Overtraining and recovery

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Overtraining develops because the indicators have not been detected over a long period of time and because athletes and coaches have not been aware of the symptoms, have not paid attention, and/or have not linked single indicators to the overall situation the athlete is experiencing. It is easy to overlook indicators considering the time schedule of athletes in the treadmill of sport. For example, Helge Meeuw, five-times German swimming champion, in 2006 described his daily routine before the German Championships:

I get up at 6:30 a.m. From 7 a.m. until 8:45 a.m. I have water training at the sport school. After that I have a quick breakfast to be at the hospital at 10 a.m. where I am doing my internship. At 3:30 p.m. I head off to the sport school for strength training or physiotherapy, followed by additional water training from 6 p.m. until 8 p.m. At 9 p.m. I am finally at home. In the beginning of this program I felt like I was in a coma. However, I took the day off before the German Championships. The recovery during this period gave me the kick to perform well.

(Körber, 2006, p. 22)

Three elements of this example stand out: (a) the challenge of balancing different tasks and responsibilities (e.g., training, work duties), (b) self-awareness, and (c) well-structured planning. The quote reads as if the recovery day was planned in his schedule and he made a conscious decision that he needed it, because he had some sort of monitoring system that allowed him to judge how he was physically experiencing the effects of his hectic life.

In another example, Whitney Myers, an American swimmer, was probably not aware of the toll overtraining had on her life, as it was described on the website of the New York Times (Reynolds, 2008):

In 2006, Myers won the women’s NCAA title in the 200- and 400-yard individual medleys and, to the surprise of almost everyone, won gold in the 200-meter individual medley at the Pan Pacific Championships. The accolades kept coming: Myers was named an all-American in several events and an NCAA Breakout Performer of the
Year and swam for the United States national team. But barely a year later, she floundered badly at the 2007 long-course championships, making the finals in only one event. For weeks before that, her performance in practices had been miserable: slow times, inert form. “I remember standing behind the starting blocks at the pool and thinking, ‘I don’t want to be here,’” she says. “I felt terrible, mentally and physically.” While trying to build on her breakthrough season, she had pushed too hard. She had overtrained. She was, for a while at least, finished as a swimmer.

Based on this description, it sounds like Whitney had trained too much without taking a break, resulting in a self-generated state of overtraining pushed by a high level of achievement motivation.

A last example comes from the coach of the French national soccer team before the quarter finals in the 2006 World Cup. The press asked him how he trained his athletes so that his team improved their physical condition from game to game. “We have done almost nothing,” answered Domenech, “only recovery. You know: old people need care” (Itzel, 2006). Although this quote may sound funny at first, physical and mental rest are important components of fitness and preparation for competition as Richardson, Andersen, and Morris (2008) have recently discussed.

Definition and description of overtraining and recovery

In the conclusion of my chapter “Underrecovery and overtraining: Different concepts – similar impact?” I (Kellmann, 2002a) answered the question in the title clearly with a “yes” and a “no”. Yes, underrecovery and overtraining have the same impact – performance declines; no, they are not similar – research has clearly shown that underrecovery is the precursor/cause of overtraining. 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 effect on performance. Kellmann and Kallus (2001, p.22) defined recovery as

an inter- and intra-individual multilevel (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 to build up and to refill personal resources and buffers. This definition also illuminates the complexity of recovery as I discussed (Kellmann, 2002a) and highlights the need to identify ideal recovery strategies on an individual basis.

Balancing training stress and recovery are essential to the achievement of optimal performance, and the avoidance of overtraining. Underrecovery can often lead to poor psychological and physical outcomes, including overtraining and burnout. Specifically, a prolonged imbalance of stress (including competition, training, and stress associated with events outside of sport) and recovery, in addition to an increase in the intensity and volume during training, can result in overtraining (Budgett, 1998). Therefore, stress and recovery should be continuously monitored during the training process (e.g., Kellmann, Altenburg, Lormes, & Steinacker, 2001). Overtraining can also result from training factors such as (a) monotonous training programs, (b) more than 3 hours of training per day, (c) failure to
alternate hard and easy training days or alternate two hard days followed by an easy training
day, (d) no training periodization and respective regeneration micro-cycles after two or
three weeks of training, or (e) no rest days (Smith & Norris, 2002). To avoid underrecovery,
the precursor of overtraining, physiological and psychological recovery should be an integral
part of the training plan (Hooper & Mackinnon, 1995).

Overtraining is characterized by an ongoing performance plateau that does not
improve with short amounts of rest and recovery. Common symptoms associated with over-
training include depressed mood, general apathy, decreased self-esteem and performance,
emotional instability, restlessness, irritability, poor sleep, weight loss, loss of appetite,
increased resting heart rate and vulnerability to injuries, hormonal changes, and the absence
of supercompensation. Another significant clinical feature of overtraining is an increased
risk of infection and other corresponding symptoms, which suggests the presence of an
impaired immune response (see Kellmann, 2002a). Alternatively, if the rest interval
between consecutive training workouts is of an optimal duration, supercompensation or a
training effect is likely to follow a workout that results in a degree of fatigue or depletion.
Moreover, supercompensation will be accompanied by an increase in performance ability
(Zatsiorsky, 1995).

One objective of studying the effects of overtraining is to establish which signs (symp-
toms, markers) predict negative processes. Physiological indicators, such as creatine kinase,
represent shifts in training loads, but are an undependable gauge for detecting early
overtraining symptoms (Raglin, 1993). Findings from studies of physiological markers of
overtraining have been reviewed, but are often inconclusive and even contradictory
(Kuipers & Keizer, 1988). Distinguishing normal from abnormal modifications in responses
to training is complex because various physiological characteristics alter when one
shifts from standard to intense training. Physicians and physiologists stress that no firm
physiological marker exists. Studies to establish decisive factors of overtraining have
demonstrated, however, that psychological indicators are sensitive and consistent (Kenttä
& Hassmén, 1998). The advantage of psychometric instruments is the quick availability
of information. Although common blood analyses and/or specific medical/physiological
diagnostics may take hours or days (and sometimes even weeks), psychological data become
available within minutes.

The phenomenon of overtraining, as described in the literature, is confusing, due, in part,
to a lack of international standardized terminology and the absence of clear diagnostic
criteria (see Kellmann, 2002a; Richardson et al., 2008). The terms overwork, overreaching,
overtraining, staleness, burnout, overfatigue, and short- and long-time overtraining have
all been used to describe overtraining. Some authors differentiate between overtraining,
staleness, and burnout and describe the different physiological and psychological effects,
whereas others do not. Adding to the confusion, terminology differs by geographical
location (e.g., Europe, North America) and professional background (e.g., medical staff,
sport psychologists).

Interrelations of stress-states and recovery demands

I (Kellmann, 2002a) proposed a general model describing the interrelations of stress-states
and recovery demands. The basic assumption of this model (Figure 31.1) is that with increas-
ing stress, increased recovery is necessary to stay in the original stress state. Limited resources
(e.g., time), however, initiate a vicious cycle: under increased stress and the inability to
meet increased recovery demands, a person experiences more stress. Recovery demands are defined as the quality and/or quantity of necessary recovery activities to level out the current recovery–stress state. 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 their situations.

With intermediate levels of stress, one can find an area of optimal performance, and thus, an area of adequate recovery. Beyond this point, one cannot meet recovery demands without additional recovery activities. Stress will accumulate, and without intervention, overtraining symptoms are likely to develop. The state of balanced stress and recovery is related to optimal performance. In a state of adequate recovery, the individual can react appropriately and cope successfully with stress without additional recovery activities. A lack of recovery, or underrecovery, can trigger a process that leads to a state of elevated stress. Because increasing stress limits the possibility of recovery, the athlete must be given special opportunities to recover to re-establish an optimal level of performance.

Applying this model to sport may explain how overtraining develops. The axis of the stress-states can be seen as a continuum of an increasing training load, which can be labeled at the extreme end points: no training and overtraining (see Figure 31.1). With additional training load the organismic recovery demands increase proportionally along the recovery axis. A short-term planned sacrifice of recovery, however, enhances long-term performance effects (e.g., supercompensation). If training load and intensity increase over a longer time with inadequate or inappropriate recovery, the individual experiences long-term under-recovery that may result in overtraining. To reach an optimal recovery–stress state, athletes need to increase their self-initiated activities to fulfil their recovery demands. At each stage 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 is, the more recovery efforts are needed to reach the individual optimal recovery–stress state. The model of the

interrelation of stress-states and recovery demands implies that it is not negative to be highly stressed as long as a person engages in enough recovery.

**Psychometric approaches to monitor training**

Athletes do not love paperwork. Many sport psychologists learn this lesson when they try to administer questionnaires to an athlete or sport team during an initial meeting. Due to such experiences, some sport psychologists refrain from using questionnaires as diagnostic tools or they desist from using diagnostics other than observation and more or less systematic interviews. Complete diagnostics, however, are central for a solid data foundation on which to base subsequent interventions for overtraining (Beckmann & Kellmann, 2003). The use of observations, interview techniques, and standardized instruments such as questionnaires is common. Ideally a combination of these approaches should be used (see Chapters 9–12).

In many sports medical doctors are around athletes on a more regular basis than sport psychologists. Verbal interactions between doctors and athletes during sport medical treatments and consultations are often aimed, in part, at detecting signs of overtraining/underrecovery. Intensive consultations depend on the time available. The use of psychometric instruments can be economical and may limit a priori biases that can affect the perspectives and perceptions of consultants. The information gained from psychometrically validated questionnaires can be used as a screening method for individual problems in large groups.

To compare athletes with normative data of physiological tests from the general population may be misleading. Inter-individual differences in recovery potential, exercise capacity, non-training stressors, and stress tolerance will affect the degree of vulnerability experienced by athletes under identical training conditions (Lehmann, Foster, & Keul, 1993). Physiological and psychological stress and recovery can be monitored during the training process to prevent overtraining; however, feedback loops of coaches and athletes need to be established on a regular basis to evaluate the scores. The key is to evaluate athletes individually, monitor them regularly, and compare the obtained data longitudinally (Froehlich, 1993).

Monitoring instruments are important for assessing an individual’s need for recovery. Research in sport psychology on monitoring training/overtraining/underrecovery has mainly involved the Profile of Mood States (POMS; McNair, Lorr, & Droppleman, 1971/1992) and Borg’s Rating of Perceived Exertion (RPE; Borg, 1998). Kenttä and Hassmén (1998, 2002) recently introduced the concept of total quality recovery, which they closely structured around the concept of RPE to emphasize the interrelationship between training and recovery. This new approach is an effective way of addressing the problem of assessing recovery and underrecovery. The POMS and the RPE were not designed for the assessment of recovery in sport, but until recently there had been no instruments available to specifically assess the complexity of recovery and stress.

Hanin (2000, 2002) introduced an alternative individualized approach suggesting that each individual has a zone of optimal functioning. Performance efficiency is maximized when the level of one’s subjective emotional experience falls within this zone. The individual zones of optimal functioning (IZOF) model provides an individualized framework and tools to describe, predict, and explain why and how individually optimal and dysfunctional states can affect athletic performance. An important extension of the IZOF model is that idiosyncratic emotion markers of these optimal and dysfunctional performance states are proposed as specific criteria of an optimal (sufficient) recovery process. In each case individually optimal recovery strategies need to be identified.
The Recovery–Stress Questionnaire for Athletes (RESTQ-Sport; Kellmann & Kallus, 2001; Kellmann, Kallus, Samulski, Costa, & Simola, 2009) is an instrument that systematically assesses the recovery–stress state of an athlete. The recovery–stress state indicates the extent to which an individual is physically and/or mentally stressed, and whether or not the person is capable of using individual strategies for recovery, and also assesses which strategies are used. Scales 1 to 7 measure temporary or stable life stresses in general, performance related stress, and physical aspects of stress, and scales 8 to 12 measure temporary or stable non-specific recovery activities (general recovery). Seven sport-specific areas assess additional aspects of stress (scales 13–15, sport-specific stress) and recovery (scales 16–19, sport-specific recovery). All items on the RESTQ-Sport are scored from 0 (never) to 6 (always). An example of an item would be: “In the past (3) days/… my muscles felt stiff or tense during performance”.

The RESTQ-Sport has been used to monitor athletes during the preparation camps for the Rowing World Championships and Olympic Games (e.g., Kellmann et al., 2001; Mäestu, Jürimäe, Kreegipou, & Jürimäe, 2006) and observe the influence of training on stress and recovery (e.g., Coutts, Wallace, & Slattery, 2007). These studies found that increases in training volume were reflected by elevated stress scores and reduced recovery scores measured by the RESTQ-Sport.

During training camps it may be beneficial to provide feedback to coaches and athletes about athletes’ current recovery–stress states to initiate interventions aimed at optimal stress–recovery balance. Figure 31.2 provides an example of how the information of the RESTQ-Sport profile has been used. A track and field athlete completed the RESTQ-Sport after arriving at a training camp preparing with the relay team for the next World Championships. Her initial RESTQ-Sport profile is represented by the bold line in Figure 31.2. The profile revealed elevated levels of emotional stress and social stress (scales related to general stress) as well as for all scales of general recovery. In the sport-specific areas, elevated scores of emotional exhaustion and injury could be observed as well as medium levels of recovery. This pattern clearly indicated that something in the life of the athlete was negatively affecting the balance of her recovery–stress state. Knowing that the heavy training was yet to come, and it would even more negatively affect her recovery–stress state, the relay coach approached her and provided feedback on her RESTQ-Sport profile. In this feedback and communication, the athlete shared with the coach a problematic personal situation. Talking to the coach helped her to address the problem and deal with her personal issues. Subsequently, even after the heavy physical training started, her recovery–stress state improved (thin line, Figure 31.2) by the end of the camp.

This example highlights one major component that may help coaches and athletes avoid overtraining: communication. When coaches can acknowledge that athletes have non-sport lives, can create an environment where athletes can express themselves, and do not punish them for being tired, the first step toward a balance between stress and recovery is made. Regular short chats with athletes are important to create that kind of environment, but the process becomes time intensive when a large number of athletes are being coached.

**Strategies to prevent overtraining**

The most frequent causes of overtraining cited by athletes are (a) too much stress and pressure, (b) too much practice and physical training, (c) physical exhaustion and all-over soreness, (d) boredom because of too much repetition, and (e) poor rest or lack of proper sleep.
Holistic training encompasses two ideas: (a) training must be balanced and varied, and (b) non-training time has a major influence on training. All factors outside the realm of training sessions, therefore, need to be evaluated as to their possible negative influences on total fatigue. Insufficient recovery time between practices is the main cause of overtraining. Factors such as nutrition, sleep deficit, sickness, travel, and competitions increase the negative effects of insufficient recovery.

Figure 31.2 Recovery–stress state at the beginning of a training camp (bold line) and at the end of the training camp (thin line).
Recovery is more than doing nothing and/or resting: it is an active process. Because recovery is specific to each individual, it is important for coaches to plan rest days during regular training, in training camps, and during competition. I (Kellmann, 2002b) suggested some activities such as dancing, meeting friends, stretching, indoor games (e.g., board games, word games, playing cards), reading books, going for walks, sightseeing, trips to a lake including picnics and swimming, or easy runs. These ideas may help coaches and support staff (e.g., sport psychologists) to individualize recovery activities, however not every activity has the same effect of recuperation for all athletes. Recovery activities for athletes can be performed individually or within a group. Sometimes athletes should be left by themselves to do whatever they want to do, and at other times it could be helpful to give some directions. Probably the most important aspect about recovery is that it is a proactive, self-initiated process to re-establish psychological and physiological resources. From this perspective people are responsible for their recovery activities, and can actively initiate them. For example, going to a movie, visiting close friends, or going for a light run can be self-initiated and, therefore, proactively put a person in charge. In regular life there are numerous possibilities for recovery, but during training camps options are limited.

Peterson (2003) identified four steps for coaches and support teams (e.g., sport psychologists) to recognize the symptoms of overtraining and to develop preventive strategies:

**Step 1: Know the symptoms of overtraining**

- Impaired performance
- No supercompensation in response to taper or rest
- Increased resting heart rate
- Weight loss
- Loss of appetite
- Increased vulnerability to injuries
- Hormonal changes
- Depressed mood
- General apathy
- Decreased self-esteem, emotional instability
- Restlessness, irritability
- Disturbed sleep.

**Step 2: Increase level of athletes’ self-awareness**

- Make it a habit to ask your athletes how they are feeling and listen to their answers.
- Encourage your athletes to keep a regular training log.
- Systematically evaluate athlete performances.

**Step 3: Model and teach the value of recovery**

- Model good recovery strategies in the context of your own life and work.

**Step 4: Keep training fun and sport in perspective**

- Coaches should make work fun and incorporate innovations to training programs to reduce stress and make sport enjoyable for their athletes.
Athletes should maintain balance in their own lives and develop their identities in other realms of interest (e.g., family, school, non-sport careers, outside interests).

Coaches need to accept the concept of athletes having lives outside of sport.

Conclusions and summary

I (Kellmann, 2002b) have pointed out that it requires a close cooperation between coaches, athletes, sport physicians, and sport psychologists to use the available medical, psychological, and performance data on an interdisciplinary basis. This process starts with open communication, adherence to agreements, quick reactions to feedback, and an openness to learn from others. The athletes are the centre of interest. Ideally the coach receives information dealing with different areas provided by the staff, and makes decisions based on this broad data base. Daily team meetings can ensure that all staff members have the same level of information. Athletes can regularly complete the RESTQ-Sport. Parallel to the questionnaire measurements, a sport medical assessment (e.g., lactate, creatine kinase) can take place. One goal is to identify those athletes whose recovery–stress states deviate from those expected based on individual or group profiles. As athletes complete questionnaires, the coaches and physicians involved receive fast feedback, and therefore, immediate interventions can be provided.

Of course, athletes can intentionally fake good answers on questionnaires, but emphasizing that the key to monitoring training is the principle “honesty first” can limit this behaviour. If the role of questionnaires is accepted, and scoring of the instruments reflects athletes’ current conditions, then awareness of the processes affecting their lives increases. A relevant monitoring tool can assess areas not covered in regular coach–athlete talks. For many coaches, life events outside of sport are not relevant to sport performance, or they may think it is too intrusive to ask about private lives. Monitoring, however, can start an educational process for athletes and coaches when the results are shared. This process only works if explanations are provided as to why underrecovery is to be avoided and how questionnaires can be used to optimize training and performance. In my applied work with the German Junior National Rowing Team on recovery monitoring (see Kellmann et al., 2001), up to 80% of the rowers asked for feedback from their questionnaire data and how it related to physiological and medical data. Recognizing they would get feedback and were not just being used as “data gathering subjects” enhanced their commitment to the program (Beckmann & Kellmann, 2003). An open communication process is important to get athletes voluntarily involved in the assessment of recovery.

In addition to the integration of recovery within the training and competition schedule, interdisciplinary cooperation is a key for better diagnosis of the recovery–stress states of individuals. To optimize this process, the consultation with athletes should be done in close cooperation between coaches, sport physicians, and sport psychologists. Therefore, all physiological and psychological data, as well as training and performance data, should be used by the interdisciplinary team (Froehlich, 1993; Kenttä & Hassmén, 1998). This process begins with a complete training documentation, the assessment of subjective and objective physiological and psychological data, and the integration of athletes’ perspectives. Clearance from the athlete needs to be obtained to adequately deal with confidentiality issues. See Box 31.1 for a summary of practical take-home messages about recovery.
Box 31.1

Summary of take-home messages regarding recovery

- It is not necessarily bad to have high levels of stress as long as the person knows how to recover.
- Recovery periods must be part of the training plan.
- Recovery is individually specific.
- Monitor the impact of training.
- Recovery involves self-responsibility.
- Regular communication is important to avoid overtraining.
- Sport psychologists can help to facilitate the communication processes and educate coaches and athletes about indicators of overtraining.

References


