Under-recovery and Overtraining
Different Concepts – Similar Impact?
By: Michael Kellmann

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 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).

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 of 298 (28%) U.S. Athlanta Olympic athletes reported that they had overtrained for the Games and this overtraining had a negative impact on performance. Similarly, in open-minded 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 the same Olympians it was identified that the need to taper, rest, not 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**

Kellman 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.

The axis of the stress-states can be seen as a continuum of an increasing training load, which can be labelled at the end points “no training” and “overtraining” (similar to Kreider et al., 1998). With an extended training load the organismic recovery demands increases proportionally. A short-term planned sacrifice of recovery enhances long-ter, 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 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-state or syndrome that occurs, the more recovery efforts are needed in order to reach the individual optimal recovery-stress-state.

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 (Legmann 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 the 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 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 preferences for recovery strategies are important elements to avoid overtraining and subsequent underperformance.