about the indicators of poor adaptation and excessive fatigue. Often these are observations recorded subconsciously rather than formalized documented notes. It is important for each coach to identify what it is that they observe that is indicative of excessive stress and fatigue. A quick assessment of these criteria at every coaching session will enable the coach to identify any non-adaptive stress responses at an early stage and then address them before they become a major issue for an athlete (Table 1).

WHAT ARE THE VARIABLES AN ATHLETE SHOULD MONITOR?

The responsible athlete will also monitor training adaptations through regular recordings in a training diary or log book. Maintaining a daily record is an essential training tool for all athletes as it enables them to learn how to evaluate their stress levels and their adaptive responses. Learning to recognize "how they feel" is one of the most important skills any athlete can acquire. Recordings of the quality of sleep, morning resting heart rate and morning body weight, and a daily rating of fatigue levels are four critical markers that should be recorded regularly by athletes. These four variables take two minutes to record and may be the first warning to an athlete that he or she is not adapting well to training and other stresses. Kellmann (2002) has designed a questionnaire, REST-Q that identifies excessive fatigue and under-recovery in athletes.

COACHING OBSERVATIONS	SIGNS & SYMPTOMS OF NON-ADAPTIVE RESPONSES
Direct Communication	Athlete tells me he has: Heavy legs Doesn't feel good Legs are sore Feels tired
Body Language	Facial expression and color Posture Signs of frustration, etc.
Performance	Poor skill execution Slow acceleration off the mark Heavy feet Poor or slow decision making / response time
Psychological	Low motivation Low concentration Aggressiveness No self-confidence
Gut feeling / 6th sense / Other things	Poor eating habits Poor diet Poor sleep patterns External stresses

TABLE 1. Example of coaching checklist for monitoring an athlete's adaptation to training and stress.

Realistically, most athletes are likely to be inconsistent with recording morning resting heart rates. Research has indicated that a more comprehensive set of variables should be monitored (Mackinnon & Hooper, 1994; Hooper et al., 1995). Some examples of monitoring sheets that include many of these variables can be found in Calder (1996) or accessed on www.ask.net.au

RECOVERY STRATEGIES: MANAGEMENT

There are four generic types of training and competition fatigue (Calder, 2003). These are METABOLIC FATIGUE (energy stores); NEURAL FATIGUE of either or both the peripheral nervous system (localized force production) and central nervous system (drive / motivation) PSYCHOLOGICAL FATIGUE (emotional and social stress factors); and ENVIRONMENTAL FATIGUE (climate and travel).

A good coach understands not only what is being stimulated through prescribed training sessions, but also what is being fatigued. The challenge is to recognize the type of fatigue and then select specific strategies to reduce and minimize this fatigue as soon as possible after the training or performance situation. There are three major specialty areas to include when designing appropriate recovery strategies for an athlete's training program.

NUTRITION: FLUID AND FUEL FOR RECOVERY

The most important nutritional considerations for recovery relate to fluid and fuel replacement strategies (Burke, 2000). Monitoring fluid loss so that it is kept to a minimum is essential. A bodyweight loss of two percent or more during exercise will result in a reduction in aerobic output. If an athlete becomes excessively dehydrated, not only can this be dangerous and lead to overheating, their aerobic capacity can be reduced by up to six-percent.

Adequate supplies of glycogen in the muscle and in the liver are needed to support the energy demands and promote recovery for the next training session. Athletes can minimize the effects of metabolic fatigue by starting each session with their fuel tanks full. They can top-up during the event with sports drinks and take other carbohydrate and protein foods. Small amounts of protein taken with carbohydrates before, during and after hard training, are also recommended to help minimize muscle protein breakdown as a result of heavy workloads (Tarnopolsky, 2000).

Nutritional supplements should be used with caution and sound scientific advice. Many coaches and athletes are pressured to use supplements and new products and it is often difficult to source reliable evidence-based information about what is appropriate and safe to use. A useful impartial website for advice on this area is www.ais.org.au/nutrition

PHYSICAL THERAPIES

A wide variety of activities and therapies are used to assist with recovery from training fatigue. Unfortunately, many recovery techniques popular with athletes and coaches have not been extensively investigated by scientists so coaches and athletes often rely on anecdotal information about what is best to use. The following list is an indication of some of the most commonly used recovery techniques.

REST: PASSIVE REST

Passive rest, particularly in the form of sleep, is an area that is not well understood by either coaches or athletes. Sleep is probably *the* most important form of recovery an athlete can have. A good night's sleep of seven to nine hours provides invaluable adaptation time for adult individuals to adjust to the physical, neurological, immunological and emotional stressors that they experience during the day. An adolescent experiencing heavy training and a growth spurt may need up to ten hours a night and athletes who are sick often need more sleep as a part of their recuperation. However, too much sleep can be detrimental to performance as it can slow down the central nervous system and lead to increased levels of melatonin that can leave the athlete feeling slow and lethargic.

REST: ACTIVE REST

Active rest is much undervalued by athletes. The end of the loading component of the training session is an ideal time to introduce active recovery activities, although active rest strategies can also be interspersed easily throughout the session. (i.e., sets and reps). Activities can be selected to fulfill several tasks. They can either help recover the physiological state of the athlete (light jog, walk, swim or cycle to recover the lactate system), recover neural fatigue (light jostling/shaking of muscle groups), or used as a means of psychological and emotional restoration (light but different activities).

Cross-training can also be used as a form of active rest provided the work intensities are modest (light aerobic) and the exercises undertaken are different to those normally performed in training, e.g., pool work after a game (Photo 1).

PHOTO 1. *Static stretching in a pool after a game.*

Rest days are essential. Ideally at least one day per week should be a non-training day. This allows time for physical and psychological recovery as well as time for other interests and personal and family relationships.

HYDROTHERAPIES

A wide range of hydrotherapies have been in use restoratively for several thousand years. Spas, pools, steam rooms, cold pools, and contrast temperature protocols were used by the ancient Greeks and Romans.

One of the few published articles on the effectiveness of hydrotherapies comes from research with nationally ranked Finnish track and field athletes (Viitasalo et al., 1995). Researchers demonstrated that underwater massaging (using the jets in a spa) following plyometrics training helped athletes to maintain leg-explosiveness on the following day. In contrast, passive rest after such training resulted in a significant reduction in leg power.

The protocols used by the Finnish researchers were very similar to those used by the ancient Romans. Essentially, this routine involves first having a shower, followed by a spa (39 to 40°C) for three minutes and then a cold shower or a plunge into a cold pool (10 to 15°C) for 30 to 60 seconds. Warm immersion produces vasodilation of the peripheral circulation and the cold immersion encourages vasoconstriction. Three to five sets of this protocol producing rapid vasodilation and vasoconstriction will accelerate blood flow.

A contrast temperature following the same protocol as outlined above, was used by researchers from the University of Canberra in 1996 to measure lactate recovery in high-performance hockey players after a series of Wingate tests (Sanders, 1996). Results indicated that lactate levels were recovered equally fast by using either the contrast water immersion protocol or the active recovery protocol. Lactate recovery following passive rest was significantly slower.

Showering within five to ten minutes at the end of a training session is a good way to accelerate recovery of both lactates and peripheral neural fatigue. Contrasting temperatures can be achieved with a shower and bath at home or the use of a small paddling pool or tub for cold immersion.

SPORTS MASSAGE

Many claims are made about the benefits of sports massage (Photo 2) and numerous research studies examining these claims have been undertaken over the last 15-20 years. Despite this there is not much evidence-based science to substantiate many claims that are made about the benefits of massage (Calder, 1990). What little information that does exist provides evidence for increased muscle and skin temperatures, leads to a relaxation response as demonstrated by a reduction in resting heart rates, blood pressure and a decrease in excitability of the motor-neuron pool. Improved mood states and feelings of well-being have been recorded in several studies and many athletes will use massage as both a means of relaxing physically and psychologically.

PHOTO 2. *Sports massage.*

ACUPUNCTURE AND ACUPRESSURE

Acupressure is often performed as an adjunct to sports massage but acupuncture requires more extensive qualifications and is less accessible and more expensive than massage. Both acupressure and acupuncture focus on applying pressure or stimulus to specific points located on 14 meridians (line patterns) on the body.

PSYCHOLOGICAL SKILLS

There are four main psychological strategies that are used to enhance recovery: debriefing, emotional recovery, mental toughness skills and relaxation techniques.

DEBRIEFING

Debriefing is one of the most useful ways to evaluate performance and provide emotional and psychological recovery post training or post match. A successful debriefing approach helps both the coach and athlete to evaluate performances objectively, identify what specific changes are needed and then set realistic goals for the next training session or match. An excellent debriefing model that focuses on process rather than outcomes is outlined by Hogg (2002).

EMOTIONAL RECOVERY / CONTINGENCY PLANNING

In the case of a major setback or traumatic situation or event, additional resources and strategies may assist the athlete to manage this process and help them to take the first steps in "coming to terms" with the situation. It is important for coaches to identify in advance the strategy or strategies that they will use if such situations arise. Contingency planning is an important aspect of preparation for handling emotionally traumatic events.

Some of the simplest distracters to use during a tournament or competition are mood-lifting activities. These can include watching an amusing video or comedy show on television, reading an escapist or adventure novel, or going to a fun park, zoo or light entertainment center. A sense of humor and a feeling of comradery, or team support, are invaluable in times of emotional stress. For athletes in extended competitions away from home, and especially overseas, planning such activities as part of the tour is essential.

MENTAL TOUGHNESS SKILLS

Recognition of the complex interaction and strong relationship between physical and emotional states is important for recovery training. This is evident when muscle relaxation is observed in conjunction with lowered heart rates and blood pressures and improved mood states. Skills associated with developing mental toughness or emotional control and relaxation strategies, are important strategies for athletes to use. Positive self-talk and developing positive body language are some of the effective skills that have been used by elite tennis athletes (Loehr, 1992). These techniques can be used within training and match situations as well as afterwards and coupled with biofeedback techniques for greater effect.

RELAXATION TECHNIQUES

Many relaxation techniques are available. An athlete needs to practice only one or two techniques on a regular basis for these to become effective tools to use to aid recovery. Some of the more common relaxation techniques include: meditation, progressive muscle relaxation, visualization, breathing exercises, music, and flotation.

CONCLUSION

Every training session is important, as it is an opportunity to become an even better performer. Athletes should aim to start each training session or game in as fresh a state as possible so that they can maximize the training benefits and experiences of the session or event. Recovery strategies are aimed at helping athletes to do this by focusing on reducing residual training fatigue and stress.

Coaches can help educate athletes to understand, plan and use recovery strategies with a view to athletes learning to manage this for themselves. Effective monitoring and recovery management will enable both the coach and athlete to train hard, perform better and more consistently, to reduce training injuries and illnesses, and to develop sound self-management strategies.

The winning formula is:
WORK HARD + RECOVERY WELL = BEST PERFORMANCE

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RECOVERY-ADAPTATION: STRENGTH and POWER SPORTS

by MICHAEL H. STONE, Ph.D. and MARGARET E. STONE, *USOC Coaching and Sport Sciences Division*

For the coach and athlete, the primary goal of the training process is to enhance performance. However, it may be argued that enhancing performance is actually a process of intentionally repeating stimuli (exercise), which result in recovery-adaptation, while attempting to avoid overstress-overtraining. There are basically two methods a coach and an athlete can use to enhance the stimulus-recovery adaptation process:

1. Reasonable planning and execution of the training program, which should include not only the training stimulus but also, built in rest.
2. Adopting reasonable methods of enhancing recovery-adaptation other than training (e.g., nutrition, nutritional supplements, possibly massage or vibration).

RECOVERY can be defined as—"regaining what was lost"—for the coach and athlete this is not very satisfying, as it returns the athlete only to where they started.

ADAPTATION can be defined as—"the process of adjustment to a specific stimulus". This process of adaptation can include adjustment in physiology, psychology and mechanics, which ultimately lead to improved performance—a much more satisfying, prospect. So, in a sports context, recovery-adaptation becomes paramount.

TRAINING—THEORETICAL MECHANISMS FOR SUCCESS—OR FAILURE

As previously mentioned, the training process is concerned with preventing overstress-overtraining while enhancing performance. There are several *hypothetical/theoretical* mechanisms, which can help us understand the training process:

STIMULUS-FATIGUE-RECOVERY-ADAPTATION (SFRA):

Conceptually an appropriate stimulus will result in fatigue, recovery and adaptation such that performance is eventually improved (i.e., supercompensation)(Figure 1).

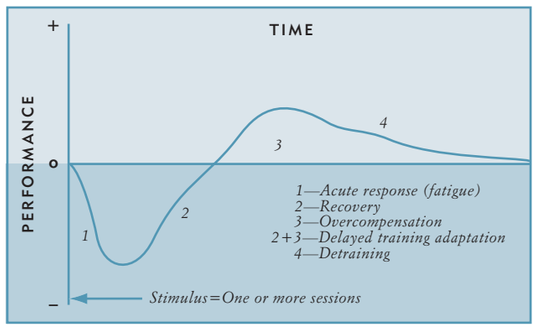

FIGURE 1. Stimulus-fatigue-recovery

This concept is not limited to a single exercise response, but may be viewed on a longer basis in producing training adaptations (Rowbottom, 2000). There are a number of observations that lend support to this concept. For example: Verkoshansky (1977, 1985) noted that a unidirectional concentrated load of strength or strength-endurance training for several weeks could result in a diminished speed-strength (power) capability among track and field athletes. Upon returning to normal training, increased performance can often be observed, sometimes beyond the original baseline values. Verkoshansky (1977, 1985) suggested that these results may be explained by the SFRA concept. Similar results have been observed among young weightlifters after a planned high volume over-reaching phase (Fry et al., 2000, Stone and Fry, 1997) and maybe linked to alterations in anabolic/catabolic hormones.

This concept has similarities to Selye's General Adaptation Syndrome (GAS), which can be used to model sports performance (Stone et al., 1991). Conceptually, adaptation or mal-adaptation is the summation of all stressors that an athlete may encounter (Figure 2). So, recovery-adaptation may be viewed as long-term interplay among various stressors and not just training.

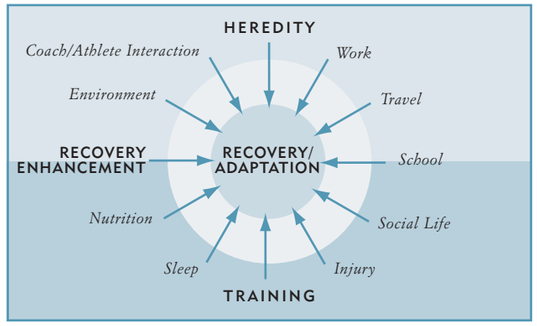

FIGURE 2. Factors (stressors) effecting sport performance

FITNESS VS. FATIGUE

A second model is Sport Preparedness. The characteristic of sports preparedness deals with the degree to which an athlete is ready to perform. Although a high level of "preparedness" does not guarantee a superior performance—it does raise the performance potential. According to this theory (Zatsiorsky, 1995), an athlete's preparedness can be determined by the summation of two after-effects of training: fatigue and fitness (Figure 3).

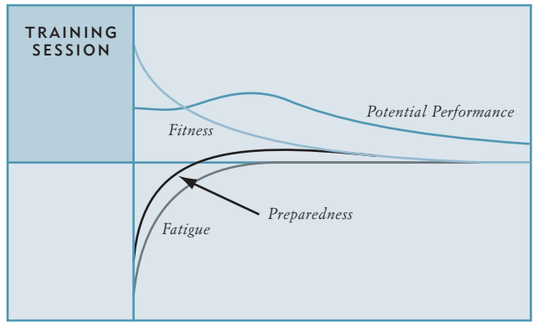

FIGURE 3. Fitness-fatigue relationship

Basically, this theory indicates that fatigue dissipates at a faster rate than fitness, thus enhancing preparedness. In contrast to the SFRA theory, which is based on a cause-and-effect relationship between these factors, the fitness-fatigue model proposes that they have opposing effects. This has a simple but profound implication for program design and implementation: Preparedness, which is strongly related to performance, can be optimized with strategies that maximize the fitness responses to training stimuli while minimizing fatigue. So, if preparedness is enhanced, performance should also be enhanced—evidence for these relationships can be found in the positive performance effects of a "taper" (Mujika and Padilla, 2003).

TRAINING STRATEGY

Fatigue is a natural consequence of training stress (especially with high volume-loads)—and adaptations are primarily manifested during subsequent unloading periods—fatigue management is key in producing a sound program. These unloading periods can be implemented at different levels in a periodized program (Stone et al.,1999a, 1999b, Plisk and Stone, 2003) for example:

MACROCYCLE—active rest/transition periods after competitive periods

MESOCYCLE—restitution microcycles after over-reaching microcycles, concentrated blocks or stressful competitions

MICROCYCLE—the use of unloading weeks following successive weeks of increased volume or intensity

INTRA-MICROCYCLE (DAY-TO-DAY)—maintenance/restitution workloads or recovery days; daily training routines can be distributed into modules separated by recovery breaks (i.e., multi-sessions per day) and additional intra-session relief breaks (e.g. rather than use a "repetition maximum" approach where each set is completed in continuous fashion, it can be advantageous to subdivide assigned workloads into clusters separated by rest-pauses, (Haff et al., 2003).

There are several levels of potential variation in the training program. Variation has clearly been shown to be a key factor in recovery-adaptation (Foster et al., 1998, Stone et al., 2000). As part of this variation, introduction of unloading periods (i.e. rest-recovery periods) into the training program structure can reduce the overstress/overtraining potential and enhance the recovery-adaptation process ultimately enhancing performance.

UNLOADING PERIODS: ESTIMATING THE WORK-LOAD

Work (force X displacement) is directly related to the energy used during exercise and is also related to the energy consumed during recovery. So, the more work performed in a training session the greater the potential for extended recovery periods.

The inability to recover not only effects adaptation, but also affects the athlete's ability to respond to the next training session. In order to implement appropriate unloading periods it is necessary for the coach to develop an understanding of the measurement or a reasonable estimate of work for their specific sport. This is relatively easy in weight-training as the volume load (repetitions X mass lifted) is associated with recovery energy (Scala et al., 1987). Thus, calculating the volume load per session can give a qualitative indication of how long it will take to recover.

However, in other sports activities estimates can also be derived from specific exercise characteristics—for example in sprinting, work may be estimated using a combination of distance run and times achieved (Kirksey and Stone, 1998). Developing estimates of work for various sports is a key factor in being able to appropriately vary exercise and unloading periods (i.e., if you don't know what a heavy work load is—then you cannot implement a light one).

MONITORING THE TRAINING PROCESS

One of the most important aspects in considering training-recovery-adaptation is monitoring the process. Failure to properly monitor results in the coach never really knowing if his or her training plan produced the desired results. A positive or negative performance result may have been due to outside factors (including chance) rather then good planning. Monitoring the training process should include the development of tests, which reflect sports specific fitness and preparedness. These tests should be:

1. Relatively easy to administer and relatively non-interfering with training—tests should include a variety of physiological, biomechanical and psychological aspects as well as performance tests.
2. Characterized by rapid data return.
3. Easy for the coach/athlete to interpret.
4. Administered in an integrated fashion with the training plan.

PROPER MONITORING CAN AID THE COACH IN:

- Developing athlete profiles and talent ID procedures.
- Standardizing testing and monitoring methods.
- Aid the coach in developing short and long-term training plans for the group and the individual athlete.

Integration of the monitoring process into the training program should entail testing at key phases—for example: just before and after general preparation, special preparation and competition and immediately after competition—this type of testing program will allow the coach to assess the adaptation of athletes to various types of stimuli across time. In this manner, the coach will know whether or not the desired results are being obtained for each training stimuli (i.e., each phase).

Training logs should be kept by each athlete so that relationships between training variables (volume, intensity factors and exercise selection) and tests can be noted. Administration of tests and interpretation tests results can be enhanced by forming a coach directed team of sports scientists and medical personnel. This process (and team) may also aid the coach and athlete in adapting training or formulating new and innovative methods of training.

In summary, recovery-adaptation is a multi-dimensional process that is driven by the training stimulus. Creative planning of the training process, which not only includes the training stimulus but also built in rest and recovery periods, can enhance recovery-adaptation. A necessity is proper monitoring of training-recovery-adaptation. Ultimately, appropriate planning and monitoring of this process can result in superior sports performance.

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MIND GAMES

Athlete Overtraining and Underrecovery:

Recognizing the Symptoms and Strategies for Coaches

by Kirsten Peterson, Ph.D.

USOC Sport Psychology

"I can't take time off! Every minute I'm not working out is a minute my competition has to get ahead of me."

"I get my confidence from knowing that I work harder than everyone else out there."

"No pain, no gain."

Statements like these are all too common in the world of sport, particularly at the elite level, where success versus failure is often measured in the smallest of increments. Yet coaches and athletes today are walking an increasing fine line between maximizing performance and going over the edge into overtraining. Training loads are increasing, by some estimates, at a rate of ten—20 percent every five years. Mark Spitz, for example, won his seven gold medals in the 1972 Olympics by swimming 9000 meters per day. Within 20 years, however, the average college swimmers were surpassing this mark, and by 1995, Olympic swimmers were putting in over 35,000 meters per day. (Raglin and Wilson, 2000).

These training increases have come with a price tag. Overtraining, defined by the USOC in 1998 as "the syndrome that results when an excessive, usually physical, overload on an athlete occurs without adequate rest, resulting in decreased performance and the inability to train" is on the rise. Differences in how overtraining is defined has made a true estimation difficult, but researchers suggest that on average, ten percent of athletes are overtrained at any given time. Endurance sport athletes are usually more hard hit-60 percent of competitive runners are or have been overtrained, by some estimates (Morgan et al., 1988). Overtraining has permeated the highest levels of sport, with twenty-eight percent of 1996 summer Olympians and ten percent of 1998 winter Olympians reported overtraining as a significant reason for their competitive difficulties (Gould et al., 2001). More disturbing, however, is the increasing prevalence of overtraining at sports' developmental levels.

The price athlete's pay for overtraining can be a high one. While most athletes who become stale or overtrained miss only a few days of training, for others, the symptoms can last much longer. This outcome is particularly true for the athlete who continues to try to train through his or her early symptoms, ignoring the warning signs.

Given the increasing likelihood that your athletes are going to experience overtraining during the course of their careers, what can you do as coach to mitigate or even prevent this from happening?

STEP 1: KNOW THE SYMPTOMS OF OVERTRAINING

While the sport scientists are still working to determine the exact mechanisms of overtraining, research and anecdotal reporting have combined to produce a list of overtraining symptoms to watch out for in your athletes:

- apathy
- lethargy
- depression
- decreased self-esteem
- emotional instability
- impaired performance
- restlessness
- irritability
- disturbed sleep
- weight loss
- loss of appetite

- increased resting heart rate
- increased vulnerability to injuries
- muscle pain/soreness

Clearly, coaches who know their athletes better are at an advantage in early detection, since many of these symptoms could be signs of other problems entirely, or even "business as usual" for some athletes. One of the detection issues with overtraining is that different athletes respond qualitatively differently to the same training stresses. What is most important, therefore, is not the presence or absence of a particular symptom of overtraining, but a pattern of differences in symptoms for a particular athlete over time.

STEP 2: INCREASE ATHLETES' SELF-AWARENESS

"When you don't feel right, back off. [In marathon training] it is all too easy to fall victim to the idea that you must run a certain number of 20-milers. When you're tired, it's better to run less."—*Joan Benoit Samuelson, USA, 1984 Olympic Marathon Champion (Samuelson and Averbuch, pp. 106 - 107).*

Easy for Joan to say, hard for most athletes to do. How can you as coach help your athletes increase their self-awareness, to differentiate between pushing through a needed hard workout, and knowing when enough is really enough and more recovery is really the answer?

- Make it a habit to ask your athletes how they are feeling and listen to their answers. Simple as this may sound, many athletes simply have not given much thought to how they feel until the feeling cannot be ignored. Helping your athletes to focus more regularly on their physical and emotional symptoms will hone their self-awareness and their ability to detect symptoms more quickly.

- Encourage your athletes to keep a regular training log. Elite athletes across sports agree, regular use of logbooks can greatly increase self-awareness and smarter training. Dietary intake, sleep quality, resting heart rate, physical and emotional well-being, as well as workout quality can all be useful information when assessing for the possibility of overtraining. For more information on putting together logbooks, refer to the USOC Sport Psychology's *Mental Training Manual*.

- Systematically evaluate athlete performances. For many athletes, their competitive performance analysis consists of the knowledge of whether they won or lost. Helping them to understand the process that went into the outcome, including fatigue, emotions, execution of strategy can be helpful in its own right to give athletes an increased sense of control over their performances, as well as connect training quality with performance. It can also help them answer the important question of whether they were adequately recovered, or optimally trained for the competition in question.

STEP 3: MODEL AND TEACH THE VALUE OF RECOVERY

A key for coaches and athletes in the battle against overtraining starts simply with how we define the issue of overtraining. As the comments at the beginning of this article reflect, it is incredibly difficult from a psychological standpoint for a high-achieving athlete to willingly do less of something in order to get better. But if we turn the problem on its head, going from OVERtraining to UNDERrecovery, we can help athletes understand that their job doesn't have to be all about backing off from training, but training smarter and doing more recovery activities.

How do you, coach, approach the concept of recovery with your athletes? Are recovery periods built into your training cycles? Do you refer to them in the same tone of voice and with the same sense of reverence you reserve for your athletes' most difficult workouts? Do you yourself model good recovery strategies in the context of your own lifestyle?

In addition to being a good role model, coaches must be good teachers of the concept of recovery to their athletes. An active rest day at the swimming pool shouldn't, for example, turn into a water polo game if rest was really the goal. Particularly at the elite level of sport, athletes need to learn that recovery is as much a part of their job as is the rest of their training regimen, their diets, or their sleep.

STEP 4: KEEP TRAINING FUN AND SPORT IN PERSPECTIVE

One of the main correlates of overtraining has proven to be the levels of stress the athlete associates with his or her sport. Gould and Dieffenbach (2001) suggest that coaches should work to dispel the myth that intense training cannot also be fun, and to incorporate innovations to training programs to reduce stress and make sport more enjoyable for their athletes. Athletes should also be encouraged to maintain balance in their own lives and develop their identities in other realms of interest, be it family, school, non-sport careers, or outside interests.

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Nutrition and Recovery

by LaGary Carter

Valdosta State University

The motto for the Olympic Games is *"Citius-Altius-Fortius."* These Latin words translate to mean faster, higher, and braver. However, over the centuries the terms have come to universally mean *swifter, higher,* and *stronger*. The relationship of nutrition to human performance is not a new concept. Greek Olympians ingested mushrooms as an ergogenic aid. Roman gladiators ate the heart of a lion to enhance their prowess in the arena. The quest for a "competitive edge" exceeds 23 centuries of sport and, no doubt, will continue throughout future generations.

Today, the amateur and professional coach or athlete is inundated with information that encourages the utilization of various dietary supplements and drugs to improve performance. There is public confusion surrounding the definition of a supplement verses a drug. The 1994 Dietary Supplement and Health Education Act (DSHEA) defines a dietary supplement as *"any product (other than tobacco) intended to supplement the diet that bears or contains one or more of the following dietary ingredients: a vitamin, mineral, amino acid, herb or other botanical; or a dietary substance for use to supplement the diet by increasing the total dietary intake; or a concentrate, metabolite, constituent, extract, or combination of any ingredient described above; and intended for ingestion in the form of a capsule, powder, softgel, or gelcap, and not represented as a conventional food or as a sole item of a meal or the diet."* The Federal Food, Drug, and Cosmetic Act (FD&C Act) defines a drug as *"any article (excluding a device) intended for use in the diagnosis, cure, mitigation, treatment, or prevention of disease and articles (other than food) intended to affect the structure or function of the body."*

In this article, we examine supplements that are permitted by the International Olympic Committee.

PROTEIN

The ingestion of certain foods and nutritive supplements following exercise seems to be beneficial in preserving and improving athletic conditioning. Researchers have reported a positive hormonal state for muscle growth when carbohydrate and protein are consumed after weight training. It has been well established in the scientific literature that eccentric muscle actions lend greater trauma to the myofibers of skeletal muscle. The concentrations of growth hormone and insulin following exercise appear to be favorable for protein proliferation when carbohydrate and protein is eaten immediately thereafter. A multi-analysis review of the scientific literature supports the premise that protein metabolism is high during prolonged endurance exercise and intense anaerobic exercise and increases the need for specific protein. Many nutritionists consider whey protein as the best form of protein to use as a post-workout meal. This recommendation is based, in part, on the broad amino acid composition required of the human body inherent to whey protein.

CARBOHYDRATES

The adequate consumption of carbohydrate is necessary for the preservation of protein for muscle tissue repair and maintenance. When the carbohydrate stores are significantly reduced, protein becomes an active fuel substrate to meet the metabolic demands of exercise. It is essential that the athlete consume carbohydrate before, during, and after exercise to sustain sufficient muscle glycogen levels. Muscle glycogen stores are most diminished during endurance exercise. Therefore, the ingestion of carbohydrate within 24 hours is crucial for the replenishment of muscle glycogen. It has been reported that the immediate intake of carbohydrate following exercise resulted in muscle glycogen restoration three times faster than that of a two-hour delay. The type of carbohydrate ingested is a key variable in the earliest replenishment following an extended bout of exercise. The post-exercise carbohydrate should have a high glycemic index that evokes a higher plasma glucose response following consumption. Some of the carbohydrates with a high glycemic index are corn flakes, honey, white bread, rice, carrots, and bananas. See chart below with some examples of foods in different glycemic index ranges:

GLYCEMIC INDEX RANGES

HIGH	MODERATE	LOW
Cane, maple, corn syrup	Whole grain bread	Yogurt
Honey	Spaghetti, pasta	Peanuts
Bagel, white bread	Corn	Beans, peas
Potato	Oatmeal	Apple, Peach, Pear, Figs

HYDRATION

Many athletes and coaches are remiss regarding the importance of proper hydration relative to optimal performance and safety. Therefore, athletes should attempt to be well hydrated before, during, and after exercise. It is important that coaches know what the Heat Index is during practice as well as competitions to assist in hydration plans for their athletes. Athletes often fail to consume enough fluids during an extended bout of exercise for homeostasis. It is suggested that an individual ingest approximately 150 percent of the "water" weight lost during exercise to restore the fluid losses of perspiration and to maintain normal urinary production. Increased sodium intake following exercise assists in rehydration by maintaining blood osmolality and stimulating thirst. Most commercial sports drinks do not possess enough sodium for post-exercise replacement. Therefore, it may be necessary to ingest sodium-rich foods such as soups, pickles, pretzels, and pizza in addition to sports drinks.

CREATINE

Creatine monohydrate, as a dietary supplement, has received much attention within the scientific community. Creatine supplementation received its initial notoriety as an ergogenic aid from its use by the British sprinters and hurdlers in the 1992 Barcelona Olympic Games. The basis for creatine supplementation is that it plays an important role in energy metabolism and adenosine triphosphate (ATP) reformulating. It seems to enhance muscle strength when accompanied with resistance training and improves short repetitive bouts of powerful activity. Carbohydrate ingestion with creatine may increase muscle uptake. The shorter and more intense activity is fueled through anaerobic energy production, while longer and less intense activity is fueled by aerobic energy production. Creatine is utilized in the reformulation of adenosine triphosphate particularly in anaerobic metabolism. Therefore, it is instrumental in decreasing the recovery time between sets of weight training or explosive exercise, which in turn allows for a greater volume of exercise to be performed and overload of the fast twitch muscle fibers. Research suggests that three grams of creatine per day will increase total muscle creatine to the same levels as five days of 20 grams of creatine per day for a period of roughly 30 days. A consensus of the data seems to show no serious side effects of creatine supplementation over a period of four years. However, further research is warranted regarding the long-term consequences, if any, of creation supplementation.

LEGALITY

Of interest is rule 16.5.2.3 adopted by the NCAA, which regulates the nutritional supplementation of collegiate athletes. The rule states *"an institution may provide only non-muscle building nutritional supplements to a student athlete at any time for the purpose of providing additional calories and electrolytes, provided the supplements do not contain any NCAA banned substances."* Coaches and trainers are allowed to give athletes supplements such as vitamins, minerals, caloric and electrolyte replacement drinks, and energy bars containing no more than 30 percent protein. Coachers and trainers are not permitted to dispense, sell, or arrange for the sale of supplements such as creatine, condroitin, glucosamine, amino acids, protein powders, and others substances for nutritive purposes. The purpose of the legislation is for institutions to provide only non-muscle building nutritional supplements for the purpose of providing additional calories and electrolytes, provided they do not contain any NCAA banned substances.

Sports medicine professionals and coaches must be ever conscious about the message and example set before their athletes. We all have an ethical and moral obligation to relay scientifically sound and medically safe information to the athletes entrusted to our care or supervision. Arguably, no supplement alone can ever replace the blood, sweat, and tears that mold and eventually shape the heart of a true winner not only on the athletic field, but more importantly—in life.

60-SECOND SUMMARY

Creating a Successful Team Climate

by Ian Rutledge

Sport Coach, Vol 25, No. 3, 2002

"One of the major challenges of sports coaching is the ability to bring a team together as a collective group and in doing so, enhancing each athlete intrinsically through individual player worth and team success extrinsically through on-field results."

This article lists ten traits of an effective team: appropriate leadership, suitable membership, commitment to the team, concern to achieve, effective work methods, well-organized team procedures, positive feedback without confrontation, creative strength, positive intergroup relations and a constructive climate. The author also shows research from DeCotiis and Koys (1980) that define eight factors that affect team climate:

1. **AUTONOMY**—the opportunity for the athlete to function independently of the group leader, and is able to make decisions on his/her own.

2. **EMOTIONAL SUPPORT**—greatest need that an athlete requires from their fellow teammates or coach. Emotional support is most needed when the athlete is performing poorly. If this support is lacking, then the team climate will be affected negatively, as players will feel abandoned and distant from the group.

3. **PRESSURE**—can create a team environment where the athletes are scared of making a mistake or cause athletes to go beyond their means to defeat a superior opponent.

4. **COACH'S RECOGNITION**—an athletic effort, improvement and performance are directly related to the athletes' self-confidence, responsibility and team worth. This in turn fosters a supportive and constructive team climate.

5. **TRUST**—is important for developing a positive team climate. Coaches should explain to athletes that they trust the athletes' judgement.

6. **FAIRNESS**—an effective team climate must be based on the athlete's perception of "fair."

7. **INNOVATION**—allows the athlete to feel that the team or play is his or her own. It promotes creativity and allows for the team individual flair to be shown (as long as it is not detrimental to the overall team goal).

8. **COHESION**—a measure of a person's attraction to, sense of belonging to, and desire to remain a part of the group.

60-SECOND SUMMARY

Hydration Controversy?

by Catherine Sellers

Hydration has been in the news lately since USA Track & Field issued an advisory on the importance of identifying individual fluid needs. Dr. Douglas Casa explains the situation as "a double-edged sword situation: drink enough fluids during activity to prevent dehydration-which could be detrimental to health and performance—but do not consume too much fluid—which could cause the potentially dangerous problem of hyponatremia".

What is dehydration? The Advisory explains that dehydration occurs from a loss of fluids, from sweat, urine and respiratory losses and a fluid intake that does not match up with these fluid losses. So what is hyponatremia? Basically, it is low blood sodium caused by excessive intake of fluid and the ingestion of low-sodium fluids during or after prolonged exercise.

There are three keys to the potential for exertional hyponatremia (EH): 1) Sports that last for longer than four hours 2) Lower intensity endurance activities 3) When athletes drink large volumes of water without adequate sodium intake.

The USA Track & Field website—www.usatf.org has published the following in regards to hydration:

- Proper Hydration for Distance Running—Identifying Individual Fluid Needs—A USA Track & Field Advisory
- USATF Self-testing Program for Optimum Hydration
- Sweat Calculation process along with a Urine Color Chart
- IMMDA Advisory Statement on Guidelines for Fluid Replacement during Marathon Running
- Fluids on Race Day

HOT OFF THE PRESS

APPLICATION FOR RESEARCH AT THE ATHENS 2004 PARALYMPIC GAMES

The International Paralympic Committee Sport Science & Education Subcommittee is responsible for establishing policies and guidelines in order to enhance scientific knowledge and to promote sports science education and research in Paralympic sports. To this end, the SSES requires prior review and approval for all research conducted at the Athens 2004 Paralympic Games.

For more information contact:
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INTERNATIONAL COUNCIL OF SPORT SCIENCE AND PHYSICAL EDUCATION

220 sport and sport science institutions co-operate worldwide to further the scientific understanding of movement and sport, education for improved quality of life, health for all and physical activity and the positive values of sport.—*www.icsspe.org*

SPORT LEADERSHIP 2003 AND ICCE GLOBAL COACH CONFERENCE

October 30–November 2, 2003 in Vancouver, British Columbia
http://www.coach.ca/e/conferences/sportleadership.htm

OLYMPIC COACH E-MAGAZINE

The U.S. Olympic Committee Coaching and Sport Sciences Division reminds you that our quarterly magazine, OLYMPIC COACH, is now available electronically as the OLYMPIC COACH E-MAGAZINE.

This quarterly publication designed for coaches at all levels can now come to you via e-mail. The quarterly e-mail provides a summary of each article in the magazine with a link that takes you directly to the full-length article. The E-magazine contains the same content as the print version of the magazine. The best news is that OLYMPIC COACH E-MAGAZINE is available to all coaches and other interested individuals free of charge. To receive your complimentary subscription, go to the web site at *http://coaching.usolympicteam.com/coaching/ksub.nsf*, and sign up. The subscription information that you provide will not be shared or sold to any other organization or corporation. Please share this opportunity with other individuals in the coaching community.

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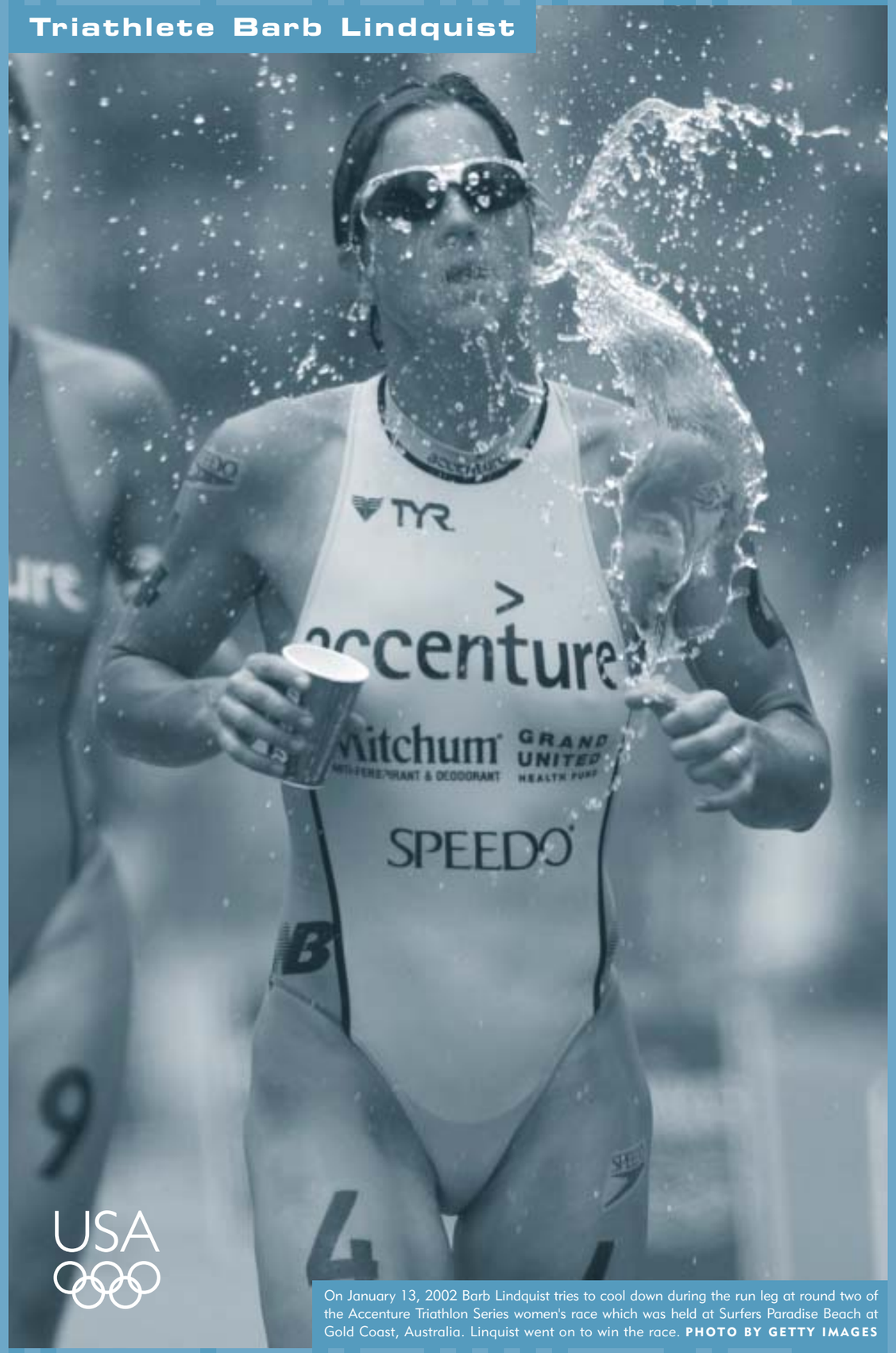
Triathlete Barb Lindquist



On January 13, 2002 Barb Lindquist tries to cool down during the run leg at round two of the Accenture Triathlon Series women's race which was held at Surfers Paradise Beach at Gold Coast, Australia. Linquist went on to win the race. **PHOTO BY GETTY IMAGES**

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