

Overtraining from a Sports Psychiatry Perspective

Übertraining aus sportpsychiatrischer Sicht

Summary

- › **Overtraining is characterized** by a mismatch between exerted strain and exercise tolerance. Overtraining is generally not sufficiently feared nor is enough attention paid to its prevention. As a result, the first warning signals and symptoms are often either perceived too late or there is a delay in the correct interpretation of signs. This often leads to negative consequences over months, which, in turn, can lead to more frequent injuries as well as depression.
- › **Due to the increasing professionalism** and density of competition in competitive sports, overtraining occurs more frequently as athletes are left with a shorter period of time to recover. In order to treat overtraining, it is first necessary to identify the syndrome. Symptoms are often disregarded and trainers and athletes attempt to compensate for poor performance with excessive training. This leads to a vicious cycle with significant reduction of the overall performance of the athlete as a consequence.
- › **Psychological parameters** can also be signs of non-functional overload. Examples include restlessness, irritability, emotional instability, recurring states of fear, emerging indifference or reduced performance motivation. However, disturbed cognitive processes as an impairment of central elements of movement control can also occur. As part of sports psychiatric support, conspicuous psychological parameters can be recorded and contextualised. The Synergetic Navigation System (SNS) is available for systematic recording and corresponding process management. The Synergetic Navigation System (SNS) can be used as an instrument for load, training and competition control to prevent non-functional overload and overtraining. It is also suitable for promoting performance and preventing injuries as well as stabilizing the psychological structure.

KEY WORDS:

Mental Health Symptoms, Mental Disorders, Injury Prevention, Exercise Intolerance, Synergetic Navigation System (SNS)

Introduction

Overtraining generally receives too little attention. It is often recognised or interpreted correctly far too late (5). The symptoms can be misinterpreted by athletes. In the case of injury-prone athletes, physical overload is often considered as a possible cause (55). Indications of overload can be given by psychological

Zusammenfassung

- › **Beim Übertraining** besteht ein Missverhältnis zwischen Belastung und Belastungstoleranz. Übertraining wird im Allgemeinen zu wenig gefürchtet. Auch der Prävention wird nicht genug Aufmerksamkeit beigemessen. In Folge dessen werden oft auch erste Warnsignale und Symptome zu spät wahrgenommen bzw. zu spät richtig gedeutet. Das führt dann nicht selten zu monatelangen negativen Konsequenzen. Im Rahmen dessen kann es zur Häufung von Verletzungen kommen oder auch zur Entwicklung einer Depression.
- › **Wegen der zunehmenden Professionalisierung** und Wettkampfdichte im Leistungssport entwickeln Athleten heutzutage leichter ein Übertrainingssyndrom, weil es im Rahmen dessen auch immer schwieriger wird, ausreichend zu regenerieren. Um ein Übertraining zu behandeln, bedarf es zunächst der Erkennung des Syndroms. Häufig werden Symptome missachtet und schlechte Leistungen mit überhartem Training versucht zu kompensieren. Der Sportler gerät in einen Teufelskreis und meist ist das Leistungsvermögen dann deutlich reduziert.
- › **Auch psychische Parameter** können als Anzeichen von nicht funktionaler Überbelastung herangezogen werden. Zu nennen sind beispielsweise Unruhe, Reizbarkeit, emotionale Instabilität, wiederkehrende Angstzustände, aufkommende Gleichgültigkeit oder vermindertes Leistungsstreben. Aber auch gestörte kognitive Prozesse als Beeinträchtigung zentraler Elemente der Bewegungssteuerung können auftreten. Im Rahmen einer sportpsychiatrischen Begleitung können auffällige psychische Parameter erfasst und in einen Kontext gebracht werden. Für eine systematische Erfassung und entsprechendes Prozessmanagement steht das Synergetische Navigationssystem (SNS) zur Verfügung. Das Synergetische Navigationssystem (SNS) kann als Instrument der Belastungs-, Trainings- und Wettkampfsteuerung zur Prävention von nicht funktionaler Überbelastung und Übertraining eingesetzt werden. Darüber hinaus eignet es sich zur Förderung von Leistungsfähigkeit und Verletzungsprophylaxe sowie zur Stabilisierung der psychischen Struktur.

SCHLÜSSELWÖRTER:

Psychische Gesundheitssymptome, psychische Störungen, Verletzungsprävention, Belastungsintoleranz, Synergetische Navigationssystem (SNS)

REVIEW

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Table 1

Stages of effort, overreaching and overtraining (32).

	TRAINING	INTENSIFIED TRAINING		
Outcome	Acute Fatigue	Functional Overreaching (OR)	Non-Functional Overreaching (OR)	Overtraining Syndrome (OTS)
Recovery	Day(s)	Days - Weeks	Weeks - Months	Months -
Performance	Increase	Temporary performance decrement	Stagnation decrease	Decrease

Table 2

Sympathetic and parasympathetic overtraining syndrome (24).

SYMPATHETIC ALTERATIONS	PARASYMPATHETIC ALTERATIONS
Performance ↓	
Exercise capacity ↓	
Muscle fatigue ↑	
Delayed recovery ↑	
Insomnia	Fatigue
Irritability	Depression
Agitation	Loss of motivation
Tachycardia	Bradycardia
Hypertension	
Restlessness	

This review is intended to provide an overview of the interfaces between sports medicine and sports psychiatry with regard to overtraining, especially as a practical guide to support athletes. The few sports psychiatric references in the publications that are currently available were pointed out.

Overtraining and Overtraining Syndrome (OTS)

Overtraining syndrome (OTS) is marked by an unexplainable drop in athletic performance despite continued, or subsequently even intensified, training (6). Per definition, the decline in performance is still evident after a longer regeneration phase of 2 to 3 weeks. Shorter, reversible conditions are referred to as overreaching or strain. Organic illnesses must be excluded as causes (54). These include infectious diseases (viral, bacterial, infectious mononucleosis, tooth abscess etc.), cardiac diseases or co-morbidities (e.g. myocarditis), anaemia, allergies, asthmatic disorders, endocrinology disorders (e.g. thyroid gland, adrenal gland disorders) or other somatic diseases.

The decline in physical performance due to overtraining arises from unaccustomed effort (23). One must distinguish between intensified training with a temporary decline in performance that can result in a boosted performance following an adequate regeneration period ("functional overreaching"), and training with permanent overload with insufficient possibility for recovery where the overload and resulting reduced performance are not intended ("non-functional overreaching"). The transition to an overtraining syndrome is continuous. An important factor is whether the recuperation phase after the training is long enough. After a purposeful intensive training, a planned reduction of training ("tapering") and sufficient

regeneration can also achieve an increase in performance (57). An unplanned loss of performance as a result of too much reduction of training ("detraining") may occur.

The causes of overtraining are varied and may in particular include training errors (57). Training that is too intensive for a longer period of time, greatly increased scope of training within a short period of time, long, monotonous training units, too many competitions, or not infrequently a combination of these, can all be causes of overtraining syndrome (25). If stress factors are added, for example conflicts, changes in life circumstances, organisational deficiencies, poor time management, examinations, feelings of exclusion, experiences of loss, unbalanced diet with insufficient nutrient density, performance pressure (from or conflicts with parents, trainers or functionaries), climate or time zone changes, insufficient altitude adaptation or too short training pause after an injury or illness, an overtraining syndrome can occur (50).

While overtraining results in typical symptoms, these are not overtraining-specific (25, 41). More than two hundred different symptoms have been described in OTS so far. Overtraining is therefore largely a diagnosis by exclusion (53). Symptoms that are frequently cited include the feeling of heavy legs, muscle or joint pain, increased tiredness, sleep disorders and loss of appetite, in combination with stagnation or a drop in performance. Psychological symptoms may also appear early on (24). Under high-intensity short-term endurance efforts, one observes impaired lactic anaerobic performance with low maximum lactate values and rapid exhaustion. One sees no significant changes in the sub-maximum range. The aerobic or anaerobic threshold values are mostly only slightly changed (52, 53).

Sympathetic and Parasympathetic Overtraining Syndrome

One distinguishes between two types of overtraining: the sympathetic (Basedow's) and the parasympathetic (Addison's) types (24). The four major symptoms are present equally in both types: Decreased performance, reduced exercise capacity, muscle fatigue and delayed recovery.

In the sympathetic type one additionally sees vegetative symptoms such as increased heart rate and blood pressure at rest as well as delayed drop in heart rate and blood pressure after effort. Further symptoms of the sympathetic type are sleep disorders, night sweats, loss of appetite, loss of weight, restlessness, irritability and emotional instability.

With the parasympathetic type, exhaustion, reduced drive and depressive symptoms are dominant (6). The parasympathetic type is harder to recognise and is marked by fatigue, physical weakness and lack of motivation. Table 2 provides an overview of symptoms (11, 22, 23, 25, 26).

It is assumed that the two types do not arise in isolation but represent two different phases (11). Overtraining is thought to begin with sympathetic symptoms before parasympathetic symptoms emerge after a few weeks if one fails to react by reducing training-load. The classical sympathetic type appears more frequently in younger, highly-motivated athletes and in explosive strength sports (e.g. sprint, game sports), while the parasympathetic type is diagnosed more often in endurance athletes (22). Quite often there is a mixed type or transition between the more early-onset sympathetic and the chronic parasympathetic type.

In elite athletes with overtraining, the loss of performance is about 3% to 6% (24). This at first glance a small reduction but can be decisive in international competitions, as the performance difference between 1st and 3rd place, depending on the discipline, is just 0.3%, and 1.3% between 3rd and 4th place (3).

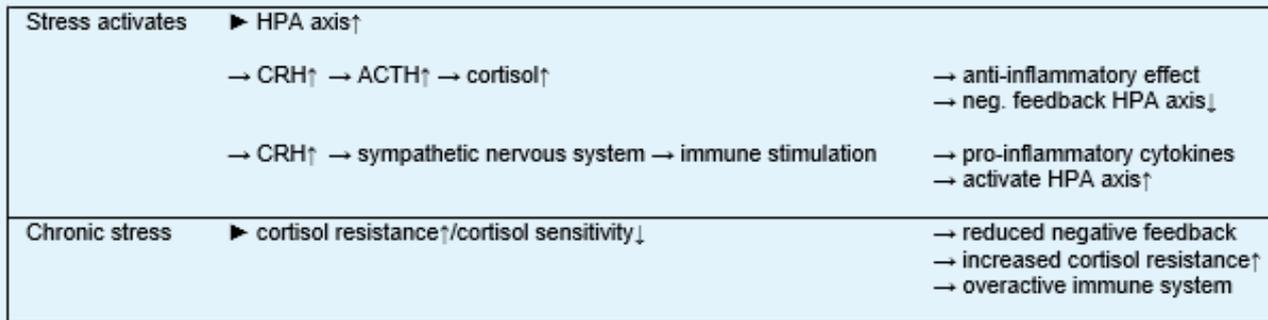


Figure 1

Effects of acute and chronic stress regulation.

Neurobiological basis: Overtraining, Hypothalamus-Pituitary-Adrenocortical (HPA) Axis, Depression and Immune System

Several pathophysiological pathways have been studied in the context of OTS (38). It is assumed that overtraining is caused not by just one dysregulation but by multiple factors. A connection between overtraining and symptoms of depression could also be traced to neurobiological factors (5). The regulation of stress hormones plays a role in both overtraining and depression (32). This is caused by dysregulation of the hypothalamus-pituitary-adrenocortical (HPA) axis, the body's major stress hormone system.

The regulation of the HPA axis happens primarily through the glucocorticoid receptors (14). In many depressed patients, these receptors have a reduced sensitivity, resulting in a shift of the regulation equilibrium in the HPA system (15). This is observed particularly frequently in recurring depressive episodes. With anti-depressant treatment, the regulation disorder is normalised (16). The normalisation of the HPA axis regulation appears to precede treatment success (17).

HPA Axis and Immune System

The stress hormone and immune systems regulate each other (47). Pro-inflammatory cytokines act as potent activators of the HPA axis at the level of the hypothalamus, pituitary gland and at the adrenergic level. Conversely, the activity of the immune system, including cytokine production, is inhibited by the peripheral hormone of the HPA axis, cortisol (13, 47, 48). Cortisol's anti-inflammatory effect is achieved through binding to the glucocorticoid receptors found in the cytosol of the leukocytes (48). The glucocorticoid receptor thus activated induces the synthesis of anti-inflammatory cytokines. The purpose of this negative feedback of the immune system by the HPA system is presumably to protect the organism from a damaging excessive immune reaction in the event of an infectious or inflammatory process (48). Stress exposure without sufficient regeneration can result in an increased risk for infections. Chronic stress can cause an overactive immune system (39).

The sympathetic nervous system is primarily responsible for immune stimulation (18, 35). As the sympathetic nervous system in turn is activated by corticotropin releasing hormone (CRH), the hypothalamus simultaneously has an activating (via the sympathetic nervous system) and inhibiting (via the HPA axis) effect on the immune system. Stress activates both the immune and the HPA system. The activated immune system then stimulates the HPA system, which in turn inhibits the immune system.

Reduced Glucocorticoid Sensitivity

Depressive disorders are frequently associated with reduced sensitivity of glucocorticoid receptors (36). This also affects the immune system cells. The leukocytes in patients with

depression show reduced glucocorticoid sensitivity (36). The immunosuppressive effect of cortisol is therefore weakened in the presence of depression. Patients with depression show signs of an overactive immune system (39).

The interaction between the HPA axis and the immune system becomes a vicious cycle: Stress leads to cortisol resistance. The cortisol resistance leads to an overactive immune system in the presence of stress. The overactive immune system increases cortisol resistance, leading to even further activation of the immune system (7, 33).

Pro-inflammatory cytokines are furthermore responsible for the sickness behaviour that is characteristic of an infection and that resembles depression, with symptoms like fatigue, lack of interest and loss of appetite (46). The immune system thus indirectly contributes to the emergence of depressive disorders by promoting and maintaining glucocorticoid resistance.

In summary, it is to say that chronic exposure to stress results in glucocorticoid desensitisation. This effect is further increased by the immune system, resulting in a vicious cycle between the HPA axis and the immune system. As a result, the organism reacts to stress with an overreaction of the stress hormone and immune systems (39). The resulting increased release of stress hormones and pro-inflammatory cytokines finally contributes to the emergence of symptoms typical of depression. It is probable that the described changes are a self-protection feedback mechanism to prevent progressive stress-related exhaustion (39).

Diagnosing Overtraining and OTS

There is still no clear single parameter for diagnosing overtraining syndrome. It continues to be a diagnosis by exclusion (23). If performance drops even after regeneration over 2 to 3 weeks without demonstrable organic pathological cause, overtraining should be considered (6, 53). In addition to decreased performance, one usually also observes reduced exercise capacity, muscle fatigue and delayed recovery. Indicators could be poor sport-specific technique or coordination. Athletes furthermore often complain of "heavy legs", together with the appearance of various mood symptoms (50). The recording of the mental state can be done using standardised questionnaires like the Profile of Mood State (POMS) or Nitsch's scale of wellbeing, which have been used in some studies as diagnostic instruments (34, 52). Recovery-Stress Questionnaire for Athletes, RESTQ/EBF-Sport (20) and "Befindlichkeitsskalen" (mood scales) BFS (1) can also be consulted. In addition, findings can be recorded as a part of continuous sports psychiatry support.

Unfortunately, we have no reliable somatic diagnostic parameters. The determination of specific parameters under rest conditions does not allow for the diagnosis of an OTS (31). Under strictly standardised conditions, which however are

Table 3

Diagnosis checklist overtraining syndrome (modified to 24, 41).

DIAGNOSIS CHECKLIST	
Indicators during training:	Reduced performance
	Reduced exercise capacity and feeling of increased effort
	Muscle fatigue
	Delayed recovery
Exclusion of somatic causes:	Anaemia (haematology, iron, ferritin, transferrin, folic acid, vitamin B12)
	Epstein–Barr virus
	Infections (BSG, CRP, differential haematology)
	Muscle damage (CK, LDH, myoglobin)
	Borreliosis
	Endocrinological disorders (diabetes mellitus, thyroid gland, adrenal gland)
	Unhealthy diet
	Disrupted eating behaviour and eating disorders
	Somatic findings (liver, kidneys, electrolytes)
	Injury (skeletal muscular, tendons, bones)
Training and competition-related causes:	Cardiac diseases
	Asthma bronchiale
	Allergies
	Increased scope of training (>5%) (hrs/week, km/week)
	Increased training load without adequate recovery
	Monotone training units
Other factors:	High competition density
	Climate-related stress (altitude, heat, cold)
	Time zone change
	Organisational stress (distances, travel times, travel hassle)
	Psychosocial stress (family, parents, relations, friends, finances, trainers, team, functionaries, advisors)
	Alcohol, tobacco, drugs, medication
	Mental health symptoms and disorders
Physiological and psychological parameters:	
Comparison with baseline values in context of sports medicine, sports psychiatry, clinical psychology and sports psychology support: Pulse, blood pressure, lab values, hormone status, performance diagnostics, heart rate variability, psychopathology, psychodynamics, behaviour analysis, self-assessment, evaluations, test psychology	
Sport-specific techniques and coordination	
Sport-specific performance tests	

difficult to recreate in practice, the determination of pituitary hormones in the blood and of catecholamines in the urine may point to a diagnosis (52). For early diagnosis, clear hormonal changes are generally only present under maximum effort conditions (reduced pituitary hormones, cortisol, free adrenaline and noradrenaline) or in twenty-four-hour urine collection (reduced free catecholamines). However, with “hormonal training management” strict standardised measurement conditions must be considered; these are difficult to implement in practice and therefore did not prevail (52). Overall, the diagnosis of an OTS requires knowledge of the individual baseline values (52). A diagnosis based on a single parameter is not possible. One also finds no typical patterns in lab results. However, under standardised conditions and with individual values for comparison, acute overreaching could be identified based on value changes, and this may also help prevent the emergence of overtraining syndrome. This requires close monitoring of the athletes. Table 3 presents a diagnosis checklist for OTS (modified to 23, 40).

Sports Psychiatry Aspects of Overtraining in Competitive Sports

With regard to psychiatric symptoms, athletes suffering from overtraining develop, to different degrees, restlessness, disquiet, irritability, emotional instability, recurring anxiety, loss of appetite, sleep disorders or depressive symptoms and disorders (28). The more marked the appearance of overtraining, the more the symptoms of depression may emerge (10). It is therefore important when caring for professional athletes to offer sports psychiatric support in addition to sports medicine care. In addition to the proper treatment of the depressive episodes, it is important, from a sports psychiatry perspective, to consider training volume and intensities, competition planning, travel hassles, organisation-related structural stress, diet and other possible problems or conflicts and include them in the treatment. It makes sense to provide prophylactic sports psychiatric support, especially for those at risk for psychiatric disorders i.e. due to a history of psychiatric disorders or for athletes who show

abnormalities in the context of a sports psychiatric screening. Sports psychiatric screenings should be carried out in the same way as sports medical examinations on a regular basis.

Training management plays a vital role in creating a good balance between effort and recuperation (23). It is often the case that a successful training rhythm is a main contributor to success. Regeneration management is particularly important (30). In addition to regeneration-promoting measures, the recording and measurement of recuperation, tiring and regeneration requirements is particularly helpful (19). The recording of physiological parameters and motor tests is carried out by sports physicians and trainers. Psychometry to map tiring and recuperation is applied in sports psychology. The control of psychological and psychopathological parameters under consideration of psychodynamic aspects, including reflecting on possible stressors, is the task of psychiatrists and clinical psychologists. Furthermore, one must take into consideration that the psychological state of the athletes is also always conditioned by the structure of their personality and possible pre-existing disorders (28). Sports psychiatry is a young discipline that has only been around for 10-30 years.

The early recognition of an overtraining syndrome is an interdisciplinary endeavour involving sports medicine, sports psychiatry, clinical psychology, sports psychology and sports science. The end phase of an OTS with depressive episode appears as a protective function of the organism to prevent continued self-harm to the organism (10, 49). This hypothesis should be further explored.

The basic personality plays a significant role in terms of self-awareness and self-protection, also and in particular in terms of recognising and respecting one's limits (28). Athletes are better protected when they know their own performance and effort limits well and can draw lines in particular vis-à-vis their trainers, or communicate clearly with them, in order to prevent overreaching (28). Athletes who for example compensate for unconscious conflicts through intensive training may be quite successful in certain sports. However, they would do well to adequately feel out their performance and load limits. It should be considered here that such processes play out more at the subconscious level. Athletes should be capable of knowing and accepting their effort limits.

The ability of athletes to deal appropriately and carefully with their performance limits should be developed from an early age (28). This is about individual experiences acquired early in life. It is therefore especially important that young athletes have access to good trainers and other important sensitive reference persons as well as a reliable environment. Sports psychiatric support may also be useful here (8). A functional management can then be obtained in combination with sports medicine and sports psychology.

If an overtraining disorder arises, it often remains elusive why, at a comparable level of effort, one athlete suffers from overreaching or overtraining while another is able to continue training at an unchanged scope and intensity or even to increase when all the findings are brought together. In particular during training, one goal is always to train as closely to competitive situations as possible and also to provoke stressful situations. This aims to optimise performance and improve

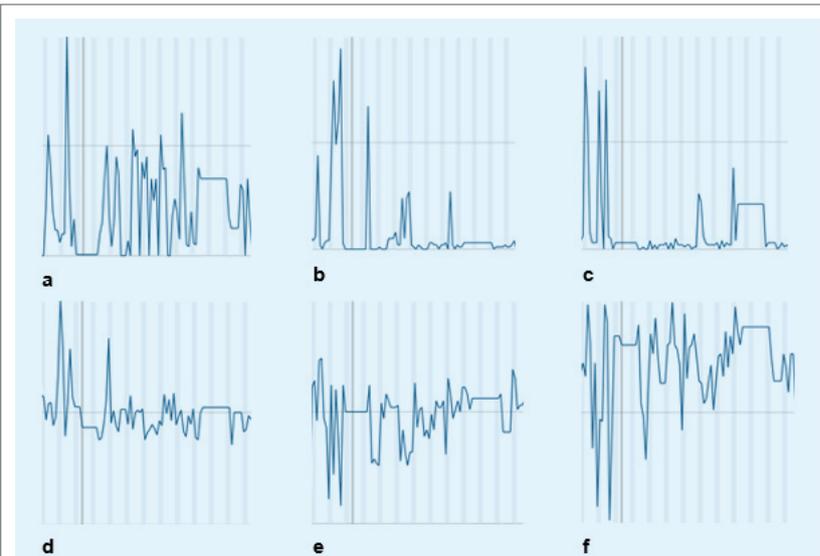


Figure 2

Time series of selected items of the Process Questionnaire Sports. Process monitoring of a cross-country skier with the SNS. X-axis: Time in units of days. Y-Axis: Intensity. (a) Training time per day. (b) Experienced grief. (c) Experienced abnormalities in body function. (d) Factor Athlete Burnout (emotional and physical exhaustion / reduced athletic accomplishment / sport devaluation) Y-axis: z-transformed factor values. (e) Self-esteem. (f) Today I was happy with myself.

the competitive potential. To overcome the stress in these situations, athletes frequently resort to optimising interventions (28). Such optimisations bring them closer to their performance limits, meaning that the danger also increases that with continuous excessive effort at their limits they develop overtraining, physical and psychological impairments or even illnesses (28).

Due to the increasing professionalisation and frequency of competitions in competitive sport, athletes today are more prone to developing an overtraining syndrome because it is becoming increasingly hard to regenerate sufficiently (28), especially in high professional sport with close schedules during the pandemic. Experienced trainers therefore now assume that professional athletes will experience a state of overreaching or overtraining, to varying degrees, at least once in their career (28). It should also be considered that in 80% to 90% of cases, athletes with overtraining problems find themselves back in an overtraining situation within three years (28). If there is a depression, patients should be treated in accordance with the psychiatric treatment guidelines (9). From a sports aspect, in both overtraining and depression it is recommended to significantly reduce exercise to a moderate level (28).

Prevention and Treatment

Studies have shown that low self-confidence, high perfectionism and unrealistic expectations (including those of important reference persons such as parents) more frequently result in depression (burnout) and overtraining symptoms (12, 27, 56). Athletes in individual sports are more commonly affected by OTS than athletes in team sports, and young competitive athletes more commonly than recreational athletes (29, 21).

Prevention

To prevent overtraining in youth sports, it is important for the training to be varied, and athletes should have at least 1 to 2 days off per week from competitive athletics, sport-specific training, and competitive practice to allow them to recover both physically and psychologically. The weekly training time, ➤

Table 4

Prevention of non-functional overreaching and overtraining (modified to 24, 41).

PREVENTION OF NON-FUNCTIONAL OVERREACHING AND OVERTRAINING

Adequate training management and tapering for competition
Periodization of training and competition
Adjust training volume and intensity based on performance and mood
Varied training
Ensure adequate calories for training load, adequate hydration and sleep
Training protocol recording differentiated physical and psychological parameters
Self-assessment and reflection on physical, mental and psychological effort with corresponding adaptation
Adequate regeneration management
Rest period of greater than 6 hours between exercise bouts
Accompanying sports medicine, sports psychiatry, clinical psychology and sports psychology support
Avoidance of external environmental conditions (organisational, psychosocial, travel-related, climatic)
Abstinence of training following infection, heat, periods of high stress

number of repetitions, or total distance should not increase by more than 10% each week. The athletes should take at least 2 to 3 months away from a specific sport during the year. The focus of sports participation should be on fun, skill acquisition, safety, and sportsmanship. Athletes should have information about appropriate nutrition and fluids, sport safety, and the avoidance of overtraining (4). Table 4 shows measures for prevention (modified to 23, 40).

For training diaries including the recording of psychological parameters, online systems are available by Internet or by App applications. A daily training protocol can then be kept. Physical and psychological parameters can be integrated. Factors to document could include training scope, distances, intensities, and times, heart rate, BMI, physical wellbeing, extent of tiredness, appearance of health complaints, muscle or joint pain, menstruation, quality of sleep, stress factors and mental wellbeing. Self-assessments, evaluations and questionnaires can also be uploaded for the athletes to fill out. The Synergetic Navigation System (SNS) for example is well suited for such monitoring and especially also for the recording of psychological processes (45).

The Synergetic Navigation System (SNS)

The SNS is an Internet-based system to record, visualise and analyse change processes and its nonlinear trajectories. It can be applied in diverse fields like psychotherapy, coaching, and team development. The presentation and evaluation of the processes allows for a collaborative process feedback of client and therapist or athlete and sport psychologist and a data-driven management of change and training processes. Questionnaires that are used for high-frequency self-assessments (e.g., day by day) produce data and time series analysis which can be used for reflecting on the visualized process. The analysis tools which are available in the SNS (e.g., time series, dynamic complexity applied to time series, intra- and inter-personal Raw Data and Complexity-Resonance Diagrams, Recurrence Plots, inter-item correlation patterns) give evidence for nonlinear patterns and pattern transitions like sudden changes (phase transitions), critical instabilities or inter-item synchronization (42-44). In particular, indicators

of pattern transitions in pathological developments or during psychotherapy or during training processes can be identified in time and can be addressed.

The process monitoring can be organized by persons who are working with the athlete(s) (e.g. trainer, sport psychologist, medical doctors or psychotherapists) or by the athlete himself (self-monitoring in his/her responsibility). Self-assessments of psychological parameters (e.g., cognitions and emotions like motivational or mood dynamics) can be addressed and compared with physiological or performance parameters. It should be noted that the SNS is not a questionnaire but offers the option to implement and to apply different questionnaires up to the choice of the user. This is possible by a questionnaire editor which is one of multiple functionalities of the SNS. By this, also personalized questionnaires for the assessment of individual topics, goals, resources or problems can be edited. Of course, also questionnaires like RESTQ-Sport, BFS or parts of them can be implemented. The responsible user (trainer, sport psychologist or sport psychiatrist) has to decide on the sampling rate, i.e., the frequency of answering the questionnaire. This is not defined or restricted by the SNS but is open to the user's choice.

Figure 2 shows the temporary overtraining state of a cross-country skier illustrated by the diagrams of the SNS (raw data time series) based on effort parameters and in the context of conspicuous mood values. The mood variability appears just for a short period of time, however, seems to be constructive for improving the somatoform autonomic symptoms, which is why the athlete underwent sports psychiatric treatment. The somatoform autonomic functional disorder successively changed to a remission state. With a significantly heightened sense of self-esteem, the athlete can reduce the frequency of therapeutic contacts and then finish treatment.

The SNS can be used as a tool for effort, training and competition management to prevent non-functional overreaching and overtraining. Furthermore, it is suited to promote performance and prevent injuries and to stabilise the psychological structure. Last but not least, providing efficient multidisciplinary support to athletes and adequate exchange between sports physicians, sports psychiatrists, clinical psychologists and sports psychologists is very helpful and useful.

Treatment

To treat overtraining, first thing to do is to identify the syndrome. Too often, symptoms are misunderstood, and those affected try to compensate with even harder training. Those athletes enter a vicious cycle, with the result of a significantly reduced performance. In competitive sports in particular, the line between gain of performance and loss of performance can sometimes be very narrow.

An overtraining syndrome can only be overcome by a significant reduction of intensity and scope of training as well as through muscular, mental and psychological regeneration measures (23). The duration of the required recuperation phase can vary greatly. Active recuperation phases with sports practiced for health are preferable to absolute rest (23). Balancing sport types, games, gymnastics, massages, sauna and baths support regeneration. Healthy living conditions, experiencing nature and perhaps changing scenery can also be helpful (31). Psychosocial stressors should be reduced. Future training concept and competition goals should be reconsidered (23). The normal training regimen should only be resumed once the athlete feels physically and mentally recuperated and desires effort (31). There is no specific treatment for OTS, such as with medication or nutritional supplements for example. Treatment with selective serotonin

reuptake inhibitor is suggested by some based on similarities between neuroendocrinological changes between depression and OT (23, 2). In addition, if sleep complaints are prominent, treatment with trazodone could be considered (23, 37).

Regarding resuming training, it is recommended to start with a daily effort of some 20 to 30 minutes with one or two training-free days a week (28). Then the effort can be individually and variably increased in coordination with the sports physician and sports psychiatrist. In individual cases, the phase until complete restoration can last several months (sometimes even years).

Conclusion

In conclusion overtraining is a maladapted response to exercise when excessive and not matched with appropriate rest and stress load. Psychological parameters can indicate overload. Psychological parameters can be captured and contextualized to prevent further progression. Physiological and training parameters can be included and related. ■

Conflict of Interest

The authors have no conflict of interest.

Günter Schiepek developed the Synergetic Navigation System (SNS) and is one of the managing directors of CCSYS GmbH. Otherwise there are no financial interests or relationships, such as patents, fees or support from companies.

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